The AIDLET Model: A framework for selecting games, simulations and augmented reality environments in mobile learning

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ABSTRACT

Smartphones and other mobile devices like the iPhone, Android, Kindle Fire, and iPad have boosted educators' interest in using mobile media for education. Applications from games to augmented reality are thriving in research settings, and in some cases schools and universities, but relatively little is known about how such devices may be used for effective learning. This article discusses the selection and potential use of electronic games, simulations and augmented reality in mobile learning supported by an operational model called AIDLET. After analyzing the different approaches to the use of digital technology and games in education, and discussing their benefits and shortcomings, a framework was developed to facilitate the selection, repurposing, design and implementation of games, simulations and augmented reality, with focus on the practical aspects of the processes used in mobile learning. It is apparent that these devices for learning are valued by students and teachers alike, and that they may be used as personalized devices for amplifying learning, specifically through amplifying access to information, social networks, and ability to participate in the world. Furthermore, whereas traditional learning is based on knowledge memorization and the completion of carefully graded assignments, today, games, simulations and virtual environments turn out to be safe platforms for trial and error experimentation, i.e. learning by doing or playing. In this context, the AIDLET model was set out and verified against a taxonomy representing the main categories and genres of games, and the article concludes with implications for how teachers, instructional designers and technologists might best capitalize on the affordances of mobile devices when designing for blended learning and e-learning courses.

Keywords: games, simulations, augmented reality, e-learning, mobile learning, AIDLET Model.

INTRODUCTION

The current model of pedagogy in conventional schools and universities is essentially teacher focused and one-way communication. It is set against evidence that shows how students learn more by collaborating with their teacher and with each other in the context of educational narratives (Pachler & Daly, 2009). Furthermore, evidence indicates that a new model of education is emerging, one that is student-centered, networked, customized and collaborative, leading to the creation of mechanisms through which infusion experiences and other rich learning contexts may support activity in novel situations (Shaffer, 2004). In addition, it is now recognized that student emotional expressions are a part of the learning process and also an essential component of basic education, a fact that continues to be a minor concern in schools and higher education. There is a growing body of evidence from the neurosciences and the cognitive sciences that recognizes the importance of emotions in cognitive processes and memory operations. The Portuguese born neuroscientist António Damásio developed a theory of emotion that has evolved from his first book, *Descartes' Error: Emotion, Reason and the Human Brain* (1994), which explains how feelings are entangled in the cogitations of the brain and the circumstances of the body. In his second book, *The Feeling of What Happens: Body and Emotion in the Making of Consciousness* (1999), Damásio further explores the role of emotion. He attempts to connect the neurology of emotion to the neurology of consciousness and extends this to the existence of a sense of self.

In fact, freedom of choice, challenge, participation, transparency, integrity, collaboration, fun, speed, and innovation has become a part of students' learning experiences. In this context, playing games may be an important aspect of learning as this generation's game-playing experiences are more widespread than the game-playing experiences of previous generations. No doubt technology is transforming the ways we learn today but the most widely accepted theories and models behind learning are still valid. For instance, the pedagogical framework for implementing new software tools, games and simulations in the context of mobile learning can be developed by drawing on concepts from: constructivism (Bruner, 1966; Piaget, 1973), social constructivism (Vygotsky, 1978), situated cognition (Brown, Collins, & Duguid, 1989; Barab & Kirschner, 2001), and communities of practice (Wenger et al., 2002). Social constructivism in the Vygostkyan way provides a series of principles that may be accomplished during the development of educational activities. The Piagetan notion of constructivism is at the core and it basically means that students modify their current knowledge schemes to integrate new information and acquire new knowledge when in contact with teachers, peers and the surrounding environment. In addition, learning activities must be situated in authentic settings and in a context that is meaningful to each individual student, and may increase in effectiveness when students are part of community that shares values and contributes to a common objective. Constructivism, situated learning, and the establishment of communities of practice constitute a robust theoretical framework for knowledge acquisition based on the notion that learning occurs in the context of activities that typically involve a problem or task, other persons, and an environment or shared culture.

A recent Educause Center for Applied Research survey of undergraduate technology used in the United States (ECAR, 2012) reports that 86% of undergraduates own a laptop and 15% own a

tablet. Web-enabled or smartphones are owned by 62% of undergraduate students, though not all use the most advanced features due to cost. Most students surveyed report using network resources for activities such as accessing social networking sites, playing online multiuser computer games, or accessing virtual worlds. Video game use has become a more diverse and popular form of entertainment than it was a decade ago (ESA, 2013). Games are not just for children, as only 32% of players are under the age of 18. The gender divide in gamers has also greatly narrowed, with males making up 55% of online game players, and women 45%. With the emergence of greater variety in game style and genre, the market is embracing a diverse range of player motivations. The numbers found in the ESA surveys will continue to shift as the games industry evolves in inclusivity.

The interest in gaming for educational purposes has also increased over the last decade, with researchers identifying key pedagogical features that make good video games inherently strong learning tools. What underlies the allure of games? Educational game researcher James Gee (2003) shows how good game designers manage to get new players to learn their long, complex, and difficult games. A well-designed game entices players into the "reality" of the game world and keeps them there until the goals of the game have been met (Salen & Zimmerman, 2004). Gee points out that incorporating appropriate challenges that are "doable," and other widely accepted effective learning principles that are supported by research in cognitive science, are in fact a large part of what makes good video games motivating and entertaining (Gee, 2004).

James Gee (2007) has narrowed down the list of pedagogical strengths to thirteen principles that link good games to good learning, emphasizing the areas of learning empowerment, problem solving, and understanding. High-quality games cycle players through new content, encouraging the player to try different ways of learning and thinking (Gee, 2003). A well-designed game doesn't distinguish between learning and playing, rather, players refine and add to their skill sets as the game progresses (Gee, 2004). When a player is successful in-game, the game expertise is linked to 'expert' behaviors such as self-monitoring, pattern recognition, high-level problem recognition and solving, principled decision-making, qualitative thinking, and superior use of both short and long term memory (Van Deventer & White, 2002).

Popular video games like *World of Warcraft*[1] emphasize cooperation and leadership rather than individual competition for the highest score (typical of arcade games, for example). These video games reward creative problem solving, multitasking, collaboration, experimentation, and stimulate the creation of models (Steinkuehler, 2004). The instant feedback and risk-free environment invite exploration and experimentation, stimulating curiosity, discovery learning and perseverance (Kirriemuir, 2002). Learning how to learn becomes an essential skill and the speed and dexterity developed playing video games becomes an added value. Social skills are also important: to be a guild master in a game like *World of Warcraft*, a player needs to be able to create a vision, recruit and inspire people, and organize the group's strategy. And while the game industry has recognized and embraced such learning fundamentals, weaving them into design to increase value to the player, educational institutions have yet to fully recognize and integrate these models.

[1] www.worldofwarcraft.com

Matching the success of video games, the methodologies of "blended learning" (face-to-face learning with an online component) and "mobile learning" (learning based on laptops, tablets and smartphones) have emerged as serious contenders to realize the e-learning needs of individuals in this day and age. According to Klopfer (2008), "e-learning itself can mean many things to many people and at its core simply means electronically supported learning, which can be online, on desktop PCs, or even on mobile devices (though the latter is sometimes referred to as *m-learning*). In practice e-learning often means delivery of information and content to learners through online hypertext, accompanied by images, audio, and video. But e-learning can mean much more, as evidenced by the recent surge of interest in using video games to teach everything from basic math skills for young learners to advanced communication skills for adults." (p. 8). For students, the major motivation for enrolling in online courses is not the technology or the network access capability, but the freedom that allows students to move through a course of studies at a time and pace of their choice (Anderson, 2008). Today, improvements in the processing power of mobile devices combined with networked media applications provide a tremendous opportunity for novel approaches to online learning that go well beyond the use of Learning Management Systems (LMS). Relevant examples are Personal Learning Environments (PLE) that enable individuals to access, aggregate, configure and manipulate digital artifacts in the context of ongoing learning experiences (Bidarra & Araújo, 2013). The power of these new virtual learning environments lies in creating (hyper)spaces that give users a sense of learning by doing, or, in the case of games, learning by playing.

The Personal Learning Environment (PLE)

This Personal Learning Environment (PLE) concept has emerged within the UK and other countries around the beginning of this century as a strategy associated with the application of Web 2.0 technologies to education (Johnson & Liber, 2008). It gained momentum from 2005 onwards with research disseminated by authors like S. Wilson, M. van Harmelen, G. Atwell, S. Downes, G. Siemens and T. Anderson (Mota, 2009). They essentially highlight the learning environment as a collection of tools and services that a learner may choose to access resources and a network of people; sometimes there is an interface (such as Elgg) to integrate the different units. These so-called Personal Learning Environments, or PLEs, are today a privileged field of research in Distance Education, encompassing several technological perspectives that may include social networks, free virtual environments and open software, connecting various learning resources that may be suitable for inclusion in current educational frameworks (Van Harmelen, 2008). However, PLEs are not just pieces of software, they comprise environments where people, tools, communities, and resources combine in a very loose kind of way (Wilson, 2008). Making a case for PLEs authors Attwell, Bimrose, & Brown (2008) stated "a PLE should be based on a set of tools to allow personal access to resources from multiple sources and to support knowledge creation and communication" (p. 82), and suggest an inventory of the possible functions of a PLE:

- Access/search for information and knowledge;
- Aggregate and scaffold by combining information and knowledge;
- Manipulate, rearrange and repurpose knowledge artifacts;
- Analyze information to develop knowledge;
- Reflect, question, challenge, seek clarification, form and defend opinions;

- Present ideas, learning and knowledge in different ways and for different purposes;
- Represent the underpinning knowledge structures of different artifacts and support the dynamic re-rendering of such structures;
- Share by supporting individuals in their learning and knowledge;
- Networking by creating a collaborative learning environment.

There is a lot of potential in PLEs, however, according to recent research (Dabbagh & Kitsantas, 2012), even if a PLE can be entirely controlled or adapted by a student according to his or her formal and informal learning needs, not all students possess the knowledge management and the self-regulatory skills to effectively use social media, for instance, in order to customize a PLE to provide the learning experience they want. In this regard, giving students information and tools to promote effective self-regulated learning may help them acquire basic and complex personal knowledge management skills that are essential for creating, managing, and sustaining PLEs using a variety of social media.

The flexibility in creating a learning environment also improves with the benefits of mobile learning, based on the emergence of many new portable and mobile devices such as laptops, PDA's, iPhones, iPads, etc. These are becoming ideal resources for global learning and lifelong learning. They also push forward the motivation to learn, combined with benefits such as speed, ease, and the cooperative construction of knowledge. Clearly "mobile technologies" are not just talk about "mobile devices" as it also means "collaborative and motivated minds", given the persistent involvement of a new generation of students in mobile learning, truly building communities of practice. This should be good news for mobile learning systems, which are often described as supporting informal learning (Sharples 2002). In this way distance learning may be apparently an individual activity, but actually is never performed in isolation as new digital media connect students to their colleagues, teachers, and the world. In this regard, today we witness the emergence of Massive Open Online Courses (MOOCs) based on the idea of "connectivism" – a "learning theory" that George Siemens (2005) and Stephen Downes (2007) developed for a networked and digital world. In 2010, S. Downes, G. Siemens, D. Cormier and R. Kop actually created a MOOC on "Personal Learning Environments, Networks and Knowledge" (PLENK, 2010) and since that year the PLE conference has been a success. Perhaps connectivism is a not new "learning theory" but an account of how learning occurs in a networked global environment, and this unites nicely with the concepts of PLE and mobile learning.

There is reason to believe that learner-driven demand and anticipated boost in mobile learning will facilitate an increasing uptake of serious games in the short term, even if simulations have a longer association of its use to support education and training – namely in applications for business, health, and military training. In any scenario, institutions and educators will need extra support when selecting, repurposing and using games or simulations in their practice, often trying to overcome factors such as time pressure, lack of experience, shortage of resources, etc. In many cases, common off-the-shelf games and lots of free games in online stores (e.g. Apple Store, Google Play) can be successfully introduced into educational processes, always a good decision as the creation of high quality educational games has a prohibitive cost. Therefore the access to tools and frameworks that may help in the process will benefit educational stakeholders. For instance, US military have considered the use of a framework for the use of

Massive Multiplayer Online Gaming in Military Training and Education (Bonk & Dennen, 2005). In another case, a framework for evaluating games- and simulation-based education in general has been proposed by De Freitas & Oliver (2006) indicating the main pedagogical requirements. In a similar approach, a study by Moreno-Ger et al. (2008) proposes a set of educational game design guidelines, namely: choosing an appropriate genre, adding assessment and adaptation to the design and integration with an online environment. But we were not able to find yet a comprehensive framework for the selection, repurposing, design and implementation of games and simulations in distance learning courses, so this became our main goal in a first study (Bidarra, Rothschild & Squire, 2011), which we now decided to update and extend to mobile learning and augmented reality.

In the next section we examine the potential for the use of games in the context of mobile learning, also introducing augmented reality in the mix, and discuss the benefits and shortcomings of this methodology. Next, supported by previous research (Bidarra, Rothschild & Squire, 2011), we introduce the AIDLET framework for the selection, repurposing, design and implementation of games and simulations, focusing on the processes involved in blended learning. Finally, we verify the AIDLET model against a taxonomy representing the main categories and genres of games, attempting to meet the needs of teachers, instructional designers and decision-makers, faced with the raise of mobile learning based on laptops, tablets and smartphones.

THE POTENTIAL OF GAMES IN LEARNING

Today there is an uptake of mobile learning and blended learning modalities that hold great potential for the instruction of a broad and diversified range of topics. It has also been widely established that well-designed interactive media tools such as games, simulations, and virtual environments may provide learners with relevant and engaging paths to content mastery. The next step is to bring these together by combining modalities and engaging learners in exploratory propositions (Bidarra & Martins, 2010). But overcoming the technology gap between learners and institutions is just one aspect of the problem. Traditional pedagogy has to be reformulated, not just accommodating the latest technology but also enabling rich social interaction, enhancing group work and communication within educational settings. Many educational researchers today would define learning as a multidimensional construct of learning skills and cognitive learning results, for instance, procedural, normative and strategic knowledge, and attitude (Pivec & Dziabenko, 2004). Academic and life success require not just the accumulation of facts and conceptual understandings, but also attitudes, dispositions, and values that are aligned with those of science. Learning is, from this perspective, about building up knowledge, skills, beliefs and attitudes that together, form an identity as someone who is a capable consumer, and perhaps even producer of scientific knowledge. Some have even speculated that this "identity-level" is a good way for educators to think about transfer. Perhaps if students experience the development of identities as competent performers in science, acquiring knowledge, skills, and beliefs congruent with those valued by various scientific communities, they will take on these practices outside of

formal school contexts. So, in line with the use of new digital media, a current tendency in education acknowledges the emergence of new learning experiences that games may turn out and seeks to understand their consequences for how we think, act, play, and learn (Shaffer et al., 2005).

Convergence of Learning Modes

In the last decade the classroom mode and the distance learning mode have been converging, in part due to the success of many e-learning experiences, based on the progress in information and communication technologies and their permeating all learning environments in most developed countries. Using computers and accessing the Web in schools and universities, taking advantage of quality learning products in digital format, linking institutions with broadband connections, using Web 2.0 networking applications, all create favorable conditions for increasing student autonomy and learning effectiveness (Moore & Anderson, 2003). But this also creates a shift in teacher's profiles and roles: the ability to virtually experience events in shared spaces determines that they become mediators between students and the information provided by a variety of sources, rather than being the exclusive owners of knowledge to be transmitted.

Globally, the implications of this re-conception of education, as a mobile and flexible exchange of ideas in a broad context, are profound. It goes beyond the traditional view of instruction as the transmission or construction of knowledge within the constraints set by a curriculum, to replace it with an ongoing process of learning through continual exploration and negotiation. As Don Tapscott (2008) puts it: "Educators should take note. The current model of pedagogy is teacher focused, one-way, one size fits all. It isolates the student in the learning process. Many *Net Geners* learn more by collaborating—both with their teacher and with each other. They'll respond to the new model of education that's beginning to surface—student-focused and multiway, which is customized and collaborative." (p. 108). We would just add that learning in this way is in fact pervasive or ubiquitous education. This means that education is available 24 hours a day, 7 days a week, anywhere, and anytime. Pervasive learning is also a social process that connects learners to communities of devices, people, and society so that students can construct relevant and meaningful learning experiences, author specific content (text, images, audio, video), in locations and at times that they find meaningful and relevant.

So, for the most part, mobile learning has become a way of life for students wherever they are. For the institutions this is good news, as for the first time in history we have educational technologies that cost nothing to governments and schools: smartphones and mobile computers (most students have one), networking software (freely available, e.g., Facebook, Twitter, Skype), learning applications (increasingly available for free in the Apple Store and Google Play), and many open educational resources (freely available at MIT – OCW, iTunes U, Coursera, etc.). On top of that, there is an enormous amount of free tools available for PLEs, such as collaborative tools (e.g., blogs, wikis, authoring software), immersive environments (e.g., virtual worlds like Second Life and Active Worlds), media production and distribution tools, and so on. There is an old adage of distance education research that states: 'It is not technologies with inherent pedagogical qualities that are successful in distance education, but technologies that are generally available to citizens' (Dias et al., 2008). We argue that the transformation of

curriculum and instruction processes must be based on the new digital media capabilities and its patterns of use by students, namely through interactive and rich content embedded in game-like learning experiences. For this to take place we also propose the integration of games and simulations with the existing e-learning standards and platforms used for online education. Ideally, these educational games should be able to coexist in environments that follow the learning objects model and have elevated pedagogical value (Moreno-Ger et al., 2008). The process of game-thinking and game mechanics to engage users and solve problems in education has more recently been (re)defined as "gamification" (Zichermann & Cunningham, 2011). Under the mark "gamification" an intense public debate is spawning as well as numerous applications developing – ranging across productivity, finance, health, education, sustainability, news and entertainment media. Some of these also involve enhancements named "augmented reality" that may be interesting for educational purposes.

The case for Augmented Reality (AR)

In fact, mobile applications can support not only games but also real world enhancements, and today these have an important role in blended learning environments, whenever virtual learning connects with the physical world. This is the realm of Augmented Reality (AR) applications that combine virtual objects with the real world on the fly. Virtual and real objects appear together in a real time system in such a way that the user sees the physical world and the virtual objects superimposed. The user's perception of the real world is enhanced and the user interacts with it in a more natural way. The virtual objects can be used to display additional context-aware information about the real world that is not directly perceived. Ronald Azuma (1997) defines augmented reality systems as those that have three basic characteristics: 1) they combine real and virtual; 2) interactivity takes place in real time; 3) and are shown in 3D.

The increased availability of smartphones and tablets with Internet connectivity and high computing power makes possible the use of augmented reality applications in these mobile devices with potential for education, breaking down the walls of the classroom, connecting schools and communities (Squire, 2013). In the near future, eventually everyone with a smartphone or a tablet will be capable of viewing augmented information. This makes it possible for a teacher to develop educational activities, games and resources that can take advantage of the augmented reality technologies for improving learning activities. We believe that the use of augmented reality will change significantly many teaching activities by enabling the addition of supplementary information that may be viewed on a mobile device (Squire & Dikkers, 2012), helping students to improve understanding of educational content.

There are already many augmented reality applications and development systems for Android and iOS smartphones and tablets. The most popular ones are: Wikitude[2], Layar[3], Metaio[4], Aurasma[5] and Augment[6]. Technically, augmented reality applications fall in two categories: *geo*

[2] www.wikitude.com/
[3] www.layar.com/
[4] www.metaio.com/
[5] www.aurasma.com/

based and *computer vision* based. Geo-based applications use GPS, accelerometer, gyroscope, and other technologies to determine the location, heading, and direction of the mobile device. The user can see 3D objects that are superimposed on the real world through the device in the direction he is looking at. Computer vision based applications use image recognition capabilities to recognize images and overlay information on top of this image. These can be based on markers, such as QR (Quick Response), Microsoft tags or LLA (latitude/longitude/altitude), or on processes that recognize an image and trigger the overlay data.

For mobile learning we should look for those augmented reality eco-systems that can be used in daily learning activities. They should be open source, or free, and user friendly, since they are going to be used by teachers that in general do not have programming knowledge (Figueiredo, Gomes & Gomes, 2013). With current augmented reality technology it is already possible to create AR content to layer over educational materials. For example, the teacher can use QR or Microsoft tags to add a layer with text information or a link to a web page in a printed homework sheet providing additional information to students. Another possibility is to use the Aurasma eco-system that recognizes images without the need of markers. This technology enables the addition of layers with animations, text or videos in a printed book to extend the academic content with additional information.

It is possible to go even further and use, for example, the AR Augment eco-system to add a layer and show a 3D model that can be used by the teacher in helping students improve learning of orthographic views. Wu and Chiang (2013) found that applying layered 3D animations provided more enthusiasm in the learning activity, better performance in understanding the appearances and features of objects and improvements in the spatial visualization capabilities. New interaction metaphors for augmented reality on mobile phones are emerging, for example, applications where users look at the live image of the device's video camera and 3D virtual objects enrich the scene that they see (Hürst & van Wezel, 2012). The development of augmented reality games for education also has some distinctive cases: *Mystery at the Museum*[7] and *Environmental Detectives*[8] are excellent examples of AR games created by the MIT Teacher Education Program.

Learning Attributes of Games

But what is the real potential for the integration of games, simulations and AR in mobile learning? What are the expected benefits and shortcomings in the learning context? It may be important to note that not all games do all things. Certain game styles and formats may lend themselves better to different sorts of players and objectives. For example, there are different player experiences in single vs. multiplayer games, but no one is superior for learning per se. It depends on what the specific learning goals and player behaviors are. Also, much like other entertainment industries, games are experiencing genre shifts as developers take specific traits from multiple game styles to achieve desired systems and play experiences. It is for these reasons

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[6] www.augmentedev.com/

[7] education.mit.edu/ar/matm.html

[8] education.mit.edu/ar/ed.html

that the attributes and styles cannot be put nicely in "boxes", or fit a precise matrix for that matter. There is considerable overlap.

The purpose of the AIDLET model (Bidarra, Rothschild & Squire, 2011) in this study is to provide a planning framework for development and inclusion of game environments for mobile learning, taking into account familiar attributes of commonly referred to game subtypes. Let's start first by identifying the broader categories of games referenced in educational game studies:

Edutainment Games
These are games that usually combine education and entertainment in a package that highlights intended educational outcomes targeted at specific groups of learner, very often targeted as youth and children's games. Most edutainment games currently in the market are not supported by empirical learning evidence and thus it's difficult to integrate them in an effective educational program.

Serious Games
These are games with many of the characteristics of entertainment games but with intended educational outcomes targeted at specific groups of learners. The "serious" adjective is generally applied to refer to products used by industries like defense, education, scientific exploration, health care, management, city planning, engineering, religion, and politics. Previous research (Simões & Bidarra (2012) has shown the advantages of the game *3rd World Farmer*[9] in motivating learners to study geography. Put simply, these are games with a serious purpose; the games may include First Person Shooters (FPS), Role-playing Games (RPG), Real Time Strategy (RTS) games, and Massively Multiplayer Online Games (also called MMOG or simply MMO). In many cases, these are the games that will better integrate with the educational workflow.

Location Aware Games
This rather new designation usually refers to virtual experiences played out in real world spaces. This last aspect makes the difference and identifies the genre more specifically, in line with that explained before about augmented reality. For example, contextualized clues can only be discovered via real world spaces with the aid of GPS devices that these days are becoming common in smartphones owned by students. Unfortunately, even with the advantage of involving students in authentic real world tasks, participation in groups, and frequent interaction and feedback, these games are sometimes difficult to integrate in the distance education workflow because e-learning students are far away and dispersed geographically. The great advantage of these games lies with collaborative and team work applications in face-to-face and blended learning, eventually associated with fieldwork and lab practice.

Global Reach Games
These represent a recent phenomenon, exampled by games such as *World of Warcraft*[10] or *Everquest*[11]. The term covers any video game online capable of supporting hundreds or thousands of players simultaneously. These by inevitability are played on the Internet and feature

[9] www.3rdworldfarmer.com
[10] www.worldofwarcraft.com
[11] www.everquest.com

at least one persistent world. In the case of *Second Life*[12], which is not a game per se, we can consider the existence of a virtual world with a game-like society of users. Many types of games can be set up in a virtual world and take full advantage of a 3D environment with its realistic interaction modes.

Going into more detail, in an effort to identify more distinctive learning attributes of games we must take a look at the design specificity and comparative merits of games' categories and genres. In many cases they extend and overlap to create mixed categories/genres. The potential for integration in a mobile learning workflow is briefly discussed.

Traditional and Casual Games
Chess, solitaire, and card games, whether traditional or game specific, are examples of such widespread games. Other casual games are commonly deployed online, and offer movement in 2D or 3D space with obstacles to overcome. Timing is sometimes critical, with heavy reliance on motor skills, memory, and planning. Themes may vary from games that expand concepts, such as the food chain, set matching, etc. to card games aimed at teaching math, anatomy, animal, and plant species. Other games in this genre have shown potential for involving students in math and physics, for example, games such as *World of Goo*[13], *Crayon Physics*[14] and *Angry Birds*[15]. Because these games were not developed specifically for education, the behaviors are not mapped directly to learning objectives. However, the player behaviors do support the kinds of scientific thinking practices that educational game environments tend to foster. Potential in this genre exists for games that support engineering and computing concepts. The *Flash* or HTML 5 technologies can be used to easily produce cards or other digital artifacts for mobile learning.

Shooting /Action
These games can include First Person Shooters (FPS) or other fighting games. The game scenarios may exist within a broader narrative framework, and are presented from a first person perspective. In shooter games, players typically aim and fire at moving objects to destroy them. This involves the development of fast hand to eye coordination and may be important in training areas associated with the police or military. In most cases the player operates virtual mechanical devices and has to accomplish some objective (e. g. drive a vehicle, fire a weapon or use a tool). Shooter and fighting games may be played solo, or designed for team collaboration. Military strategy games in these genres may also include cultural learning objectives, using local cues to engage with others in-game to accomplish missions. These games can be played in mobile devices as a drill-and-practice component of a course, for example, in engineering, sports, or military training. Team development objectives can also be met through multi-player modes.

Adventure Games
The adventures or quests offer a series of challenges usually within a detailed framework. Most adventure games do not rely on speed or "twitch" play for success. A classic example in this

[12] www.secondlife.com
[13] www.worldofgoo.com
[14] www.crayonphysics.com
[15] chrome.angrybirds.com

genre is the interactive fiction game *Myst*[16]. The tasks in the game may be relevant to the curriculum and the learning process, often in terms of motivation, as in the case of Sid Meyer's *Civilization*[17], a widely popular and researched game that involves geography, history, and politics (also falling within the strategy genre). There is definitely room for the deployment of this kind of games in education, but a large screen is usually better than a small screen.

Role-Playing Games
A Role-Playing Game (RPG) is a game in which the participants assume the roles of fictional characters. Drawing from original RPGs like *Dungeons and Dragons*[18], players inhabit a role with status and responsibility within a shared context, and in which the context is defined by a set of rules. The educational function of RPGs may be extensive. Players in educational RPGs may establish the actions of their characters (e.g., lawyers or politicians) based on their characterization, and the actions succeed or fail according to a formal system of rules and guidelines. This may be interesting for many courses requiring students to learn those kinds of skills and the related tacit knowledge. This is also very useful for learners to practice behaviors in an environment that provides clear consequences based on the context and rules of the game world.

Strategy Games
Sometimes called Real Time Strategy (RTS) games, this genre of video games emphasizes skillful thinking and planning to achieve a goal. They involve strategic, tactical, and sometimes logistical challenges. There are many good examples of this type of games, in the areas of history, economy, management, ecology, society, etc. Typically these games involve multiple challenges and are aimed at developing problem-based skills. Two very popular and successful titles are: *Civilization*[19] and *Age of Empires*[20]. These are very expensive games to design and produce but some of the themes and inherent characteristics of those commercially available may be interesting for specific courses, a laptop computer is recommended for effective playing.

Simulation Games
For a game to be considered a simulation game, as opposed to a pure simulation or a virtual world, a game system must exist in which the player has a role and specific objectives. In simulation games, the player operates a model or simulation that behaves according to a programmed set of rules. Many simulation games focus on some element of realism, thus forcing players to understand and remember complex principles and relations and progress by trial-and-error. These often very expensive games can teach anything, from flying a plane up in the sky to steering a submarine deep in the ocean. Typical examples are *Flight Simulator*[21] and *SimCity*[22], popular mainstream titles that have been used for educational purposes. Social simulation games

[16] cyan.com
[17] www.civilization.com
[18] www.ddo.com/en
[19] www.civilization.com
[20] www.ageofempires.com
[21] www.microsoft.com/games/flightsimulatorx
[22] www.simcity.com

are also a large component in the simulation genre, with Will Wright's *The Sims*[23] the most widely recognized title. Another interesting simulation game for Business Project Management training is *INNOV8*[24], developed by IBM a few years ago. These kinds of simulation games are often suitable for online cooperative work and thus very apt for integration in mobile learning, but many titles require a very powerful machine with an appropriate display card.

Modeling Games
Modeling is often a component of the game rather than the game in itself, and usually is tied with other types of games (action, strategy, simulation, programming, etc.). For example, some car racing titles involve creating a track or building the car before you can race it. This genre is also linked with programming games, as learners may create the models before they are able to program them. Examples include robots, cars, bikes, machines, factories, companies, electronic devices, etc., all with educational potential.

Programming Games
A programming game is basically a computer game where the player has no direct influence on the course of the game. Instead, a computer program or scripts are written in some domain-specific programming language in order to control the actions of the characters, often robots, tanks or bacteria, which seek to destroy each other. Many programming games are considered environments full of digital organisms, related to artificial life simulations. Games that enable users to build micro worlds have been created at the MIT *MediaLab*[25], and extensive research has been published on this (e.g., programming of Lego robots and Logo projects). The potential for use in mobile learning is great and technology is often freely available.

Massively Multiplayer Online Games
A Massively Multiplayer Online Game (also called MMOG or simply MMO) is a game capable of supporting hundreds or thousands of players simultaneously. The most accomplished and famous MMO is *World of Warcraft*[26], with many millions of players all over the world, but in education this is a hard choice to make due to enormous technological demands (software, servers, technical support, etc.). Nevertheless, there are a few multiplayer games with pure educational intentions, for instance, in MEGG[27] there is capability to build an online multiplayer educational game on any theme, with menus, text, graphics and multiple choice quiz banks. Recreational MMOs with didactic potential may include: *A Tale in the Desert*[28], *Pirates of the Burning Sea*[29] and *Astro Empires*[30].

Virtual Worlds

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[23] thesims.ea.com
[24] www-01.ibm.com/software/solutions/soa/innov8/index.html
[25] http://media.mit.edu/
[26] www.worldofwarcraft.com
[27] www.cybertrain.info/megg.html
[28] www.atitd.com
[29] www.burningsea.com/page/home
[30] www.astroempires.com

The unique qualities of 3D virtual worlds can provide opportunities for rich sensory immersive experiences, with authentic contexts and activities for experiential learning, simulation and role-play, including the creation of complex environments and scenarios. Hundreds of university systems around the world use *Second Life*[31] and *Active Worlds*[32] as a lively part of their educational programs. Many of the previous types of games can be set up in a virtual world and take full advantage of a 3D environment and its realistic interaction modes. One example is *SLOODLE Game Show*[33], an open source game for *Second Life*. Web 3D open standards, such as X3D and VRML, also support Web-based delivery of virtual environments for education. These have a great potential for learning and training purposes, by allowing one to circumvent physical, safety, and cost constraints.

Layered Reality Games

These games are representative of a new set of experiences that consists of roughly three different categories of games: Augmented Reality Games, Hybrid Reality Games, and Alternate Reality Games, mostly involving active engagement, participation in groups, frequent interaction and feedback, and connections to real world contexts via Wi-Fi and cell networks. We have discussed above the potential of AR and these games surely represent the future as more and more people have access to devices with camera, GPS, accelerometer, gyroscope, Internet and other useful features for mobile learning.

In general, research shows that learning through games is possible by immersing players in relevant experiences, by modeling expert problem solving, by providing guidelines to solve a problem, and by structuring problems so that the player builds on previous knowledge, which are all features of powerful and well designed learning environments (Bransford et al., 2000; Gee, 2003). On a less positive note, according to Huntington (2006), there are obvious barriers to the development or adoption of educational games in general. For instance:

- High development costs in an uncertain market makes investment in educational gaming innovations too risky for the commercial video game producers and even the educational media industries.
- Change in institutions comes slowly in terms of adopting any new innovations as do making the necessary organizational changes that allow the use of new learning technologies.
- There is unwillingness on the part of institutions to give up textbooks in order to purchase educational gaming products.
- The specific educational values that are tied to established standards have not been proven through in-depth research.
- Some parents and teachers have very negative attitudes about the use of videogames in the classroom.
- Games are especially good at teaching higher order skills, which are not typically assessed in standard examinations.
- Access to computers is sometimes so low that it can't play a mainstream role in student learning (the case of many developing countries).

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[31] www.secondlife.com

[32] www.activeworlds.com

[33] www.youtube.com/watch?v=SRVVrAp_64U

So, the application of games in education requires more than just their availability and adequacy; a new educational perspective is needed. Squire (2008) suggests the following scenario: envisage for a second that you are a teacher or instructional designer, charged with developing an advanced science course, covering a few hundred new terms, facts and concepts. How would you go about designing materials that handles these concepts? What kinds of experiences would you want learners to have? How would you pace them and how would you know if they truly mastered what you needed them to learn? These questions, which may seem traditionally the domain of instructional technologists, are also relevant for video game designers. As games get longer and more complex, designers devise ways to “teach the player” to see and act in particular ways. Whereas educational technologists ask if education can happen at a distance, gamers show you that it already does, as game designers and distributed game communities help them become better players. Part of what is interesting about contemporary video games is how experiences are ordered so that players are "taught" the game through the careful construction of levels, missions, and interactions. Few, if any, of the so called "serious games" or even research prototypes that have been made, to the best of our knowledge, take advantage of most of these design principles.

Lastly, how is educational assessment performed? In games that are designed for learning play behaviors are mapped to the specific actions that relate to the learning goals. Other design considerations that promote attainment of educational goals include deciding how pass and fail states map to desired player performance. Games’ environments designed for specific learning goals may also include threshold points in-game, much like educational threshold concepts are gatekeepers for understanding future content, game threshold points can be designed to scaffold player skill and require player mastery of certain behaviors before progressing in the game world. Games also provide opportunities for learning from feedback loops. As players are evaluated on their performance, feedback loops help guide player behavior towards desired outcomes. In this way, the development of the game system will support player progress in both micro and macro objectives. Assessment instruments may include capture logs of player performance in situ, recordings of student performance, and discourse analyses of students' work in game play. Other documents emerging from the game (including students' writing, illustrations, or digital representations) can be analyzed to identify how their thinking is (and is not) affected by the game experience.

THE AIDLET MODEL

Considering the current educational context, to attain high quality learning results based on constantly connected, highly interactive, and fully mobile media environments, the right teachers, materials, methods, and games have to be found. But this may be a rather costly and challenging proposition for many organizations as it involves: investment in new information and communication technology (mildly expensive), faculty and tutor re-training (time and capital intensive), development of engaging digital materials (games and simulations may be expensive), review of internal processes (habits are difficult to change) and, last but not least, establishment of a credible and high quality brand name (online learning is often regarded as a

kind of lower-grade education, not to mention games-based learning). However, even with the adoption of new digital media, games and simulations, we must accept the fact that not all knowledge can be acquired through online learning. In some cases it is not suitable for acquiring all the necessary skills, for example in:

- Health sciences, especially surgery and hospital practice;
- Experimental sciences, which require laboratory practice;
- Applied psychology, involving direct interpersonal experience;
- Court training in law, about oratory and argumentation.

A way to overcome this difficulty is to separate theoretical content from the corresponding practical component. The former may be taught in distance learning mode, and, to a certain extent, practical learning may be supported by AR, simulations and games representing real situations. On that note, Starr (1994) argues that simulations – the process of setting up scenarios and exploring under what conditions they might work – are at the core of business, government and science. For many years researchers have studied the uses of simulations in education and established that well-designed simulations will develop in the student a profound, flexible, spontaneous, kinesthetic understanding of the subject matter (Gibson et al., 2007, Issenberg, 2006, Teodoro, 2004, Kezunovic et al., 2004). Squire & Giovanetto (2008) argue that when considering the higher education of gaming, a core intellectual feature of a twenty-first-century educational system should include inroads into participation in cultures of simulation. In fact, students who learn by means of simulations can improvise better in real world contexts. They can handle unexpected situations with ease and knowledge learnt is not structured around a set of norms or processes but developed from intrinsic personal experience. This is the kind of knowledge students retain for a long time. Unquestionably, today video games are the individual's primary exposure to this important way of thinking. And in the probable scenario that games/simulations may not be developed or cannot be applied, online learning can be made more game-like (Gee, 2003) in an attempt to change the inflexible and prescriptive models in use today.

Dealing with the Issues

Based on our observations and on data collected we consolidated a clear-cut framework to assist teachers, instructional designers and managers in making the right decisions about the adoption and use of educational games, simulations and AR. But for a framework or toolkit to be effective, no matter how simple or practical it is, a particular learning context has to be defined. Previous research by De Freitas & Oliver (2006) on the kinds of questions facing tutors when thinking of introducing games- and simulation-based learning into their practice, started with some basic questions:

- Which game or simulation to select for the specific learning context?
- Which pedagogic approaches to use to support learning outcomes and activities?
- What is the validity of using the chosen game or simulation?

So, trying to answer those questions, our research evolved by exploring real world practices and went on identifying the main concepts and activities that defined those practices, in the belief

that a certain way of thinking and doing could be derived and applied to new situations. For instance, the traditional classroom environment, where an instructor can guide the activity of the students, is very different from the online educational environment in which specific game genres have to be identified and suitable frameworks set (Moreno-Ger et al., 2008). So, in the case of e-learning we were confronted with the existence of three main groups of requirements: the definition of an approach closely linked to educational content specifications, the repurposing of existing game/simulation titles vs. the design and development of specific games/simulations, and the integration of games/simulations in the educational workflow.

The framework we propose builds on these requirements and is rooted in research previously conducted into conventional teaching/learning with games (by Prensky, Gee, Gibson, Jenkins, Squire, etc.), all sharing essential features such as students, teachers, and resources; but in this model we had to go beyond that by explicitly addressing the requirements imposed by the typical context of mobile learning and blended learning. A relation may be established with the ACTIONS model (Bates, 1995, 2000), a media selection and evaluation framework often used in distance learning research. 'ACTIONS' is the acronym for seven main criteria that Bates proposes for selecting a specific learning technology, namely: access, cost, teaching and learning implications, interaction, organizational issues, novelty and speed. In this model he uses a pragmatic approach to the effective costs of technologies, and relates these to other important features that are relevant for decision-makers. The fundamental principle is still valid today: educational technologies are not good or bad; it's the way they are used that dictates the success or failure of a project. The same can be said of the application of games, simulations and AR in mobile learning.

Applying the model

The chief benefit of using a conceptual model for instructional design is that common pitfalls can be avoided. So, our purpose is twofold: (1) to help teachers and instructional designers in the implementation of game- and simulation- based learning, and (2) to support organizations and decision-makers in the process of choosing the right tools and methodologies. Of course, an overall educational strategy must be in place, indicating the materials and learning objectives (content), the ways to choose, validate, organize, and present content (curriculum & instruction), the individual attention offered to each student (tutoring), the grading and confirmation of a level of competency (assessment), and the creation of peer groups that both make learning more effective and engaging (learning community).

The framework we propose tries to beat the shortcomings of other models, not specifically tailored for the use of games in education, by introducing a six-dimensional model with the acronym 'AIDLET', addressing issues related to availability and cost, interaction and communication capabilities, distance education workflow integration, learning design potential, engagement and ease of play, thematic value and adequacy (summarized in table 1).

Table 1. The *AIDLET Model* for selection and implementation of games in mobile learning.

AIDLET Model	**Questions**

Availability and cost	Is there an adequate game for the organization and for the learners? What is the cost? If the available version is not suitable, can it be modified? The game or simulation has to be developed from scratch? At what cost? Is AR a viable alternative?
Interaction and communication capabilities	The game is state-of-the art in terms of concept, interface and design? Is it Web 2.0 ready? The interaction and communication features are adequate for mobile learning?
Distance education workflow integration	Does it integrate with e-learning practice? What kinds of connections can be made to other Web 2.0 tools and media?
Learning design potential	What kinds of learning are supported? What instructional approaches are possible within the constraints of the game/simulation? What other technologies can be integrated in supporting teaching and learning?
Engagement and ease of play	Are the game characteristics engaging and user-friendly? Is it accessible to teachers and students less experienced in games? How long does it take to master the basics of the game?
Thematic value and adequacy	Can the game content be used without any side effects? Are the themes appropriate? What social skills does the game develop? Are these congruent with cultural, societal and organizational values?

The six steps provide main criteria for consideration, certainly not intended as prescriptive, allowing for practitioners to be more critical about how they implant games and simulations into their courses. With this basis, teachers, designers and decision-makers may develop their own metrics for introducing games and simulations in specific educational programs. The key-aspects of the model may be described as follows:

Availability and cost

The widespread use of games as entertainment is a known fact but it doesn't mean that games in general are effective for learning purposes. Some games can be selected and used to assist the learning process and others have to be designed from scratch to support a specific course. The first decision is whether to consider the repurposing of an existing title or the development of a new game. There are basically three options: get an "off-the-shelf" title, contract with a development firm or get in-house production. The costs are very different and tend to increase from the first to the latter. There is no stable and robust model to use here as it all depends on the instructional design to be used and the budget on hand. For instance, learning history with Sid Meyer's *Civilization* is quite inexpensive, because the title is widely available at affordable prices, while developing a game for a new course on telecommunications surely has a prohibitive price. Today, there is also an enormous amount of free games available in both the Apple Store and Google Play repositories, not to mention the apps and other educational resources that can be installed in tablets and smartphones. The consideration of AR games may be also a viable alternative as some free apps are available for learning purposes.

Interaction and communication capabilities

Games and simulations are by definition very interactive yet not all of them support useful educational interaction that leads to effective learning. Furthermore, the *quantity* of interaction that is possible with a system does not guarantee the *quality* of the interaction in terms of attaining learning goals. A sense of security and progress is important and depends both on the ends to be pursued and on the means to achieve them. The design of the interactions is vital to the success of the game/simulation as these are initial requirements that make or break the deal. A poorly made design will never be used by students no matter the amount of research and development that was spent in the project. Also some essential Web 2.0 features of cloud applications are important to enable connection with other people and resources, not only for support, as is usually the case to tackle technical problems, but to achieve strong motivational and multiplying effects that facilitate learning. The current boom in social networking is a solid indicator of this requirement.

Distance education workflow integration

Learning with the new digital tools really implies much more than just using intensively a given set of applications: it comprises all the human factors and qualified work involved in conceiving appropriate learning materials, devising a sound pedagogical strategy, providing each student with efficient support, assessing individual progress, grading students, and certifying their final results. So many questions arise: how games and simulations integrate with a distance education workflow? How do we monitor student's activity? What if the students do not visit all the areas in the game/simulation? What if they wander around wasting time? How much time and effort is necessary to accomplish all the tasks? How do we assess the students? Etc. Of course, there is no ready answer to these questions; the idea is to figure out the answers specific to each project before going any further. In the case of blended learning the online component has to be programmed and adjusted to the requirements of face-to-face teaching, with a proper integration of games, AR and other resources. An essential aspect is to make sure that every one has a mobile device with the minimum requirements for access and interaction.

Learning design potential

The best way to see the instructional benefits of specific games and simulations is to evaluate how they are used in education. For example, evaluating the performance of titles in the so-called "Serious Games" genre, namely, investigating the kinds of learning that may be supported, the instructional strategies that are possible within each game constraints, the e-learning platforms and technologies that are compatible. Only when students feel comfortable with the online environment and the technology provided will they be able to study and contribute. On the other hand, excessive involvement with games and simulations may damage the interaction with other course content and with other students, and this certainly needs to be monitored closely. A structured approach to learning design implies that typical game-based learning scenarios have to be developed, where synchronous or asynchronous communications may be used, for instance:

Synchronous Scenarios

- Training of dialogue and articulation
- Leading and conducting meetings
- Courtroom conferencing and interaction
- Business conferencing and interaction
- Collaborative design in architecture
- Health professional interaction practice
- Surgery and operation theater practice

Asynchronous Scenarios

- Dynamic learning activities (e.g., driving a vehicle, operating a machine)
- Active exploratory learning (e.g., archeology, history, CSI, detective work)
- Goal oriented brainstorming (e.g., advertising, marketing)
- Policy decision making (e.g., business, government, orgs)
- Business decision making (e.g., marketing, sales, operational)
- Process management (e.g., commerce, industry, communications)
- Strategic planning (e.g., business, government, orgs)
- Case study (e.g., business, sociology, health, ICT)
- Experiential activities (e.g., laboratory, field trip)
- Debating relevant issues (e.g., policy, business, academia)
- Science modeling (e.g., chemistry, engineering)
- Reporting, expressing and communicating (e.g., business, health, science)
- Multimedia communications design
- Web communications design
- Scientific investigation
- Computer programming
- Information systems design
- Computer graphics design
- Computer games design
- Language laboratory
- Cultural events management
- Sports strategy and tactics

Engagement and ease of play

This aspect usually becomes apparent only after students start playing a game, interacting with a simulation, or using AR, when participants become excited and joyful about it. Here, as well as in television contests, there must be a challenge that the player can understand and may be able to succeed at by using his or her knowledge, intelligence, and dexterity. To be engaging an educational game or simulation must be composed of purposeful, goal-oriented, rule-based activities that the players perceive as fun. This means that we must be aware of any signs of either cognitive overload or excessive dispersion of attention in the players that may impair learning activities. A preliminary test period with a game or simulation is a must and may be accomplished with a small group of volunteers using representative equipment.

Thematic value and adequacy
These are perhaps the most subjective of all the components in the model: what is "valuable" and what is "adequate"? These are important criteria because we have to consider information that is relevant to a specific culture, society, group or organization. Many games and simulations will not be suitable for adoption because of issues related to religion, politics or race, for example. On the other hand, many games and simulations were developed to engage players in a very respectful game play, for instance, *World Without Oil*, *Food Force* or *3rd World Farmer*, but may not be suitable for the specific learning goals set out in the curriculum. Furthermore, some games and simulations may be too restrictive and prevent students from developing their own meanings, interpretations and critical views. This also means inquiring what instructional activities can be created to maximally address weaknesses of the game (e.g., missing, misleading or inaccurate content). Other essential aspects to evaluate are the topics breadth or depth, and the types of strategies that are promoted by a game (e.g., trial and error, problem-based, etc.).

Discussion and Recommendations

To test our conceptual framework we analyzed many off-the-shelf games & sims in an attempt to assess its potential for selection, repurposing and implementation through e-learning (Bidarra et al, 2011), and updated the original evaluation considering AR and new games for mobile technologies now widespread in tablets and smartphones. Following the AIDLET model, we made use of a scoreboard to evaluate the sensible application of typical examples representing the main categories and genres of games (summarized in table 2).

***Table 2**. Assessment of typical examples representing the main categories and genres of games.*

Sim or Game	Availability & Cost	Interaction	Distance Edu	Learning Design	Engagement	Thematic Value
Traditional	Good	Average	Average	Average	Average	Average
Action	Average	Good	Average	Average	Good	Average
Adventure	Poor	Good	Average	Average	Good	Average
RPG	Average	Good	Good	Good	Good	Good
RTS	Average	Good	Good	Good	Good	Good
Simulation	Average	Good	Good	Good	Average	Good
Modeling	Average	Good	Average	Average	Average	Average
Programming	Good	Good	Good	Average	Good	Good
MMO	Poor	Good	Poor	Average	Good	Poor
Virtual World	Average	Good	Good	Average	Average	Average
AugRG	Average	Average	Average	Average	Good	Good

HibRG	Average	Average	Average	Average	Good	Good
AltRG	Average	Average	Average	Average	Good	Good

Poor = hard choice (may be expensive, difficult to integrate, cover themes not appropriate, etc.)
Average = compromise (a good choice in some cases, may be partially used, depends on instructional design, etc.)
Good = safe choice (already tested, easily available, low cost, most themes appropriate, etc.)

Popular games may range from shooting games to casual games, from role-playing games to family entertainment games. However, our findings concerning the potential of games in mobile learning show that simulations, strategy (RTS) and role-playing games (RPG) are the genres that may support quality learning according to the AIDLET framework. This is in line with the ESA report (2013) that indicates strategy and role-playing online games as the kinds that are played more often. Success titles of these categories include *SimCity, The Sims, Civilization* and *Age of Empires*. Many of these games are supported by high quality simulations and have been used for educational purposes. Furthermore, some of the games examined are responsible for engaging large groups of remotely located users, leading to the expansion of educational projects in many organizations, sometimes using multiplayer online role-play gaming approaches as a means for engaging and retaining large remotely located learner groups (De Freitas & Griffiths, 2007). On a less positive note, we are aware that games are not for all topics, learners, or environments; games are effective only if matched to content, learning styles, digital literacy and educational context, also, they may be expensive to integrate and implement. In addition, not all games are alike as they have diverse underlying strengths and strategies.

The field of game-based learning is changing so fast that it is hard to keep up with all the research. As a result, there is an opportunity for new research and researchers to focus on the kinds of questions that will sustain a move toward a full-grown scientific field. If we don't blend academic requirements with game initiatives and experiences there is the risk of all these efforts becoming a fad.

CONCLUSION

This article started with a review of the values underpinning new digital media, games, simulations and AR in today's education. We chose to focus on how these are enacted in social practices supported by contemporary digital habits, and how they may be present in mobile learning, but at this point in time we were not able to demonstrate how online education was significantly transformed through the deployment of this technology or indeed by any other means. In fact, while paying attention to how technological artifacts are enacted in society we were simply able to identify familiar patterns of interaction and communication that are of value to mobile learning and blended learning. Games are often heralded as one remedy for the failure of conventional education but our interpretation of the research data would be to see them in terms of the influence of a popular new media form in our societies. The implications for understanding the relationship between games and learning therefore are that games need not be defined as an essential instrument or a type of content but as contemporary human creations whose forms and meanings are strategic for education. In this regard, educational institutions need to adopt these innovative modes of learning in order to make a difference in academic development and deal with new learning styles. Also, contemporary organizations need employees proficient in effective communication, teamwork, project management, and other soft

skills such as responsibility, creativity, entrepreneurship, corporate culture, etc. Simulation- or Game-based learning may be the right answer to those needs, particularly if supported by AR and appropriate e-learning methodologies. In this context, the role of the instructor is a critical (if somewhat overlooked) component in the deployment of instructional games, as are other learner support strategies such as helpdesk or online mentoring. The task ahead is certainly a difficult one but we think the AIDLET model may help teachers and instructional designers make better decisions regarding the application of game-based learning in their particular topics. We believe this is a great time for stakeholders to take on the challenge of adopting new digital media, serious games and interactive simulations.

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