Games and Learning: Gamification in formal educational settings

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ICS 668

December 10, 2012

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Abstract

The purpose of this exploratory literature review on games and education is trifold:

First, it serves as the final project report for Social Informatics 668 and presents research which indicates a social dimension of learning (while being engaged with a game), which in consequence directly relates to this class and requirements of this report. Second, it introduces gaming and Gamification within an educational context, both formal and informal. Third, it will present particular examples and applications of contemporary research in informal and formal learning environments. Among others, the discussion and conclusions will state that traditional education is in its early steps of a transition from an institutionalized, formal and static model of education towards an innovative, informal, dynamic and more social learning environment using using elements and mechanics of games to enhance student success, motivation and ultimately, to foster a better learning.

The conceptual structure of this paper as follows: Section 1 summarizes the two main topics of this paper, games and learning (in formal and informal contexts). Section 1.1 proposes a central hypothesis which states that games and Gamification mechanisms are potentially useful for educational contexts. Picking up on that, section 1.2 summarizes a discussion of current challenges in formal education, accordingly section 1.3 outlines both, the learning possibilities games include, and skills gamers can bring into, learning. Section 2 outlines a concise history of games and learning (section 2.1), defines key terms and concepts (section 2.2) and presents a “directionality dilemma” education and games are somewhat gridlocked into at present (section 2.3 and 2.4). Section 3 highlights two selected studies (section 3.1) and a certain examples Gamification mechanics have been implemented (section 3.2). Section 4 consists of the summary
and conclusion (section 4.1) concluding with various focal points of current research and possible future work.
1 INTRODUCTION

1.1 Exploratory learning by games and formal education in classrooms

The crossings of games and institutionalized education (or formal learning) are an interesting research area nowadays: According to Salen (2007), the 20th century learning paradigm was mainly focusing on the acquisition of basic literacy skills (for example reading, writing and calculus). In contrast, the 21st century learning paradigm, along with the proliferation of Information and Communication Technologies (ICTs) and data networks, should rather center on high literacy skills, such as complex problem solving skills and dynamic expression through language and media. For instance, it is no longer sufficient and sought to memorize and repeat information, but rather to be able to search, identify, connect and remix information in a meaningful way. Therefore, Salen (2007) assumes that learners immersed in these digital tools and networks learn across languages and cultures with a high-level of self-activity, creativity and independence. The author agrees to this view and further sees contemporary education living through that change at present. The question at hand is not only if games facilitate learning, but rather how to use them in institutionalized contexts, which is the main topic and question of this literature review.

1.2 Current challenges in formal education

In 2004, Foreman et al. (2012) interviewed five thought-leaders from academia and industry and published a structured summary of the discussion under the title Game-based learning: How to delight and instruct in the 21st century. Due to the size and inertia of public education systems and transformation processes in present culture and society, even ten years
later, the discussion is still valid today and will serve as the introduction to the current challenges in formal education.

The conversation covers 6 main topics and starts with the dysfunctions of conventional instruction which refer to problems with the current educational system, such as a static, 19th century, instructional paradigm and culture in schools and universities still prevailing nowadays. Particular examples are the lack of exploration of possible solution spaces as well as the abundance of failure experiences for students. On the other hand, online education and gaming has the potential to challenge a massive amount of players or learners in one, single virtual environment for a specific purpose. America’s Army and its various iterations and platform releases (U. S. Army 2012) is one example of the potential power of simulations and visualizations, especially useful in natural science classes. Game-based learning communities, for example the World of Warcraft gaming community (Blizzard 2012) are the third point of interest, as said games conventionally foster social learning due to collaboration or competition and dynamic and mutual peer-to-peer interaction, in contrast to static and one-sided student-book interaction.

Moreover, collaborative Massive Multiplayer Online Roleplaying Games (MMORPGs) possess means for a better learning future as they not only deliver a just-in-time information model to the gamer (for example a developing and expanding story), but also employ cognitive principles of engagement with the content, such as high-frequent decision making multiple times a second, once more in stark contrast to teacher-centered design lectures. The question how to implement such an envisioned model in traditional institutions of higher education could be caused by a generation change of instructional staff (Gee), namely the leave of the baby boomer generation in schools and. These, due to their unfamiliarity with games so –called “digital
immigrants”, in university faculties and high school class rooms will make space for younger teachers and professors more, which in turn will be more used and sympathetic to new and unconventional approaches. Most likely, small and flexible institutions, which have to remodel themselves to be able to re-compete with other universities will be the trend-setters and early adopters of modified curricula and Gamification mechanics in the everyday scholar life.

1.3 Superpowers of gamers

Admittedly with a positivist perspective, Jane McGonigal’s TED talk (2010) and book (McGonigal 2011) explains why games can change the world for a better. She states some quite interesting facts on MMORGs, such as World of Warcraft. For example, the average young person born and raised in a country with a “strong gamer culture” will have spent 10000 hours of playing online games by the age of 21. According to her, that means the existence of an “entire track of parallel education” as for children in the US, 10080 hours is the time a student has to invest into from 5th grade until the time he graduates High School (not failing any class). Further, McGonigal presents 4 superpowers, which are characterizing gamers nowadays (as her question is to understand what gamers are actually good at?) According to her, gamers have

- an urgent optimism which is the desire to act immediately tackling an obstacle while having the belief of a reasonable hope of success;

- are good at creating and maintaining a social fabric by playing together experiencing bonds of trust and cooperation;

- are blissful productive, meaning that gamers are happier working hard in their free time (by playing a game) instead of relaxing. She concludes that gamers are willing to work hard all the time, if they’re given the right work (or game).
- the need and desire for an *epic meaning* of what they do. One example of that is the second largest wiki in the world, the World of Warcraft Wiki (2012). In contrast to Wikipedia, the World of Warcraft Wiki has almost 100000 pages while the English language version of Wikipedia.com (2012) has 4.1 million articles covering all kind of knowledge, whereas the World of Warcraft wiki is covering exclusively content related to the world of the game.

### 2 BACKGROUND

This section provides a short background to gaming and learning and will outline key terminologies, such as gaming, Gamification and formal, respectively informal learning. Moreover, the thesis that education is already gamified in opposition of the anti-thesis, that games are fostering instructional learning will be opposed.

#### 2.1 Background and key definitions of gaming and learning

According to Salen (2007), games and learning can be dated back to 1840, the leading example being the educational institution of the so-called “kindergarten”, invented by Froebel (2012) integrating learning through the usage of games and play. Computer technologies to enhance learning have been used in 1968 by innovators, such as Atkinson, Morningstar or Suppes (Salen 2007), and since then dramatically increased in use up to day. Related disciplines games, and therefore Gamification mechanics originate from are for instance, the learning sciences, film studies, anthropology, performance studies, computer science and youth development “*creating an ecology of interrelated disciplines*” (Salen 2007, p. 3).

#### 2.2 Gaming and Gamification
Salen (2007) defines gaming as “…the sum total of activities, literacies, knowledge, and practices activated in and around any instance of a game” (Salen 2007, p. 9). A more recent definition for Gamification comes from Lee and Hammer (2011), in which the term refers to “the incorporation of game elements into non-game settings” (Lee and Hammer 2011, p. 1). Later, it is also defined as “…the use of game mechanics, dynamics, and frameworks to promote desired behaviors” (Lee and Hammer 2011, p. 1) and attempts to harness the motivational power of games in real-world settings and problems – such as in this case, the motivational problems of schools and universities.

Detering et al. (2011) sees Gamification as an “umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement” (Detering et al. 2011, p. 2425).

His paper, devoting almost all effort to define and scrutinize Gamification, introduces as well variants, such as gamefulness (such as the experiential and behavioral quality), gameful interaction (such as artifacts affording that quality), and gameful design (such as designing for gamefulness, typically by using game design elements). He summarizes that Gamification refers to the use of game design elements in non-game contexts” (Detering et al. 2011, p.2). In elaboration of the before said, Gamification means
- the use (rather than the extension) of
- design (rather than game-based technology or other game related practices)
- elements (rather than full-fledged games) characteristic for games (rather than play or playfulness)
- in non-game contexts (regardless of specific usage intentions, contexts, or media of implementation).
2.3 Gamified Informal and Formal learning contexts

Informal- as opposed to institutional learning, or simply put, learning versus education is stressed by Salen (2007) as an antagonism of informal in contrast to institutionalized learning becoming a key issue as “many of the more radical challenges to existing learning agendas are happening in domains such as gaming, online networks, and amateur production that usually occur in informal and non-institutional settings. […] She concludes that “rather, we hope to initiate a dialog about learning as it spans settings that are more explicitly educational and those that are not” (Salen 2007, p. vii-viii).

Spikol and Milrad (2008) differentiate to the term “meaningful learning” which is characterized by

i) engagement in authentic activities;

ii) allowance for experimentation, conversation, collaboration and reflection;

iii) potentially connecting and integrated outside, informal learning with the formal classroom;

iv) the integration of students in the design process.

Along with their case study using social constructivism as theoretical foundation, an intellectual perspective claiming that knowledge is not only a subjective interpretation, but as well social in nature and mutually constructed, Spikol and Milrad (2008) propose 3 levels of learning, derived out, but not limited to mobile settings, a so-called

i) micro-level (usability and satisfaction of user);

ii) a meso-level (learning and educational experience);

iii) and a macro level (impact on learning and teaching practice).
This continuum of small, individualized efforts, such as gamified, mobile applications (Spikol and Milrad 2008) over gamified courses at the University of Indiana in Bloomington (Gaming the classroom 2012), using avatars, experience points and leveling up to enormous, informal learning repositories, such as Khan Academy (2012) or formal schools, emphasizing Gamification to enhance learning, such as the Quest to Learn (2012) Charter School in New York City are trendsetters developing curricula with game elements

Claimed to be the first comprehensive seminal work on Gamification, Salen and Zimmerman (2003) present with Rules of Play a unified framework, covering for example different types of games and concluding with eighteen design conceptual, or heuristics, (for example contexts for social play, storytelling mechanisms).

2.3. Is education already gamified?

One might argue that education is already “gamified” (applying Gamification mechanics to courses, classes and assignments) to some extent. One might view experience points equivalent to assignment scores - passing a class shares similarities with the “leveling treadmill” often found in MMORPGs. Also, being awarded with a degree can be interpreted as some kind of badge. However, the main difference of these general similarities in education (as opposed to games) is that educational achievements mostly rely on formal rules, penalizing mistakes and reducing opportunities for trial and error.

In both realms under investigation, the educational (with mechanics, such as curricula, classes, assignments) and the gaming realm (with mechanics such as achievements, missions, kill counts and avatars), the educational realm misses two other very important dimensions games
usually provide players with; namely the emotional and social dimensions, usually lacking in formal education contexts.

Therefore, Lee and Hammer (2011) state that the existence of game-like elements is not translating directly and fully to engagement in high-schools and institutions of higher education because of three reasons:

First, good game designs perfectly match the difficulty level to the player’s cognitive abilities. For instance, good games present well-tailored processes guiding a player through the game (tutorials), while keeping him engaged and motivated. Moreover, games offer usually multiple ways to solve a problem and present incremental sub-goals. This directly relates to current challenges of the US educational system, as according to Bridgeland et al. (2006), student motivation and engagement are major challenges nowadays.

Second, games, especially simulations, are perfectly-fitting sandboxes which allow recovery and therefore learning from mistakes. As a result, they cover an important emotional dilemma student’s face in traditional institutions of higher education, such as the excessive demand of the one chance to pass a final exam, or to fail the course. Likewise, games and simulations enable students to see failures as an opportunity to recover and learn from along with frequent feedback cycles to create an environment where effort and not mastery is rewarded, an old problem in higher education.

Third, players in games usually take on different roles and identities or avatars), such as the role of a secret agent or a fantasy character, proven to be successful in schools as well (Nasir and Saxe 2003). This leads to experiences of social credibility and recognition; Lee and Hammer (2011) envision herein the possibility of taking the quest or identity of a scholar.
Some examples how to implement gamification principles into educational contexts are exemplified by Lee and Hammer (2011): "Read an optional library book on the topic being taught in class? Receive “Reading” points. Get perfect attendance and complete all homework assignments on time for a month? Earn an “On Target” badge. Get assigned as a “Lead Detective” role in science class? Work hard to ask the best questions” (Lee and Hammer 2011, p. 2).

2.4 Gaming literacies

Salen (2007) takes the opposite approach emphasizing that games are already robust learning systems while presenting three distinct game literacies.

First of all, the effort to learn the rules of the game enables participation, ultimately creating transformation potentials (by winning or losing the game or adapting the strategy). On the other side, degree alterations or syllabi deviations of the static curricula in High-schools or universities are usually lethargic, and if possible, burdensome for students and teachers.

Second, “modding” (the ability to create, remix or modify and share content in a game system) is a second literacy, while the search and usage of out-of-game resources, such as guides, FAQs and forums creating opportunities for peer-to-peer learning is a third. The last literacy present, exclusively in multiplayer online games, is dynamic collaboration across individuals in collective or competitive action as “Gamers voluntarily invest countless hours in developing their problem-solving skills within the context of games (Gee, 2008)” (Lee und Jessica 2011, p.1). McGonigal (2011) exemplifies these literacies in an prospected development of student characteristics and personal qualities, such as persistence, creativity and resilience.
3. Exemplary studies

Spikol und Milrad (2008) studied the impact of mobile games on learning in an informal education setting. Using a mobile application and an ethnographic approach, 38 children participants used a mobile game aimed to enhance physical activity and to foster contextual learning and team collaboration. The conclusions contain that their mobile game promotes exploration, content generation, collaboration, problem solving and navigation in space ultimately supporting cognitive and social skills.

Sharritt und Suthers (2009) study examines how video games can mediate the collaborative interactions of students, and how particular kinds of collaborative interactions are promoted by the game affordances. The descriptive study of how school students playing three different games in pairs (Civilization III, Roller Coaster Tycoon 3, Making History: The Calm & The Storm) used, likewise to Spikol und Milrad (2008), ethnography and ethnomethodology. It confirms that the user interface constrains the expressive acts possible. Furthermore, representations and terminology provided and presented by the game, create opportunities for discussion and influence strategic choices, for example the display of a sequence of actions required when building rides in Roller Coaster Tycoon 3. The study showed that cues in user interfaces can direct attention and design has implications on learning (either positive or negative).

The conclusions state that representations in games can influence collaboration in 3 distinct ways, i) consideration and negotiation potentials in pairs playing a game, ii) private referential sources, iii) implicit awareness.
4.1 Summary and Conclusions

This brief literature review on Gamification in the context of formal education gives a short history, defines key terms, presents examples from micro-level applications to macro-level implementations, such as gamified schools along with two studies to illustrate possible synergy effects gaming principles for formal learning might have.

Gamification in educational environments, both formal and informal, is still in its infancy, but realized in selected examples. No longitudinal studies could be identified measuring positive learning outcomes when Gamification principles are thoroughly implemented. Two observational studies in informal learning environments using games indicate positive learning outcomes for the participants. In the first study, social constructivism and ethnomethodology have been used to explain and observe children while in the latter high school students interacting in pairs and groups with games revealed insight in the consequences of the user interface design on, for example collaboration.

Lee und Jessica (2011, p. 4) conclude that Gamification is not a panacea. The author agrees to that stance. But games are richer learning experiences than most formal educational environments offer to students nowadays. Most importantly, games, especially multiplayer online games, offer an informal learning experience on three distinct levels, the formal, the cognitive and the social. Arguably, the cognitive dimension, not elaborated on this review, is been evident in educational contexts while the center is clearly on the formal dimension as the main focus. In the authors opinion the social aspect gaming inherits is the dimension offering the most potential to be useful in formal education.
4.2 Future Work

Future research could investigate to what extent the three dimensions correlate and if there is a tradeoff. For example, is formal learning hindering social learning? Is it possible to maximize learning on all three dimensions, the formal, the cognitive and the social?

Spikol and Milrad (2008) see trade-offs on the implementation level, while students could be motivated to engage more in the classroom, the learning would be incentivized. While education could become joyful experience, making it mandatory could make students feel surfeited. Giving teacher the tools, such as gamified ICTs and curricula would need a massive transition and rollout phase, eating up resources of teachers and staff.

Sharritt und Suthers (2009) recommend research on the (lack) of adoption and impact of games in the classrooms, the educational value of specific games, gender and gaming, social behavior in massive multiplayer games.

Also, Salen (2007) and Mcgonigal’s (2010 & 2011) literacies are worthwhile to be investigated further. Research questions and studies could investigate how to address the validity of these claims while studies to examine the enhancement potential on learning outcomes when exploiting a specific literacy are desirable.
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