

The Impact of Gamification

Recommending Education Scenarios

<http://dx.doi.org/10.3991/ijet.v8iS1.2320>

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Abstract—Many students play (computer) games in their leisure time, thus acquiring skills which can easily be utilized when it comes to teaching more sophisticated knowledge. Nevertheless many educators today are wasting this opportunity. Some have evaluated gaming scenarios and methods for teaching students and have created the term “gamification”. This paper describes the history of this new term and explains the possible impact on teaching. It will take well-researched facts into consideration to discuss the potential of games. Moreover, scenarios will be illustrated and evaluated for educators to adopt and use on their own.

Index Terms—gamification, definition, scenarios, achievements

I. INTRODUCTION

Taking a look at young human beings or animals, you may witness that basic learning is done playfully [see 1]. This playful behavior continues as long as the animal is adolescent but stops as soon as it becomes a grown-up. Comparing this situation to young human beings such as students, one may notice that education using playful elements usually stops after elementary school at the latest. Considering the fact that students have already acquired the skills to learn and advance by using gaming scenarios, it is not comprehensible why this method is not used for education.

Even more, the gaming industry is generating revenues in the billions [2]. Today’s young learners gain skills and a method to learn by using games [3] in their everyday lives but have to use other methods to be successful in school or at university. This situation needs to be remedied, and over the past five years an increasing number of teachers and researchers has recognized this and coined the term “gamification”.

But gamification is controversial [4]. Some think it is just a synonym for a hype in the e-learning community, others argue it has a negative influence on learners and a third group believes it is the cure-all for education as we know it. Maybe the truth lies somewhere in between. This paper aims to illustrate how the term “gamification” is used in the academic world and how different gaming scenarios can be used for teaching so that one can make up one’s own mind about the ongoing discussion.

II. GAMIFICATION – DEFINITIONS & FACTS

Since 2008 different approaches have been made to define gamification. This chapter will illustrate which elements were chosen for each definition and how the term is defined throughout the gamification community.

Moreover, facts will be presented proving that a more in-depth discussion is inevitable for e-learners today.

According to a 2011 Gartner Research Report [5], “it is estimated that by 2015, more than 50 percent of organizations that manage innovation processes will gamify those processes.” In view of this, education has to prepare students for this scenario. Education institutions need not be afraid of this as almost 97% [6] of young people play games in their everyday life.

As mentioned, various attempts have already been made to define gamification. The ones of importance are described shortly hereafter and evaluated regarding their impact on education scenarios.

Deterding, Dixon, Khaled and Nacke state that “gamification is the use of game design elements in non-game contexts” [4]. This statement is broad and simple but does not define the term “gamification” without further explanation. To determine what “game design elements” are, we have to give preferential consideration to the definition of a “game”, thus separating it from “non-game contexts”.

The philosopher Wittgenstein defines a game as “a range of disparate human activities that bear to one another only what one might call family resemblances” [7]. This definition is old-fashioned and therefore does not seem applicable in a modern definition of the term “game”. Moreover, it does not outline the term in a clear manner. Other definitions have to be taken into consideration. The definitions of Caillois and Crawford seem to hold promise.

Caillois defines a game as an activity that must have the following characteristics:

- **fun**: the activity is chosen for its light-hearted character
- **separate**: it is circumscribed in time and place
- **uncertain**: the outcome of the activity is unforeseeable
- **non-productive**: participation does not accomplish anything useful
- **governed by rules**: the activity has rules that are different from everyday life
- **fictitious**: it is accompanied by the awareness of a different reality [8]

The definition by Crawford, a computer game designer, shall be mentioned since the impact of software-based games on gamification is crucial. He attempts to define the term using a series of dichotomies:

- *Creative expression is art if made for its own beauty, and entertainment if made for money.*

- *A piece of entertainment is a plaything if it is interactive. Movies and books are cited as examples of non-interactive entertainment.*
- *If no goals are associated with a plaything, it is a toy. (He notes that a toy can become a game element if the player makes up rules, e.g. The Sims and SimCity are toys, not games.) If it has goals, a plaything is a challenge.*
- *If a challenge has no "active agent against whom you compete," it is a puzzle; if there is one, it is a conflict. (Crawford admits that this is a subjective test. Video games with noticeably algorithmic artificial intelligence can be played as puzzles; these include the patterns used to evade ghosts in Pac-Man.)*
- *Finally, if the player can only outperform the opponent, but not attack them to interfere with their performance, the conflict is a competition. However, if attacks are allowed, then the conflict qualifies as a game.[9]*

Crawford's definition may thus be rendered as: *an interactive, goal-oriented activity, with active agents to play against, in which players (including active agents) can interfere with each other [10].*

Based on the above-mentioned definitions it can be stated that the term "game" cannot be defined using a one-sentence answer. Regarding the definition of "gamification", the items "*fun*" and "*fictitious*" mentioned by Caillois shall be given greater attention while the item "*non-productive*" must be negated for the use of gamification in an education environment.

Regarding the term "elements" it is stated that "*gamified applications use elements of games that do not give rise to entire games*" [4]. Therefore, the question if something is already a game or a gamified application is a question of personal point of view and individual usage of the element. In the end, all elements (e.g. goals, rules) put together constitute a game [11]. It does make sense to link these elements to the definitions of the term "game" highlighted before. Therefore only elements that correlate with the term "game" can be considered "*game design elements*".

Finally, a "*non-game context*" can be defined as a situation in which "*gamification uses games for other purposes than their normal expected use for entertainment (asserting that entertainment constitutes the prevalent expected use of games)*" [4]. It seems evident that what constitutes a "non-game context" will change significantly the more gamification increases. Once contexts with no or insufficient links with games are connected through gamified elements, the above definition will have to be amended to "*Gamification is the use of game elements in contexts that originally had no link to game-related elements.*"

A completely different approach to defining gamification has been taken by the advertising industry. Even though this definition is not consistent with the use of the term in this paper, it should be mentioned.

Many companies currently use leaderboards for sales and customer loyalty programs. Businesses have recognized that it is becoming harder to retain customers and engage employees. Management frequently believes that gamification can be used to motivate and inspire certain behavior in both customers and employees. In

addition, gamification is also used to target customers. Using gamified elements, businesses are able to get attention and achieve loyalty while creating an identity for their brand or product. [12] This approach is important to recognize as it can also be applied for education purposes. Loyalty to a class, study program or even university, for example, is important to retain motivation and (social) engagement.

To demonstrate the potential of games and thus gamification, the most interesting facts [13, 14, 15, 16] regarding software-based games are mentioned hereafter:

- Not only "youngsters" play games
 - Average age of gamers: 37 years (they also have been playing for an average of 12 years).
 - Average age of most frequent game purchasers: 41 years.
 - Percentage of youth playing computer & video games: 97%.
 - Percentage of gamers older than fifty (2011): 29% (a significant increase from 9% in 1999); this figure is certain to rise in coming years with nursing homes and senior centers across the USA now incorporating video games into their activities.
- Games have already "invaded" people's homes
 - 77% of American households own videogames.
 - 68% of parents believe that playing games provides mental stimulation or education, 57% believe games encourage their family to spend time together, and 54% believe that playing games helps their children connect with their friends.
 - Percentage of female gamers: 42%. In fact, women over the age of 18 represent a significantly greater portion of the game-playing population (37%) than boys age 17 or younger (13%).
 - Percentage of gamers who play games with other gamers in person: 65%.
- Gadgets have undergone a process of "smartization"
 - 55% of gamers play games on their phones or mobile devices.
 - 2,600,000 games are downloaded each year in Germany.
 - Revenues of mobile games have increased by 40% in 2012.
- Games are addictive
 - Gamers have collectively spent 5.93 million years playing World of Warcraft.
 - Time spent gaming per day in the US: 215,000,000 hours.
 - Highest proportion of active gamers by country in percentage of the population:
 - Germany: 66%
 - Mexico: 57%
 - Russia: 53%
 - UK: 52%
 - Brazil: 47%
 - USA: 42%
 - China has the largest number of gamers.
- Games are of value

- In 2011, gamers in Germany spent EUR 380,000,000 on virtual items and services.
- The revenues of the gaming industry in the US are estimated to be beyond US\$ 22,000,000,000.
- Games are already present at the workplace
 - 46.6% of the German employees surveyed play games during working hours: 10.0% do so daily, 15.5% several times a week, 7.0% once a week, 3.6% once a month, and 10.6% less than once a month.
 - 61% of the CEOs and CFOs surveyed play games during their working hours.

Especially the last fact demonstrates that an important step has been taken to help gamification: stakeholders are familiar with the subject. Nevertheless, these facts also show that games can be hazardous to people due to symptoms such as addiction which often result in social isolation. This always needs to be taken into consideration when applying game elements to education scenarios.

Based on the above definition and facts, a set of scenarios for educational usage will be introduced for further evaluation and discussion.

III. SCENARIOS

"Where games traditionally model the real world, organizations must now take the opportunity for their real world to emulate games," says Brian Burke, an analyst for Gartner. In order to emulate, you have to develop gaming scenarios in your everyday teaching. To this end, some offline as well as online scenarios will be described and evaluated which use:

- Leaderboards
- Badges
- Level Systems
- Achievements
- Rewards
- Geolocation Services

Businesses such as IBM have already recognized gamification as an enabler and developed games to train employees. In the virtual environment "Innov8" players can learn how IBM operates business processes [17]. Inside Innov8 Online, one encounters three different game scenarios:

- ***Smarter Traffic*** – Players have to evaluate existing traffic patterns and re-route traffic based on incoming metrics.
- ***Smarter Customer Service*** – Using a call center environment, players are able to develop more efficient ways to respond to customers.
- ***Smarter Supply Chains*** – Players have to evaluate a traditional supply chain model, balance supply and demand and reduce environmental impact.

IBM states that *"Players quickly see how practical process improvements can help meet profitability, customer satisfaction and environmental goals while addressing real problems faced by municipalities and businesses today. And when they're done playing, they can compare scores with other players on global scoreboards."*

IBM addresses several topics with "Innov8". Primarily, it introduces its way of business process management to employees and non-IBMers. It can communicate its business process management model to employees worldwide without any need to move employees, i.e. without expensive and time-consuming travel. IBM can also train people at any time without any restrictions regarding course schedule or teaching staff availability. To non-IBMers, the company can show professional behavior and a "coolness factor". The Youtube teaser shows IBM trying to transport strong emotions and feelings [18]. Finally, the wording used by IBM for marketing, such as "Smarter XY", is also communicated to players. This wording is clearly linked to IBM products and services and will easily be recognized by every player.

"Innov8" is already used academically by the University of Southern California [19]. Using a leaderboard, "Innov8" encourages players to compete with one another, thus illustrating how gamification software may be used in blended and distance learning scenarios.

Taking into consideration that gamification scenarios should be applied right at the start of a semester and that many soft skills classes take place at the beginning of term, it stands to reason that gamification scenarios for team building are of interest. Furthermore, keeping in mind that many students are already playing (computer) games together during class (but with absolutely no relation to the subject of the class itself), it seems a good idea to lure them away from their notebooks. Scavenger hunts are ideal for this end and can easily be connected to education goals.

In a scavenger hunt an educator can form teams or let students search individually. It is possible to link the scavenger hunt to education goals. With mathematics content, for instance, it is possible to create equations that point to a certain geographical position. Students will be able to find a certain viewpoint, building or even hidden object. Only those who can describe what they have seen or found can be considered to have solved the equation successfully. The students, on the other hand, will be fully aware of their success if they are able to retrieve the correct information or hidden object.

An actual riddle shall serve to further explain this idea. Many such riddles can be found at "<http://www.geocaching.com>". The topics the riddles cover arise from various disciplines and are therefore suitable for every field of education. The following puzzle [20] is a *"musical challenge that leads you to a historic area in Needham in search of a micro cache."*

The text of the riddle states:

Tom Lehrer (born April 9, 1928) is an American songwriter, satirist, pianist, mathematician, and singer. As a graduate student at Harvard University he began to write comic songs to entertain his friends. His style consisted of parodying the then-current forms of popular song. By the early 1960's Lehrer was employed as a resident songwriter for That Was The Week That Was, a satirical TV show. In the 1970's he concentrated on teaching mathematics and musical theater, although he also wrote for the children's television show The Electric Company. In the early 1980's, Tomfoolery, a revival of his songs on the London stage, was a surprise hit.

1. Go to: <http://www.privatehand.com/flash/elements.html>

Listen to one of our favorite songs where Lehrer sets the names of the chemical elements to the tune of Gilbert and Sullivan's "Major General's Song".

2. Determine the answers to the questions listed below. (Downloading the lyrics in PDF format will probably be helpful to accomplish this task)

3. Match the elements to their atomic number and discover the cache coordinates.

The coordinates listed at the top of this page will take you to the parking area for Village Falls Park. Although the area is child friendly, the dam area is not a place where small children should be allowed to go unaccompanied.

Cochrane Dam is a long stone dam across the Charles River with the stone bridge of South Street as a backdrop. The water falls about nine feet at this location and can be quite dramatic, especially during high water periods. Also on site are the masonry remains of the mill which once stood on this site. These include the concrete wheel pit and raceway. A little used railroad bed borders Red Wing Bay with wooden trestle over the nearby Charles River."

To solve the riddle the answers to the questions above have to be entered into the following form:

Micro Cache: 42° AB. CD 71° E. FG	
A	First element of the song's second set (the ones with the white letters outlined in black).
B	Comes after rubidium.
C	In good company with bismuth, bromine, lithium, and barium
D	The first element to fall off the bottom of the screen in the song.
E	Element that follows the ones that have their last two letters colored red.
F	The seventh element mentioned in the song.
G	The second element in the line that has all "s" elements.

Figure 1. Form to fill in Solutions with Coordinates

Those able to solve the riddle will find a small plastic tube containing a logbook. To prove their successful mission they have to sign the logbook. The owner/educator may collect it after a certain amount of time and check who has been able to solve the task.

Educators may create their own riddles or use existing ones at "<http://www.geocaching.com>". It is important to mention that students need to have a device (such as a mobile phone) that is capable of receiving a GPS signal and displaying the information (on a map). It is also possible to give students certain hints at a specified time. As a result, many students will be able to solve the riddle and find the cache. The educator can evaluate the performance of the teams or of each student individually.

To help incoming students get to know the city "Multi-Cache Riddles" can be used. Students have to go on a scavenger hunt with their GPS device and follow a certain route. The following is an example of a multi-cache through the City of London created by the geocacher "frozboz":

From a Swan to the Canary

A series of riverside caches from Swan Pier to Canary Wharf using the Riverside (Thames) path. The journey will take you past the Tower of London, through the St Katharine Docks (a separate mystery cache "Katherine and Thomas" to try there), then through the Hermitage Basin of the old Western docks on to Shadwell Basin before rejoining the Thames past Limehouse basin before reaching Docklands. A wide variety of cache styles from nanos to regulars.

As with a lot of urban caches you'll need to be sensitive to local residents, passers-by and gardeners. Be aware of potential watchers (whether in offices or via security cameras). However, if you are approached by either Police or Security Officers avoid acting suspiciously and explain what you are doing.

A good selection of pubs and restaurants around here.

When we set this series my friend was taking photos using a camera mounted on a tripod: a wonderful excuse to hang around a particular area without attracting too much attention!

Good public transport connections at either end, the Docklands Light Railway is generally not too far away in the section between St Katharine Docks and Lime House Basin.

No need to go into any private areas or onto flowerbeds etc for any of these. Generally flat and well paved throughout.

Small magnetic key box. Bring a pencil / pen.

The cache: Boozy Swan

This one is a simple multi cache at the extreme westerly end of the series. When I saw step three, I knew that I had to include it as a special bonus.

We'll end up a little north of the river but the Thames path doesn't run riverside here either. There is a pedestrian footbridge adjacent to help you across the busy Upper Thames St dual carriageway if you prefer not to cross at the lights.

This area is known as Vintry, after the Vintners' Company. The Vintners' Company, with its first Charter in 1364, is one of the Twelve Great Livery Companies of the City of London. The first three stages keep us near the grand Vintners Place.

As with many things British that have been around a long time, the Vintners' Company has a series of interesting and almost unique privileges. In medieval times it was within the gift of the Sovereign to allow Livery Companies the right to what was known as "a game" of swans on the Thames. In effect, this meant that a certain number could be culled for the Company's feasts. It is not known when the Vintners' Company acquired their "game", but the right to own swans on the Thames continues today, as it does for the Dyers' Company. It is therefore a myth to say that the Sovereign owns all the swans on the Thames, although the Crown does have ownership of all unmarked birds.

There is an annual ritual known as "Swan Upping". Every year, normally in the third week in July, the ancient

tradition of Swan Upping takes place on the Thames between Eton and Abingdon. Swan Upping is the annual census of swans on that stretch of the river during which the cygnets are marked. Under the command of HM The Queen's Swan Marker, three teams of Swan Uppers, Her Majesty's, the Vintners' and the Dyers', row in six skiffs up-river catching and marking the cygnets. Until fairly recently, the birds were marked by cutting their beaks; one "nick" for the Dyers' and one either side for the Vintners'. Her Majesty's birds were unmarked. This practice stopped in 1998 and now the Vintners' and Dyers' birds have a ring on their left leg (the Vintners' with two Coats of Arms to replicate the two "nicks") while the Queen's have none. During the marking, the birds are also given a health check by The Queen's Swan Warden, who is a vet. You can find out more about the Vintners' long relationship with swans, including how they have contributed to the health and protection of these birds by looking on The Vintners' Company website.

Step One: N 51 30.607 W 00 05.586

The coordinates will place you in the middle of the road on Southwark Bridge. Clearly I wouldn't want you to stand here, so descend about 25' into Fruiterers Passage (steps either side of the Bridge if you do not possess sufficient superhuman powers to descend vertically).

Look at the various prints on the wall to see what this area was like many years ago plus selected engineering plans of both the old and new Southward Bridges.

Look for the large print, courtesy of the Vintners and Fruiterers, that shows St Pauls Church (rather than Cathedral) by CJ Visscher. Note the date of the original print. IAB6

Step Two: N 51 30.665 W 00 05.580

Back upstairs. The coordinates will place you at the end of Queen St. However, it is not Queens we're after here, but their spouses. How many Kings have taken up residence here? (note they all live together in one house). This will give you C.

Step Three: N 51 30.663 W 00 05.644

Remember I mentioned Swan Upping in the intro? Well, here we see how the well dressed Swan Upper from the Vintners' Company attires herself.

How many barrels on each of the ten large buttons on the front of the jacket? This will give you D.

Final location

Not far to walk to the final location – just three or four minutes probably.

For the coordinates below, solve each bracket to give you a single digit. A, B, C and D are all single digits (i.e. 0 – 9 inclusive)

$N 51 30.6(A + 3)(B + 4) W 00 05.7(C - 4)(D + 4)$

Just to help you as a sanity check, assuming that you are at Step Three: you will not cross Upper Thames St (the dual carriageway), Queen St, Lambeth Hill or Queen Victoria Street.



Figure 2. A QR-Code

Buildings make for poor GPS reception around here. I had 16' accuracy reported plus checked location subsequently on Google Earth (wonderful tool!)

There are cameras here, but none appear to be focused on the cache. This can be a busy location during weekday lunch time and commute. Evenings and weekends are very quiet.

Have a look at what is growing on the fence near the cache. Not quite ripe when I set the cache, but they might be when you're passing by! Perhaps the Corporation of the City of London knows a thing or two about global warming that we don't. [21]

Obviously this trip would introduce students to this particular part of town while also suggesting where to spend one's leisure time. As most riddle-makers are students themselves, multi-caches are available at almost every university location. Thus educators do not need to spend much time on preparing the hunt. This task can easily be outsourced.

Another possibility to perform a scavenger hunt is by using a QR Code, which can link to any website using a barcode scanner. Taking into consideration that most students own a smartphone with built-in camera and that applications able to scan QR Codes can be obtained for free, this option for creating a scavenger hunt seems highly convenient. The educator can place the QR Code at any location he or she likes and link it to any website considered worth accessing. On this website the educator may provide further tasks or information. These tasks or information may consist in another riddle or point to another QR Code location. The chain of QR Codes is infinite and can therefore be used generously by the educator.

Another tool worth mentioning is "StoryTec" (Fig. 3), developed and maintained by TU Darmstadt. "StoryTec has been conceptualized as rapid prototyping environment to facilitate the authoring process of interactive applications. Examples include, but are not limited to story-based city and museum guides, classical Web-based training courses, game-based learning appliances for kids, students and families as well as process-oriented, individual and collaborative simulation and training environments for trainees and employees or personalized exergames to increase the motivation for a sportive and healthy life" [22]. StoryTec can be considered a toolkit rather than a ready-to-use game. It may be used by educator or students to create their own storyboard and can serve a wide range of educational fields.

StoryTec is available for free for education purposes and can therefore be tested extensively before being used in the classroom.



Figure 3. StoryTec

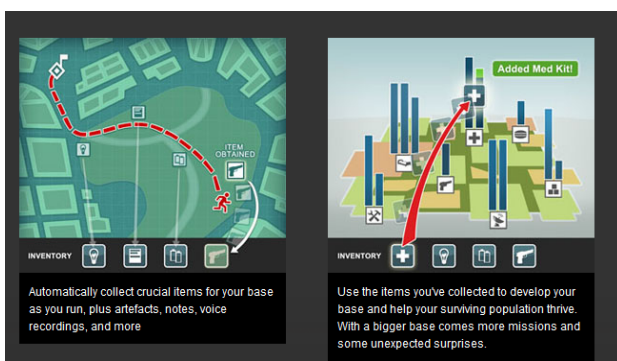


Figure 4. Zombies, Run!

Finally, a way to motivate students to engage in sports activities is the Smartphone Application "Zombies, Run!" [23] (Fig. 4).

"Zombies, Run!" is an "ultra-immersive running game" for smartphones. Players can listen to a predefined story using their headphones. They receive orders and voice recordings while running. After completing a run, they can build and grow their "base" with the items they have collected. The task is to save people from zombies. To do so, they automatically collect items like medicine, batteries and ammunition while running. These items can be assembled freely on the "Zombies, Run!" platform.

For education purposes, "Zombies, Run!" records distance, time and pace. Although the application has only just been deployed, it will be interesting to see if using it has a motivational influence on a person's running behavior.

III. CONCLUSION

Caillois' claim that games are non-productive and participation therefore does not accomplish anything useful must be discounted since non-productiveness does not apply in the education context. Gamification can prove the opposite. The definition of "gamification" should thus be amended to "Gamification is the use of game elements in contexts that originally had no link to game-related elements." The more non-game-related elements receive gamification treatment, the more they drift towards game-related elements. Therefore, gamification can be considered a virus. It will be interesting to see if this virus is benevolent. Still, it is also important to pay attention to

the fact that games are addictive. Students who already are or easily tend to become addicted have to be treated differently. It does not make any sense to use gamified content with them since they will happily take this opportunity to turn their attention away from the educational purpose. On the other hand, this might be an opportunity to lure them away from their addictive behavior. In this case gamification could turn into a "bridge" back to the real world.

The facts mentioned before show that the gaming industry has a huge impact on society at large. The increasing number of players can be regarded as evidence that most students are not only familiar with gaming but also experience it as joyful. Moreover, they are open-minded towards gamified elements in education scenarios. If students demand gamified education, educators should be able to respond in a suitable manner (even if they do not want to use gamification in their teaching).

Concerning concrete scenarios, scavenger hunts for team building purposes work best. They are easy to implement, to adopt and to develop in such a way that they meet the educators' requirements. Software-based tools are more sophisticated to design and demand a highly qualified developer; on the upside, they can be designed more individually. Educators who do not have the knowhow or resources to develop software-based tools can rely on already existing tools, which are free of charge most of the time. It is possible, for instance, to generate a QR Code without further knowhow if one uses a QR Code generator like <http://qrcode.kaywa.com>. The code can be linked to any existing website and may thus become a flexible tool for education. To help incoming students become familiar with the city, educators can easily use already existing "multi-caches" found at <http://www.geocaching.com>.

This paper has attempted to summarize the brief history of gamification and to enable the interested audience to easily implement scenarios in their own teaching. Moreover, an invitation is being extended to collaborate on further research on this topic. After all, it would be a shame if educators were not able to make teaching and learning a bit more joyful – especially when neither teachers nor students need to learn a new skill to be able to take part in a gamified education class.

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This article is an extended and modified version of a paper presented at the International Conference on Interactive Collaborative Learning (ICL2012), held 26 - 28 September 2012, in Villach, Austria. Received 23 October 2012. Published as resubmitted by the author 3 December 2012.