Use Cases for Gamification in Virtual Museums

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Abstract: Museums face the problem of decreasing number of visitors. One way to solve this problem is to attract new target groups such as young people. Therefore, some museums started to develop online museums where they digitally present their exhibition artifacts to a larger audience. One way to reach this goal are virtual environments. But how can potential visitors be motivated to visit the museum continuously and how can knowledge of the artwork be transferred? Gamification is one approach that could solve both problems. In this article the authors develop gamification approaches for a virtual museum guide based on different use cases.

1 Motivation

Museums usually exhibit artifacts such as paintings, sculptures, jewellery, mummies, and so forth. However, exhibitions are rather passive and non-engaging [BFG05]. Especially younger visitors often feel not addressed by today’s museums [STA10]. During the last years, a shift has taken place in the museums’ identity “from simple holders of cultural objects to educational and at the same time entertaining institutions” [LV04] to reach new target groups [GG08].

 Ideally, educational techniques, which keep the “traditional museum experience” and provide entertainment for target groups using new technologies [SC02] at the same time, could be developed. Offering a museum in a virtual world reduces the effort, which has to be taken by visitors: Instead of going to a museum one simply enters it via a computer or mobile device. Generally, virtual worlds are characterized by social interconnectedness and generation of content by users [Or07, ML07]. Virtual worlds (VW) differ from other social media platforms [SSL08] by embedding those properties in a virtual 3D-context and by extending them through a wide range of interaction possibilities (bridging of geographical and physical barriers) [PC10, AK10, Wa09, Ba04, Ca05, DM09, SB12, SL11, SLF10]. Due to this, virtual worlds offer novel possibilities for museums to present their artwork in an innovative way while addressing a quite
larger audience. Scientific literature does not provide a single definition for VWs. Contemporary VWs are generally characterized by several authors as graphical, persistent, immersive environments, which facilitate interaction among users that are represented as avatars [CFF10, Be08, SLF10].

Although communication between visitors is an advantage comparing to an ordinary museum, visitors should also learn something about the exhibitions. In this spirit, gamification is one approach that might help to increase engagement of users [VA12]. ‘Gamification’ describes the integration of traditional game elements in a non-game context – such as the virtual world of a museum.

Consequently, the question this paper wants to answer is, how gamification approaches can be integrated into virtual worlds, especially in the context of a museum. For this purpose, use cases of a gamified museum guide are designed and evaluated. The next chapter provides an overview of the current scientific discussion, followed by a definition of the term gamification and the theoretical background behind it. Chapter 4 contains a description of five sample use cases, which are evaluated in chapter 5. For the evaluation, different criteria are developed and formed into a guidance for game designers. The paper closes with a conclusion and an outlook to further research.

2 Related Work

Bartle generally defines virtual worlds as "places where the imaginary meets the real" [Ba04]. Schroeder underlines the potentials of virtual worlds to support interaction in a special way: "persistent environments in which people experience others as being there with them and where they can interact with them" [Sc02].

Generally, virtual worlds can be classified into two types: (1) multi-user virtual environment (MUVE) and (2) Massively Multiplayer Online Role-Playing Game (MMORPG). The major difference is that in MUVEs the users do not have a certain goal that needs to be achieved or a start-finish-character as in MMORPGs. According to Bartle’s apprehension, virtual worlds facilitate users to witness the virtual 3D-environment in form of an avatar and to become part of that environment conditioned by the feeling of immersion. As a result, the user experiences a strong degree of reality even though he/she is only using an electronic medium. This effect is called immersion [FLH08].

Very similar to immersion is the flow principle defined by Csikszentmihalyi. He established the term “flow” for a specific kind of happiness characterized by intense concentration, loss of self-awareness, a feeling of perfectly challenged and a sense that time is flying. Gamification abets both, immersion and “flow”. Due to this we focus on our research in gamification approaches utilized for a virtual museum guide to tie in the visitors [Cs85].

Virtualization of museums started with so-called mixed reality: Göbel and Geelhar use that term to describe their virtualization of a dinosaurs museum [FLH08]. Next to each
skeleton, there are screens providing additional information about the current species, e.g. an animation of its way to move. Severson and Cremer describe a similar approach with a historical reconstruction room demonstrating Cedar Rapids in the 1990s and 1920s [SC02]. Bay et al. presents an interactive museum guide [BFG05]. The visitors are guided through the museum using tablets providing additional information.

All these approaches integrate a virtual reality into the traditional museum. Other papers also present separated virtual museums. At the beginning of the millennium, Charitos describes an architecture for a virtual museum – from database design to web representation [Ch01]. On the one hand, the virtual museum is integrated into the traditional museum; on the other hand, remote visitors are connected via customized software. Wojciechowski and Walczak describe the ARCO project, which aims at developing the whole chain of technology to create, manipulate, manage and present digitalized cultural objects [WW04]. For the virtual representation, templates are used.

The previously described approaches focus on the representation of information. Lepouras and Vassilakis point out that education through entertainment is important [LV04]. Swartout et al. state that their main goal for their museum guide is to increase pupils’ interest and engagement [STA10]. Approaches used to achieve this often contain entertainment aspects. Squire and Jenkins describe how different games support the learning process [SJ03]. Moreover, Kapp largely describes how to use gamification to improve the learning process [Ka12].

3. Theoretical Background

Gamification is one approach to increase the entertainment and thus the motivation factor of users [Va12]. There are many scientists trying to define the term gamification [De11; Do12; Va12]. One central goal of gamification is the improvement of users’ engagement [De11]. Therefore, the term becomes vague. Following Deterding et al., “Gamification is the use of game design elements in non-game context” [De11]. Thus, gamified applications try to motivate the user by game design elements.

Although the definition seems to be tangible, some further explanations are necessary. At first, the term game needs to be specified: In everyday language, the terms play and game are used interchangeably; in fact, their meaning differs. A play is a more free form with improvisational aspects, whereas a game “is structured by rules and competitive strife towards a goal” [De11]. Therefore, games have a desired outcome. Deterding et al. point out that gamified applications have little space for an open, exploratory free-form play [De11], whereas Squire and Jenkins laud games like Civilization III and Revolution for their open game style as educational useful games, because students start to ask “What if”-questions [SJ03]. Both statements seem to be antipodal, but they do not expulse each other.

The overall goal of Civilization III is to manage economies and plan the growth of civilizations [SJ03]. A player seems to have countless opportunities, but in fact, this
overall goal restricts a player. However, games can be defined as rule-structured plays, which guide players towards a desired outcome [SJ03].

Secondly, the expression “non-game context” needs a further explanation. Gamification uses game mechanisms where they are usually not expected. This expectation depends on social, historical and cultural aspects [De11]. Consequently, there is not the non-game context, but – depending on the target group – players will expect game elements or not.

As mentioned above, gamification is propagated by marketing, which may result in a lack of appropriate use. Vassileva argues that gamification leads to short motivation only [Va12]. One cannot order students to play, but one can create a space where play is encouraged through game mechanics [Re11]. Thus, to avoid players’ short motivation, they have to enjoy the activity, which means a game has to give experiences of competence, autonomy and relatedness to the players [Va12].

Nicholson introduces the term meaningful gamification [Ni12] to select such elements that contribute the player’s motivation. Meaningful gamification “is the integration of user-centered game design elements into non-game context” [Ni12]. Nicholson modifies Deterding et al.’s definition by adding the term user-centered and thus specifying game design elements more precisely.

Game design elements should be meaningful to the user and result in positive change in the user’s mind. Furthermore, the cornerstone of every design element is information: The design element must be attached to an activity [Ni12]. The opposite of user-centered design elements are mechanism-centered ones. Game designers often want to adopt new and interesting design elements into their games. However, they do not integrate into the game per se; trying to insert them may result in a lack of understanding the game play [Ni12].

Lastly, the term game design element requires further attention. Game design elements are incorporated elements of games [De11]. They have “accumulated a number of patterns, rules, and feedback loops, that are motivational, and create user engagement and loyalty” [Va12]. For example, scoring systems, avatars, group chat functionality and so forth are game design elements. In literature, several gamification are already identified, a sample of the most prominent ones follows: levels; inaccessible areas, boss monsters, tools, controllers, power-ups, score, high score list, public information, communication channels, rewards, puzzle, luck, trade-offs, randomness [BH05].

Besides the term gamification, some similar concepts exist. Firstly, serious game is a concept for games designed for a primary purpose other than pure entertainment [Xu11]. As gamification, this concept focuses on the entertainment factor of games; thus, the differences are slightly. However, a serious game is still a game, whereas gamification is used in a general context [Re11].

The concept of persuasive game is used to describe the power a game may have to change and disrupt ones social and cultural positions. An example for a persuasive game is Anno 2070: The gamer has to choose between an economy based on fossil or renewable energy. However, the atmosphere emphasizes that a green future looks much
brighter. Consequently, this game tries to persuade the gamer to choose the renewable alternatives.

Lastly, gameful interaction design “defines the structure and behaviors of interactive products and services, and the user interaction with those products and services”, to achieve a change in the behavior of their users [Xu11].

However, so far it was not mentioned why gamification increases ones motivation. Next to the above described game design, positive psychology is used to “create an environment that is more challenging and rewarding which results in an increased desire to participate and contribute” [MH13]. Positive psychology does not focus on the diagnosis and therapy of depression but studies “what makes normal people stronger and more productive” [MH13].

Within this theory, Csikszentmihalyi established the term “flow” for a specific kind of happiness characterized by intense concentration, loss of self-awareness, a feeling of perfectly challenged and a sense that time is flying [Xu11]. To achieve a flow, conditions like a clear task and feedback are pre-requirements; during a flow, characteristics like control must be achieved [Cs91]. However, the challenges must fit the players skills, especially as they increase over time [Xu11]. Even for the relatively short time span of the visit of a museum the “flow-principle” appeals application. Cause to the integration of game aspects, which enable “flow” for shorter time periods.

To sum it up, the basis for good gamification is to put the needs and goals of users over the needs and wishes of the game designers [Ni12]. This is basic principle for the evaluation method developed in chapter 4.

4. Design of Use Cases

In this chapter, five different use cases are presented, each containing several game design elements. Each use case represents a museum guide – at least somehow the player
disCOVERs a museum exhibition. The used game design elements are mostly picked from [BH05]. Every use case begins with an abstract description of it; afterwards the most important game design elements are selected and explained more detailed. The use cases may be somehow devised and the link to museums on the first view is weak. But generally, they are based on established stories from well-known computer games and modified to the context of a museum. To keep in mind, this work should provide design samples for gamification based on virtual museums guide, which should be exemplary proven if they generally fit to gamification principles.

Use Case 1

A thief tried to steal a valuable, ancient artifact. He was arrested in the museum already; however, he split up the artifact in some parts and hid them within the museum. The players are the responsible chief inspectors. During the thief’s interrogation, he does not directly tell where to find the parts, but he gives clues or riddles. The players write them into a notebook and consult the staff of the museum to solve them. However, the employees do not like each player equally and therefore give different answers to their questions. The players need to communicate with each other to collect their answers and exchange their knowledge.

This small use case already uses some game design elements. First, the riddles and clues given by the thief are collected in a notebook. Another used design element are communication channels [BH05]. Here, synchronous channels are required, whether they are audio or plain text channels is not important here. This element is used for teaching players one another. The most important design element in this use case are the rewards [BH05]. For each solved riddle, the players receive a part of the stolen artifact. They have to find all to do their job properly.

Use Case 2

Two employees of the museum guide the player through the exhibition. For each item of the exhibition, the two guides are involved in a pros and cons discussion. Although their professional wisdom is noteworthy, they are little oblivious: They forget where the keys for the next room or the controllers to enlighten it are. Furthermore, some rooms behave strange: There is no gravity, they are full of water, or it rains. To enter these rooms, the player has to find certain tools like magnetic shoes, diving gear or an umbrella. Only with the use of these tools, keys and controllers, the player is able to enter each room and to see the whole exhibition.

The first design pattern used in this use case is that two guides present the exhibition. As mentioned above, the advantage of this design element is a possible, vivid discussion [STA10]. Different opinions are transported by different characters and thus seem more authentic. Furthermore, controllers and tools [BH05] allow players to interact with the virtual world. The physical disorder creates further attention. With respect to meaningful gamification, the overlaying map is introduced: It allows the player to plan where to look next for tools and controllers [BH05].

Use Case 3:
The third use case is used for a short, broad overview of the museum. The player finds him-/herself in an empty and closed museum. He/she does not want to get into trouble and decides to find a way out of the museum without starting the security system. It is deactivated for each room via playing a short game concerning the topic of the room; for example, to puzzle an important picture in a given period of time. For each game, the player gets points. After he escapes from the museum, the overall points are calculated and compared with other players on a high score list.

The main design element of this use case is the stealth mode [BH05]. This element creates tension, because the player has to focus on not being captured. The intention of the little games in this use case is not to deliver knowledge, but to create interest in the content of the museum. Scoring and high score lists allow comparing the results of different players and thus create further tension [BH05].

Use Case 4:

This use case is a multi-player guide again. During the tour through the museum the players suddenly find themselves in a different period of time. Each player receives a different role description that enables him or her to emphasize with his or her new role. The roles are for example a priest, a farmer, a citizen of a big city, and so on, during the thirty years’ war. After emphasizing with their roles, a discussion starts where each player has to behave as he expects his character to react. The computer sends messages like “Swedish troops have captured Magdeburg”. These interrupts will influence the players’ behaviour and thus will sensibilize them why people reacted the way they did.

The only design element introduced within this use case is the roleplaying [BH05]. This element creates an imaginary situation and requires all players to stick to their roles. If all players identify themselves with their roles it will deepen the emotional immersion. This use case is adopted from the game Revolution [SJ03].

Use Case 5

In the last use case, the player becomes an avatar. The more questions the player asks or the longer he listens to the guide, the more credit point he receives. Credit points are the currency within the museum. For very good questions, long listening, or helping other players, the player receives some kind reward like a ring, a jacket, a medal of honor, and so on. He is able to show these rewards on his avatar and he is able to sell them and buy other things.

This very short use case already contains several game design elements. Avatars [BH05] are used to tightly connect players with their success: The rewards he receives decorates the avatar. The currency [BH05] as well as the trading system [BH05] additionally try to measure a player’s experience.
5. Evaluation of Use Cases

5.1 Methodology

At first, we discussed different scales to measure the grade flow realized throughout gamefication elements. In our literature research we identified that an appropriate framework is the EGameFlow scale to measure learners’ enjoyment of e-learning games developed by Fue et al. [FSY09]. They created a framework with eight factors; each factor has about six items, in sum 56 items. The factors, namely concentration, goal clarity, feedback, challenge, autonomy, immersion, social interaction and knowledge improvement, are the key ingredients of a good e-learning game [FSY09] and the items try to measure a factor is implemented (c.f. table 1): The more items are selected, the better a factor is fulfilled.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item No.</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal Clarity</td>
<td>G1</td>
<td>Overall game goals were presented in the beginning</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>Overall game goals were presented clearly</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>Intermediate goals were presented clearly</td>
</tr>
</tbody>
</table>

Table 1. Excerpt from questionnaire [FSY09]

These factors and items worked well for Fue et al.’s framework, but not all of them fit the requirements for the upcoming evaluation. Fue et al. used their framework for students and afterwards calculated means and standard deviations for every item and factor. However, such a big inquiry is not the intention here. This paper aims to provide game designers a first, easy, to be verified method to evaluate their game design elements to prove meaningful gamification. Factors and items that are just reasonable with a certain sample space have to be left out. As mentioned above, game designers tend to use mechanism-centered design elements. Due to this, game designers should focus on a user-centered perspective, but take the technical restrictions into account. Thus, the framework needs to be adjusted to the given purposes (c.f. table 2).

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item No.</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>C1</td>
<td>Player is not distracted from tasks that the player should concentrate on</td>
</tr>
<tr>
<td></td>
<td>C2</td>
<td>Player is not burdened with tasks that seem unrelated</td>
</tr>
<tr>
<td>Goal Clarity</td>
<td>G1</td>
<td>Goals were presented at the beginning of the game or during the game</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>Goals were presented clearly</td>
</tr>
<tr>
<td>Feedback</td>
<td>F1</td>
<td>Player receives immediate feedback</td>
</tr>
<tr>
<td></td>
<td>F2</td>
<td>Player receives information on his success or failure immediately</td>
</tr>
<tr>
<td>Challenge</td>
<td>H1</td>
<td>The game provides “hints” in the text that help the player overcome the challenge(s)</td>
</tr>
<tr>
<td></td>
<td>H2</td>
<td>The game provides video and audio auxiliaries that help to overcome the challenge</td>
</tr>
</tbody>
</table>

2315
The difficulty of challenges increases as the player’s skills improve.

The difficulty is tailored to the player’s abilities.

**Autonomy**

A1 Player knows the next step in the game

A2 Player is guided to the overall goal (maybe unnoticed)

**Social Interaction**

S1 Players cooperate with each other

S2 The cooperation in the game is helpful to the learning

S4 The game supports social interaction between players

**Technical Restrictions**

T1 Game engine is able to build the design elements

T2 Server / infrastructure resources are sufficient

T3 Player’s hardware is expected to be sufficient (average hardware assumed)

T4 Further licences or hardware is required

**Effort**

E1 Difficulty to implement use case

E2 Time required to implement

<table>
<thead>
<tr>
<th>Table 2. Adjusted Framework for Evaluation (according to [FSY09])</th>
</tr>
</thead>
<tbody>
<tr>
<td>The factors knowledge improvement and immersion are very subjective; to measure them here is not purposeful. The same goes for some of the items. They are just reasonable with a bigger sample space. Thus, many items are left out. The remaining items can be evaluated by the game designer himself or in a group of game designers, at least as a first hint.</td>
</tr>
</tbody>
</table>

On the other hand, factors like technical restrictions and required effort are important for game designers. The factor technical restrictions is measured with the items ability to implement elements with the given engine, server and client hardware restrictions, as well as required licenses. These items should remind the game designer to restrict himself to an achievable design. The required effort is measured with an approximated difficulty to implement the use case and with the expected amount of time required.

The use cases were evaluated by six students who developed a virtual museum using gamification approaches. They were presenting the use cases and asked to rate whether a factor of the framework is fulfilled or not. For the evaluation, the items of each factor are summed up. Each item is measured on a scale with four different entries to allow a more differentiated evaluation for each item. The sum of items und participants for each factor is then divided by the amount of items for a factor. Thus, the result is between 0 and 1. It is not possible to compare the results between factors or even between cases – the result can merely indicate whether the implementation abets the proposed utilization of gamification in museums.

### 5.2 Discussion and Results

In the following chapter the results of the evaluations are discussed for each of the use cases. We found out that use case 1 has a high support for concentration, goal clarity,
autonomy and social interaction. The goal is easy to understand and a quest book simplifies the recapitulation of sub-goals and it also guides the players through the game. However, this use case misses a feedback functionality. The players only receive feedback via finding parts of the artifact; an intermediate feedback is missing.

The second use case suffers on the factor challenge: This use case is about finding tools and controllers, but there is no story or character development that guides the player to an overall goal. As this is a single player use case, there are obviously no points for social interaction.

Use case 3 especially shows weaknesses for the factor autonomy. Again, a simple permutation of the same idea, namely winning games to deactivate the security system, does not provide a challenge.

Use cases 4 and 5 have many weak aspects: the factors feedback, challenge and autonomy are low ranked. In contrast to the other use cases, these use cases are not integrated into an overall story like a robbery. This could be a reason, why challenge and autonomy do almost completely fail. Without a story in the background, an overall goal seems also difficult to define and thus feedback is hard to give.

No use case has problems with technical restrictions. However, the effort differs – surprisingly it increases with bad results in the other factors. This may additionally indicate that wisely used game design elements – in sense of meaningful gamification – do not only give a reasonable and good gamified application, but also decreases the effort of implementation.

The evaluation shows that all presented use cases have weaknesses for the factor challenge; especially all items concerning an adjusted game behaviour to the player’s abilities are classified as low. Thus, there is a need for integrating game design elements concerning this aspect for all use cases. To sum up, the results of the evaluation, table 3 emphasizes immediately, which factor is insufficient fulfilled by which use case.

<table>
<thead>
<tr>
<th></th>
<th>UC 1</th>
<th>UC 2</th>
<th>UC 3</th>
<th>UC 4</th>
<th>UC 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Goal Clarity</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Feedback</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Challenge</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Autonomy</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Technical Restrictions</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Effort</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 3. Evaluation Results
6. Conclusion

In conclusion, one could state that for a good meaningful gamification one has to select a context at first, e.g. museum guide, and afterwards to develop a coherent background story, limiting the game design elements. They can be chosen from a game within the same genre as the background story, different games, or pattern books [BH05]. Choosing a background story, the game designer focuses on elements that do fit in the context with respect to meaningful gamification.

During the evaluation some weaknesses of the evaluation method appeared: Firstly, there is no measure for knowledge creation. In chapter 5.1 it is argued that the factor knowledge improvement is left out, because it is not possible to measure objectively whether there is an improvement or not. However, without this factor the evaluation does not measure the overall goal for the non-game context museum guide at all. A factor with one item called “required improved knowledge” could be integrated. The scale for this item needs to be further specified. Unfortunately, the results of this item are very vague, because they are subjective to some extent.

The same goes for entertainment. There is no criterion mentioned that covers the player’s enjoyment to play directly. As this aspect is very subjective, there was no solution found by now to measure it without a bigger sample space. Thus, game designers have to have this aspect always in mind, although the presented questionnaire does not give any hints on this aspect.

However, this research depends on limitation. First al all, this paper focuses on developers and just represents their point of view. The user’s point of view is not considered. The sample of the asked developers is small and the evaluation of the use cases need to be carefully interpreted. Nevertheless, this paper contributes knowledge to the usage of gamification elements in virtual worlds for museums.

Further research may be conducted by an intensive literature analysis of adopted gamification approaches in museums or a web analysis to figure out, which gamification approaches are already used and established in practice. Furthermore, the described use cases should be implemented and a user-test might prove the findings of this paper derived from the experiences of the game developers. Based upon these results, the adopted framework by Fue et al. could be proved.

References


