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Lessons learned from theory and praxis

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APPLIED GAMIFICATION IN SELF-GUIDED EXHIBITIONS

LESSONS LEARNED FROM THEORY & PRAXIS

Peter Vistisen, Vashanth Selvadurai, Rameshnath Kala Krishnasamy

ABSTRACT

This paper contributes to the current understanding of applied digital gamification by providing insights from two design cases from the Danish aqua zoo, the North Sea Oceanarium, concerned with self-facilitated exhibitions. Grounded in a short review of the current state of art, we provide two empirical case examples, concerning a mobile augmented reality design and an Instagram service. Analyzing the design process behind these cases, we identify some of the challenges arising from applying gamification in practice, and whether these insights verify, extents or contradicts current examples of applied gamification research.

Specifically, the cases provide insights to the challenge of on-boarding visitors into participating and using the designed products during their visit. In both cases, providing certain incentives for using the app or participating in the Instagram challenge, seemed to activate and engage more visitors and motivate them to participate in the activities as well as downloading the app and preparing for the activities on their own volition prior to their visit. By looking closer at what might have triggered the motivation with the visitors, a connection could be made to gamification and serious games, pertaining to the applied game design arena, in that there is something about extrinsic motivational properties at play, that persuaded the visitors to use the digital experience layers.

INTRODUCTION

Emerging technologies offer up new ways for visitors to experience exhibitions in or at attractions, such as museums and science centers, through digitally augmented layers. Whether it is to augment, drive, enhance an existing exhibition or be the exhibition itself (Damala et al 2007, Antoniou et al 2015, Coenen et al 2013). Exhibitions, in contexts such as museums, science centers, zoological attractions or similar contexts, have a long track record, in the field of academia, of being used as research test beds for various explorative research projects, that operate in the intersection between disciplines in design, technology and human factors, to test and develop bleeding edge technologies. The context provides a playground for testing novel ideas, where the goal can be to test technical implementations, several different related subjects, a technological platform or search for new ways to augment and enrich the visitor's experience through digital layers and media technologies (Damala et al 2013, Vlahakis et al 2002, Chen et al 2016). The latter, is the point of departure for this study's area of interest, with a focus on exhibitions in different contexts. Museums, in this study uses the inclusive definition provided by Falk and Dierking in the Museum Experience (1992). These are "historical homes and sites; science and technology and nature centers; aquaria, zoos, and botanical gardens; as well as traditional art, history and natural history museums." (Falk & Dierking 1992).

Alongside the point of departure, i.e. digital experience layers for museums, this study is focused on a very specific challenge within the area of interest; self-facilitated exhibitions. By self-facilitated, we mean exhibitions that are not staffed with dedicated guides, custodians or curators to follow the

visitor's around, but only personnel to assist, instruct or otherwise help the visitors before entering the exhibitions. The inclusion of this dimension, is due to an increasing number of unmanned exhibitions and attractions emerging over the past few years. This development has been on the rise in recent years due to economic constraints that are forcing certain established exhibition sites and landmarks to shut down permanently (Micklethwait 2011, Taul 2014). As an alternative to shutting down, technological interventions are explored to enable self-facilitated experiences at exhibition sites, so the staff can be cut down to a bare minimum, often skeletal crews, who runs maintenance and other practical tasks. The museum context has a long tradition of playing with emerging technologies as means for mediating knowledge to a broad audience. This is substantiated in the academic fields, by looking at the growing field of cybermuseology, that expands upon the established museology field, "...which reflects on the concepts concerning all museum activities from collection management to visitors' needs...", with reflections that advance the idea of the efficient use of digital media by museums." (Leshchenko 2015).

There have been several iterations of implementing technologies to support experience layers for exhibitions over the years, that are targeted at self-guided experiences. Early examples included audio-guides, displays with posters or signs/notes which were solutions that found wide-spread adoption, most likely because these solutions are/were relatively inexpensive and easy to implement and not too complicated for the visitor to decode. These solutions secured the historical objects and enabled unfacilitated curation. These are examples of how technological intervention could alleviate the staff (custodians and curators), with automated guides and added security, by securing the objects behind protective glass, etc. Later examples, become increasingly interactive, such as projections on display pieces, touch-based interactions (e.g. displays, buttons, etc.) and handheld devices such as PDA's (Walz et al 2007, Wakkary et al 2009, Coenen et al 2013). More recent examples are increasingly based on personal devices and context, where mobile and smart devices are becoming the baseline platforms for delivering digital experiences (Chung et al 2016, Sanchez & Pierreoux 2015). A rich body of research exists in the museum context where mobile devices, such as smartphones, tablets, PDA's etc. have been used to deliver augmented reality, location-based/context-aware content, virtual reality and other types of digital content. This is underpinned by reviewing the accumulated research on technologies that are particular, but not exclusive, to handheld and mobile devices, such as augmented, virtual and mixed reality (AR)(VR)(MR) has revealed that these types of digital layers can create immersive and engaging experiences, that can positively impact the user experience, learning and motivation. It can even impact a visitor's emotional attachment to a location (Chang et al 2015). This also corresponds to how visitors at museums expect learning and education mixed with elements of fun and games as a part of the museum experience in more recent times, due to the massive mainstream adoption and day-to-day use of mobile devices (Matossian et al 2012). These examples, the volume of research into mobile technologies as platforms for delivering digital experiences at exhibitions, and the results they have produced, explicates the technical capacity and technological capability that these devices encompass.

Parallel to the technological advancements, the user participation barrier has also decreased. More and more users are now accustomed to carry and operate smart devices; the devices themselves have been revamped over time to deliver an increasingly positive user experience and include even the most novice users and enable them to complete tasks with relative ease. The decrease of interaction barriers means more users can access and experience digital layers that were not too long ago mostly aimed at tech savvy users. In other words, the digital divide has been decreased to a level where more users can participate in digital experiences. This enables new types of

interactions, where a broader audience can participate, instead of letting cumbersome, hard to use devices set up blockades for user interest.

The parallel development of technologies, incrementally and iteratively reaching new levels of maturity with each leap forward, and the diminishing threshold of user participation combined, gives rise to re-evaluate and test previous experiments and concepts within the museum context, as earlier stages of the technologies might have lacked maturity to succeed.

For instance, using virtual reality might have been more disruptive to the visitors' experience, when it was a brick-top, with poor fidelity and a horrible user experience, that never fully matured until recently. Now the same technology can be presented on smartphones, that yield a significantly better experience, as it is technically more capable at delivering higher fidelity content. So instead of being disruptive to the social experience, as has been reported in user studies (Cosley et al 2008), it could potentially provide an experience that ties into social interaction (Haesler 2016).

However, by investigating these efforts into improving the visitors experience or creating attractions through new technological platforms or by improving existing, a new challenge arises; having the visitor put the developed product, system or service into operation. E.g. if it's an app, the user must first see the value in installing it and subsequently learn to use it and then actually use it. A review of the existing literature, dealing with the constellation of context, user and technology, in this paper museum, visitor and personal smart devices, such as smartphones, a gap has been identified in that there are no reports of the visitor acquire the digital experience layer, without any or sufficient guidance. Thus, this paper will add a third dimension that is concerned with visitors using the developed systems on their own volition. Or in other words, how to make them use it.

GAMIFICATION TO INCREASE ENGAGEMENT & FACILITATE ON-BOARDING

This paper will explore this gap, through two cases from a continuous research involvement with the Danish aqua zoo the North Sea Oceanarium conducted in 2012-14 and 2016 respectively. The first case is a mobile augmented reality smartphone application, designed to provide the visitors with a 'role', that put the visitor in the seat of a movie director while exploring the North Sea Oceanarium exhibitions and the second case is an experience layer designed to motivate the visitor to create user generated content through Instagram posts, thus have the visitor generate content to a larger transmedia experience across pre- during and post-visit.

Museums are, incidentally, an informal setting where play and entertainment is often a part of the experience, inextricably interwoven with the educational aspect. A number of recent studies have focused on the educational value and entertainment potential to visitors at interactive exhibitions (Horn et al 2014, Leong et al 2014, Moesgaard 2015, Göbel et al 2006). Additionally, the effects of gamification along with serious games and other research fields neighboring the game design arena (Hamari et al 2014, Lingnau et al 2012, Hassen et al 2012) – gamification understood as the use of game design elements and principles in non-game contexts to improve user engagement, flow and learning (Deterding et al 2011).

The emerging technologies, combined with a present and on-going problem of shifting exhibition sites to unmanned, self-facilitated visitor experiences, the challenge of on-boarding visitors to actively participate on their volition frames this study's three dimensions. Based on lessons learned from previous studies, that fits this framing, a potential in exploring motivational affordances as proposed by Deterding (2011) in a conceptual model for situated motivational affordances of game

elements by extending upon Zhang's motivational affordances in ICT design and use (Zhang 2008), is investigated to further uncover the potential to weave in gamification elements to instigate a motivation that can assist in putting digital experience layers targeting exhibition in self-facilitated contexts. Thus, this paper aims to contribute with practical lessons learned about applied gamification in an exhibition context, with a special focus on how visitors are on-boarded the gamified exhibition design.

RESEARCH DESIGN

The two cases of applying gamification in an exhibition context, are based on a four year long constructive design research study - based on the methodological consideration from Koskinen et al (2012) in which the constructive activity of design is seen as a vehicle for knowledge contribution within a specified area of concern. In this regard, we consider the two cases as design interventions - used to investigate how applied gamification in an exhibition context could facilitate and engage the visitor's experience.

The research data is gathered from a combination of field notes and design documents from the multiple design iterations of each of the two designed products, and design ethnography (Hughes et al 1997) from user studies both prior and after implementation of the products. The data from the iterations from the design process are further examined from use data collected during the first period of implementation, to support whether the gamified experience succeeded in increasing engagement during the visit. We analyze these data sources in regard to which lessons each case can teach us, about applying game elements in exhibition contexts, in order to increase engagement and initial on-boarding of digital products implemented in the exhibition.

The North Sea Oceanarium as context for the study

North Sea Oceanarium is an aqua zoo located in the city of Hirtshals in Denmark, and is Northern Europe's biggest aquarium measured by water capacity. The exhibition is covered by both the national and international laws and conventions of Zoo facilities and offers knowledge regarding the North Sea and its surroundings. The North Sea Oceanarium is a government approved zoo facility, and is a non-profit organization where profit is mainly dedicated the development of the exhibition. The North Sea Oceanarium comprise 35 full-time and plus 35 seasonal employees, and has between 150.000 and 175.000 visitors each year.

As part of the organizations 2020 strategy, a focus on researching digital extensions of the physical experience at the zoo was set in motion. The authors were involved as researchers in this initiative. Below we present two cases from the first four years of the collaboration, in which digital gamification was applied to either augment or extent the physical experience.

CASE 1: THE NORTH SEA MOVIE MAKER

The first part of exploring the digital potential of the exhibition on the North Sea Oceanarium was centered around creating a literal 'layer' of digital elements on top of the existing exhibition. Thus, our first case will detail the development of the mobile augmented reality application 'The North Sea Movie Maker', which used gamification as an approach to motivate pre-teen visitors.

The North Sea Oceanarium has a very broad group of visitors, ranging from entire families, single pairs, grandparents with grandchildren, school classes, and interest groups. This makes it hard to

design an exhibition which encompass and delivers an optimal experience to all visitors - a challenge shared by many museums and zoo's (e.g. Brida et al 2013, Todd & Lawson 2001).

The physical zoo experience of sea animals and aqua culture in the exhibition was originally designed around a narrative metaphor of a 'North Sea Expedition' of different archetypical fictive personas. These included the role of an adventurous captain, a knowledgeable scientist, an attractive female diver, a cheerful ship cook, and a rough no-nonsense fisherman (figure 1).

Figure 1: The five fictive personas of the 'North Sea Expedition' (left), used to guide the visitor on the journey through the seven locations around the Oceanarium exhibition (right).

The exhibition experience was designed around following these personas on an expedition at thematic locations of the Oceanarium, accompanied by an 'expedition passport'. At the seven locations, the visitors were encouraged to look for a stamp post, and stamp their passport to mark the location as being visited. At the end of the visit, in the Oceanariums theme shop, the expedition pass could be exchanged into a diploma for finishing the North Sea Expedition journey. The main idea behind this journey was to act as guiding principle for the visitors, as well as a way to deliver a constant flow of factual information about the sea life and culture at the seven different locations. Thus, the existing exhibition at the North Sea Oceanarium already showed to be based on some of the mechanics and principles often explored in gamification research and practice, towards namely the use of 'badges' (the stamps) to show reward progression (figure 2) (Zichermann & Cunningham 2011).

Figure 2: The expedition pass, the stamp stations and visitors stamping their pass at one of the seven expedition locations.

This existing gamified experience of exploring the North Sea Oceanarium through the expedition concept had been in function since 2010, and had shown to successfully engage the younger visitors

(<10-year-old). The young visitors actively sought to gather all the stamps at the seven locations, and the parents acted as facilitators via the hand-out exhibition map, which aided the children in finding the stamp spots.

The troublesome tweens

However, through initial observations in 2012, one visitor group in particular was identified as challenging to reach with the expedition concept, as well as the exhibition area in general. This was the so-called 'pre-teens' or 'tweens' visitors, who are between 10-14 years old, and thus not yet old enough to not join their families, parents and typically younger siblings, on their vacations and visits to attractions like the Oceanarium. However, when visiting the Oceanarium with their families, the majority of the tweens evidently showed little interest in the exhibition experience. Instead, the tweens tagged along their families, and sometimes helped their younger siblings in accomplishing the expedition tasks in the passport, without being particularly engaged themselves. We did however observe, how the tweens were actively engaged with their smartphones during the visit at the Oceanarium; texting with friends, taking selfies and checking out social media. Their smartphone behavior corresponds with Fowler & Noyes' (2014) investigation of the 'always on' mobile media use of children and young adults.

This led to the hypothesis, that we might engage the tween target group by integrating their smartphone as an active part in the North Sea Expedition narrative, by giving the tweens a specific role during the visit, which encouraged them to capture their family's visit in a fun way. To enable this, we sought to enhance the physical context through a digital augmented reality layer, in which animated special effects are extrapolated on top of real life footage from the user's smartphone. The augmented reality effects would act as 'hidden layer' on top of the exhibition, which could be revealed by recording small video clips of the family at the seven physical locations, and thus integrate the digital layer with the existing expedition journey.

Using digital layers, such as augmented reality, in attraction contexts like a museum or zoo, has been discussed in previous contributions by e.g. Wojciechowski et al (2004), Damala et al (2008), and Madsen et al (2012). Most of these studies has dealt with the *usability* and *utility* dimensions of working with digital layers in attractions, and has contributed by addressing issues such as for what types of content augmented reality is useful to extend upon, and which considerations must be made when appropriating a physical space to include digital content. While these issues are important, the utility potential of augmented reality as a technology, and the user friendliness of different applications only gives us knowledge about the technical, and rational aspects of creating digital layers in attractions. However, the *desirability* has been a more elusive object of study in HCI and design research, associated with the emotional impact, brand perception, and social capital what has been established as user experience design (Hassenzahl & Tractinsky 2006). Recently however, the discourse of gamification research has aligned much of the promise of gamification with that of desirability in user experience design, inspired by e.g. the Mechanics Dynamics Aesthetics (MDA) frameworks emphasis on the game aesthetics as an enabler of the desirable 'fun' (Hunicke et al 2004), but with a motivational focus (e.g. Hamari 2014, Walz & Deterding 2015, Seaborn & Fels 2014).

This use of gamification to enhance the desirability of a product was an intriguing point of venture for our experimentation with applying mobile augmented reality in the exhibition context to increase the motivation and engagement for the tween visitors.

Game elements in the North Sea Movie Maker application

After agreeing upon exploring the potential for a gamified mobile augmented reality application, targeted towards the tween visitors, the design process of what would become known as 'The North Sea Movie Maker' app was started. The concept was to assign the role as 'documentarist' to the tweens, following their family's expedition to the seven locations, and at each location making a short augmented reality movie clip. From this followed the idea of designing a dedicated 'moviespot' sign on the floor in the exhibition to signify were in the physical context the digital layer could be activated. These moviespots removed some of the limitations of using augmented reality, such as camera tracking an object with the phone in the dimly lit setting of the Oceanarium (e.g. Mekni & Lemieux 2014). To encourage the visitors to immerse themselves in the capturing of the augmented reality sequence, a scenography was created, with spot lights resembling a movie scene. This scenography was furthermore in proximity to the physical stamps of the locations, while still being constrained as digital zone with enough space to explore the playful interaction between the tween user of the app, and the family acting in front of the scenography. Below the user scenario of the North Sea Movie Maker interaction is depicted (figure 3):

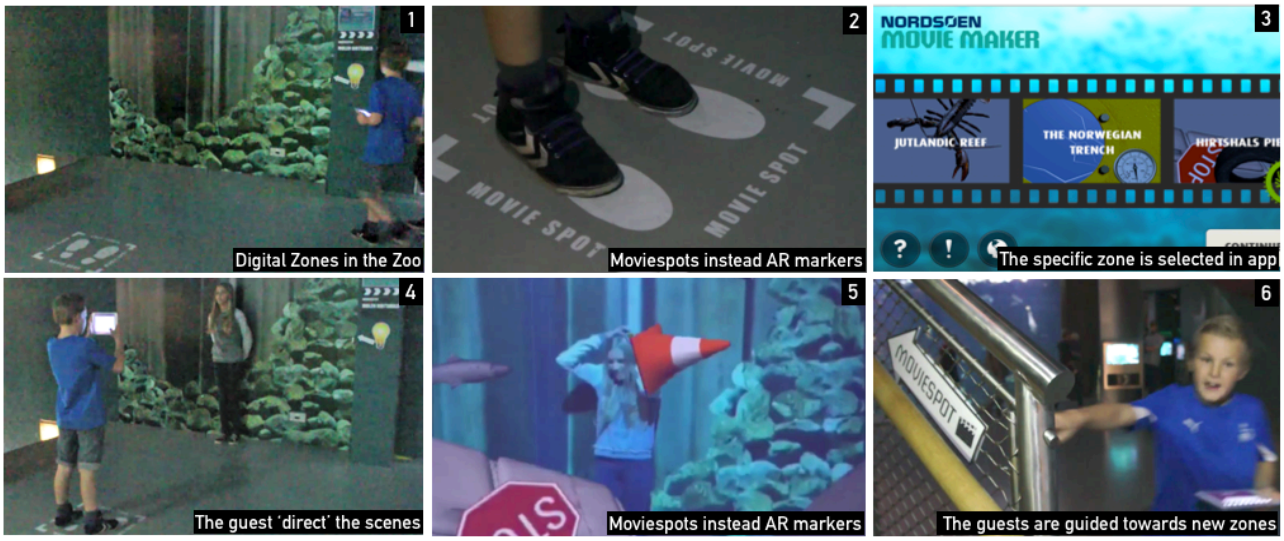
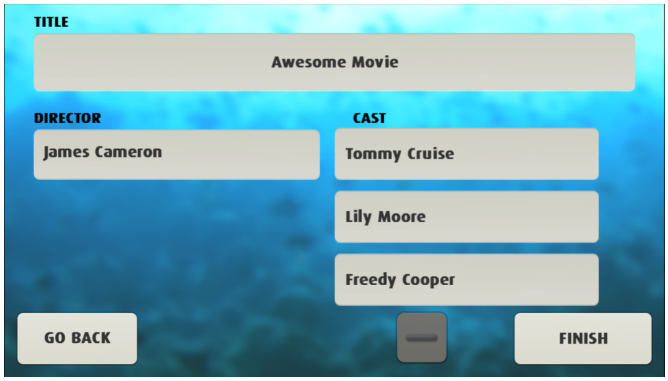


Figure 3: The user journey of the visitors using the augmented reality app 'North Sea Movie Maker'

Through the application, the user captures live video footage at each of the seven expedition posts. During capture, the footage becomes real-time distorted by the app, while animated special effects are put on top of the video, creating a digitally augmented scene where fish and other actors interact with the filmed visitors. The video is saved live onto the mobile phone, and are mixed together with clips from the other expedition spots into one coherent movie with special effects. This final movie output, which the user can customize with credits, title and video clips becomes the extrinsic 'reward' from completing the expedition journey through the exhibition.

A gameful design which enables play

Despite not being a game, the concept of the North Sea Movie Maker application made uses of several game mechanics in an effort to make both the interaction gameful, as well as achieve a behavioral quality of gamefulness (Deterding et al 2011). Below we have mapped a brief overview of the components used in the application, crossed with the game mechanic it uses to achieve a certain gameful interaction (figure 4)

COMPONENT	MECHANIC	EXAMPLE
Movie strip main screen	*Showing 'progression' between locations, like 'levels' in a game.*	
Digital stamps resembling the physical stamps from the expedition passport	*Giving 'badges' as rewards for completing the task.*	
Credits and title screen	*'Personalization' by including the social group into the product.*	

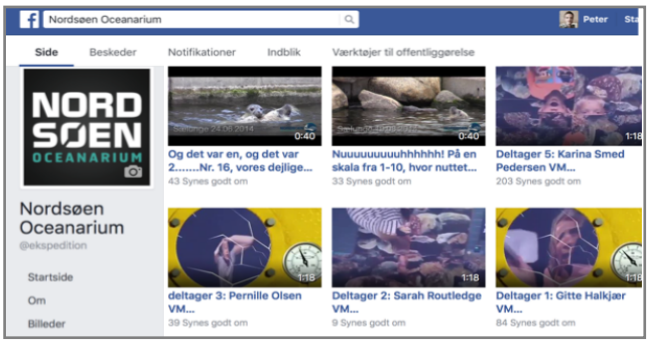
COMPONENT	MECHANIC	EXAMPLE
Aiming scope in capture mode.	*Constrains interaction, act akin to an aiming 'crosshair' in games, by letting the user enact some level of control of the augmented reality effects.*	
The physical moviespots and expedition metaphor	*Creates a 'journey' and a narrative around the context of the exhibition, supporting the digital moviespots role as 'levels'.*	
Social media sharing and gratification from the Oceanarium	*Establishes a modified 'Leaderboard' to compare against other families produced videos & establishes the foundation for various formalized 'Competition' elements.*	

Figure 4: Game mechanics applied in the North Sea Movie Maker.

From a motivational point of view, these applied game mechanics were designed to balance between the classic modes of '*playing'* and '*gaming'* (e.g. Deterding et al 2011), were a game design can lead to playful behavior, and switch back to the rule bound gaming again when encountering a new gameful interaction trigger. The application itself is ruled by a set of simple rules: Find a moviespot, record an augmented reality clip, find the next spot, and finish with a complete edited movie. However, following these rules when using the app does not inhibit moments when the explicit rules for a moment are suspended in more improvisational play. When e.g. the tween directs the family in front of the moviespot's scenography, and retakes the clip while giving new instructions, to explore new variations of the augmented reality, the rules of the gameful design break down and are replaced by a momentary playful interaction. The gameful design is

restored in the moment that the tween accepts the latest recorded clip, gets a completion stamp, and is transported back to the main screen, indicating the next spot to find in the expedition journey.

This potential dynamic between using the application as a playful and gameful element illustrate the mix of intrinsic and extrinsic factors we sought integrate into the app user experience. To create desirability about the visit for the tweens, the application seeks to establish an intrinsic motivation by creating a social role during the visit, which accommodates the tweens own media use an interest for visual media. Furthermore, small tidbits of factual information added before each capture situation in the application aim towards creating curiosity towards some of the little-known facts about the sea life and culture at the specific moviespot, coupled with a sense of achievement from having explored and captured the families visit in a fun way.

The intrinsic motivation is supported by the extrinsic factors stemming from the applied game mechanics. Each of the seven moviespot locations in a sense act as a level, which has to be completed, earning the user an achievement stamp (or in classic gamification sense, a badge), which remediates the physical stamp in the younger user's expedition passport. Furthermore, when collecting all the seven video clips, the app creates a final short special effects movie, with sound, music, as well as personalized title and credits screens, it can be regarded as the users receiving an extrinsic reward for participating the in (optimally) intrinsic family experience of exploring the seven locations. Finally, when the completed short movie is generated from the application, the users are asked to share the movie either by SMS, mail or via social media. If social media is selected, the application automatically generates the hashtag #northseaoceanarium, enabling the North Sea Oceanarium to locate user generated content, and emphasize the user's content on their social media pages.

Thus, this mix of intended intrinsic behavior, and the designed extrinsic elements provided by the application, sought to facilitate a change in engagement in the tween users, towards perceiving the visit to the North Sea Oceanarium not as family duty, but as a desirable fun activity. This design was implemented in October 2012, and used as the basis for a series of experiments, in which we observed families on site in the Oceanarium, and assessed whether the gamification elements of the application created the hypothesized intrinsic behavior.

Engagement through 'playing the visit'

Following the implementation of the application, we initiated a four-week design ethnography study in which we tagged along families using the application during their visit. Here we selected mainly visitor groups which included at least one family member in the 'tween age' between 10-14 years old. We observed their interactions when locating and exploring the seven moviespots, and their group dynamics around creating the augmented reality video clips. Upon exiting the exhibition area, we prompted them with a short in-situ interview, asking about the experience at the Oceanarium, as well as how the application influenced their visit.

When comparing our observations with the responses from talking to the guests we saw a qualitative pattern emerge of when the tweens, their parents, and their younger siblings (if any) could be assessed to perceive the experience with the application as desirable. When the parents were the 'user' of the application taking on the role of 'documentarist' capturing the augmented reality videos they found it to be a stressful thing to remember to do, and they often choose not to continue using the application unless specifically prompted by the children. This could be explained by viewing the parents as already having a specific role during the visit, and thus also in the

expedition journey. The parents acted as facilitators of their children visit, organizing when to see what, where to go, and ensuring that the family 'got their money's worth' during their visit. Adding the extra layer of a digital application, and an extra role during the visit, simply resulted in a stressful information overload. On the other hand, if the family also included a younger child (<10 years), who got the role of documentarist in the expedition, the parents would be engaged in the interaction, while the tweens remained passive. The parents were instructed by the younger children to act out in front of the moviespot scenography, but the tweens were less motivated, and to some extent seemed too embarrassed to act out in front of both their family as well as other visitors. The tweens however, were only indicating to be engaged, and enjoy themselves, when the they took on the documentarist role, directing the clips, while not participating on-screen themselves. Here, the tweens facilitated their family's enactments in front of the scenography, clearly pointing and verbally directing what do next. In these situations, we also observed the aforementioned dynamics in- and out mix between gameful and playful behavior - with the families sometimes spending longer periods of time at one location just playing with different compositions, before moving on to 'play by the rules' again.

We argue these three observed behaviors somehow correspond with the archetypical states in Cszikszentmihalyi's (2013) theory of flow. The parents had too many other roles to attend to during the visit, and thus saw interacting with the application to be stressful. On the other hand, when the tweens were not assuming the role of the documentarist, they were not challenged enough, even though they both had the capabilities and the desire to explore the mobile medium, resulting them being bored. The optimal flow state, between challenge and capabilities, was reached, when the tween had a role, and thus a set of goals, and the mobile application as a tool to fulfil the goals (figure 5).

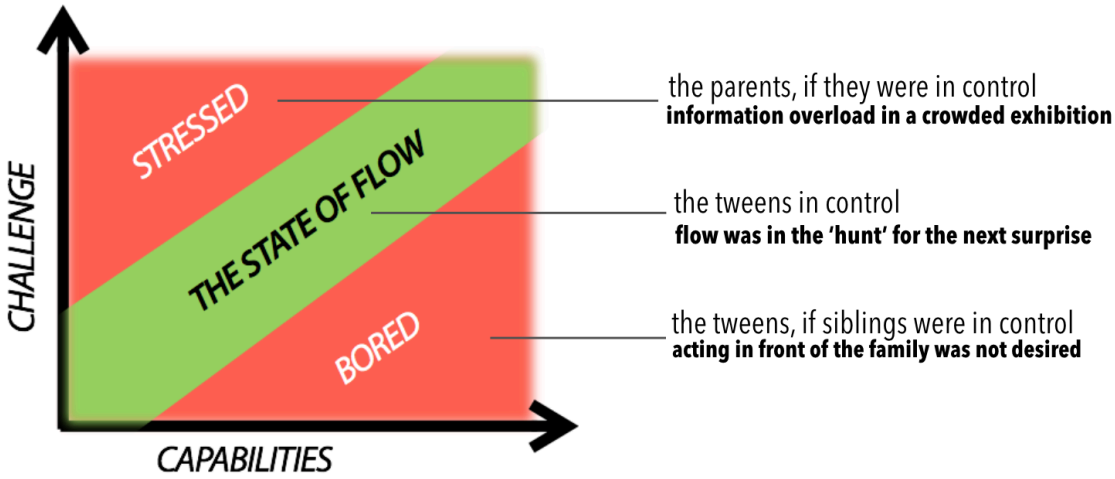


Figure 5: Visualization of the difference between parents, young siblings, and tweens in terms of reaching a state of flow when using the North Sea Movie Maker application.

Having a role supported the pre-teens' social interaction with their family as participators in the experience, and in reaching a state of flow throughout locating the moviespots, capturing augmented reality clips, and further investigating the exhibition for the next locations. Thus, our observations suggest, that the applied game elements work to create the motivation to be engaged through 'playing' through the visit.

From completion to wayfinding

An auxiliary finding from observing the visitor's experience with application, was a pattern of how the applied game elements such as 'completion stamps' seemed to have an unexpected effect on the user's wayfinding during the visit having a 'player role' during the visit, locating the digital zones at which the user would get a stamp for completing, the visitors proved to move around in less visited areas in the zoo in order to locate the next 'levels' from the application (figure 6). This seemed to indicate, that the extrinsic, and rather rudimentary, mechanic of using badges to indicate progression towards finishing the augmented reality movie, also led to an intrinsic curiosity towards exploring more of the exhibition. While this might of course be extrinsically motivated (finding the next location to progress in the application), spending time exploring the exhibition together with one's family can also be seen as intrinsically rewarding in itself (spending time doing an engaging activity together).

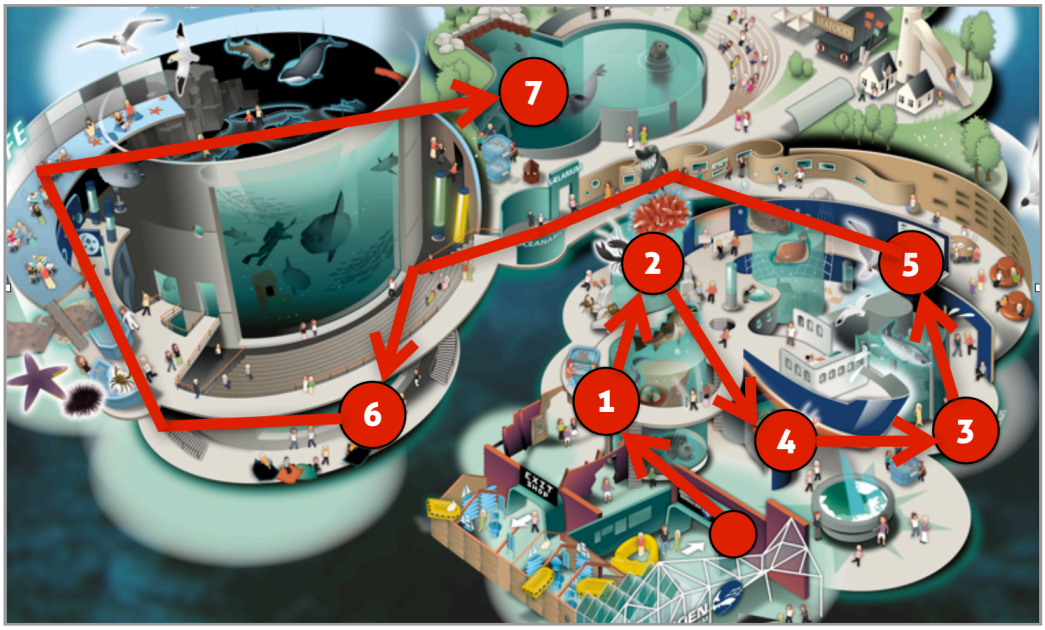


Figure 6: When observing the visitor's behavior with the North Sea Movie Maker application it was a clear pattern, how the application guided the visitors in their journey through the exhibition, seeking out all seven location, and through this also ventured through the majority of the physical exhibition - even less visited areas.

To investigate this behavior further, we examined to accumulated usage data from the application's analytics backend, to observe how many of the visitors using the application at the first of the seven moviespots, who also ended up finding and using the application at all seven moviespots. The usage data revealed that 78% of the users showed to reach all seven moviespots during their session (figure 7).

Skærmbillednavn	Skærmbilledvisninger	Unikke skærmbilledvisninger	Gennemsnitstid på skærmen
	221.177 % af total: 100,00 % (221.177)	104.631 % af total: 100,00 % (104.631)	00:00:38 Gns. for visning: 00:00:38 (0,00 %)
1. Overview	73.291 (33,14 %)	16.295 (15,57 %)	00:00:50
2. Post record: (1)Vraget Stornoway	11.999 (5,43 %)	6.736 (6,44 %)	00:00:30
3. Recording: (1)Vraget Stornoway	11.362 (5,14 %)	6.796 (6,50 %)	00:00:28
4. Post record: (6)Det Åbne Hav	10.550 (4,77 %)	5.682 (5,43 %)	00:00:30
5. Post record: (2)Jyske Rev	10.476 (4,74 %)	6.408 (6,12 %)	00:00:28
6. Post record: (4)Molen Hirtshals	10.455 (4,73 %)	6.069 (5,80 %)	00:00:30
7. Post record: (3)Norske Rende	9.705 (4,39 %)	5.844 (5,59 %)	00:00:27
8. Recording: (2)Jyske Rev	9.606 (4,34 %)	6.238 (5,96 %)	00:00:26
9. Post record: (7)Sælkoloni Limfjorden	9.600 (4,34 %)	5.370 (5,13 %)	00:00:28
10. Post record: (5)Doggerbanke	9.101 (4,11 %)	5.010 (4,79 %)	00:00:28
11. Input	8.814 (3,99 %)	5.352 (5,12 %)	00:00:38
12. Recording: (4)Molen Hirtshals	8.789 (3,97 %)	5.456 (5,21 %)	00:00:27
13. Recording: (6)Det Åbne Hav	8.676 (3,92 %)	5.181 (4,95 %)	00:00:27
14. Recording: (3)Norske Rende	8.314 (3,76 %)	5.432 (5,19 %)	00:00:28
15. Recording: (5)Doggerbanke	7.685 (3,47 %)	4.617 (4,41 %)	00:00:26

78%

Figure 7: Usage data from the North Sea Movie Maker, showing how 78 percent of users starting at the first moviespot ('Vraget Stornoway') also ended up recording an augmented reality clip at the other six movie spots.

We argue, this high percentage indicate that in an exhibition context, the intrinsic motivation towards completion and experiencing a sense of flow due to the agency facilitated through the application can act as a latent wayfinding mechanism. However, this finding does also touch upon the possible 'exploitation' enabled by gamification (Bogost 2011) of unconsciously coursing the user to commit other actions than what he/she intents. While acknowledging this as an ethical consideration when designing with game elements, we do also argue that in an exhibition context, where the primary desired result can be argued to have an engaging and memorable family experience, latent effects like wayfinding through gameful completion of tasks is creating a desirable behavior for both visitors and attraction.

The challenge of facilitating on-boarding

Until now, our findings from observing the families indicated that including the tweens in the expedition concept via the augmented reality application worked, as well as enabling an auxiliary wayfinding benefit for the entire family. While this gives credence to the benefits of applying gamification in the exhibition context to motivate challenging target groups, we did also face one significant obstacle after implementing the application.

Though the application engaged the visitors during their visit, a major obstacle was to create the initial motivation and awareness about the intrinsic value of using the application - an issue which relates to what Zichermann & Cunningham (2011) labels the 'on-boarding' of the gameful experience. When the visitors used the application, the desirable outcomes were clear, but these findings were all based on an initial implementation, which included the visitors being actively introduced to the application upon arrival. This had been integrated as part of the launch of the application, in which two guides supported the visitors in either downloading the North Sea Movie Maker to their own phones or borrowing a small tablet with the application installed. After the

initial launch week, the facilitated on-boarding support was stopped, due to constrained resources, and instead a series of introduction posters, how-to leaflets as well as web and social media marketing took over. However, the effect of leaving the on-boarding to be self-facilitated by the visitors resulted in a significant drop in active users, evident in an overview of the app usage data (figure 8):

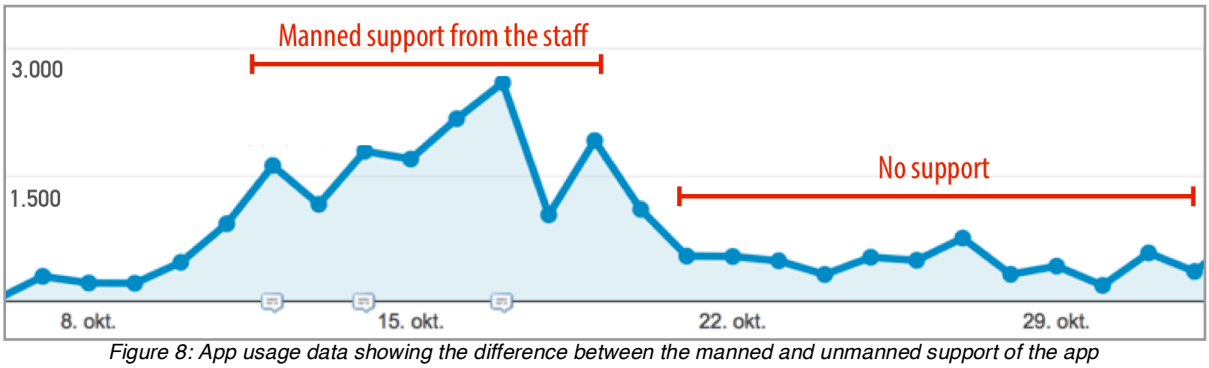


Figure 8: App usage data showing the difference between the manned and unmanned support of the app

Even though we saw no significant change in the completion rate of the active users there was a dramatic drop by an average of more than 50% of the total usage in days after the staff facilitated introduction stopped. Furthermore, from our observations in the following days the visitors actually did orient themselves towards the posters, and moviespots at the seven locations in the exhibit, indicating that they did become aware of the presence of the application, they just did not use it. We argue the problem here rose from a challenge of using new emerging technologies in an unfamiliar way, making it challenging to perceive the desirability of using the application during the visit. This was evident from response given from many guests during the manned setup with an oft-repeated inquiry of variations of 'what does it do?', before on-boarding the application.

Our first attempt to solve this challenge, was to remediate the static introduction posters, into a video poster. We build a hypothesis upon Chow's (1989) notion of video as a persuasive change agent, as well as Raijmaker's (2009) use of video to create empathy. The aim of the video poster was to provide a recognizable medium to facilitate the visitors decoding of the possible user experience of the application, by showing a step by step introduction to the moviespots and how to interact with them at the seven locations (figure 9). As such, the video poster acted as tutorial to the gameful experience, and showcased the extrinsic reward of the special effects videos created by the application.

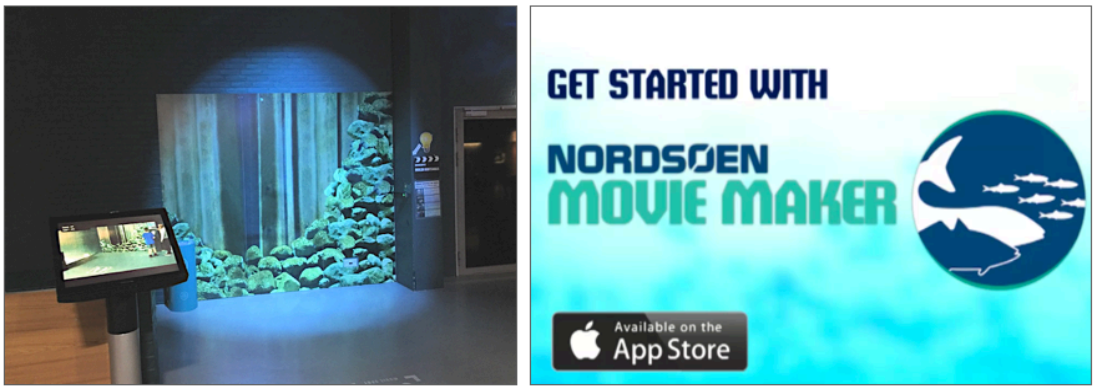


Figure 9: The video poster stander besides the digital zone (left) and the intro screen of the video guide loop (right)

While the video poster showed to attract attention from visitors, only a few of the observed visitors actually downloaded the application after seeing the poster. This was further supported from further examination of the app usage data, which showed no significant change in active users before and after the implementation of the video poster.

This lack of effect from the video indicates that the use of video itself, was not enough to create the hypothesized empathetic reaction in the guests, towards realizing the intrinsic value of using the application themselves. This might be due to the normative nature of video poster, being framed step by step, and showing a group of visitors which follows the 'rules' of the application without breaking out into the aforementioned playful interactions. This indicated that there might be a better potential for reaching visitors with a screen based medium, if the value of the extrinsic reward is mixed with the intrinsic value of play and fun arising from striving towards the reward.

We sought to explore this, by adding a very clear and present extrinsic reward from using the application, by setting up a competition event, where visitors uploading their augmented reality videos to the North Sea Oceanarium Facebook page would compete for a 1-year free pass to the exhibition (figure 10). Contrary to the video posters attempt to facilitate the desirability of making the guest intrinsically identify with the potential user experience, the competition instead sought to create a portfolio of visitor videos, for other visitors to be intrinsically motivated by, via an initial extrinsic reward to the participants.

On the day of the competition, we challenged the visitors to make an augmented reality movie during their visit, and share it on Facebook, and urge their own network to also share and like it.

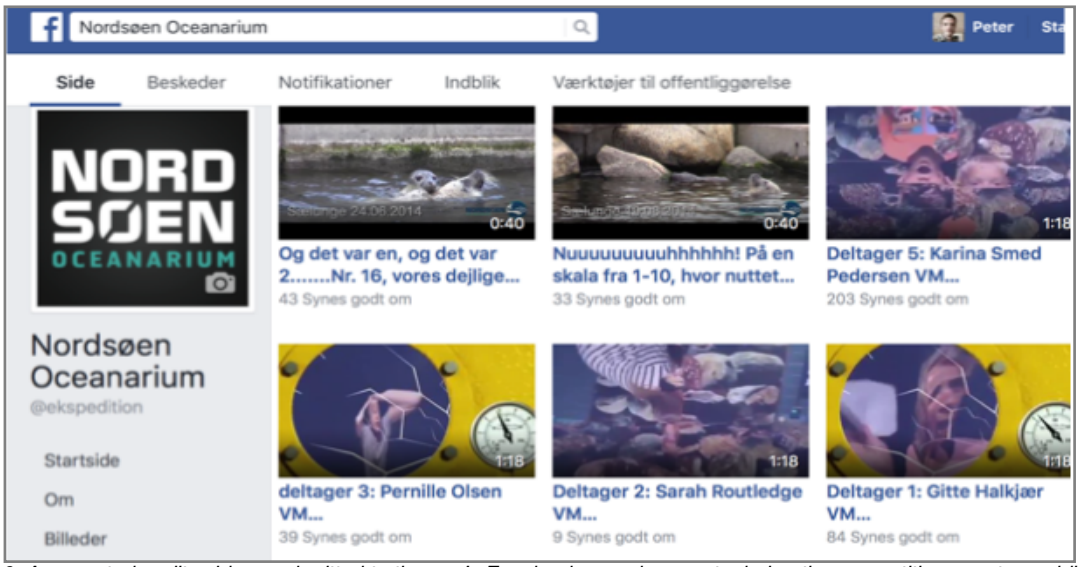


Figure 10: Augmented reality videos submitted to the zoo's Facebook page by guests during the competitive event, providing other users with other visitors experience of using the application, and providing inspiration for ways to interact with the augmented reality effects.

The augmented reality videos uploaded to Facebook created a substantial social media influence by reaching 6.664 profiles and gaining 508 likes on the videos alone. This seemed to indicate, that having a material extrinsic reward, which was much more concrete than the extrinsic rewards of badges and movieclips inside the application itself, did motivate the on-boarding. This was further supported in the application usage data, which showed a significant spike in active users on the day of the competition (figure 11):

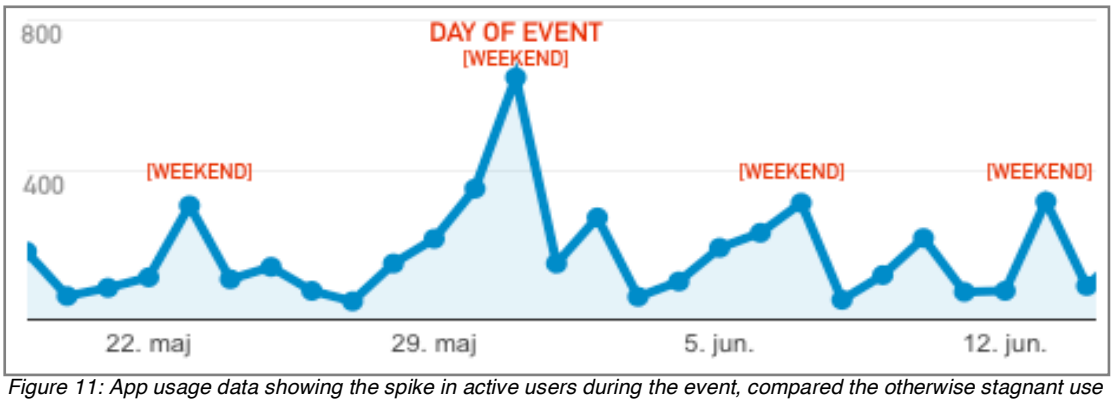


Figure 11: App usage data showing the spike in active users during the event, compared the otherwise stagnant use

That adding an extrinsic reward works to spark a momentary engagement and perceived value of the application is however not that surprising. Rather it presents the paradox that even though more visitors used the application, they did not necessarily do it for the intrinsic value of having a fun and memorable family experience, but 'just' the chased the reward. Intrinsic motivation, where visitors recognize the value of the potential family experience enabled by the application per se, is would arguably be preferable. But the actual facilitation of decoding this experiential value appeared challenging without an initial extrinsic motivation.

However, it also seemed that due to the increase of active visitors using the application due to the competition, they gradually seemed to attract the attention of other visitors. This seemed to generate momentum where the extrinsically motivated on-boarding spawned a second wave of more intrinsically motivated on-boarding.

These findings indicate a challenge when working with digital layers in physical context in general, but also reveal a challenge of creating gamified digital experiences in the first place. Due to the lack of experience with e.g. augmented reality, the perceived value of using the technology during the visit was simply too low for many of the visitors to decode how the application could benefit their visit to the exhibition. If the potential of the extrinsic motivational game elements (such as receiving a special effects movie in the end) are not easily perceived prior to the use, on-boarding visitors into users can be a challenge.

Furthermore, it seemed that rather than normative step-by-step motivators, real life examples of real visitors can create empathetic connections enabling the visitor to realize and interpret the intrinsic value by empathizing with previous visitors. This topic became the object of study for the second case study with the digital layer of the North Sea Oceanarium.

CASE 2: THE INSTAGRAM PHOTOBOOK

Following the long-term results from case 1, we initiated a new digital design intervention at the North Sea Oceanarium in the spring of 2016. This experiment is still active, and this section of the paper will therefore mainly focus on briefly documenting the aspects of the first two iterations, and how they support and substantiate the findings from case 1.

The second case took its point of venture from the strategic challenge exhibitions face in the direct competition with other tourism-stakeholders, collaterally framed 'the experience economy' (Mossberg 2003). This competition has created an expectation for new spectacular changes in the exhibition among the recurring visitors, contrary to previous foci on mainly attracting new visitors.

To fulfill these expectations, exhibitions have implemented interactive experiences, seeking to engage the visitor in co-creation through user-centered design and expanded the interaction possibilities with cross-media initiatives (Opperman & Specht 1999, Simon 2010, Hall 2013).

Many researches argues and discusses innovative design techniques and present transmedia suggestions, among others, for improvement based on their case-studies (Simon 2010, Kidd 2014, Hall 2013, Kim & Hong 2013, Pardo 2011).

In the entertainment industry, different companies have successfully proved to enrich their products with transmedia concepts that binds the pre-, during- and post-activities to extend and deliver a coherence experience (The Dark Knight 2008, Tron: Legacy 2010, Halo 2 2004). Transmedia concepts typically contribute with extra content and normally used to promote products like feature films, TV-series, books and other similar entertainment products.

Novel ways to enhance the experience in exhibitions with certain aspects of transmedia are being investigated through experiments (Kidd 2014, Hall 2013). However, literature reviews, desk research and searching in databases with relevant search queries, the result on transmedia in an exhibition context, based on quantitative data were still limited. Furthermore, there were little research on visitors' pre-, during- and post-experience.

On this basis, we hypothesized that there was a potential to extend the exhibition experience by incorporating the pre- and post-activities as part of the experience, where the physical exhibition will function as the 'core media platform' (Davidson 2010). Another area with potential to expand the visitors' experience is through user-generated content, which also can increase the visitors' engagement and learning (Russo et al. 2007:26).

Currently, the North Sea Oceanarium does not have a tactical focus on the promotion of user-driven content on social media, but have only made limited experiments such as the North Sea Movie Maker competition, detailed in case 1. For example, the content generated on Trip Advisor, Facebook, and Instagram by the visitors about North Sea Oceanarium, are not systematically recognized by the organization.

Exhibitions usually value and use Facebook more than other social media services (Groneman 2014). North Sea Oceanarium is not an exception as their activity on Facebook is high, whereas the activity on other social media like twitter and Instagram is very low.

Instagram is a qualified media platform to explore user-generated content as a collection of user-generated photo material, can characterize the perspective of the visitors of the exhibition and thereby contribute and complement to the existing stories in the exhibition (Giersing 2014). This case will explore Instagram as the media platform due to its capacity to generate a valuable and distinctive contribution to the entire exhibition experience. Furthermore, this social media platform has not been sufficiently utilized by North Sea Oceanarium.

THE INSTAGRAM CONCEPT

The case study was carried out over two iterations. Its purpose was to promote Instagram activities as a constitutive part of the exhibition. It aimed at motivating the visitors during the visits to create

content on Instagram. The goal was to extend the visitors' experiences across pre-, during and post-visit as presented in figure 12 and contribute to a wider transmedia experience.

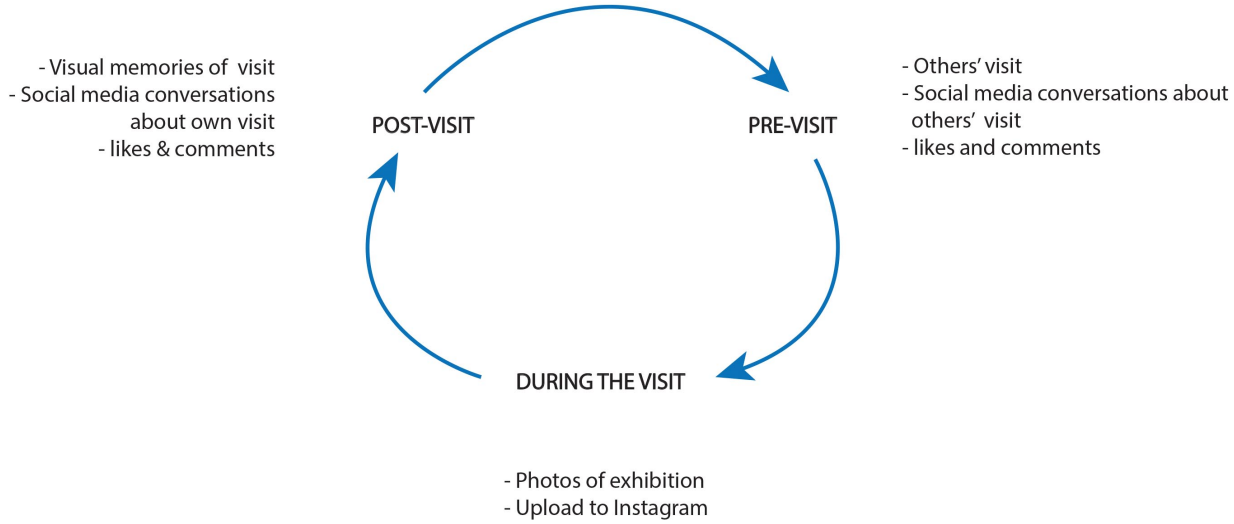


Figure 12. An illustration of the three visit phases and their different activities and content

The generated content during the visit activities are accumulated into post-visit content for previous visitors, as well as it becomes pre-visit content for potential future visitors. Hence, the content posted on Instagram represents entry-points before, during, and after the visit to the exhibition. Thus, not only the visitors' experience is extended, but there is a likelihood of a rise in number of future visitors as well.

During the Visit: The visitors are informed to take photos on six different Insta-spots in the exhibition and post them on their Instagram profile with a pre-created hashtag. The six Insta-spots have six different hashtags relative to the different locations and are noticeable through the green floor labels. Figure 13 shows one case of the Insta-spot.

Figure 13. A picture of one of the Insta-spot locations and the floor label with the hashtag and a small description in three languages; Danish, German and English.

Post-Visit: Following the visit, the visitors can compile, download and share a digital photobook with the uploaded Instagram photos. As shown in figure 14, hashtags enable the creation of a

photobook that consists of different photos connected to their specific locations with additional facts and information. The photobook has 13 pages and communicates in Danish, English and German. The visitors also receive a link to the photobook which is automatically sent to their email. Furthermore, the uploaded photos generate activities on social media in the forms of likes and comments from the social network of the visitor.

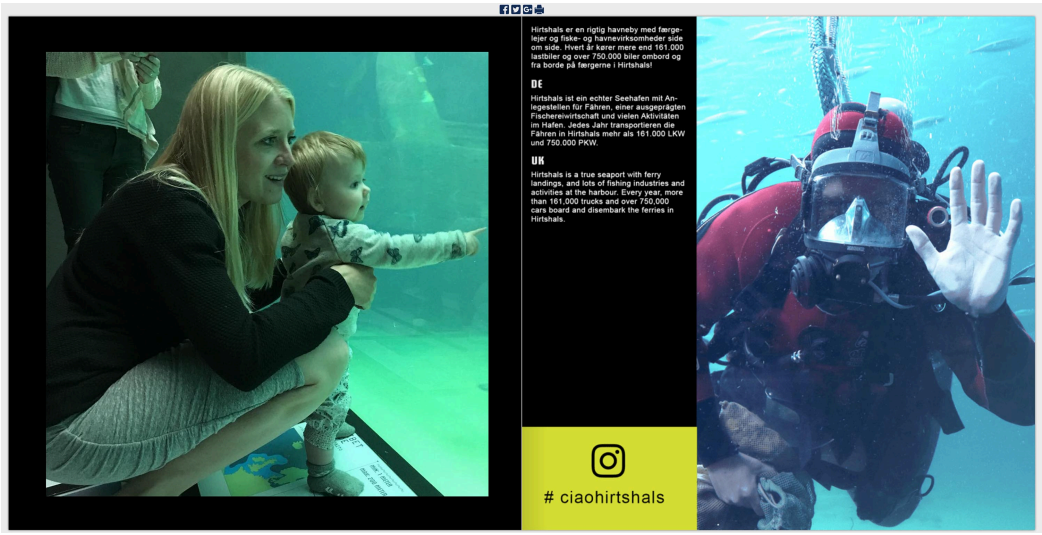


Figure 14. A picture of one of the pages in the photobook.

Pre-Visit: Before coming to the exhibition, the visitors' can explore photos posted on Instagram thanks to the promoted hashtags, through their social media networks. Because of this, as presented in figure 15, the social networks will have an entry-point to the exhibition from the perspective of other visitors. The people participating in these social media networks are potential visitors of the exhibition, which is critical to marketing.

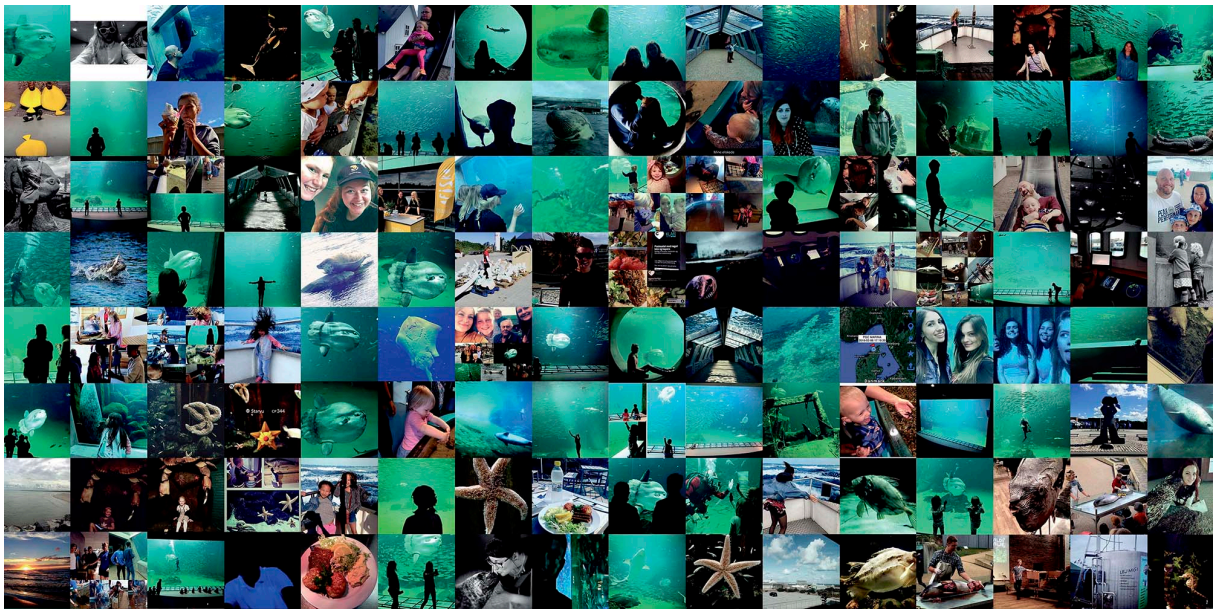


Figure 15: A photo collage of the Instagram photos with the hashtag #nordsøenoceanarium.

SOCIAL MEDIA IMPACT

In the first iteration, conventional methods were used to promote the Instagram activity to resemble any other promotion being conducted for new activities in the exhibition. The purpose of this was to distinguish between the effect of facilitated activity in contrast to self-facilitated activity.

The activity was facilitated by the exhibition guides, who offered an introduction at the beginning and helped the visitors. Printed flyers and big posters with the Instagram activity were located at the entrance. There were also flyers around Instagram spots as well. Figure 16 shows the printed flyer. The visitors' engagement was rewarded extrinsically with a digital photobook, which created a motivation to engage in the Instagram activity.

Figure 16. A picture of the two inner pages from the information flyer.

Iteration one was carried out from July 7th, 2016 to October 3rd, 2016, where 96.331 people visited the exhibition. Their Instagram activities resulted in 137 posts and received 1.199 likes and comments. In total, 15.034 users of social media were reached. The data for the six Insta-spots are given in figure 17.

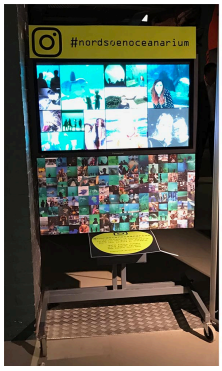
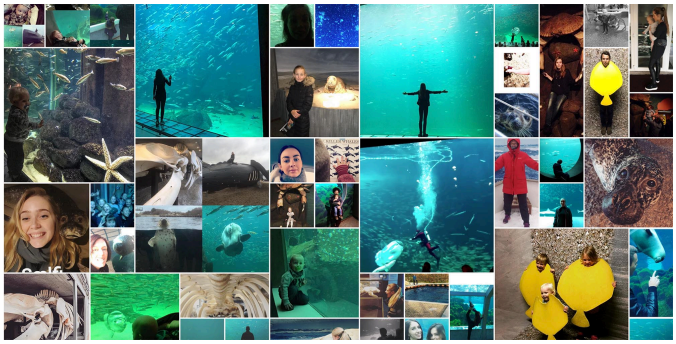
	#hirtshals wind	#hirtshals fish	#hirtshals crab	#hirtshals cafe	#hirtshals seal	#ciao hirtshals	Totally
Posts	42	26	25	6	25	13	137
Reach	7.729	1.430	1.004	593	2.107	2.179	15.034
Likes & comments	531	164	103	61	201	139	1.199

Figure 17. A table with the results from the first iteration.

From the data, it is possible to conclude that the number of visitors who have completed all six Insta-spots are very low according to the number of visitors in the time period. It also possible to observe that the number of posts on the different Insta-spots varies from 42 posts on #hirtshalswind to six posts on #hirtshalscafe. The last Insta-spot #ciaohirtshals only have thirteen posts, which

indicates that the visitors probably give up along the way. From the data obtained from the first iteration, it is evident that the content generated per visitor is generally very low. Upon the discussion in the organization, it was discussed that the low activity might have occurred because of the number of hashtags and the complexity level of the conventional communication methods. Together, these might have lowered the motivation to engage. Furthermore, the photobook did not produce the expected extrinsic motivation among the visitors. A reason for this could be that the photobook couldn't be viewed before completing the entire activity and therefore made it hard for the visitors to see the value of the reward. All in all, the Instagram activity did not have the anticipated effect in producing user-generated content.

From the results obtained from the first iteration, we redesigned the Instagram activity to be self-facilitating and reduced the number of hashtags to one #nordsøenoceanarium. The promotional materials and the introduction from the exhibition guides where also removed. The photobook where replaced with a big screen installed in the hallway between two main exhibition halls with a controlled live feed. The screen displayed photos that visitors uploaded to Instagram with the given hashtag. A brief overview of the used components and the game mechanics are mapped in the figure 18.

COMPONENT	MECHANIC	EXAMPLE
Big screen used in iteration two.	*Showing other visitors experience through the featured photos. It also gives the opportunity to be featured as well. This works as a reward for the visitors' engagement. The mechanic of showing 'playthroughs' are an increasing used element to engage players towards matching or besting other players.*	
Featured photos on the big screen used in iteration two.	*Establishes a modified 'leaderboard' to compare and or be inspired by other visitors' contributions. It also establishes the foundation for various formalised 'competition' elements.*	

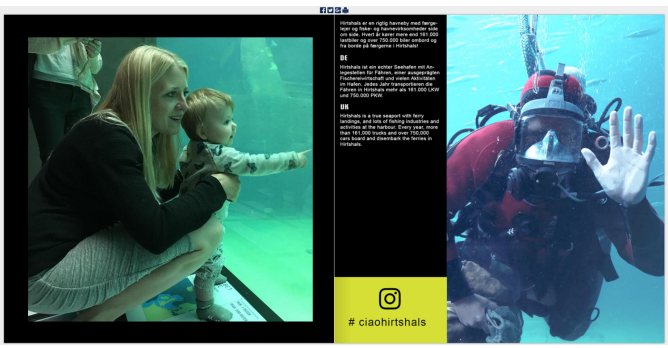
COMPONENT	MECHANIC	EXAMPLE
Photobook rewarded in iteration one.	*Finding and posting photos from all Insta-spots releases a photobook. This can be related to collecting 'badges' that releases an 'achievement'.*	

Figure 18 Game mechanics applied in the Instagram activity

Both extrinsic and intrinsic motivation are utilized to engage the visitors in the Instagram activity. The previous visitors' Instagram photos inspires and reminds new visitors to take photos and works as intrinsic motivation, where the possibility to be displayed on the big screen works as an extrinsic motivation.

Iteration two was carried out from October 15, 2016 to November, 2016, where 14.376 people visited the exhibition. Their Instagram activities resulted in 57 posts and received 1.292 likes and comments. In total, 12.938 users of social media were reached. The data are given in figure 19.

	#nordsøenoceanarium
Posts	57
Reach	12.938
Likes & Comments	1.292

Figure 19. A table with the results from the second iteration.

Two parameters were changed in the second iterations; the number of hashtags and the way of motivating. The conventional promoting methods and the photobook where replaced with a big screen. Although the durations of iterations and numbers of visitors are not identical, it is possible to analyze them from the results produced per visitor. It can be seen from figure 20 that the social media impact of the second iteration was much higher. There was a significant rise in posts, comments, likes, and reach in the second iteration per visitor. In comparison to the first iteration, the second iteration likes and comments are 7.77 times more effective, the reach is 5.62 times more effective, and the number of posts are 2.79 times more effective. It proves the enhancement of both marketing and the experience. Due to the replacement of the conventional promoting methods with the big screen, the organizational effort was also minimized.

	Iteration 1	Iteration 2	Relative social media impact
Posts per 1000 visitor	1.42	3.96	2.79
Reach per 1000 visitor	160	899.97	5.62
Likes & Comments per 1000 visitor	12.45	89.87	7.22

Figure 20. A table with the overall effect and social media impact according to both iterations.

From the results of this case study it indicates, that the use of big screen and the reduced number of hashtags led to the increased impact. In this way, the Instagram activity was made less complex and stimulated more visitors to participate.

The photos on the large screen were created by previous visitors. Hence, it functions as a point for on-boarding the gameful experience for current visitors and creates expectations for them. The screen also reminds them to take their own pictures during their visit. A chance to have a picture displayed on the big screen is a significant extrinsic motivational factor for engagement. This echoes our results from case 1, where visitor created content seemed to offer much higher engagement, than normative pre-made content.

Also, the case demonstrated that it is much more efficient to have one instead of six hashtags, perhaps because it is easier for visitors to remember it – the engagement was so to speak amplified through simplifying the gameful interactions needed to participate fully. Furthermore, in the second iteration, visitors were not confined to taking photos only in six Insta-spots, but in the entire space of the exhibition. This was also possible in iteration one, but the problem was that the idea behind it was to connect photos with Insta-spots. As it can be observed from the photos, in the second iteration, the green floor labels rather served as a reminder to take a picture. Bearing in consideration that there were no requirements from the activity itself in the second iteration. The visitors were more free to participate in the Instagram activity in contrast to the iteration one with the idea of the complete photobook.

The way the game mechanics where communicated in iteration 2 indicates to be more effective than the way it was communicated in iteration one. By presenting the result of previous visitors' experience, it was possible to motivate more new visitors to engage. The possibility to compare and be inspired by previous visitors' contributions, indicates to work as a leaderboard and opens the possibility for competition among the visitors as well. As such, the intrinsic motivation of capturing the memories and experiences of the visit, was enabled by ensuring that the extrinsic rewards were explicitly known and decoded prior to onboarding the Instagram concept – reinforcing our lesson learned about the on-boarding dynamic between intrinsic and extrinsic elements in gamified exhibition designs.

DISCUSSION - EXTENDING THE DISCOURSE OF APPLIED GAMIFICATION

As mentioned in the introduction, the exhibition context has a history of being used as a test bed, just as the two cases in this paper. Research into the effect of gamification, as *"...a process of enhancing services with (motivational) affordances in order to invoke gameful experiences and further behavioral outcomes.*" (Hamari et al 2014, Houtari & Hamari 2012) has shown that there is indeed a potential in gamifying services, such as the exhibition at the North Sea Oceanarium. However, it is important to note that the context which is being gamified, as well as the users using it, impact the effect greatly (Hamari et al 2014). The two cases studied in this paper present a number of game mechanics, that have been identified in the implemented design solutions, and their effects have subsequently been explicated. The results of these implementations reveal potential incentivize mechanics to on-board new users to a digital experience layer, they are unfamiliar with, and thereby invoke an intrinsic motivation, through game design elements.

The first case presents results, where unintended 'side-effects' emerged, such as guidance/way-finding, with exploration of the exhibition through a completion mechanic; as well as incentivizing 'on-boarding' of new users, whom seemingly lacked the intrinsic motivation to acquire and use the

Movie Maker app, through extrinsic rewards. Data analyzed from the Movie Maker app, revealed patterns related assistance from staff vs. self-facilitated acquisition of the app. Periods where there had been personnel present to assist the visitors in downloading or supplying a tablet with the app pre-installed, and instructing them on how to use the app versus a period where there had been no personnel to assist the visitor; the number of users dropped drastically. After having made this discovery, other related projects were revisited to explore the data with this new knowledge, and the same pattern emerged where a situation where the visitor has a staff (or in some cases a researcher) explain what the system does, they are willing to give it a go while being reluctant when they are introduced to it through posters and similar guides. This was revealed to be mainly because they did not understand how using the app would support their desired experience during the visit, because it was a less known type of technology interaction at the time, that was being explained through conventional means. The second case introduced a service layer to increase user-generated content, by utilizing Instagram as a platform where visitors could document and share their experiences at the North Sea Oceanarium. This revealed that by offering an open setting to let the visitors control and create their own stories, instead of dictated Instagram spots and hashtags, the visitors were more willing to create and share their stories, combined with a large display to present the experiences that the other visitor's shares. Thus, when new visitors arrived and saw previous visitors' experiences, they were much more inclined to engage with Instagram at the North Sea Oceanarium.

In other words, the intrinsic value of the visitor's experience was veiled in a system designed to provide a digital experience layer that seeks to augment, drive, enhance an existing exhibition or be a self-contained exhibition. Optimally, the visitor would engage with and see the intrinsic value-potential offered by systems designed to deliver such experiences, but a key problem identified is that if the visitor does not understand the concept they are being presented with, they will simply skip it. But, as revealed through the two cases, building extrinsic motivational triggers, offered by game design components and mechanics, such as rewards, progression, sharing mechanics, into the digital experience layer, has shown resourceful in on-boarding and retaining the visitors' interest and engagement throughout the visit.

The mechanics identified through implemented components are in line with the most frequently studied mechanics in other gamification studies. A literature review of empirical studies on the effect of gamification reveals that the most frequently implemented mechanics for motivational affordances are leaderboards, points, badges, levels, rewards, story/theme, progress, challenge, clear goals and feedback, with positive results, if implemented appropriately (Carolei 2015, Hamari et al 2014, Sanchez 2015). However, gamification as a field of study is still relatively young. In 2010 the term gained traction in academic context and has slowly grown over subsequent years, to gain a momentum over the past few years (Hamari 2014). Most of the research still points at appropriating the trigger mechanics to the context in which they are being used (Hamari 2014). Other studies have shown gamification's prowess in guiding visitors around exhibitions with positive results, so there is reason in exploring the potential further. There does seem to be a lack of studies in implementing extrinsic on-boarding mechanisms, to have motivate the user to actively engage in a gamified system, especially in a self-facilitated setting.

CONCLUSIONS

Based on the two case's practical lessons learned, this paper has sought to contribute to the existing body of knowledge about applied gamification in an exhibition context, with a special focus on how visitors are on-boarded the gamified exhibition design. Our studies are in line with many previous

contributions, when it comes to applying gamification to a service to instigate motivation, but by analyzing the results, new knowledge emerged that could benefit a specific design challenge that has not been covered in the existing body of research; namely on gamification as a method to target adoption and usage of services. Especially in a context where there are no assistance or instructors present to help the user understand and use the service. Although on-boarding has been explored in existing gamification examples, such as the initial interest and rewards to motivate users to dig deeper or spend more time with a new service, i.e. habit building, the mechanics have not been investigated in their potential to introduce and explain unknown concepts, such as new and emerging digital experience layers, at self-facilitated exhibitions with a barebone staff. This should be further explored with studies targeting adoption, acquisition and usage of digital experience layers through gamification, where the service itself is either unable to or challenged in that it cannot clearly communicate the intrinsic value for the visitor by using it.

REFERENCES

Brida, J.G., Disegna, M., Scuderi, R., 2013. Visitors of two types of museums: A segmentation study. Expert Systems with Applications 40, 2224–2232. doi:10.1016/j.eswa.2012.10.039

Antoniou, A., O'Brien, J., Bardon, T., Barnes, A., & Virk, D. (2015). Micro-augmentations: situated calibration of a novel non-tactile, peripheral museum technology. Educational Technology and Society, IEEE.

Bounia, A., Nikiforidou, A., Nikonanou, N., & Matossian, A. D. (2012). Voices from the museum: Survey research in Europe's national museums.

Carolei, P., & Schlemmer, E. (2015). Alternate Reality Game in Museum: A Process to Construct Experiences and Narratives in Hybrid Contexts. Edulearn.

Chang, Y.-L., Hou, H.-T., Pang, C.-Y., Sung, T.-T., & Chang, K.-E. (2015). Apply an Augmented Reality in Mobile Guidance to Increase Sense of Place for Heritage Places. 166-178.

Chen, G., Zhang, Y., Chen, N.-S., & Fan, Z. (2016). Context-Aware Ubiquitous Learning in Science Museum with iBeacon Technology. Learning, DEsign and Technology.

Chow, M.D., 1989. The role of the video professional in a research environment. ACM SIGCHI Bulletin 21, 83–87. doi:10.1145/70609.70622

Coenen, T., Mostmans, L., & Naessens, K. (2013). MuseUS: Case Study of a Pervasive Cultural Heritage Serious Game. ACM Journal on Computing and Cultural Heritage, 6.

Cosley, D., Lewenstein, J., Herman, A., Holloway, J., Baxter, J., Nomua, S., . . . Gay, G. (2008). ArtLinks: fostering social awareness and reflection in museums. ACM.

Damala, A., Marchal, I., & Houlier, P. (2007). Merging Augmented Reality Based Features in Mobile Multimedia Museum Guides. Anticipating the Future of the Cultural PAst, pp. 259-264.

Damala, A., Schuchert, T., Rodriguez, I., Moragues, J., Gilleade, K., & Stojanovic, N. (2013). Exploring the Affective Museum Visiting Experience: Adaptive Augmented Reality (A2R) and Cultural Heritage. Heritage in the Digital Era, 2(1), 117-142.

Damala, A., Cubaud, P., Bationo, A., Houlier, P., Marchal, I., 2008. Bridging the gap between the digital and the physical: design and evaluation of a mobile augmented reality guide for the museum visit, in: Proceedings of the 3rd International Conference on Digital Interactive Media in Entertainment and Arts. ACM, pp. 120–127.

Davidson, D. (2010). Tentpole. In D. Davidson, An Introduction to the Art of Creating Integrated Media Experiences. ECT Press.

Deterding, S., Dixon, D., Khaled, R., Nacke, L., 2011. From game design elements to gamefulness: defining "gamification." ACM Press, p. 9. doi:10.1145/2181037.2181040

Deterding, S. (2011). Situated motivational affordances of game elements: A conceptual model. CHI.

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification: Using Game Design. CHI.

Falk, J. H., & Dierking, L. D. (1992). The Museum Experience.

Haesler, S., Obernesser, K., Raupp, T., Jahnke, C., Stapf, J., Bräker, J., . . . Steinicke, F. (2016). Edutainment & Engagement at Exhibitions: A Case Study of Gamification in the Historic Hammaburg Model. Mensch und Computer.

Fowler, J., and J. Noyes. 2014. Attitudes and use of mobile phones in tweens. in: Advances in the Human Side of Service Engineering: 40.

Freund, L., Cellary, W., 2014. Advances in The Human Side of Service Engineering. AHFE Conference.

Giersing, S. (2014). At dele autoriteten. Brugernes billeder som fremtidens kulturarv? (Sharing Authority. Users' photos as the cultural heritage in the future?) In *Sharing is caring : åbenhed og deling i kulturarvssektoren (openness and sharing in the heritage sector)* (pp. 199-207). Copenhagen, Denmark: Statens Museum for Kunst.

Groneman, S. T. (2014). Når museer prioriterer sociale medier. (When museums prioritize social media) *Nordisk Museologi, 1*, 37-53.

Hall, S. (2013). *Creating Strong Cross Media Concepts for Museum Exhibitions.* Cross Media Interaction Design, Department of informatics. UMEÅ University.

Halo 2. (2004). (Microsoft) Retrieved December 27, 2016, from 42 Entertainment: http://www.42entertainment.com/work/ilovebees

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does Gamification Work? - A Literature Review of Empirical Studies on Gamification. IEEE.

Hassenzahl, M., Tractinsky, N., 2006. User experience - a research agenda. Behaviour & Information Technology 25, 91–97. doi:10.1080/01449290500330331

Horn, M. S., Routman, E., & Weintrop, D. (2014). Programming in the pond: A tabletop computer programming exhibit. Scopus.

Houtari, K., & Hamari, J. (2012). Defining Gamification - A Service Marketing Perspective. ACM.

Hughes, J., O'Brien, J., Rodden, T., Rouncefield, M., 1997. Ethnography, Communication and Support for Design. Lancaster University.

Hunicke, R., Leblanc, M., Zubek, R., 2004. MDA: A formal approach to game design and game research, in: In Proceedings of the Challenges in Games AI Workshop, Nineteenth National Conference of Artificial Intelligence. Press, pp. 1–5.

Juho Hamari, J.K., 2014. Measuring flow in gamification: Dispositional Flow Scale-2. Computers in Human Behavior 40, 133–143. doi:10.1016/j.chb.2014.07.048

Jung, T., Dieck, M. C., Lee, H., & Chung, N. (2016). Effects of Virtual and Augmented Reality on Visitor Experience in Museum. Information and Communication Technologies in Tourism, Springer.

Kidd, J. (2014). *Museums in the New Mediascape.* Ashgate Publishing.

Kim, J. H., & Hong, J. Y. (2013). *Analysis of Trans-media Storytelling Strategies* (Vol. 8). International Journal of Multimedia and Ubiquitous Engineering.

Koskinen, I., Zimmerman, J., Binder, T., Redström, J., Wensveen, S. (Eds.), 2012. Design Research Through Practice. Morgan Kaufmann, Boston.

Leong, Z. A., & Horn, M. S. (2014). Waiting for Learning: Designing Interactive Educational. IDC.

Leshchenko, A. (2015). Digital Dimensions of the Museum: Defining Cybermuseology's Subject of Study. ICOFOM.

Lindinger, C., Haring, R., Hörtner, H., Kuka, D., & Kato, H. (2006). Mixed Reality Installation 'Gulliver's World': Interactive. Technologies for Interactive Digital Storytelling and Entertainment.

Lingnau, A., van Dijk, B., Kockelkorn, H., Schmuch, J., & Ruthven, I. (2012). Enriching Children's Experiences During and After a Museum Visit. Advanced Learning Technologies (ICALT), 2012 IEEE.

Madsen, C.B., Madsen, J.B., Morrison, A., 2012. Aspects of what makes or breaks a museum ar experience, in: Mixed and Augmented Reality (ISMAR-AMH), 2012 IEEE International Symposium on. IEEE, pp. 91–92.

Mekni, M., Lemieux, A., 2014. Augmented reality: Applications, challenges and future trends, in: Applied Computational Science—Proceedings of the 13th International Conference on Applied Computer and Applied Computational Science (ACACOS '14) Kuala Lumpur, Malaysia. pp. 23–25.

Micklethwait, J. (2013, 12 21). Temples of delight. Economist. Retrieved 03 03, 2016, from http://www.economist.com/news/special-report/21591707-museums-world-over-are-doing-amazingly-well-says-fiammetta-rocco-can-they-keep

Moesgaard, T. G., Witt, M., Fiss, J., Warming, C., Klubien, J., & Schønau-Fog, H. (2015). Implicit and Explicit Information Mediation in a Virtual Reality Museum Installation and its Effects on Retention and Learning Outcomes. ECGBL, 387-394.

Opperman, R., & Specht, M. (1999). A nomadic Information System for Adaptive Exhibition Guidance . *Archives and Museum Informatics, 13*(2), 127-138.

Pardo, F. (2011). *New media and transmedia for documentary storytelling : a comprehensive approach.* Science and Natural History Filmmaking. Montana State University.

Raijmakers, R., Sommerwerk, A., Leihener, J., Tulusan, I., 2009. How sticky research drives service design, in: Service Design Network Conference in Madeira.

Russo, A., Jerry W., Lynda K., & Sebastian C. (2007). Social media and cultural interactivity experiences in museums. Nordisk Museologi, 1, 19-26.

Sanchez, E., & Pierreoux, P. (2015). Gamifying the Museum: A Case for Teaching for Games Based Learning. European Conference on Games Based Learning.

Seaborn, K., Fels, D.I., 2015. Gamification in theory and action: A survey. International Journal of Human-Computer Studies 74, 14–31. doi:10.1016/j.ijhcs.2014.09.006

Simon, N. (2010). *The Participatory Museum.*

Steffen P Walz, R. B. (2007). REXplorer.

The Dark Knight. (2008). (WARNER BROS) Retrieved December 27, 2016, from 42 Entertainment: http://www.42entertainment.com/work/whysoserious

Taul, B. (2014). Museer: Hovedtal. (Danmarks Statistik) Retrieved 03 03, 2016, from https://www.dst.dk/da/Statistik/emner/museer-og-kulturarv/museer

Todd, S., Lawson, R., 2001. Lifestyle segmentation and museum/gallery visiting behaviour. Int. J. Nonprofit Volunt. Sect. Mark. 6, 269–277. doi:10.1002/nvsm.152

Tron: Legacy. (2010). (Disney) Retrieved December 2016, 2016, from 42 Entertainment: http://www.42entertainment.com/work/flynnlives

Vlahakis, V., Karigiannis, J., Tsotros, M., Gounaris, M., Almeida, L., Stricker, D., . . . Ioannidis, N. (2002). ARCHEOGUIDE: First results of an Augmented Reality, Mobile Computing System in Cultural Heritage Sites. ACM.

Walz, S.P., Deterding, S., 2015. The Gameful World: Approaches, Issues, Applications. MIT Press.

Wakkary, R., Hatala, M., Muise, K., Tanenbaum, K., Corness, G., Mohabbati, B., & Budd, J. (2009). KURIO: A Museum Guide for Families. ACM.Wojciechowski, R., Walczak, K., White, M., Cellary, W., 2004. Building virtual and augmented reality museum exhibitions, in: Proceedings of the Ninth International Conference on 3D Web Technology. ACM, pp. 135–144.

Zhang, P. (2008). Motivational Affordances: Reasons for ICT Design and Use. Communications of the ACM, 145-147.

DECLARATION OF AUTHORSHIP

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I hereby declare my contribution to the manuscript to be as described below.

PV	VS	RK	
X	X	X	Conception and design of study
X	X		Data collection
X	X		Data analysis and interpretation
X	X		Writing the first draft of the manuscript
		X	Contributed to revision of manuscript
X	X	X	Finalising the manuscript

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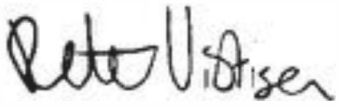
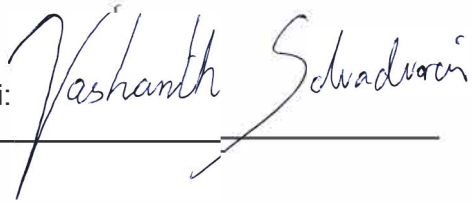
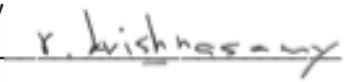
Peter Vistisen: 

Vashanth Selvadurai: 

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