Balancing Enlightenment and Experience in Interactive Exhibition Design

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Abstract. This paper presents insights from a collaborative design research project, in which a zoological aqua park in Denmark integrated multiple gamified digital installations in their new exhibition design. We document how these designs are in a tension between allowing game-based interactions, and the didactic communication about facts in the exhibition. We study the implemented solutions based on qualitative interviews with visitors, and with quantitative data from the backend game analytics of the installations. From triangulating these data sets we show how attempts to deliver purely fact-based information through didactic design elements fail to succeed in engaging the visitors, while stealth learning sparks enlightenment about the subject matter. Our results suggest that this is true both in cases in which users fully understand and play through the intended interactions, as well as when more negotiated interpretations of the digital installations are performed. From this our contribution are guiding principles for the balance, between experience and enlightenment in gamified exhibition designs.

Keywords: Interactive exhibitions · Experience design · Informal learning

1 Introduction

Museums are historically created and developed in a field of tension between a perception of the museum as a means of public information and enlightenment, and as a facility for visitors' experiences and entertainment. This tension becomes especially visible in the museums' dissemination and exhibition design as a number of dilemmas that contemporary exhibitions and dissemination practices seek to deal with [1]. The discussion about 'enlightenment' versus 'experience' has always played a major role in the discourse around museums [2]. 'Enlightenment' is here connected to the informative, factual, forming, educational, and didactic, while 'experience', on the contrary, is associated with the engaging, involving, emotional, narrative, imaginative, playful, and entertaining. Furthermore, Hein has also noted that these discourses also have more philosophical roots, from a classical didactic expository view of museums, towards more modern constructivist views seeing museum visitors as active agents of their own experience and learning at the museum [2]. The experiential dimension has in recent years been associated with adding more interactive experiences through applying digital

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technologies - often by providing game elements such as quizzes, scavenger hunts or actual video game interactions in installations in the museum context. These gamified experience designs have seen widespread popularity among audiences, and especially shows to engage and motivate younger audiences, who have grown up in a significantly more entertainment-oriented media landscape than just a few decades ago [3, 4]. Through games and interactive exhibitions, these new audience are becoming 'users' of the museum exhibition a performative arena, in which experience-oriented content is seen as a platform to deliver the facts about the museums subject matter.

However, in the museum context, this trend towards increased use of gamified experiences, are still facing opposition from traditions favoring more traditional means for assuring an ordered, factual and authoritative delivery of educative content to enlighten our societies. While the degree of resistance varies, the debate between enlightenment and experience can be found in most modern museum context often leading to compromises made when creating new exhibitions. These compromises often result in arbitrary mixes of experience-based and enlightenment-oriented form and content - especially when making decisions about designing interactive digital exhibitions. If designing a primarily experience-oriented feature, such as a game element is added, the designer will often meet the demand for also including a clear and present layer of enlightenment too - e.g. by adding a text page with facts to read before playing. In this regard, the enlightenment is forced into the experience-based interaction design and would be true also in the opposite situation in which simple gamified elements (e.g. so-called 'badgification') is added as a superficial add-on to an exhibition.

It is our hypothesis, that this tension of traditions and its resulting compromises in design are not optimal for either tradition and only serve to create inadequate interactive exhibition design. Instead, interactive exhibition design needs to balance the traditions, by allowing for other types of enlightenment than authoritative didactic expository while the gamified installations should also not stray too far away from communicating a message about the subject matter. The question is then, how do we balance modern interactive exhibition design with the museums need for delivering complex facts in a compelling manner which both enlightens and entertains the visitor?

This paper presents insights from a collaborative design research project, in which a zoological museum in Denmark collaborated with the authors about the integration of multiple digital installations in their new exhibition design. From studying the user behavior through both qualitative and quantitative research, we show how attempts to deliver purely fact-based information through didactic design elements failed to succeed in engaging the visitors, while a more informal delivery through socially engaging interaction design sparked enlightenment about the subject matter through a manner of stealth learning [3].

2 Enlightenment or Experience? An Ongoing Discourse in Museum Research

This section details the background for the design space, showing the debate, between enlightenment and experience design through four archetypical positions.

Sæter discusses the museums' basic values and objectives in a historical perspective on the challenge framed as being between conservation and consumption [5]. This describes a major historical movement 'From enlightenment to entertainment' as it is called in a headline; i.e. from the modern museum where the basic values and objectives were to teach and educate the public through displays to the present-day post-modern museum that moves towards becoming a 'commercial entertainment product' [5]. The objective for the modern museum is to both educate and enlighten, with the basic values rooted in the belief in development, culture, formation, and progress. In contrast, the objective of the non-constructive, or post-modern museum, is entertainment, and the basic values are lack of worry, freedom and openness [5]. Sæter even speaks – with reference to Belk [6] – of a 'disneyfication' of museums which "…has sacrificed education and enlightenment for superficial entertainment based on illusions. In the competition for the audience, museums create an illusory hyped-reality" (Our translation) [5]. The first position in the debate between enlightenment and experience, exemplified by Sæter, is thus for the museum's classical enlightening as well as opposes the use of experience and entertainment-based dissemination and exhibition design.

Diametrically opposite is the case with Kirschenblatt-Gimblet, who describes a paradigm shift: "From an informing to a performing museology" [7]. The shift is characterized by a movement from 'information' to 'experience', from 'knowing' to 'feeling', from 'things' to 'stories', and from 'display' to 'mise-en-scène'. The new museology is characterized by, among other things, a more theatrical or dramatic approach to the museum experience – what is here called 'museum theatre' [7] – that, instead of merely presenting objects, makes use of museum practices such as scenography, mise-en-scène, tableaux, scenarios, installations and 'habitat displays'. This approach gives pride of place to drama, the narrative and emotional engagement and, in place of the cognitive and visual, focuses on the somatic and affective. "This is a special kind of theatre", writes Kirschenblatt-Gimblet, "and its point is not information but 'experience', a term that is at once both ubiquitous and under-theorized. 'Experience' indexes the sensory, somatic, and emotional engagement that we associate with theatre, world fairs, amusement parks, and tourism". Therefore, this new modus is also called "the expo style" [7] or "the expo mode of the new generation museum" [7] with a reference to 'world fairs' and the Expo-World's more performative oriented display forms that are also far more 'customer focused' and 'commercially positive' [7]. That is to say, a shift from the traditional enlightening, information-oriented museum to a more experience-oriented museum. The second position, exemplified by Kirschenblatt-Gimblet, is thus - opposite Sæter – critical of the classical museum's informative and educational functions, and in favor of a more performative, experience-oriented, engaging exhibition practice.

In a Danish context, Skot-Hansen has set out to illuminate and discuss the current situation in which the Danish public museums find themselves, and in particular their role in the experience economy [8]. The experience economy is here seen as both the cause of and solution to the current challenges facing the museums. The point of departure is that the state-subsidized museums are under both economic and political pressure, in part because of the experience economy. The museums are challenged by the experience economy, partly by competition from other more commercial experience-oriented attractions, as well as an audience who is increasingly pampered by more engaging and

sensational experiences, partly in the form of demands to enter into the experience economy as well as the economic development of cities and regions. Therefore, museums must re-evaluate their classical role as institutions of enlightenment and education [8]. The museums, hence, find themselves in a tension field between what can be described as enlightenment on the one hand and experience on the other. Skot-Hansen expresses it in this way: "The discussion on enlightenment versus experience … permeates the public debate on the role of museums; not least the question of where the boundaries lie" (Our translation) [8]. Later, Skot-Hansens elaborates: "The museums are moving in a field of tension between being cultural institutions based on the five pillars (collection, registration, preservation, research and dissemination), and being experience-saturated attractions that contribute to the Danish experience economy's continued development" (Our translation) [8]. At the same time, experiences and the experience economy are seen as the solution to the challenge, among other things, in that the museums can and must learn to work strategically with experience development, i.e. learn from the instruments of the experience economy in relation to using experiences such as staging and strengthening experience value and use orientation. It should not be done solely for creating an economic surplus or added value, but primarily to create relevant, challenging and lasting experiences for the audience. Therefore, one of the main conclusions of the report is that the experience-economic performance of museums should not be judged only on their contribution to the local and national economy but should be judged according to artistic and cultural criteria [8]. The third position, represented by Skot-Hansen, is thus not a simple 'for' or 'against', respectively, enlightenment and experience. Rather, the relationship between the two approaches takes the form of a means to an end, i.e. using experiences and the experience economy as instruments to promote the core purpose: enlightenment.

Finally, a fourth position is represented by Floris and Vasström who – as far back as 1999 – discussed whether the objective of museums is enlightenment or experience [9]. Floris and Vasström associate the genesis of museums to the modern society's formation project and the modern democratic nation states' narrative of progress and freedom. Just as they point out, that the modern project and the narrative about the necessary course of development and continuous progress in the present time have collapsed. The enlightenment element relates particularly to the museum's original, historical form, and often there has been a focus of enlightenment in a pure, next puritanical form, where the experience had only a subordinate role [9]. On the other hand, they link the experience to more current practices where many museums have, in recent years, to a much higher degree, made use of entertaining and activating elements of dissemination in exhibitions and in their overall work. A practice they particularly associate with experience centers and the new visit centers with historical themes. Even so, the attitude is that the museums should also learn from the experience aspects and implement the lessons learned where the museums should take up the challenge instead of blindly distancing themselves from the experience centers etc. and stamping them as disneyfication. This perspective advocates for a synthesis of the two aspects into a new formation or educational project – having both enlightening and entertaining experiences where it is not a question of either or. Floris and Vasström's position, is thus not characterized by a 'for' or 'against' enlightenment and experience, respectively, or a suggestion to instrumentalize one as

a means for the other as an end. Rather, the case is that the contradiction or conflict between enlightenment and experience dissolves in favor of a new more nuanced and complex understanding of a possible synthesis of enlightenment and experience, where one can obtain enlightenment and learning through experiences – as in 'experience-based learning' – and get experiences and enjoyment through enlightenment, information and learning – as in 'learning-based experiences' or 'edutainment'.

As can be seen from the above, the discussion about enlightenment versus experience is an ongoing and dominant discourse within the museum area and in the scientific literature on exhibitions. This marks the arena of which this study's constructive design research project entered, with an attempt to balance the tension between positions, in ensuring enlightenment in a museum context, through an experience-based approach.

3 Interactive Exhibition Design

The recent discourse of museums and exhibitions elaborates a partial and complementary picture of the complexity in balancing between enlightenment and experience. For the past two decades, exhibitions around the world have explored different methods to comply the requirement without compromising the enlightenment aspect. Starting from film and audio guides to integrating number of digital technologies to enrich visitors' experience [10].

Already a decade ago, Tallon argued that exhibitions can enhance the exhibition experience by providing involving experiences through new digital technologies [11]. Users are increasingly engaged and actively involved, among other things through interactivity and active contribution [12–15]. As such, today, it is almost unavoidable to interact with a number of digital technologies during an exhibition visit, which have enabled new kinds of interaction between exhibition and its visitors. Although the post digitization phase of exhibitions reflects a more thorough incorporation of digital content in exhibition practices [16], the expectation by exhibition visitors for new digital experiences are increasing parallel to the technological advancement. The potential of digital technologies not only contains qualities in providing involving experiences, but also richly authentic learning experiences that enrich visitors' enjoyment and learning, which would be difficult to provide through other media [17, 18]. As such, this area has in recent years attracted international attention and investments on digital experiences in exhibitions [19–23].

Studies have shown that digital technologies can facilitate knowledge acquisition, and especially interactive digital technologies have shown to enhance visitor interaction and substantiate learning [24–27]. Studies with focus on design and evaluation have provided insight into how visitors interact with digital technologies in exhibitions [4, 28, 29]. However, knowledge regarding how visitors understand, apply and respond to new digital technologies ability to mediate both enlightenment and experience is more limited [20, 21].

Gammon and Burch emphasize the importance of hardware, software and content being based on an understanding of users' needs, desires, expectations and behavioral patterns [17]. Obviously, this does not sound like a particularly surprising conclusion. However, reality is often that many digital exhibition projects are not based on actual

user tests or reconciliations with users' expectations, who have to use the digital offers [19–21, 30, 31]. Compared to this view, it does not seem surprising when Gammon and Burch point out that users often respond unexpectedly and surprisingly to digital installations in relation to exhibition organization's expectations, intentions, and desires [17]. A large amount of literature exists about museum visitors' experience in the physical exhibition space. However, research into what characterizes the exhibition visitors' digital interactive communication, as well as what wishes and expectations museum users have for digital communication, is still scattered. Heath and Lehn's studies are another example of more critical studies of digital exhibitions [19, 20]. They conclude that it is often the case that digital installations in museum rooms facilitate interactivity between one user and a machine and thus do not involve other surrounding museum users. They justify that much technology in museums is based on home computers, and they emphasize the importance of developing new technologies that are adapted to the particular social interaction that one wants to create in exhibition contexts. As such, both Gammon and Burch, as well as Heath and Lehn, point out that where there has been much research in computer software and hardware for home use, it has not applied to the same extent in exhibitions which is a significantly different context. Several studies show that users' use of and expectations for computer-based technology is very different when it takes place in an exhibition than when it takes place at home [32, 33]. Thus, there is a need to focus on the engagement, interaction, and knowledge dissemination, involving experiences can craft through new digital technologies [34]. It is important to investigate how to further integrate digital media on the terms of the exhibitions subject matter, in order to ensure that the experience-based content (in software and hardware) is formed around the enlightenment goals of the exhibition, rather than as a technical add-on.

4 Investigating the Tension: The Hunters of the North Sea Concept

To experiment with balancing the tension between experience and enlightenment through designing digital exhibition elements as an integrated part of a modern museum, the authors participated in a major re-design of an exhibition area at the Danish zoological museum 'The North Sea Oceanarium' (Oceanarium). The Oceanarium is an aqua zoological facility in Denmark disseminating the flora and fauna in the North Sea through a combination of learning and entertainment. The aqua zoo driven by 35 full-time employee and is reinforced with additional 35 seasonal employees on high season periods. The exhibition has around 160.000 visitors every year [35].

In 2017 the Oceanarium initiated a renewal project of an old exhibit dated back to 1998. The desire was to create an involving family experience that enlightened about the food chain in North Sea from predators to prey between the coast and sea. The exhibit extends over a larger area in the exhibition, and therefore was divided into smaller areas with different media platforms to disseminate the content and provide an involving experience respectively to children, youths and adults. As such, the desire was to explore the potential of emerging digital technologies to create integrated digital experiences that enlightened about the food chain in North Sea.

The authors were involved in both conceptualization, design, and implementation of four major digital exhibition installations, which all represented different facets of

the tensions, and compromises, arising when balancing experience and enlightenment related aspects of interactive exhibition designs. Below we will detail the design of the four interactive installations in the new exhibition.

4.1 The Four Gamified Installations

Today, play and entertainment is often a part of an exhibition experience. Various studies have demonstrated the potential of play and entertainment to instigate learning at interactive exhibitions [36–38]. As such, all four digital installations were designed to enrich the visitors in the new exhibit through using various gamification elements to engage the visitors. The four installations, covered in the study, are named: The Big Ocean Window, Seal Hunter, Seal Nursing, and Hold Your Breath.

Fig. 1. The interactive installation Big Ocean Window (BOW) with the big 100 m^2 digital screen and the six individual touch screens for controlling the fish avatars on the large screen.

The Big Ocean Window (BOW) disseminates the food chain of predators and prey between cost and deep sea. The installation consists of a 100 m^{20} LED screen connected with six individual touch screen control units, where the visitors can interact with the shared big screen by taking role as a mackerel hunting for food, while they also have to avoid being eaten by bigger predators (see Fig. 1). The control units consist of a screen with a first-person view (the maceral), joystick to control the directions, and a button to attack (see Fig. 2).

The big screen provides a third-person view, giving an overview of the virtual space. The visitors must orientate where the food and predators are on the big screen and use the control unit screens to attack or escape. Points are given for the number of fishes the visitor catches, and if the visitor gets eaten by a predator, then the game ends. The game can be played collaboratively by some helping with the navigation on the big screen while one is controlling the maceral. It can also be played against other players on other units competing on number of fishes caught. Apart from the game aspect, visitors can also access a didactic lexicon feature, where information about different animals in and

Fig. 2. The 3. person perspective of the mackerel player avatar, controlling one of the hunting, and hunted, fishes on the big 100 m^2 main screen digital simulation of the maritime eco system.

around North Sea can be found. Furthermore, it also gives possibility to inspect the animals through 3D models (see Fig. 3).

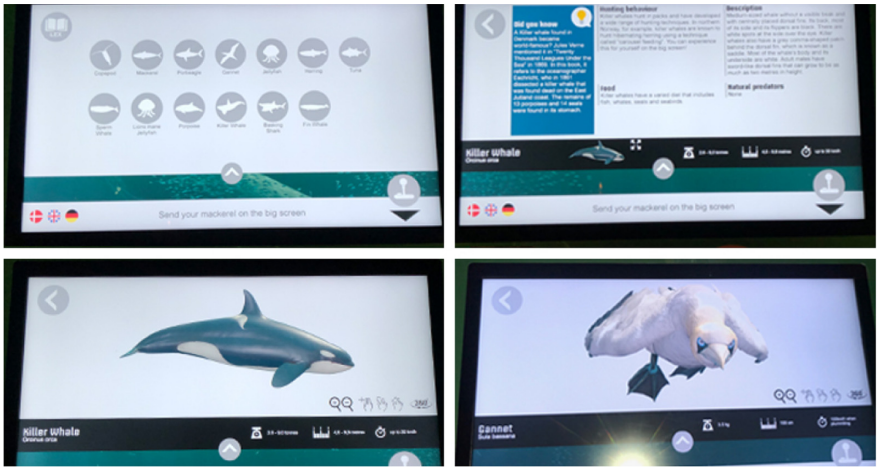

Fig. 3. The BOW's didactic lexicon, featuring fact-based information, and detailed 3D visualizations of the animals present in the virtual aquarium's play sessions.

The BOW installation represents the integrated design principle by resembling a real aquarium, adding the smaller touch-screens as the primary game element, while also enabling spectators to just experience the simulated interactions of large sea mammals

- such as sperm whales, orcas and dolphins – which cannot normally be displayed alive in zoological facilitates due to either logistical or ethical concerns. Thus, the integration of the large digital aquarium using digital technology, and experience-based interaction design, was an example of how the merge between the positions, by enabling the enlightenment about part of aquatic fauna not feasible to portray through other means.

The second installation, Hold Your Breath, is about how long the visitors can hold their breath. According to the time they can hold their breath, their face will be augmented with a respective animal that can hold the breath equally. The interaction happens through a button, which the visitors have to hold down while they are holding their breath. The visitor's face is captured through a camera and presented on a screen with the changing augmentation on their face in real-time (see Fig. 4). This installation was designed through a principle of using the visitor's own body, and human lung limitations, to provoke reflection and enlightenment on how they compare various animals, while using the game-based interactions and rewards as mechanics to promote the visitor to revisit the installation, compete socially, and thus unlock more information about the animals through the augmented reality rewards.

The third installation, The Seal Hunter, is a dual player game with two touch screens facing away from each other. On the one side, a seal can be controlled through a first-person view hunting for fishes, where the controller vibrates in the direction of fishes imitating the way seals navigate with their whiskers, see Fig. 4, picture four showing the control system. On the other side, another visitor controls several fish groups through a third-person view, where the fish groups can be navigated towards the seal as a collaborative game, or prevent the seal in catching the fishes, by navigating the fishes away from the seal.

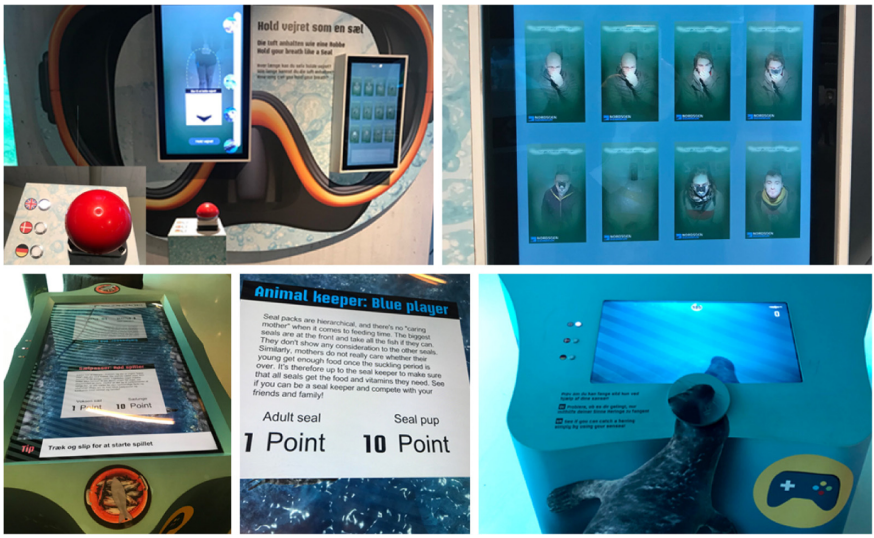

Fig. 4. To the top left 'Hold Your Breath' installation, followed by the screen presenting the augmented photos of the players. Bottom left picture shows the 'Seal Nursing' installation followed by the point information on the screen. Bottom right picture shows the controller of the 'Seal Hunter' installation.

Finally, the Seal Nursing installation is about nursing the seals by feeding them. Concretely, the visitors must throw fish to the seals. The visitor gets one point every time a seal catches a fish, and if the visitor manages to feed a seal pup, it is awarded with 10 points. This resembles the importance of feeding the seal pups in a zoological facility as the bigger seals usually steals the food from the pups. The game installation can be played as a single player game or dual player competitive game (see Fig. 4, picture 3).

The last two installations show how the digital technology could be integrated into the setting, right below the aqua tank with live seals but using the digital technology and game-based interactions to mediate the hard-to-observe social behavior of seals.

5 Method – Studying the Users in Context

The user study, of how the visitors interacted with the new digital installations in the exhibition was based on both a qualitative and quantitative strategy.

The Oceanarium has over the years gone from just evaluating their performance through employee impression and gut feelings to be a more data-driven organization. Today, most of their exhibits and the digital installation logs data, which are used to improve the usability and the visitor experience. Thus, they agreed to prioritize a rather detailed data analytics back-end to be implemented in the four installations to enable us to perform a quantitative overview of the user behavior.

The quantitative data collection was based on tracking these data points and analyzing their balance between the experience-based and enlightenment-oriented interactions (e.g. interaction with the game-elements vs. reading through the digital lexicon). With one of the installations, the Big Ocean Window, our data tracking module was ready to be implemented alongside the summer launch of the exhibition, while data tracking modules of the three other digital installations were first implemented in the late summer/early fall. The Big Ocean Windows dataset is thus based on 121.538 playthroughs (one-six players a time), while the Seal Hunter set is based on 8.967 playthroughs (with two persons a time), and the 'Hold Your breath' installation data set was based on 12.601 playthroughs (one player a time).

To complement the quantitative data set, two days of field studies were planned, and conducted in the fall of 2018. The exhibition was implemented in the summer of 2018, but the study itself was postponed to the fall in order to let the amount of visitors, the technical adjustments of the installations, and the zoo personals own behavior around the exhibition stabilize to a 'new normal' before observing and interviewing the visitors in situ. The observation days were further based on a premise of 'not too few, not too many' visitors present in the zoo to optimally represent a typical visitor and event flow of a day in the zoo. We conducted video observations for four hours around the exhibition area to identify patterns of user flow among the installations, and to identify specific behaviors to be investigated further through interviews. The interviews where performed in the exhibition context based on a semi-structured interview guide asking questions detailing aspects of the interaction design, the visitors understanding of what they experienced, and an assessment of both if they had fun as well as felt informed about the subject matter. A total of eight group-based interviews were performed with visiting families, being prompted for an interview immediately after leaving the exhibition area,

and where generally aimed at being short and concise at a maximum duration of five minutes per interview.

6 Data Analysis

The following section will present our analysis of the empirical data collected from the digital installations, with the aim of exploring user behavior in relation to experiential gameplay, and didactic enlightenment. We structure the analysis by first presenting the quantitative data collected from the installations themselves, and how we modelled the data sets to address issues of experience vs. enlightenment regarding the subject matter of the installation.

6.1 The Big Ocean Window

The BOW had six separate touch screen stations, from which the visitor could interact with the virtual 100m2 aquarium on the primary screen. Each of these stations provided a total of 31 digital data tracking points, which we modelled into one data set combining seven data points which would provide data on both the gameplay elements, alongside the use of the fact-based lexicon features of the installation.

Based on the gathered data on BOW, it was possible to determine that 30–50% of the play sessions ends with the player 'completing' the game without being eaten during the game's total play session of 120 s. The other two types of play sessions, ending through game inactivity or by the visitor's fish avatar being eaten, constituted between 50–70% of total sessions. Thus, it can be noted that the majority of the players managed to complete the game, which indicate that the difficulty of the game seems to be appropriate for the target audience by not being too easy to complete nor too hard to accomplish. An initial hypothesis was that several visitors would find it difficult to navigate precisely due to the inverted control of the x-axis in the game and the third person perspective on the big screen. However, in the interviews, it turned out to be mixed as to whether it is actually experienced as difficult to control the game, indicating that the inverted joystick pattern was not a design error, but an ambiguous pattern to interpret. Especially children between the ages of 5 and 12 seem to have an easier time getting used to the controls, which does not indicate any usability problems.

It was not possible to quantify how many play sessions one player was associated with since no user logins data was required to play in order to ensure a fast user onboarding. From the video observations it was possible to observe a clear tendency where the majority of players played more than one session before stopping. Especially the children played more than one game and were often inspired by watching how others played, which kept them playing. Concordantly, there were also observed a number of situations where more than one child participated in the same play session. Here, they spotted the predators on the big screen and warned the playing child on the individual unit. This social dimension was particularly evident in families with more than one child, which also was the group with most repetitive play sessions (Fig. 5).

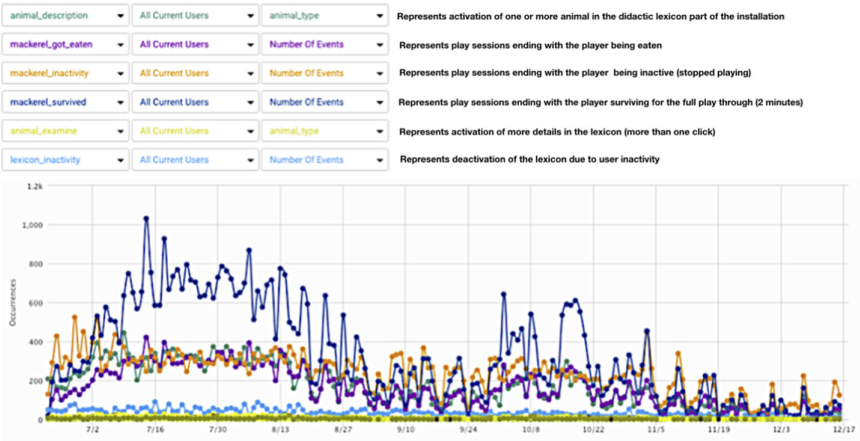

Fig. 5. The data model from the 'BOW' showing how we compared different use metrics between the game-based elements, and the use of the fact-based lexicon feature.

Based on the observations, it seemed only a few of the visitors actively interacted with the didactic lexicon section of the BOW screens. Although a larger group of visitors were observed to have found the way to the front page of the lexicon, they quickly clicked away without spending time reading or exploring the 3D models. This is further substantiated with the gathered statistical data of 121538 play sessions, where 23% of the play sessions shows an activation of the lexicon, which gives a picture of a relatively large use of the lexicon in interaction with the game section. However, only 23%, of those who activated the lexicon, actually did interact with the lexicon's 'examine' functions (e.g. clicking around and exploring the 3D models), which only accounts for 7% of the total play sessions. Thus, the reason for the high activation of the lexicon, was clarified in the interviews, where several revealed that they had interpreted the images of the maritime animals in the lexicon as an opportunity to actively select animals for the game on BOW. In the 7% of the play sessions where the 'examine' function was used, the visitors primarily interacted with whales and sharks, which accounts for 56.5% of the play sessions where the 'examine' function was used. Based on the interviews, it was clear that these animals are the ones that attract the relatively few visitors who choose to dive deeper into the lexicon.

To the questions about the non-use of lexicon, several interview persons replied that they did not find the lexicon's factual part essential to their ability to feel enlightened by the BOW. They expressed that they saw the experience with the BOW as a way for their children to be able to put themselves in relation to the biologically realistic and correct interactions with the animals in the BOW and thus function as a good supplement to the more facts-based learning they could get in other parts of the exhibition. They did however point to, that they assessed that their children did learn 'something' through playing the game, by being able to set themselves in relation to the portrayed food chain, and through seeing themselves in relation to the comparable sizes of the marine animal avatars of the game. Similar comments were given from a larger group consisting of three families with children, who also stated that the BOW for them was a way for the

children to experience how complex the food chain is and how fast it can go from hunter to the hunted through their own interactions.

These comments nuance the image of game sessions that activated the lexicon, as well as who interacted deeper with the 'examine' functions. The low usage of the lexicon could be interpreted as a lack of learning and information potential in BOW, where the gaming experience is the only prominent element. But with the visitors' comments in the interviews, as well as the observations of their behavior interacting with BOW, it is evident that there is another form of learning and enlightenment taking place. Here, it is about the BOW giving the visitors the opportunity to experience themselves in relation to the animals (both in terms of size, behavior and mutual interaction) and in this way achieve a more informal learning. Based on the visitors' opinions, it is not because they feel they lack fact-based learning during their visit, but rather sees experience-based learning, like the BOW, to support the fact-based learning in other parts of the exhibition.

6.2 Seal Hunter and Nursing

The Seal Hunter & Nursing installation had two connected stations, with physical controls of the shared big screen in which the simulated seals hunted for food. The installation provided a total of 25 data points from which we build a data model of six data sets, which would reveal how the playthrough took place and what 'feeding strategies' the users applied during their playthrough. We triangulated this with the answers provided from users right after having interacted with the installation in order to supplement the behavioral data with attitudinal statements. Specifically, we sought to probe for whether the visitors had actually realized the defining features of how seals hunt for food, how the seals were different - e.g. the baby seals needing different kinds and amounts of food, but were harder to feed due to the competition for food from the adult seals.

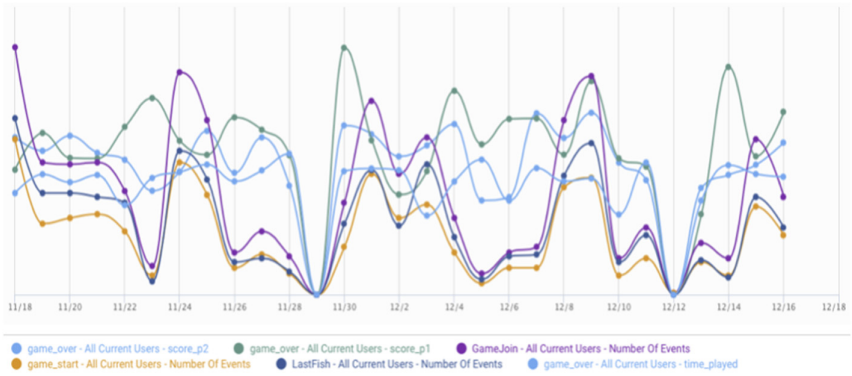

Fig. 6. The data model from the 'Seal Nursing' installation showing e.g. the relation between number of play throughs, time played, and amount of points gained by the two players.

According to the 'Seal Hunter' and the 'Nursing' installations, the majority of the games were played by two players. Here, a general behavior was observed among the

players. It appears that the majority of players misunderstood the purpose and arguably missed the communicated elements presented prior and during their play sessions. It was only on the Seal Nursing installation where these observations could be substantiated via the gathered statistical data since the Seal Hunter analytics only provided data regarding how the seal was navigated in the game. As such, according to Seal Nursing, there was a clear pattern illustrating a low success rate of collecting points during the play sessions, which was between 9–23 points on average in every play session on a day (with successful playthroughs reaching scores closer to 75 points) (Fig. 6).

This can be linked to the fact that no gaming session reached the full 60 s, but most often ends 10–15 s before as a result of running out of fishes. In combination with the observational studies, this revealed that most players did not discover the difference between the points they get in relation to the size of the seals (for example, the baby seals get 10 points and the other seals gets 1 point). They throw the fish quickly in the belief of having an endless amount of digital fish. This was a result of not reading the guidelines for the games, neither the physical nor the digital displayed on the screens. This trend was general for the two installations where they start playing without knowing what the games are about. In the Seal Hunter there was an articulated doubt about whether it was a collaborative game with each other or a competitive game against each other. A family explained that it was not a problem that they should explore the game, in which they found the value of helping each other in their situation. As such, in some cases, they decode the games and adjust the game strategy, but in many cases, they never really decode the purpose and either abandoned or played with their own terms. Here, the information part is lost pretty quickly, as the experience part is not easily understandable.

6.3 Hold Your Breath in Augmented Reality

The ‘Hold Your Breath’ installation was by far the simplest installation in terms of data output from the installation, which mainly registered time of breath hold, the augmented reality effect obtained, and whether the user had any interaction with the augmented reality photos afterwards. However, we modelled the data to compare the frequency of the various unlocked augmented reality effects in order to learn if the progression between the easiest to obtain (the ‘Gannet’) was proportional to the hardest to obtain (the ‘Whale’).

When tracking on the play session, it was evident that the majority of sessions achieved none of the four augmented reality milestones. The second highest is not surprisingly the first milestone ‘Gannet’, which is achieved after 30 s while holding the breath. On average, it is approximately half of the game sessions that reaches the first milestone and gets rewarded with the augmented effect on the screen. From here, it falls quite drastically, where only between 5–10% of the players reach the second milestone ‘Porpoise’, ‘Seal’ and ‘Whale’ as a milestone. This gives an indication of the time of holding the breath is logarithmic to the ‘Whale’ which means the difficulty of having to stay for more than 30 s is too great for most players. From the observations, it was evident that when groups of visitors tried the game together, a fast competition emerged, and the game was generally played by almost all visitors more than once. This indicates that the interaction and social dynamics of the game seem to work, but part of the enlightenment aspect disappears when so few visitors earn milestones other than ‘Gannet’ (Fig. 7).

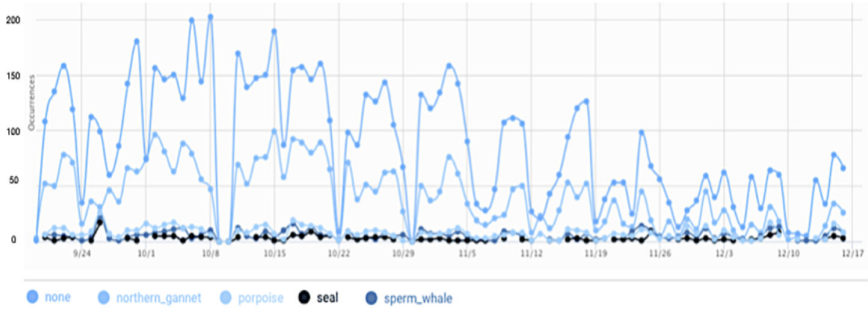

Fig. 7. The data model from the 'Hold your Breath' installation.

According to the data, the whale appears more often as a milestone than the 'Seal' and the 'Porpoise'. This shows that there are more users who reach the last milestone than the two in the middle. This corresponds to the observations, where it was clear that the players in groups competed to hold their breath longest. In contrast, another pattern was also observed in which the players, after the first few real attempts to hold their breath, actively began to make their own interpretation of the installation's use. Here, the players simply chose to pretend that they hold their breath, while the button is held down and the various milestones were unlocked. The players then breathe out, although during all 2 min of interaction, they have just pretended to not have breathed. This creative play with the installation testifies that the player understands both the intent and the interaction with the installation, but freely interprets the situation to play with on the premise of holding their breath. These players thus reach the whale as a milestone which explains why the last milestones were experienced more often than the middle ones.

This again points to the relationship between enlightenment and experience in the installation. The difficulty of the installation obviously prevents a number of players from achieving all the milestones, and thus also prevents the total amount information. Conversely, the play with the installation also shows that the players freely interpret the rules, immerse themselves into the interaction, unlocking the augmented reality effects, and thus also obtain the factual information.

7 Synthesis

This section seeks to identify and elaborate the conditions and dependencies between enlightenment and experience as seen in our analysis with the previous state of art, and the four introduced positions in museum research.

The analysis illuminates a number of issues regarding the conditions and dependencies between enlightenment and experience that have been identified in the implemented digital installations, and their effects have subsequently been explicated. From studying the user behavior through both qualitative and quantitative research, the results of these implementations reveal how such attempts to deliver purely didactic design information digitally failed to succeed in engaging the visitors, while a more informal delivery

through game-based interactions with the content sparked enlightenment about the subject matter in the form of a more reflective relation between user and subject matter of the installation. This aligns with other studies (e.g.) [4, 39, 40] and can be seen to align with Floris and Vasström's position on experience-based learning in museums as an inclusive position of seeking a balance, rather than a dominance, of either experience or enlightenment-based parts of the installations. Finally, we argue that the results from the studies of the four installations reveal a process akin to what Sharp [3] has labeled stealth learning – disguising didactic facts behind integrated digital installations, promoting reflection through the visitors' active participation in the game-based interactions. As such, from the gathered insights, we can point to three guiding principles for the balance, between experience and enlightenment in game-based exhibition designs to accommodate this type of stealth learning.

1. Avoiding adding 'forced' fact-based features and content as an add-on to the game-based exhibition designs, since these run the risk on only seeing limited or misinterpreted use. If factual content is to be presented in an authoritative way it should be done either through design placed prior to or after the game-based interactions as preparation or debriefing of the player. Our studies showed that users did in fact reflect and were able to digest the facts in relation to the game-based experience.
2. Letting the informal learning be front and center for game-based interactive exhibition design, by being enlightened about their own relation to the facts through performative play which promotes reflection. This requires a discussion in relation to the four positions of what the role of museums should be in society, and whether we can accept less formal facts to be delivered if the visitors leave the exhibition with their own subjective reflections on the subject matter experienced.
3. If informal learning is not desired, and authoritative enlightenment is needed, the two are better separated. In these cases, game-based elements should deliver purely entertaining experiences, and the exhibition facts should deliver enlightenment on their own respective premises. This requires a stricter discussion about when and where, in a museum context, interactive experience design could be used to give the visitor a 'break', potentially avoiding so-called 'museum fatigue' [41], and thus, ensure their motivation to learn more after the 'break'.

The first principle encourages a mix of second and third positions in current discourse about exhibition design at museums, favoring more experience-oriented practices where the experience is an instrument to promote the enlightenment. The second principle encourages the fourth position where one can obtain enlightenment and learning through experiences, as in 'experience-based learning', and get experiences and enjoyment through enlightenment, information and learning, as in 'learning-based experiences' or 'edutainment'. Finally, the third principle encourages the first and second positions, where enlightenment and experience are strictly separated to focus on what each one is best at.

8 Conclusion

We initiated this research through the hypothesis, that the tension of traditions in exhibition design are not optimal for either traditions, and serve to create inadequate interactive exhibition design. We argued how it is often the case that either the experiential or enlightenment-oriented design elements are forced upon each other. This study focused on how the engagement, interaction, factual communication, and the educational effect of interactive experiences can create through game-based interactions in an exhibition context. Through the quantitative data set, triangulated with situated interviews, the study shed light on how visitors understand, respond, and acquire knowledge based on actual users' reactions and expectations over time. The data has shown a clear pattern supporting our hypothesis by demonstrating how attempts to deliver purely fact-based information through didactic design elements failed to succeed in engaging the visitors, since it either competes unfavorably against the play-oriented part of the experience. However, the interviews did indicate the presence of a more informal delivery, through what we regard as stealth learning during playthroughs. These situations promoted enlightenment, about the subject matter, not through the delivery of facts, but through users seeing themselves in relation to the subject matter. The facts were so to speak reflected upon through playing the games and through their social interactions about the play session afterwards. This might not be the authoritative ideal of older museum discourse, but it aligns with post-modern and constructivist views on museum design [5] – giving further empirical basis for game-based exhibition design as an enabler of experience-based learning. In such cases, enlightenment is assessed through gained reflections, wonderment and new questions sparked, rather than the transfer of facts alone. This is not to be seen as the only design strategy going forward, but rather as a data supported argument for allowing game-based experiences in exhibitions to function on their own terms, and not be forced to adhere to authoritative fact delivery. Rather, interactive exhibition design needs to balance the traditions, by allowing for other types of enlightenment than authoritative fact delivery, while the gamified installations should also not transcend into straying too far away from communicating a message about the subject matter. Our study shows that certain type of enlightenment can arise from building game-based experiences around the facts, but without forcing the facts upon the users. In the end, this is reflected through the three proposed guiding principles to consider when seeking to achieve a balanced exhibition design between experience and enlightenment.

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