GAMIFICATION AS A STRATEGY TO IMPROVE
USER-EXPERIENCE WITH INTERACTIVE MUSEUM EXHIBITS

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SYED AHMED JAWWAD ZAIDI

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submitted by **SYED AHMED JAWWAD ZAIDI** in partial fulfillment of the requirements for the degree of **Master of Science in Industrial Design Department, Middle East Technical University** by,

Prof. Dr. Gülbin Dural Ünver   _____
Dean, **Graduate School of Natural and Applied Sciences**

Prof. Dr. Gülay Hasdoğan   _____
Head of Department, **Industrial Design**

Assist. Prof. Dr. Naz A.G.Z. Börekçi   _____
Supervisor, **Dept. of Industrial Design, METU**

Examining Committee Members:

Assist. Prof. Dr. Fatma Korkut   _____
Dept. of Industrial Design, METU

Assist. Prof. Dr. Naz A.G.Z. Börekçi   _____
Dept. of Industrial Design, METU

Assist. Prof. Dr. Pinar Kaygan   _____
Dept. of Industrial Design, METU

Assist. Prof. Dr. Cankiz Elibol   _____
Dept. of Interior Architecture, Hacettepe University

Assist. Prof. Dr. Pelin Gurol Ongoren   _____
Dept. of Architecture, TOBB ETU

Date: 6th September 2016

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name: Syed Ahmed Jawwad Zaidi

Signature:

ABSTRACT

GAMIFICATION AS A STRATEGY TO IMPROVE USER-EXPERIENCE WITH INTERACTIVE MUSEUM EXHIBITS

Zaidi, Syed Ahmed Jawwad

MS, Department of Industrial Design

Supervisor: Assist. Prof. Dr. Naz Börekçi

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Gamification principles offer a promising approach to enhancing user experience, specifically in the public sphere, while at the same time providing an opportunity for the user to have an engaging learning experience. Interactive museum exhibits afford immense potential to explore the relationship between engagement and gamified experiences. Since the introduction of digital interactive devices, creating engaging experiences for museum visitors has become a challenge, especially when catering to the millennial generation.

This thesis study attempts to analyze and classify aspects of gamification with reference to museum experiences based on user-testing conducted with applications developed for museum visitors. An inductive approach to the research includes a preliminary study of a millennial population sample analyzing the various dimensions of their experience, as well as an empirical study to elicit user perceptions regarding areas covering motivations, perceived issues and ease of use. Conclusively, suggestions regarding improving interaction with exhibits are made.

Keywords: Gamification, Museums. User-Experience, Interactive Exhibits,

ÖZ

MÜZE MEKÂNLARINDA KULLANICI DENEYIMININ ZENGİNLEŞTİRİLMESİ İÇİN OYUNLAŞTIRMANIN STRATEJİ OLARAK KULLANIMI

Zaidi, Syed Ahmed Jawwad

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Oyunlaştırma İlkeleri, özellikle ortak alanlarda kullanıcı deneyimini zenginleştirmek için umut vaat eden bir yaklaşım önermekte, bir yandan da kullanıcının derinlemesine bir öğrenme deneyimi yaşamasına olanak sunmaktadır. Etkileşimli müze sergileri katılım ve oyunlaştırılmış deneyimlerin arasındaki ilişkiyi sağlamak açısından büyük potansiyel taşımaktadır. Dijital etkileşimli cihazların kullanılmaya başlamasından bu yana, özellikle yeni nesil kullanıcı göz önüne alındığında müze ziyaretçileri için katılımcı deneyimlerin yaratılması zorlu bir görev olmuştur.

Bu tez çalışması müze deneyimlerine kıyasla oyunlaştırmanın unsurlarinin irdelenmesini ve sınıflandırılmasını amaçlar. Çalışma Kapsamında müze ziyaretçileri için geliştirilmiş uygulamalar kullanıcılarla test edilmiştir. Tümevarımsal bir yaklaşımla, bir on çalışmada Y kusagindan temsilcilerin deneyimlerinin farklı boyutları araştırılmış, ardından uygulamalı bir çalışma yürütülerek etkileşimli müze uygulamalarının sağladığı oyunlaştırılmış öğrenme deneyimi, motivasyon, algılanan hususlar ve kullanım kolaylığı acilarından irdelemiştir. Sonuç olarak, etkileşimli sergilerle olan etkileşimin geliştirilmesi yönünde önerilerde bulunulmuştur.

Anahtar kelimeler:

Dedicated to

Ali Akbar,

...for making it all possible

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CHAPTER 1

Introduction

1.1 Problem Definition & Background

Museums hold a unique place in society as not just the stewards of cultural objects of value but also of preserving identity and for providing a unique learning environment to its visitors. This learning can take place when engagement with the exhibits is at an optimal level and when the exhibits present the information in a way that corresponds to the interest level of the visitors, who may represent a diverse stratum of individuals from various demographics and cultural backgrounds.

In order to adapt to the changing nature of museum goers and the public at large, the museums should attempt to cater to them in a way that is in sync with the times and the preferences of the current generation (Cembalest, 2009).

While various strategies are suggested to enhance the engagement of museum visitors such as making the experiences more resonant, rich and interactive (Templeton, 2011), there exists a gulf in understanding the perception of the users and how they interact with these installations. Existing aids to museum experiences, such as audio tours and touch screens are limited/static in terms of the content they provide (Templeton, 2011). Also, technology progression poses challenges to the end-users when it comes to comprehending and ultimately benefitting from the innovation due to a paradox that technologyholds within itself (Norman, 2013).

Games have shown to be beneficial when used as a persuasive strategy to encourage or discourage certain behaviors among people as early as 6th Century BCE when the ancient kingdom of Lydia in present day Turkey had to cope with a severe drought to

sustain themselves with the limited amount of food that they had. Leading gamification expert, Jane McGonigal, in her book 'Reality is Broken', mentions that the kingdom survived through 18 years of food shortage by playing games, which proves the powerful potential that the concept of gamification holds (McGonigal, 2011, p5)

Gamification presents us with one strategy to enhance the user-engagement levels of museum visitors, with respect to the design and usability of interactive displays, since most of the visitors embody a lusory attitude when visiting a museum, this approach becomes even more relevant as a strategy. What is needed is an understanding of the current perceptions of members of the general public in terms of their perceptions and experiences of museum exhibits and a focus on the interactive nature of the exhibits that are designed to engage their audiences. Increasingly, 'gamified' or game-like experiences are being incorporated into the museum space in order to attract more visitors and to engage them in a free-choice learning environment.

1.2 Effectiveness of Games and Meaningful play

Koster (2013) emphasizes that any form of communication, whether in writing or otherwise, becomes an art form when it is open to multiple interpretations by the consumer and focusing on narrative, this is where games need to emphasize in order to improve user-engagement. The 'Self-determination theory', propounded by Ryan and Deci (2000), states that during an activity, intrinsic motivation of the participant can lead to a higher level of interest and thus, a chance of greater long-term success.

According to instructional designer Car-Chellman (Car-Chellman, 2010), "Most of the educational games that are out there today are really flash-cards. They are glorified drill-and-practice. They don't have the depth and rich narrative that really engaging video games have….We need to design better games." Even games can become boring if the proper method of sustained engagement is not employed. Realism and immersion with 3D graphics do not equate to engagement and it can be created without depending on them. Schell describes a shift in general perceptions towards 'reality' and 'realism', bringing real life to the game world, as well as a shift to reality, giving the examples of 'Reality TV', 'REAL organic food' 'REAL beef',

etc. Authenticity is the most valuable thing in products today, since virtual experiences have cut us off from nature (Schell, 2010).

1.3 Implications of Gamification

Schell (2010), in an inspiring TED talk states that games will pervade all aspects of our life and due to the decreasing costs of sensors and technology, we will have point systems that reward us for every daily task that we perform, thereby giving us motivation to complete the task and in the long run, encourage us to become better persons. In terms of museums, interactive exhibits that resemble games have long been employed to promote engagement and encourage users to participate in the indirect learning that takes place as a result of the interactions.

Gamification is cited as one of the fastest progressing technologies recognized by Gartner's Hype Cycle for Emerging Technologies (Gartner, 2012) and by 2020, 40.9 billion devices are predicted to be connected to the internet, powered by the Internet of Things (IoT), many of them enabling gamification. At the same time, Gartner also predicts that 80% of the current gamified applications will fail to meet business objectives, primarily due to poor design.

The definitions of what constitute games is also an endless debate since the boundaries of where artistic experiences merge into immersive games is not, and more likely cannot be defined. Koster (2013) prefers to call games 'interactive experiences' rather than games due to this.

Studies have shown that we learn while experiencing anything that is fun, and as Deterding (2010) states, "fun is learning under optimal conditions". The meaning of a game itself is subjective, as Koster notes, the lines between game experiences may not be clearly delineated as some may subjectively perceive a given system to be a game, whereas another may see it as something other than a game. What is established though is that in terms of pervasiveness, games are just as encompassing as architecture, as Schell notes: "You can put a painting, a radio broadcast, or a movie into a game, but you cannot put a game into these other things. All these other types of media, and all media that is to come, are subsets of games." (Schell, 2008, p48)

1.4 Aim and Scope of Study

The primary aim of this thesis is to suggest ways, employing gamification, which can add value to the museum experience by generating positive experiences. In this regard, it becomes necessary to capture the perceptions of users, specifically 'millennials' in experiencing game-like interactions and to propose strategies based on existing empirical research that can enrich the design process to produce more compelling and engaging exhibits for users to experience.

Complementary to the main aim is to explore the specific dimensions that constitute, in the eyes of the visitors, a satisfactory and engaging experience. This thesis hopes to explore museum spaces as not just repositories of knowledge but spaces for generating positive experiences, which may be achieved through the strategy of gamification. The thesis seeks to achieve the following key aim:

- To suggest ways to improve the museum experience, focusing on 'positive design' aspects of the museum experience (Desmet and Hassenzahl, 2012)

The aim of the study will be facilitated with achieving the following goals:
- Carry out an inductive empirical study, on interaction between museum visitors and interactive exhibits
- Review the implications of study on enhancing the museum experience

The scope of research, while excluding the entire museum space and contextual attributes, will be covering the following areas in this thesis study:

- Research on the theoretical background of gamification
- Research on gaining the perceptions of museum visitors and the dimensions of their experiences with interactive exhibits

1.5 Research Questions

The thesis searches for the answer to the main question of suggesting which strategies can be adopted to improve the museum experience for the visitor:

How can *gamification* techniques be meaningfully translated to design better experiences, specifically in a museum context?

In doing so, the following sub-questions are investigated:

- What are the dimensions in a museum context that people find interesting?
- Which factors that define the interactive experience for museum visitors are important to them in their visit?
- What strategies can be formulated for behavior change in museum visitors from passive observers to active participants, while making the experience intrinsically rewarding?

In terms of dimensions, aspects that are associated with the experience of visiting a museum and using a gamified application need to be investigated and the factors that make up the experience in interacting with the exhibits should be explored.

1.6 Outline of Thesis

The thesis study is divided into the following units to categorically explore the initial research questions posed at the start of the undertaking.

Chapter 1- Introduction

This chapter deals with the background and aim of the proposed study and gives an introduction to the general topics concerning museums, gamification and user experience. The aims of the study relating to inquiring how gamification can benefit the museum experience, along with the scope are defined and the relevant research questions are posed.

Chapter 2- Literature Review

The literature of relevant areas are analyzed and discussed in this chapter, with a division of content under dimensions of interaction, gamification, its frameworks, museums, visitor and player types, millennials, defining experience and technological developments in the museum context. Examples of both digital and non-digital gamified experiences are cited with the aid of literature.

Chapter 3-Research Methodology

This chapter describes the steps that will be taken to conduct the research. It outlines the methods to define a context as well as the relevant user-group, and to engage

participants to conduct the study. A preliminary study along with limitations, a review of gamified museum apps and a main study are described.

Chapter 4-Findings of the Studies and Implications

The chapter presents the findings of the research data collected from the preliminary study, focus group and survey and analyzes the results of the qualitative data that is obtained. The feedback on the two interactive applications is presented and discussed.

Chapter 5- Conclusion

This chapter deals with the conclusions and findings from the entire research and proposes methods based on the findings to formulate constructive strategies for enhancing user-engagement in museums through gamification.

CHAPTER 2

Literature Review

2.1 Sources of Literature

While Google Scholar has been used to determine the most cited articles and a general body of literature, journals have also been utilized to collect a rich resource of papers and content that deals with gamification, user-experience and museum visitor experiences. These include JSTOR, Elsevier and Sage (Education). The following terms were used either in combination or singularly when searching for results pertaining to the varied topics: 'Gamification', 'User-Experience', 'Engagement', 'UX', and 'Museums'.

Among the body of work dealing with museums, user-experience and gamification, the number of articles, books and websites, ranging from 1978 to 2016 were reviewed in determining their relevance and value to the dissertation are summarized in Table 1.

Table 1 Literature Review Content

Type	Content	Number
Journal articles	Gamification	78
Books referred	Museums User-experience	9
Web content	Engagement	14

Among the key books that were referred to in the course of the literature review, there was The Design of Everyday Things by Donald Norman, which deals with

human-centered design issues, 'Gamification by Design' by Gabe Zichermann (2011) as well as 'The Gameful World' (2014), a collection of chapters and articles written on gamification by authors from all across the world. 'Digital Technologies and the Museum Experience' (2008), edited by Loic Tallon and Kevin Walker gave valuable insights into the development of technologies for museum spaces.

2.2 Dimensions of Interaction

While experiencing a certain interaction, an extremely focused state of engagement, with a concentration on the task is experienced by the users, this state is described as 'flow'. Csikszentmihalyi (1988; *cited in* Conway, 2014), describes 'flow' as a psychological state where skill and challenge are balanced in an optimal state, while performing an activity. He further states that the experience enables the user to better their skills while performing the task at hand and overcoming the challenge:

> "A starting point would be to say that one society is 'better' than another if a greater number of its people have access to experiences that are in line with their goals. A second essential criterion would specify that these experiences should lead to the growth of the self on an individual level, by allowing as many people as possible to develop increasingly complex skills. (Csikszentmihalyi and Csikszentmihalyi 1988: p78; *cited in* Conway, 2014)"

While flow (Figure 1) represents an important factor in sustained engagement, which is crucial to game players of all kinds, and to some extent gamification, in the context of museum visitors, a limited duration may not allow for users to go into a state of flow when experiencing exhibits, on the other hand, a sense of absorption may accompany a person for the limited time of interaction that takes place. This absorption can be crucial in promoting engagement among visitors.

Malone and Lepper (1987) have claimed that individuals desire an optimal level of challenge; that is, people are challenged by activities that are neither too easy nor too difficult to perform and this balance should also be maintained in the interaction with gamified exhibits.
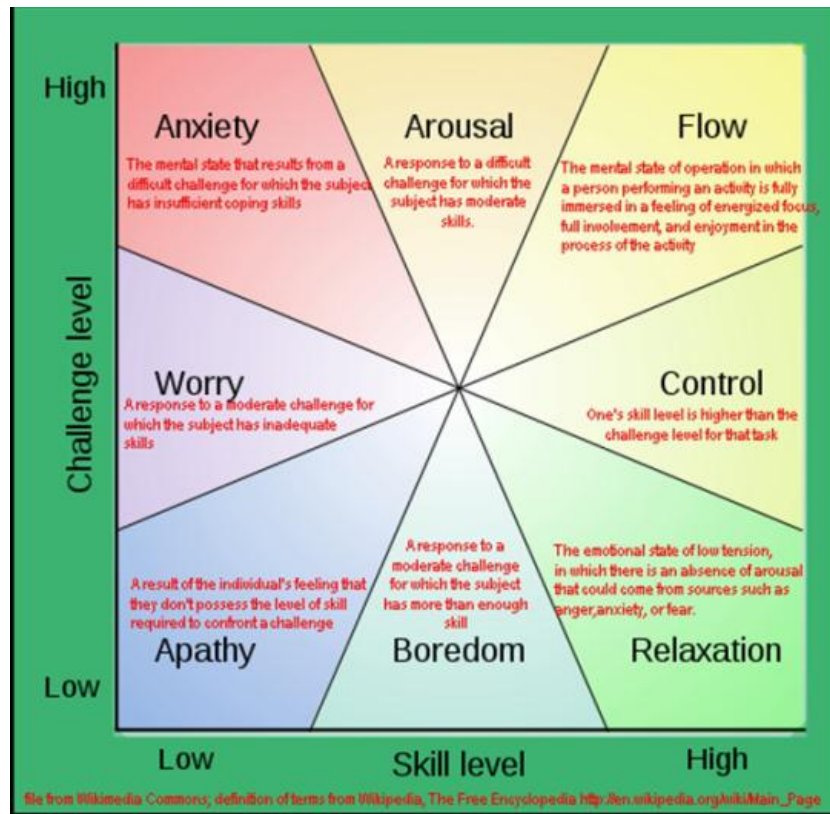
Figure 1 1 Flow Theory, Mihaly Csikszentmihalyi, Retrieved from:
(http://www.science20.com/positive_psychology_digest/some_thoughts_and_questions_csik
szentmihalyis_flow)

Don Norman, the foremost authority on interaction design posits the following
(Norman, 2013, p81) when stating positive emotions dealing with the fundamental
principles of interaction design:

> "When there is understanding it can lead to a feeling of control, of mastery, and
> of satisfaction or even pride—all strong positive emotions. Cognition and
> emotion are tightly intertwined, which means that the designers must design
> with both in mind."

Further, Norman states that "The same technology that simplifies life by providing
more functions in each device also complicates life by making the device harder to
learn, harder to use. This is the paradox of technology and the challenge for the
designer." specifying feedback as a necessary ingredient for improving user-
experiences, which when coupled with control and mastery form a key principal of
gamification. He also mentions the paradox that technology brings with it, where the
complexity of products makes them harder to operate resulting in the user's
alienation as products become more developed and complex (Norman, 2013, p81)

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This presents us with a key area of user-experience that can be addressed through gamification in enabling users to keep their pace with the progress and complexity of technology. Falk (2012) too, emphasizes the educational benefits that entail a meaningful interaction that takes place with a museum experience, and terms this as 'free-choice learning'.

2.3 Gamification

The techniques employed by Gamification enable the possibilities to make experiences more engaging and ultimately to be more easily adopted by the users of any system. While gamification has been used for centuries in terms of the solving problems and for persuasion, it has only recently been given recognition by formulating a definition among the experts in this new field, which is discussed in the following section. The origins of the concept discuss the history of initial forms of gamification employed in the last century, as well as the definition and scope of gamification with reference to non-digital forms. Also discussed in subsequent sections is the opposition to the concept of gamification as put forth by its critics.

2.3.1 Origin and Definition of Gamification

From the onset of delving into the world of gamification, one thing becomes clear, that either many individuals are hearing the term for the first time or if the contrary, there seems to be a misnomer in terms of the implications that the word carries. Among the very first examples of the concept in use are the S&H Green stamps used in the United States since 1896 to reward customer loyalty at supermarkets and retail stores. In 1910, Kellogs and Kracker Jacks also started a reward scheme for its customers by incorporating prizes into their packed products. Although the literary concept of gamification has roots as far back as 1973, appearing in a book titled 'The Game of Work' authored by Charles Coonradt in 1984. The term itself is believed to have been used first by Nick Pelling in 2002, but was not adopted widely until late 2010, prompted by some of the bigger names in the industry (Bohyun, 2015). The existing definition of gamification originates in the digital media industry and was first documented in 2008, then used by Brett Terill, described as "taking game mechanics and applying them to other web properties to increase engagement" (Terill, 2008). While several subjective points of view exist in defining the word,

owing to the many varied areas of applicability for the concept, there is a broadly accepted definition that states that gamification is "the use of game elements in non-game contexts" (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011).

Increasingly, the millennials or 'generation y' are expecting more game-like experiences, since they have grown up playing one form of game or another, they are more readily receptive to game-like experiences (Zichermann, 2011), but defining in specific, the categories for gamification may yet take a few more years as the concept is applied in the numerous fields. The following arguments discuss the concept further in terms of the other definitions put forward for this concept.

According to the Oxford dictionaries, the following definition, as a noun, is given for gamification (source: http://www.oxforddictionaries.com/definition/english/gamification):

Gamification; [MASS NOUN]

Pronunciation: /ˌɡeɪmɪfɪˈkeɪʃ(ə)n

"The application of typical elements of game playing (e.g. point scoring, competition with others, rules of play) to other areas of activity, typically as an online marketing technique to encourage engagement with a product or service;"

Contrary to this, Deterding et al. (2011) argued in their definition that due to the increasing ubiquity of technology in experiences, there is no need to limit gamification to the digital realm, and this has been seen in the instances of the Skyfall Coke Zero challenge for a James Bond premier (Figure 2), a promotional event for the movie in which participants had to complete an obstacle course which enabled them to win a prize (Coca-Cola company, 2014) the Water Challenge (Figure 3) gamified stairs by Volkswagen (the Fun Theory, 2011) and, One example is that of a shower curtain designed to conserve water by inflating soft spikes once the user exceeds a four minute time limit (Buecher, 2016).

While sensors and feedback might be essential aspects of creating gamified experiences in the real world, there may not necessarily be relatively more complex aspects such as points and leaderboards in generating motivation among the users.

Figure 2 2Skyfall Coke Zero challenge (http://i.huffpost.com/gen/828444/images/o-BOND-COKE-ZERO-STUNT-facebook.jpg)

Gamification may not always refer to a digital app or a technology-dependent system, as employed by most business and service sector organizations. Some of the best examples of gamified systems lack any involvement of *advanced* digital components, a famous one being the Volkswagen initiative to incorporate interactive steps at a subway station to encourage people to use the staircases. Another variation of this involved a slide that people slid down instead of walking down the stairs.

Figure 3 3Non-digital Gamification (https://www.pinterest.com/source/theberry.com/)

There are yet others who equate gamification to the service system model in marketing (Huotari and Hamari, 2011) as a potential strategy for equating marketing aspects of services to create engaging user-experiences, by adding systematic game elements and as a useful aid in enabling learning (Iosup & Epema, 2014).

Gamification as a strategy is proven to have been employed over a broad spectrum of areas of living since the last century, such as ensuring customer loyalty (S7H Green stamps) encouraging users to adopt a healthy lifestyle (Fitocracy), preventing accidents and enabling safety (VW Speed Camera Lottery, Text Ninja) as well as facilitating learning based on games (Ananth Pai, WBL elementary) (Ngai, Tao and Moon, 2015). Apart from these, the principles pertaining to gamification have also been employed in digital applications and services, as a motivational strategy (Huotari & Hamari, 2011), by incorporating them to services such as airline mileage reward systems and in the gamification of internet experiences, primarily to boost user-engagement. Table 2 summarizes chronologically, some of the key gamification examples by the persuasive goals for the experience, while the list cannot include *all* the examples; it gives us an insight into the use of the concept through history.

An example where gamification has successfully been employed in terms of encouraging engagement has been Lee Sheldon's school experience, which utilized points (XP) and leaderboards, and as a result, class-participation, attendance and homework all showed notable improvements (Koster, 2013).

Table 2 Chronological examples of Gamification

Name	Year	Persuasive purpose / Incentive
S&H Green Stamps	1896	Stamps rewarding customer loyalty
Kellogs & Kracker Jacks	1910	Prizes packaged within products
Banana Time	1959	Incorporating 'fun' to garment factories
Multi-User Dungeons (M.U.D)	1978	First virtual multi-player platform by Richard Bartle

Fun Learning	1980	Intrinsically motivating computer games, Thomas Malone
AAdvantage	1981	First frequent-flyer program launched by American Airlines
Facebook	2004	Encourage social interaction
Volkswagen's 'Fun-theory: Gamified Stairs'	2009	Encourage using stairs
'Show Me'	2009	Conserve water by visualizing consumption
VW 'Fast Lane' subway slide	2010	Decrease time in taking stairs
Speed Camera Lottery	2010	Swedish initiative to gamify traffic speeding problems
FoldIt	2011	Successful mapping of HIV virus
Fitocracy	2011	Promote exercise activity
'Zombies, Run!'	2012	Gamify running through audio stimuli
Coca-Cola Indo-Pak	2013	Overcoming physical & political barriers
Coca-Cola 'Happy ID'	2014	Encouraging citizens of Peru to smile in their ID pictures
Asphalt Green Gym	2016	Gamified exercise space
Pokémon Go	2016	City exploration

With over 40 billion digital devices linked to the internet wirelessly by 2020 (ABI Research, 2014), games and game-like interactions will have a significant impact on all spheres of life, along with the positive effects of adopting these methods

(McGonigal, 2013). The generation leading the forefront of this transformation is the 'Millennial' or 'Generation Y' that has grown up in the decades intersecting the two centuries, with video games as a key source of their entertainment and most receptive to game-like experiences (Cook, 2013). This cohort, defined as 'Generation G' by Zichermann, shows an immense potential to 'multi-task' and displays this in the way they perform several demanding tasks simultaneously while playing online games (Zichermann, 2011). This generation will also be more demanding in terms of engagement with greater expectations with their surroundings and with the way their experiences are designed and shaped. Zichermann, in his book Gamification by Design, further claims that in the right context, everything holds the potential to be gamified, depending on the mechanics employed (Zichermann, 2011, p2).

2.3.2 Game: Elements, Mechanics and Dynamics

While there are countless elements to any designed game and they may vary from game to game, there are a few basic mechanics that can be said to be universally applicable to most games. Game-mechanics may refer to the way that a player interacts within the game environment, which may be as simple as moving a cursor onscreen, to complex dynamics such as a player controlling a virtual avatar that performs complex acrobatics and provides feedback corresponding to physical and emotional realism.

According to game design literature, the MDA (Mechanics, Dynamics and Aesthetics) framework gives a starting point for understanding the workings within games. The 'mechanics' in a game refer to the relationships between the basic elements, agents and objects, also defining the behaviors in a given system, such as the interactions of a player and the game world. Another important aspect of gamification is 'dynamics' that defines the behavior within the gameplay, while 'aesthetics' concern the player's emotional responses during gameplay (Hunicke, LeBlanc, & Zubek, 2004).

Another way of looking at the concept that gamification embodies is of observing the improvement in utility that has been brought about by recent industrialization in the form of electronic appliances and tools that have not only decreased the labor-

intensive work of previous generations but actually foster positive emotions when using them. Regardless of whether it is people operating a fully-automatic washing machine domestically or a laborer working on a construction-site, better and more joyful ways of doing work have been enabled with the progression of technology, hence the characterization of work itself is evolving. Thus gamification presents a logical next step towards generating a more user-friendly and engaging work context, with a reduction in stress for all users.

2.3.3 Gamification Opposed: The flip side of the coin

While the advocates of the concept of gamification propound its benefits, there remain a fair number of opponents to the concept as well. Advances in technology while empowering people on one hand, have also enabled an inconspicuous exploitation of people's privacy in an unprecedented way. The ability of governments and corporations alike to track and maintain records of individuals has caused concern among many citizens aware of the implications of the misappropriation of information and the sheer invasion of privacy that ensues. Likewise the marketing tactics that have evolved over the recent years in the business world also play a role in gathering and subsequently using certain aspects of data to exploit unwary customers. Besides these factors, video games themselves, a key vehicle for gamification, are time and again criticized for the sheer amount of violence and competitive behavior that they generate.

According to Kapp (2013), "the reduction in the cost of making sensors and the ability to miniaturize them are making it possible to track all kinds of activities that were previously difficult to track." (Kapp, 2013, cited in Brigham, 2015, p474) In terms of generating learning experiences, immersive technologies utilizing the body and gesture sensing Kinect platform by Microsoft, also offer a promising role when merged with gamification principles (Yoshida et al., 2015). This ability to track and monitor every second and movement of people's activities may not be a very comforting idea to most people, as there may only be a fine line in the difference between exploiting the visitors and truly serving their needs. The points, badges and leaderboards (PBL) that are meant to incentivize and motivate the users have been used in such a brazen manner with a plethora of online game-like applications that they have been reduced to mere numbers.

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Intrinsic and extrinsic motivations may exist for the same activity at a given time. With some activities, people will continue to perform the activity even if the extrinsic motivation or tangible reward is removed, for the sake of the intrinsic satisfaction. For other activities purely based on extrinsic rewards, there is very little likelihood of the person continuing once the extrinsic motivation, such as points is removed. A deprecating term used by Robertson in describing the phenomena is 'pointsification', where people are only motivated by the short-term gain of points rather than actually persuaded for behavior change. Bogost, a vehement opponent to gamification terms the concept as 'exploitationware', dismissing it as a marketing gimmick or plain rhetoric disguising 'counterfeit incentives' that reciprocate no real value to the customers (Bogost, 2011). The author states the sentiment shared by many among the academic circles, that momentary, tangible rewards adversely affect the genuine incentives to a gamified experience while diminishing the intrinsic motivation and feeling of accomplishment within people.

While this view holds true, the intrinsic satisfaction and intense engagement provided by well-designed gamified experiences cannot be overlooked, and the 'magic' of games as mentioned by Bogost does to a large extent provide a fulfilling experience to the users. The exponential growth in the gamification industry has shown that as long as customers are satisfied utilizing the benefits of a gamified system, there would seem to be little adverse effects on the relationship with the customers. Also, any exploitation on part of the companies is unlikely to be sustainable in the long run

In a blog post, Rodley (2011) claims that gamification is akin to a buzzword and interactivity within museum spaces has gone through the same stages that gamification is experiencing when taken in a museum context. While gamification may be employed as a strategy to implement the relevant game mechanics, it cannot be seen as an antidote for all the hurdles experienced by exhibit developers in their quest to inspire and attract more visitors. The source of his skepticism lies in his argument that superficial rewards such as badges and points counter the inherent motivations that visitors bring when aiming to experience genuine learning. Elaborating on this, Rodley states that for adults, museum exhibits that are designed as 'too easy' would be dismissed by the adults as mere play, devoid of sustained

engagement and ultimately lacking in a sense of 'flow' (see Section 2.2). Some of the skepticism associated with employing gamification may have initially been related to the high-costs of incorporating technology in the past. This is a challenge that is being overcome rapidly as lower cost solutions are being deployed in more and more areas and the quality of components increasing as well, providing better and more reliable feedback.

Consequently, while there are some undeniable aspects of exploitation of gamification by those in position of power, it does not diminish the positive and beneficial potential that the concept holds within itself to empower and motivate people for the greater good, when used in the right manner. Designers should strive to differentiate between the beneficial and exploitive facets of this entity, to ensure that they look beyond cosmetics steps such as PBLs and create truly meaningful experiences for the users setting, themselves apart from exploitative devices.

2.3.4 Bartle's Player types

According to Bartle (1996), all players fall into 4 categories: *Explorers, Socializers, Achievers* and *Killers*. While *explorers* are interested in knowing the boundaries of a game, they gain pleasure from discovery, *socializers* are more interested in developing relationships and the *achiever's* key objective is to achieve goals, they derive pleasure from challenges. *Killers* are the group that is genuinely interested in defeating others and like to impose themselves on others. While they derive pleasure from both destruction and competition, they may also be the ones most willing to help others. In the words of Bartle (1996), the four categories are described as follows:

"Achievers regard points-gathering and rising in levels as their main goal (…) Explorers delight when the game reveals its internal machinations (…) They try progressively esoteric actions in wild, out-of-the-way places, looking for interesting features (…) and figuring out how things work. (…) Socializers are interested in people, and what they have to say. The game is merely a back- drop, a common ground where things happen to players. Inter-player relationships are important: empathizing with people, sympathizing, joking, entertaining,

listening; even merely observing people play can be rewarding—seeing them grow as individuals, maturing over time (…) Killers get their kicks from imposing themselves on [and causing distress to] others."

These player types defined by Bartle have been utilized over the years as a general framework to understand and develop game guidelines, and have also been modified further by recent experts in the field of gamification. In particular, the HEXAD framework developed by Marczewski (see Section 2.4.2) is based upon these four basic character types. Although being abstractions of real life user types, this division provides a somewhat reliable model to understand the kinds of people who engage with games in general and gamified applications in particular.

2.4 Assessment of Gamified Experiences

While gamification is peaking its hype phase (Gartner, 2012) and is currently evolving to encompass more and more areas of living, there have been recent attempts to define and explain the structure of gamified experiences. The following tools, utilized in terms of frameworks, have been developed by experts to assess the gamified experiences. The tools will help enable an understanding of the motivational and reward aspects behind any gamified system.

2.4.1 OCTALYSIS Framework by Yukai Chou

According to Yu-kai Chou, the gaming industry is the first to have mastered human-focused design as opposed to function-focused design, which has traditionally been emphasized. Yu-kai Chou has defined the Octalysis framework (Chou, 2013) that describes eight core drives or motivations behind a person's willingness to engage in any task (Figure 4). These core drives are:

1. Epic Meaning and Calling
2. Development & Accomplishment (challenge/ PBL)
3. Creativity & Feedback
4. Ownership & Possession
5. Social Influence & Relatedness
6. Scarcity & Impatience (Facebook)
7. Unpredictability & Curiosity

8. Loss & Avoidance

These core drives go beyond the traditional mantra of points, badges and leaderboards, and categorize them in terms of being oriented either to the left or right side of the brain, with the right side associated with self-expression, creativity and social dynamics, and the left-side corresponding to ownership, logic and calculations. This division of the drives also affects which factors motivate a person, with the intrinsic and extrinsic factors connected to the right and left side of the brain respectively.
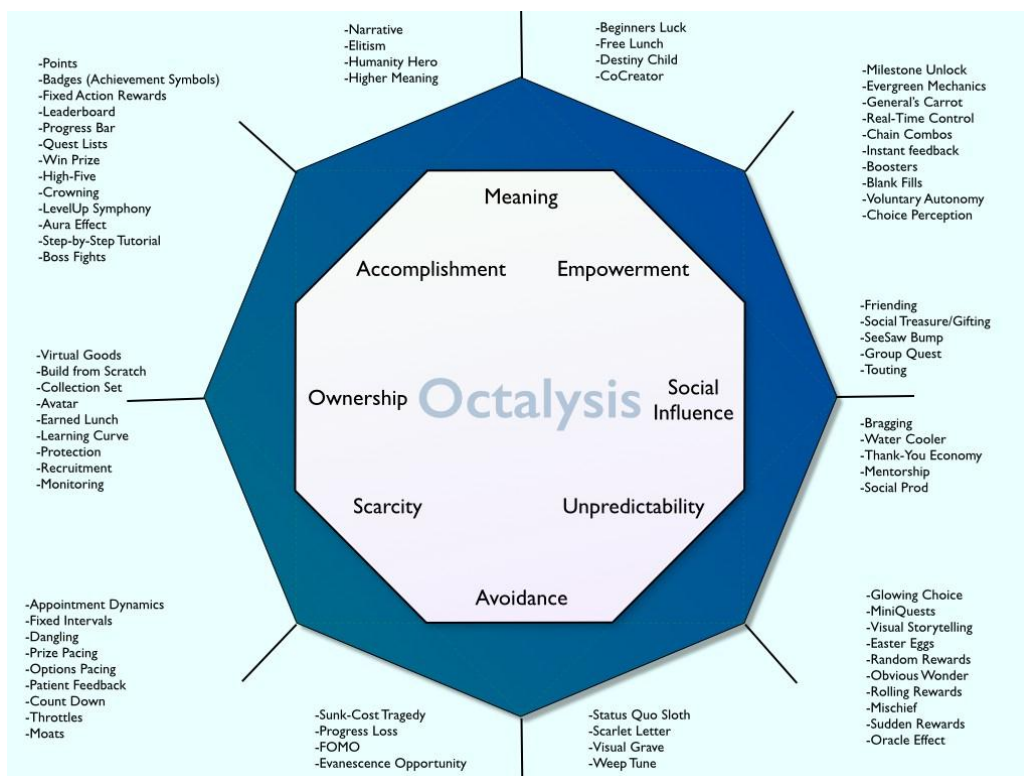
Figure 44 8 core drives of Gamification as defined by Yu-kai Chou
(http://octalysisgroup.com/wp-content/themes/octalysistheme/img/framework.jpg)

Extrinsic motivation, although widely used in terms of points or tangible benefits in gamified systems, has shown to have an adverse effect in the long run and is susceptible to reduce the motivation of the users. The Octalysis framework also divides the core drives diagonally into negative and positive aspects that should all be considered when designing an optimal gamified system.

In terms of museums experiences, '*Epic meaning and calling*', along with '*Unpredictability and Curiosity*' may be the driving factors for museums visitors while '*Development and Accomplishment*' can be an intended result of in the

perception of the museum visitor. '*Social Influence and Relatedness*' may form another factor that can be utilized to create further intrinsic motivation towards increasing visitor participation.

2.4.2 HEXAD Gamification User Types by Andrzej Marczewski

According to Marczewski there are six basic user types (Diamond, 2015) defined in a gamified system (Figure 5), the first four of these are the intrinsically motivated types who are driven by the RAMP framework (Figure 6), while the motivations driving the Disruptor and Player types are a little less clearly defined:

- Philanthropist
- Socializer
- Free-spirit
- Achiever
- Disruptor
- Player
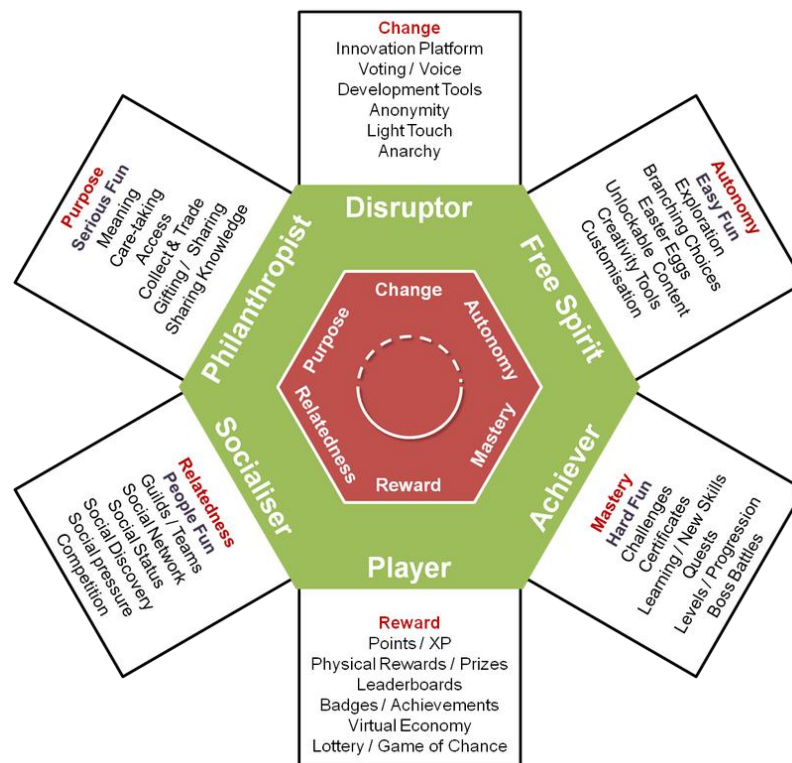
Figure 55 Gamification User Types/Experiences, (Retrieved from:
http://www.mrhebert.org/uploads/1/3/7/7/13773605/2035776_orig.png)

In the 'RAMP' breakdown, Marczewski identifies the traits associated with the player types that he names:

- Relatedness (Socializer)
- Autonomy (Free-spirit)
- Mastery (Achiever)
- Purpose (Philanthropist)
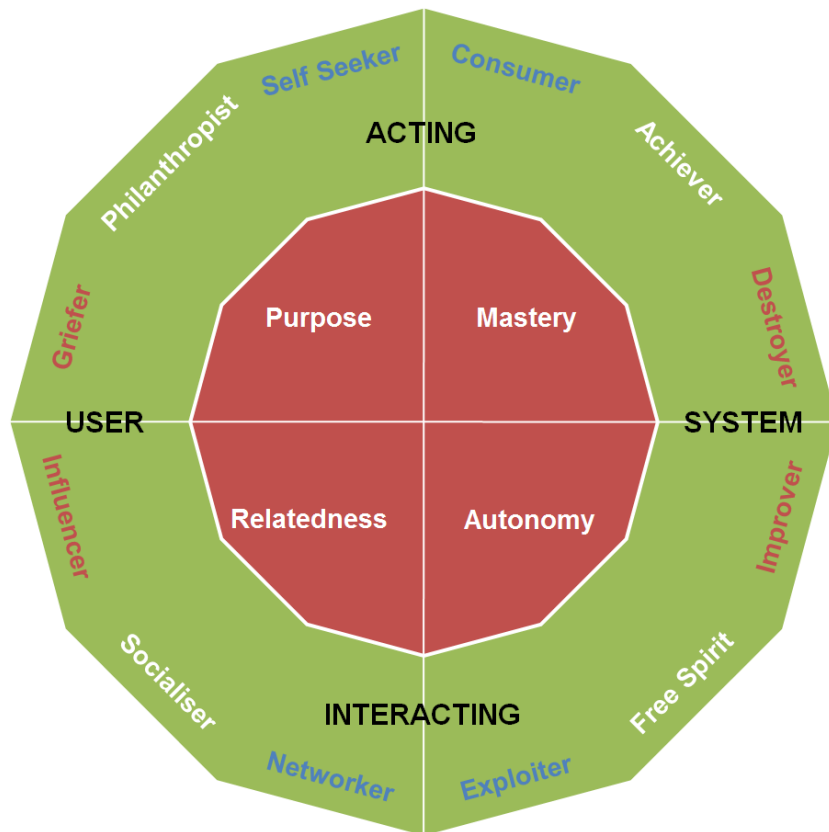
Figure 6 6 RAMP Framework (Retrieved from: http://www.gamified.uk/wp-content/uploads/2015/12/dodecad-3.png)

2.4.3 Defining 'Fun'

Since the focus of this study is to engage the millennial audience through the 'fun' appeal that can be offered to them through a gamified experience, it becomes necessary to look at the key theories that have attempted to define 'fun' and how they perceive the factors that constitute a fun experience. According to a survey conducted by XEO Design (Lazzaro, 2004), fun is categorized as shown in Figure 7 in the following manner:

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- Easy Fun
- People Fun
- Serious Fun
- Hard Fun

Figure 7 7 Types of Fun (http://www.edutopia.org/sites/default/files/content/b4/farber-why-gamify-4keys.jpg)
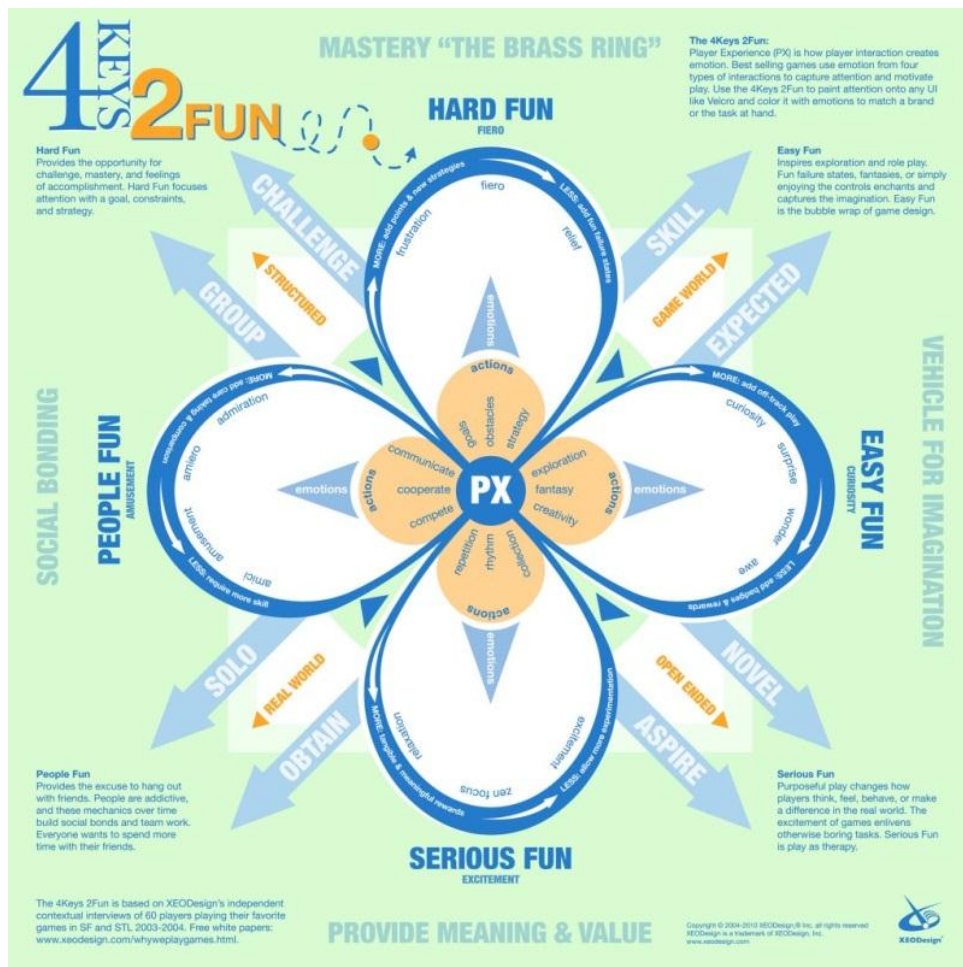
The types of emotions evoked during a 'fun' experience are broken down and associated with the four kinds of fun defined above. While 'Easy fun' is driven by *exploration, fantasy* and *creativity,* the resulting emotions include *wonder, awe, surprise* and *curiosity*. 'People fun' on the other hand relies on *communication, cooperation* and *competition*, which trigger emotions of *amusement, admiration, amici* (friendliness) and *amiero* (social bonding). 'Hard fun' is usually initiated by *goals, strategy* and *obstacles*, while these actions can lead to feelings of *frustration, relief* and *fiero* (triumph). 'Serious fun', most often employed by gamification, is

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seen as associated with collection, repetition and rhythm, while it generates emotions of *excitement, relaxation* and *zen focus*.

When designing a new gamified system, an important factor is to keep into account which type of fun and engagement is intended; a lack of the right 'fun' factor may result in decreased motivation or engagement by the user instead of the other way around. This thesis study aims to focus on the 'Easy fun' and 'People fun' aspects of gamification experienced by the users as opposed to the more long-term engagement strategies employed by marketing and business ventures. The museum exhibits that are analyzed are also reviewed in the same light.

2.5 Museums

A museum is described by Fyfe (2006) as a place that materializes and visualizes knowledge. A museum's function is to collect, preserve, and present information and knowledge for the public to appreciate and learn from. To compete with the entertainment industry, modern museums are attempting to move away from the perception that they are boring educational institutes by becoming active learning centers where people, especially young children, can discover new knowledge about the world and challenge themselves (Falk & Dierking, 2012). Despite these efforts, according to Bay (2006), the number of visitors to museums is dwindling, and new strategies to better engage with visitors need to be adopted (Bay, Fassel and Van Gool, 2006).

The term 'museum' comes from the ancient Greek word *Musaeum*, meaning *'Institution of the Muses',* and referring primarily to the Mouseion at Alexandria, which housed the library of Alexandria in ancient Greece founded either by Ptolemy I Soter or Ptolemy II Philadelphus (367 BC to 246 BC). This institute was analogous to modern-day universities where there existed storehouses for keeping a record of texts and scholars of the time would come together to discuss philosophy, music or poetry (El-Abbadi, 1992). Another site considered to house the first museum is Ennigaldi-Nanna's museum in modern-day Iraq, thought to have existed in 530BCE. The present role of museums as facilitators of preservation and repositories of knowledge has only developed since the Renaissance after 'Cabinets of Curiosities'

known as '*Kunstkammers*' became a popular phenomenon during 16th century Europe.

Interactive exhibits are found to have originated in 1889 in Urania, Berlin. The first types of which were activated by the users. During the 1960s, interactive displays were widely propagated as they were adopted by the New York Hall of Science, the Exploratorium and the Lawrence Hall of Science, and exhibits with interaction capabilities were developed. Willem Sandberg, who was director of the Stedelijk Musuem (1945-1962) is credited to have pioneered the first audio tours for museums (see Section 2.7.2). He also recognized that the museum experience was a dialogue between the visitors and exhibits in contrast to a one-sided narrative enunciated by the exhibitors (Tallon & Walker, 2008).

The museum space is one that is evolving rapidly with time and is no longer just a place intended for learning. With the consumer economy increasingly reaching more parts of the world, the distinctive lines between spaces of retail, leisure and didactic concerns are blurring, and one can see the efforts of museum managements to utilize the all potential spaces within museums, such as cafes and souvenir shops to attract a greater audience.

2.5.1 Typologies of Museums

To define in the words of the International Council of Museums (ICOM), as adopted by the 22nd General Assembly in Vienna, Austria on August 24th, 2007:

> "A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment. (ICOM, 2007)"

The list of typologies of museums is exhaustive and it is not possible to contain or list all the different museums that exist around the world. However, while there is an unending list of exhibition spaces and museums that constitute a representation of every aspect of life, and in some cases even fiction, there exist a few general categories that mostly relate to curating aspects of history such as the natural history

and science museums, museums relating to artworks, and museums concerned with ethnography.

As far as defining the types of museums is concerned, Gurian (2006) gives us a foundation of five categories, namely:

- Object-centered
- Narrative
- Client-centered
- Community-focused
- National

Gurian states that museums traditionally being centers of excellence, serve the purpose of contemplation, collection and preservation, they either fall into one, or a mix of the categories defined above, with the 'object-centered' focusing on the aesthetic and material value of the exhibits. Art museums mostly compose this typology and they mostly cater to a knowledgeable and elite demographic.

The 'narrative' type of museum usually involve storylines developed around historical accounts of objects that are also presented as visual evidence, the primary motive behind these kinds of museums is to enable learning and to this end employ a wide range of multimedia extensively.

The museums that are focused on the audiences are 'client-centered' and usually employ the most interactive, purpose-built environments for their visitors. As these kinds of spaces incorporate fun along with educational agendas, science centers and children's museums fall into this category.

The museums falling in the 'community' category are some of the least recognizable as they are integrated with the local populace, often utilizing community centers. These are geared towards the general well-being, and social development of a community, but are most likely to be under-funded.

'National' museums are a source of pride for the country and are often home to political agendas fueled by national aspirations, thus being susceptible to projecting a one-sided view. Among these categories, for the target audience of this study, there

can be a bridging of the first three kinds of museums stated, with an emphasis on generating interactive experiences and shifting the focus as per the nature of the exhibit.

2.5.2 Museum Exhibits

First we look at the various types of display exhibits that are used in museum environments and the purposes for which they are utilized and then we look at the specific aspects that enable the interactions between visitors and exhibits.

When it comes to enhancing the learning and general experience of visitors, technology-based interactive exhibits can genuinely engage and motivate users to participate in all that the museum has to offer (Witcomb, 2006) while encouraging voluntary learning on part of the visitors. In the words of Koster (2005, p98), "Fun is about learning in a context where there is no pressure" This fact alone makes interactivity an indispensible tool for both museums and science centers to create appeal for the visitors in contrast to the more traditional museum spaces.

Programs and applications that encourage users to manipulate certain elements of exhibits manually ultimately enable the visitors to spend more time within the given spaces of museums or science centers (Hinrichs, 2008).

The process of exhibition design involves numerous steps that start off with research regarding the topic and a development of concepts based on the research. Following this is the schematic design and development of the exhibit, which is then executed in the fabrication and installation phases.

An interactive exhibit in the form of a diorama, gamified application or a reactive display with physical input from the user can go a long way in enhancing what would be a simple experience of observing images, artifacts or relics that are on display. The exploratory nature of the discovery methods allow for users to obtain open-ended and diverse results. This is in contrast to the '*didactic expository model*' and the '*stimulus-response model*' where visitors are only given information passively or a single correct response option is given, respectively. Research has shown that an approach that allows for users to experiment and interact can result in a more engaging experience. Integrating games and elements of play can assist

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greatly in the creation of immersive experiences as well as create opportunities for learning through the interactions. Games facilitate the ability of the visitors to discover and can empower the audience to take charge and explore museum objects more intimately while facilitating co-experiences by transforming the museum into a social space (Beale & Villeneuve, 2011).

2.5.3 Context, Reality and the Sensual Experience

> "The old concept of the display case has been replaced by that of experience. (...) Above all the former highbrow attitude has been overtaken by an effort to involve all five human senses" (Wagensberg, 2000, pp. 14-15).

Within museums immersive experiences are becoming more important than ever and the role of non-visual senses has grown as technologies have matured. This may include the omni-present audio guides or exhibits where tactile and haptic exchange is conducted, as well as elaborate exhibits that are designed to provide momentary experiences of smell, climates and even tastes. Theme parks are the main domain where the sensory experience is utilized to its maximum potential and the use of this is extensive, so much so that it has been termed the 'experience economy' (Pine and Gilmore, 1998). Besides these features, the spatial characteristics of an environment, especially in the museum context, are incomplete without detailed attention to lighting, acoustics, and positioning of the exhibits. All of these details are also articulated by the architectural make-up of the space.

While this thesis study focuses on the interactive exhibits provided in a museum space and the interactions of users with those exhibits, the museum environment itself cannot be ignored in terms of the holistic experience that the visitors encounters within the space. Although depending on typologies, the space itself may vary from a quiet and contemplative setting to hands-on and raucous, the exhibits and their positioning in relation to one another also play a major role in defining the overall user experience.

Rodley (2011) emphasizes the role of physicality and the context when designing interactive exhibits, since everything within a given space poses some influence over the other elements present and the placement, scale, and relational relevance also contribute greatly to the success or failure of an exhibit. While cognitive learning,

that is learning using willful thinking, is a part of the goals that museums aim to achieve, the affective learning from feelings and evoked emotions that one gains when interacting with the environment and exhibits is invaluable.

In terms of meaning making, the museum space has evolved in recent years to allow for greater contributions from the visitors in enriching the experience with their personal expression, through a 'bottom-up' approach (Tallon, 2015).

While technology has been adopted over the last few decades to improve comprehension of exhibits by the visitors, there have also been some concerns among initial museum curators as to the effectiveness of technologies in terms of being detrimental to visitor engagement rather than facilitating it. A Museums Journal review from the 1960s notes:

> "There is a danger that with the wide application of mechanical gadgets the quality of visitors may suffer. There are many who would be dismayed if they saw throughout the building people with black boxes around their necks pass by with a faraway expression in their eyes (…) guided by some mysterious forces they walk, turn, and stop in almost synchronized precision before exhibit after exhibit." (Tallon, 2015, p.xx)

All in all, the museum presents a unique space for members of the general public to visit and to create meaning from not just the content on display but from the way that content is displayed. This thesis study, while sensitive to the role of context and environment, mainly focuses on the interactive exhibits and the interaction of the users with the associated applications. In instances of design for Imagineering (see Section 2.7.6) a more detailed analysis and study can be undertaken in the future, where the role of the five senses in immersive experiences can be explored further.

2.5.4 Falk's visitor types and free-choice learning

The museum as a concept has undergone tremendous changes throughout history since its inception, and the same can be said of the museums of today which may shape the perceptions of future visitors. Museums are also dependent on the demographics of a city, as these demographics change, the same is reflected in the number and profiles of the visitors.

According to Falk (2013), most studies until very recently, especially concerned with census data have only focused on demographics and *who* the museum visitors are in contrast to what their motivations or experience within the space is. This fact is earlier mentioned by Hood (1992), who cites that previous studies, while defining participation patterns and demographics, have failed to address the causes of *why* people attend museums or otherwise thus we are unable to gauge the factors pertaining to their motivations and personalities. As cited by Hood (1992), the psychographic dimensions of users, describing a detailed consumer profile, include the following:

- people's inherent values
- opinions
- attitudes
- interests
- concept of self
- social interaction behavior
- expectations
- satisfactions
- goals
- activities
- group memberships
- social position
- consumption behavior

Hood states that once we cater to the psychographic dimensions, the demographics follow, instead of the other way around as was the general perception during the author's time. A key methodology propagated by Hood was to know the dimensions of why people made a decision not to visit museums (Hood, 1983), stating that we can only find issues with our museum spaces by talking to people who avoid us, rather than finding the contrary.

The research thus conducted showed that lack of attendance had more to do with the ambiance and perception of conforming to the 'museum code', rather than with offerings of museums. Hood was a believer in practical, actionable data and inquired about the benefits that user's gained from investing their time, effort and money in a

museum visit, and gained valuable data that reflected commonly held misconceptions about museums relating to the attitudes of museums in relation to visitors and about the economic and educational backgrounds of perceived museum-goers.

While the experience is valued by museum promoters, the targeted audience may not see it as such and will weigh the rewards and satisfaction based on their perceptions and criteria of what constitutes an engaging experience. There was a need to examine the experiences that non-museum goers value and the choices they make about spending their leisure time and resources.

In terms of what constitutes a good experience for the visitor, people may visit not just to participate actively but to also learn something new, experience a challenge, and sharing the time with a loved one while doing a worthwhile activity.

A valuable contribution on part of Hood has been the raising of awareness among the trustees and staff of the museums on understanding their visitors better and being empathetic to their needs. An important summation of the findings by Hood is in her words: "No matter who one is, everybody is a somebody at the museum." which emphasizes the need to treat all visitors with friendliness and care.

Balancing what people *should* know and what they *want* to know (free-choice learning) Falk defines users into five general categories (Figure 8):

- Explorers
- Facilitators
- Professionals/Hobbyists
- Experience Seekers
- Rechargers
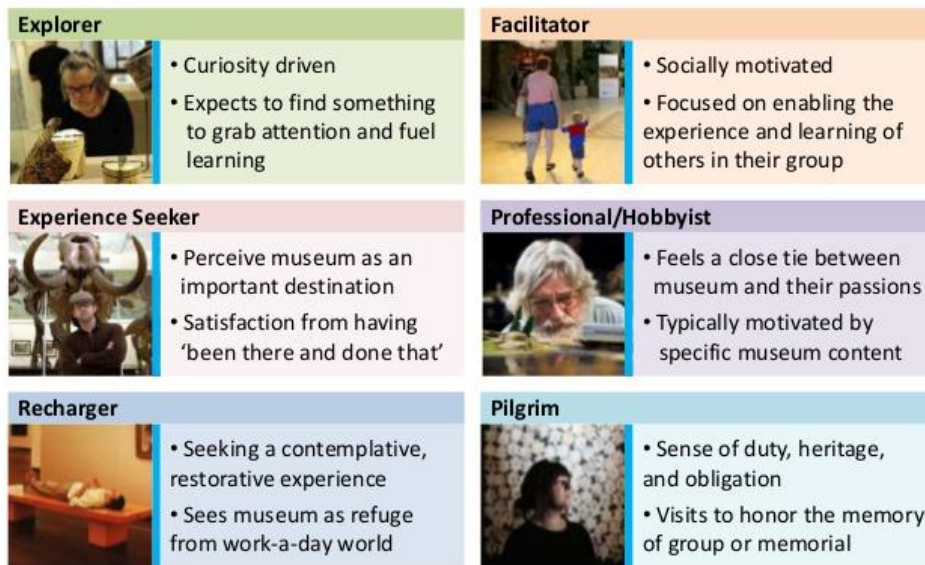
Figure 8 8 Adapted from: Falk and Dierking, The Museum Experience Revisited, 2013

Table 3 Falk's visitor types and Bartle's player types

Visitor Type (Falk)	Motivation	Example
Explorers	personal curiosity	Casual browsers
Facilitators	other people and their needs	Parent accompanying a child
Experience-Seekers	desire to see and experience a place	Tourists
Professional/Hobbyist	specific knowledge-related goals	Scholar researching explicit topic
Rechargers	desiring contemplative / restorative experience	Elderly visitors
Player Type (Bartle)		
Explorer	Discover the unknown, satiate curiosity	-
Collaborator	Developing networks / friends	-
Achiever	Attaining status, overcome challenges	-
Killer	Winning and overcoming others	-

The interesting dimension about Bartle's player types and Falk's visitor types is the overlapping of at least 3 areas which show common attributes. The table above summarizes the visitor and player types as described by Falk and Bartle respectively (Table 3).

Falk states that through years of research, an important finding has been the profile of average museum visitors as being better educated and more affluent when contrasted with the general public. He goes on to emphasize that due to the dynamic and ephemeral nature of the museum visit, a 'one-size-fits-all' approach to the visitors would not work as visitors may assume any one of the five roles defined above when visiting a museum. This means that with each experience, the same person could assume a completely different identity.

2.5.5 Millennials as a User Group

While visiting museum exhibits, the foremost way for creating meaning of what the visitors see is to employ a constructivist approach that employs interactivity along with discovery to enhance the user experience. This is a reason why children often form the primary audiences of museums along with their families (Kidd, Ntalla, & Lyons, 2011) which gives even more credence to the pursuit of engaging the adolescent audiences, namely 'millennial' population, which makes up the largest segment of the population demographic. It also presents us with a challenge of providing sustained engagement, keeping up with technological trends.

According to Goldman Sachs, Millennials forming the largest segment of society in the US and being born between the 1980s and 2000s have seen the most rapid change and transformation in living than any other group of humans previously ("Millennials Infographic", 2016). Also described as 'the first digital natives', as compared to the older 'Generation X' and 'Boomers', they are the most socially connected generation through text messaging, social media and instant messaging. Being more prone to debt, they stand with less money to spend and lower employment. In other words, those that reached adulthood at the turn of the century (2000) and are not only technology-savvy but also represent the portion of society that are the hardest to appeal to in terms of involving them in engaging experiences. This is also the group that is most difficult to attract in terms of museum visitors.

2.6 Defining 'experience'

User experience itself is an elusive and somewhat intangible domain which usually makes it difficult to describe in explicit terms, even though there has been a considerable amount of research done on the nuances of the way people engage with an experience.

While Dewey (1934; cited in Wright et al., 2003) describes experiences as being multidimensional and difficult to isolate; they are also dependent on the situation and circumstances relevant to the person. Not only is the experience unique to the individual but it may also be ephemeral and fragile and may not seem the same in recollection as in the moment itself (Wright et al., 2003).

User experience is described as being a dynamic relationship between people, places and objects (Buchenau and Suri, 2000), whilst being composed of an infinite number of smaller experiences (Forlizzi and Ford, 2000).

Past experiences and events may also influence an experience. According to other authors, experiences also include an awareness, and subsequent reflection on the experience itself with respect to their feelings (Sonneveld, 2007; Schifferstein and Hekkert, 2008).

An emphasis on approaching possibilities rather than problems and enabling design for positive user-experiences can help us achieve far better solutions (Desmet and Hassenzahl, 2012).

Marc Hassenzahl (2011; cited in Jensen, 2014): "We should definitely shift attention (and resources) from the development of new technologies to the conscious design of resulting experiences, from technology-driven innovations to human-driven innovations".

Jensen supports this opinion by putting forth the view that experience-based design (XbD) can enable the exploration of possibilities by gaining a better understanding of experiences at a profound level, thus enabling us to move beyond problem-solving and to create more engaging and meaningful user-experiences when designing systems and products (Jensen, 2014).

2.6.1 Defining the museum experience

Lykke and Jantzen (2016) isolate 10 dimensions of information interaction within the museum space through an empirical study. Some of the dimensions are cited more than others in terms of frequency and are not dependent on the technological aspects of the experienced object(s). These experience dimensions are listed in Table 4:

Table 4 Experience Dimensions within a Museum space

No.	Name
1.	Involving
2.	Spontaneous
3.	Interesting
4.	Relevant
5.	Learning
6.	Unique
7.	Interactive
8.	Fun
9.	Close
10.	Authentic

In terms of recalling the museum experience, Falk (2013), with the help of his student, undertook a qualitative study that attempted to identify the factors that contributed to recalling the museum experience and 22 subjects were asked to give telephonic interviews that enabled a categorization of memories into 10 individual classes, which were further narrowed down to things grouped into four factors, namely:

- Novelty
- High emotional content (for visitor)
- Supporting initial needs and interest
- Supported by later experiences

Döpker et al. (2013) emphasize the need to have a narrative as a backdrop to a successful gamified experience. This narrative approach can prove successful in

developing engaging exhibits that not only can visitors engage in willfully but also have a recall value as a positive memory of the visit.

It becomes necessary for us to analyze and to categorize the various interactive exhibits offered by museums, especially those that are reliant on a capacitive touch screens to enable interactions between the users, the following section looks at the technological development that has taken place within museums around the world.

2.7 Technological development within the museum context

When looking at gamification in a museum context, it becomes imperative to study the chronology and the way that technology has shaped the museum experience for its visitors. A review of existing technologies and future prospects will enable a better comprehension in the mind of those wishing to design better user-experiences in the museum context.

Although technology presents its own benefits in engaging visitors and can be easily deployed, it cannot be depended upon as the sole means to encourage meaningful participation (MacDonald & Alsford, 1991), what is needed is to present strategies that balance the intrinsic motivation and satisfaction of visitors while using the technologies to engage them.

2.7.1 Reinterpreting experiences

Given the growth of communicative and digital devices, especially with regards to sensors and feedback capabilities, immersive technologies such as VR and the Internet of Things (IoT) are constantly redefining user experiences. Today, there are more options than ever before to give content-rich sensorial experiences to those seeking them.

Exploring 3-dimensional environments with the aid of a virtual reality headset is becoming increasingly common. A number of new concepts and devices will once again re-interpret how we experience museums, which in turn will shape the perspectives of the general public regarding their attitude to the museum space. A brief introduction to the technological aids used in museums over the course of history is given in the following sections.

2.7.2 Audio tours and guides

The first instances of technology being utilized to assist the visitor in his experience were the audio guides developed as an `ambulatory lecture` at the Stedelijk Museum, utilizing short-wave communication (Tallon & Walker, 2008). The arrangement consisted of a pre-recorded analogue broadcast on a closed-circuit short-wave radio system, which was then transmitted through loop aerials installed at various places around the gallery, and was then received by portable receivers and listened with the aid of headphones. The recordings were available in English, German, French and Dutch and there were spatial limitations on using the system, which resulted in the visitors moving within defined spaces and time intervals.

The benefits of using this technology were recognized early but could not be implemented widely due to the costs and relative limitations of the technology at that time. Beginning with the 'ambulatory lectures', a number of handheld technologies and specifically audio-tours have since been a part of every major museum, with Acoustiguides, Sound-Trek audio guides and the Telesonic Lorgnette 'radio-guides' during the 1960s to a progression to Sony Walkman-styled tours, with mobile phones, Mp3 players, PDA guides and digital cameras falling into the category of 'multimedia tours'. Through the progression of technology, there have been numerous endeavors to facilitate museum visitors with assistive devices.

2.7.3 Touchscreens and information kiosks

Touchscreens and information kiosks are perhaps the most basic and widely used components within any public space where guidance and information is required. Although they have existed for many decades, being used primarily for kiosks, vending machines, automated teller machines (ATMs) and industrial equipment, they have only been incorporated widely within the last decade, and physical buttons are now relatively passé. The first mention of such a concept can be traced back to the 60s when E.A Johnson proposed a description of the mechanisms involved (Johnson, 1967).

Using a touch-sensitive surface enable the elimination of any intermediary input device such as a mouse, track-pad or a stylus and during the 80s the systems were

adopted by airlines to reduce workload and improve situational awareness of pilots on commercial airlines.

There exist two kinds of touchscreen technologies, the 'perimeter-based' screens and the 'overlay systems'. Within the overlay systems lie the most commonly used capacitive-touch and resistive touchscreens. The capacitive touchscreens are dependent on the conductivity of the object to determine the location of the point of touch and will usually not function if there is hindrance between the finger or conductive stylus. Though being durable and used widely in tablets and smart phones, they may also not function well when wet.

Different from this are the resistive touchscreens which actually contain moving parts at a micro level. When pressure is applied onto the screen, two layers of material, usually transparent and separated by air is pressed together, thus completing a circuit that determines where it has been pressed. These types of displays are less durable than the capacitive screens and also do not react as well, making them cheaper in comparison.

The perimeter based touchscreens work on a principal whereby cameras or sensors and light-emitting diodes (LEDs) are embedded in the frame of the screen and breaks in the acoustic or light waves of the diodes are transformed into signals that register the user's input. Perimeter based systems are generally of three types: the 'optical touch' technology, using CMOS sensors, 'infrared touch' technology, using infrared lights and the 'surface acoustic wave touch' technology, manipulated by ultrasonic waves to determine touch points. All aforementioned technologies hold the potential to be incorporated onto regular LED screens, thus converting them into touchscreens.

Although in terms of content and detail, the displays are helpful, there exist some problems of lag in interacting with touchscreen application in the public domain. One factor is the constant usage by multiple people leading to smudges and marks on the screen, thus hindering good input. Another problem may be the lack of access for older children (see Figure 9) and people who are physically-challenged or restricted in movements.

Figure 9 9 Interaction with a touchscreen information kiosk

2.7.4 VR experiences

Virtual Reality (VR) experiences are a form of immersive technologies first developed during the 1950s. The concept was first recorded in essays by Antonin Artaud in 1938 and was mentioned in a 1935 novel 'Pygmalion's Spectacles' as an actual device by Weinbaum (2016). A concept of an 'experience theater' was put forth by Morton Heilig in the 1950s and this the actualized as a functioning device in 1962 that was named 'the Sensorama', a device that enabled the engagement of senses of sight, smell, sound, and touch, as experienced through the five movies that were played on the device (McLellan, 1996). In coming years, VR experiences will have one of the biggest impacts on our lives and will definitely shape the way we experience things, especially museums. A brief list of the current technologies, along with their features is provided in the following parts.

StarVR

Project StarVR promises to deliver a virtual experience that gives a more immersive experience through an ultra-wide, 210° field of view, with position and eye tracking to give a better feedback to the user (Figure 10). The module for the StarVR seems to have incorporated two display screens, one for each eye to give it the generous field of view. It is expected to launch in late 2016.

Figure 10 10 StarVR, offering an ultra-wide field of view
(http://core0.staticworld.net/images/article/2015/06/starvr_1-100590929-orig.png)

FOVE

The FOVE markets itself as a VR headset that has gone ahead of the 2nd generation body and head-tracking to incorporate eye-tracking into its device (Figure 11). This not only enables better feedback for the users but also improves the graphical interface of the device by focusing the processing power on the part which is being looked at instead of the whole virtual environment.
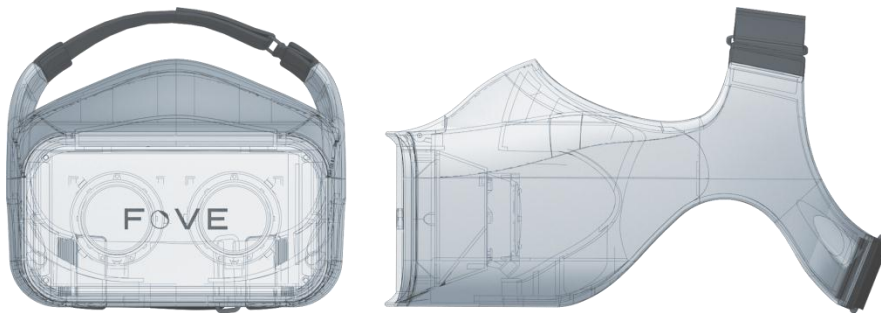
Figure 11 11 FOVE, incorporates interactive eye-tracking for improved performance
(http://www.getfove.com/assets/images/desktop/landing/Fove_Landing_Tech_Specs_Illus@
2x.png)

VIVE

The VIVE is developed by HTC and VALVE and emphasizes the translation of a real environment to the internal display through a series of sensors while two handheld controllers operated wirelessly are used to perform various interactions within the virtual environment (Figure 12). The VIVE has launched in early 2016.

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Figure 12 12 The VIVE by HTC, shown with controllers (https://s3-us-west-
1.amazonaws.com/shacknews/assets/editorial/2016/02/VR_HMD.jpg)

GLYPH

The Avegant GLYPH mediaware, launched in mid-2016 is designed to be a light-
weight and portable personal theater that provides a rich quality of audio and video
content to the user (Figure 13). The design of the device is a paradigm shift from the
existing form associated with a virtual reality device and resembles a headphone
design.

Figure 13 13 The Avegant GLYPH VR headset
(http://www.theverge.com/2015/1/4/7491191/vr-company-avegant)

2.7.4.1 The VOID Walkthrough platforms

The Void provides the most immersive experience developed so far and is powered by a vast array of sensors, feedback mechanisms and stimuli to make it an extremely hyper-realistic and engaging interactive user-experience. Users mount VR headsets, hold representative objects (guns, fire-torches, etc.) and venture into a pre-designed environment where the space and its logistics correspond to what the users are seeing in the virtual environment in their headsets (Figure 14). This is termed as a hyper-reality world in contrast to the virtual-reality world by the developers of the VOID and they propagate the system with the tagline `The vision of infinite dimensions`. ("The Vision of Infinite Dimensions | THE VOID", 2016)

Figure 14 14 The VOID walkthrough VR experience (Retrieved from: http://www.roadtovr.com/wp-content/uploads/2016/01/theVOID.jpg)

2.7.5 KINECT

The Kinect platform was developed by Microsoft as a motion-sensing input device primarily for the XBOX 360 and has gone numerous changes and developments since its launch in 2010. The system is used as a Natural User Interface (NUI) which presents opportunities for engaging and creative experiences through active interaction of young and old alike (Price et al., 2003). The Kinect incorporates an RGB camera, an infra-red sensor, infra-red illuminators along with a multi-array microphone which together enable users to give control input through gestures and voice commands (Figure 15). This is intended to eliminate the need for physical controls on part of the user.
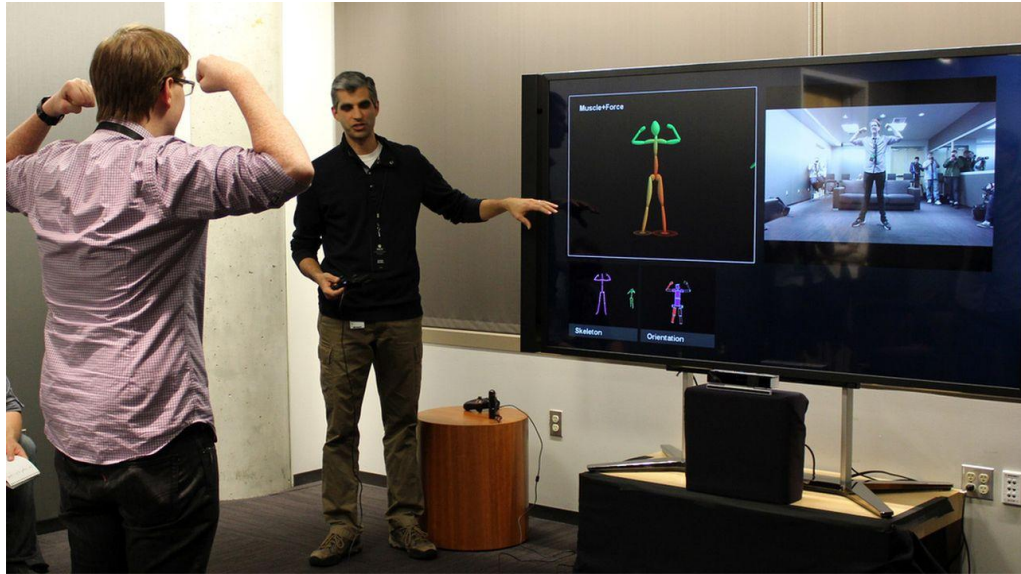
Figure 15 15 Using the Kinect system (vox-
cdn.com/uploads/chorus_image/image/22136697/xbox_one_kinect_privacy.0.jpg)

2.7.6 Imagineering

Improvements in technological devices and wearable computers have increased our
capabilities to have better and more natural gamified experiences. Components such
as sensors and processors have now enabled instantaneous feedback to the users thus
enabling richer and more playful experiences. Pioneered by the Walt Disney
company in 1962, Imagineering brings the latest in engineering capabilities to bring
imaginative ideas to life (Imagineering, 2010). The creators behind Imagineering
employ a diverse range of technologies such as robotics, animatronics, surround
sound and realistic simulations to create a hyper-realistic experience for visitors to
theme parks. A large number of professional are required to execute these mega-
projects including illustrators, engineers, architects, graphic and lighting designers
among others. While this is an ideal solution for creating immersive experiences,
there may be limitations on the number of people who can access these facilities due
to the cost, logistics and expertise required in producing such exhibits.

2.7.7 QR codes and RFID

Some of the most recent developments in assisting the museum experience have
been through the use of Quick Response (QR) codes, which offer a way of
conveying digital information regarding exhibits in a very low cost and efficient
manner. While QR technology is a recent phenomenon developed to facilitate

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smartphone usage, Radio Frequency Identification (RFID) has been in use extensively over the last few decades since its inception in the 1960s (Hsi & Fait, 2005)

Although GPS technology may not be as effective due to enclosed spaces, QR and RFID have proven to be more effective in conveying the required information to museum visitors through low-cost cards and labels.

QR codes are printed in the form of bar-codes or patterns with embedded information that are instantly recognized by smartphones and either convey a piece of information directly or send a link to the phone that can be accessed over the internet by the users. This technology is widely adopted by the younger generation to carry out tasks and to communicate information within specific environments, making it feasible to be incorporated in gamified experiences. RFID, on the other hand, uses radio frequency signals to enable communication between a reading device and a tag, usually requiring a close proximity between the two to enable reading or writing of information. A similar technology now incorporated into smartphones is the Near-Field Communication (NFC), which also has promise to be incorporated into digital experiences by museum visitors.

2.7.8 Multi-User Virtual Environments (MUVEs)

Three-dimensional Multi-User Virtual Environments, known as MUVEs have been advocated since the last decade as another gamification approach to engage users by allowing them to explore virtual reconstructions of the museums and exhibits (Urban, Marty and Twidale, 2007). Urban et al. (2007) look at the implications of interaction-centric designs and review the development of such virtual environs on a virtual world platform, 'Second Life', which presents avenues to apply positive user-experiences to real-life scenarios, based on the engagement of virtual audiences. Döpker, Brockmann and Stieglitz (2013) also advocate the use of MUVEs to engage audiences to tackle a dwindling number of museum visitors, especially the younger generation that is less receptive to the museum concept. This in itself might seem like a solution but may in fact in the long run go against the intent of the museum stakeholders to attract more visitors to their physical spaces. By providing a digital alternative to the prospective visitors, the chances of them paying a visit to the actual

spaces is bound to reduce. Instead, MUVEs platforms could be utilized to generate interest and initiate a gamified service that would encourage the prospective visitors to pay a visit to their local museums.

The technologies discussed in the preceding sections all enable a platform on which gamified experiences can be designed or facilitated, the further incorporation of these into everyday products and devices will translate to greater affordances for the users in terms of gamifying experiences.

2.8 Conclusion

This chapter has presented the literature relevant to the focus of research and available regarding the topics of gamification, museums experiences and the technology associated with creating immersive experiences, as well as the user demographic that is intended to be researched through empirical studies.

While gamification is seen as a recent and evolving phenomenon, there is no doubt about the usefulness and proven results that it has brought to engaging customers and intrinsically motivating users for improved experiences. The general concern among authors in the literature is that museum visitors are dwindling in number and need to be engaged with better strategies, which may or may not be dependent on technology. Motivating visitors to come to the museum will present a challenge in coming years unless strategies are changed and richer and better engaging experiences are created for the users.

There is also a general perception among gamification experts that the millennial population segment is one that is the least likely to engage in museum visits, primarily due to the high level of stimulation that they have grown accustomed to and thus they lack interest in experiences that do not provide the same level of satisfaction (Zichermann, 2011).

Further research is required on the dimensions that are important to users in a gamified experience and how they perceive a gamified experience in a museum setting. The role of realism, its perceived usefulness to the engagement and comparisons between levels of realism provided by digital applications need to be

addressed, with empirical studies on how the experiences are viewed by the millennial population and what aspects satisfy their engagement with the exhibits.

The areas of what motivations, rewards and benefits in experiencing the museum exhibits also need to be addressed, while the issues that users of such gamified systems would face, along with their solutions are also intended to be investigated .

The intent is to utilize grounded theory techniques (Strauss and Corbin, 1990) along with a generative research method in determining the answers to the questions posed in this thesis. The following chapter will describe the studies carried out with the aim of analyzing the factors that may contribute to understanding the outlined problems.

CHAPTER 3

Research Methodology

This chapter describes two studies conducted among participants representative of the millennial population segment to gauge the dimensions of their experience, as well as to elicit their perceptions regarding gamified experiences with museum exhibits. Contextmapping methods can prove fruitful in accessing knowledge for inductive research (Slees-wijk Visser et al., 2005) and a combination of methods may elicit results that are productive. The preliminary study is a combination of observations and interviews conducted at museums on site with visitors, carried out with the aim of gauging the perceptions as well as discovering which dimensions of interaction the visitors regard as most engaging, along with a narration of their past experiences. The second study is a participant observation on the users interacting with shortlisted exhibits designed with game and play elements, carried out with the aim of discovering which aspects of their experience were essential to the positive design of interactive exhibits.

3.1 Stages of the Research

Following the literature review conducted in the last chapter, the stages of the research (Figure 16) are composed of three main phases: preliminary study of museum visitors, a main study comprising of a review of interactive museum exhibits, and a user-testing phase consisting of empirical observation of user's interaction with exhibit applications. This would then be followed by a focus group and survey that will be utilized to conduct an experience evaluation of the user perspectives. The final stage, after the research will be of the collection of data, its

analysis and a summary of the findings and conclusions from the whole research that will enable key strategies to be formulated.

Figure 16 16 Stages of the Research

3.2 Preliminary study: 'Perceptions of museum visitors on user-engagement in interactive exhibits'[1]

In order to gauge the dimensions of user-experiences regarding museum exhibits, an initial qualitative study was conducted with 10 participants being interviewed about their experiences in recalling the most engaging visits to museums as well as relevant subjects such as their experience with video-games and interactive devices. The analysis of the user study was conducted utilizing grounded theory techniques (Strauss and Corbin, 1990).

The primary aim of this research was to gain an understanding into the dimensions that create a satisfactory and engaging user-experience among the visitors with reference to the interactive exhibits. Topics that were intended to be inquired in the research included: information exchange, interaction with the exhibits and environs, as well as various other aspects of the experience such as learning and games.

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[1] *Study was conducted as part of the course* ID-531 *Methods of User Research, submitted to Assist. Prof. Dr. Gülşen Töre Yargın*

This initial research, conducted with nine participants at the Ankara Ethnographic Museum, was an inductive study geared towards discovering which dimensions were relevant to the experience of museum visitors. In their interactions within the museum environment, the visitors were inquired through semi-structured interviews about the qualities and dimensions that they perceived as important and contributing to a positive user-experience, as well as the influences they perceived with the presence of other visitors. These dimensions were intended to be fruitful in deriving strategies to design better experiences that would enable a more profound engagement for the visitors within the museum context.

The scope of research was targeted at adolescent museum visitors, with all participants selected from a 'millennial' cohort as are defined in sampling (see Section 3.2.3). The following questions were intended to be addressed during the course of this research:

- What are the dimensions that people find interesting in a museum context?
- Which factors are most important to them in their visit to the museum?
- What could make the experience more rewarding / incentivized?

While *curiosity* is one of the primary emotions to be invoked by a displayed exhibit, there need to be other dimensions, such as *challenge* and *narrative* that contribute to making that exhibit engaging. There was an attempt in this study to illuminate the facets of the causal relationship between experiences and responses on part of the visitors.

This multidisciplinary investigation includes topics that cover the museum experience, the user-experience, positive psychology as well as the literature associated with human-computer interaction (HCI). An exhaustive literature search was thus conducted to review books and articles associated with gamification, user-centered design and theories of motivation (Chapter 2).

While the preliminary study is intended to be dedicated to understanding the factual aspects and the perspectives of the museum visitors regarding their interaction with touchscreens and exhibits, latter studies were to be based on observations and analysis of interaction scenarios. The questions in these semi-structured interviews

were open-ended, to prevent directing the user and to enable a flexibility in obtaining crucial details. There was also a progression from general to specific in the open-ended questions asked from the participants of the study.

In order to have clarity, it was ensured that all the participants had an understanding of what interactivity means and what the topic of the research is concerned with.

3.2.1 Museum of study

Although there were numerous museums within Ankara that could be accessed for research, a list of six museums was initially shortlisted as locations to conduct interviews with actual visitors in an original setting. After consultation with various professionals associated with the topic, including architects and designers, a list was generated of museums that had interactive exhibits, the museums are namely:

- MTA Tabiat Tarihi Müzesi, Ankara
- Anadolu Medeniyetleri Müzesi, Ankara
- Resim Heykel Muzesi, Ankara
- Ankara Etnografya Müzesi, Ankara
- Erimtan - Arkeoloji ve Sanat Müzesi, Ankara
- MKEK - Sanayi ve Teknoloji Müzesi, Ankara
- ODTÜ Bilim ve Teknoloji Müzesi, Ankara

The primary reason for selection was to have a background research on the spaces in which installed interactive exhibits, providing audio and visual feedback to the users based on haptic input, were available and functioning. The Museum of Anatolian Civilizations, Ankara and the Resim ve Heykel Muzesi, Ankara, located in the same periphery as the Ankara Ethnography Museum have interactive exhibits installed within their spaces, but were not selected for the research mainly due to the exhibits being non-functional at the time of the research. The Erimtan museum, though technologically more superior to the other museums, could not be accessed for research due to non-responsiveness upon multiple contacts.

Ultimately, the Ankara Etnografya Müzesi (Ankara Ethonography Museum) was decided upon as a source of interactive exhibits for the study, based on the operational conditions of the exhibits. The museum was contacted and permission

for visiting and conducting the study was obtained, but with a decline on part of the museum to give any statistics, a brochure however, on the historical background to the museum was provided by the authorities.

3.2.2 Interview guide

The questions prepared for the interviews with participants were open-ended and semi-structured, to allow for the eliciting of subjective responses from the users on their experiences and to prevent researcher bias as well as any directing of the participants. The questions listed mainly aimed at obtaining the rich data on past museum experiences of the participants, as well as maintaining the possibility of generating new perspectives on the research topic.

The first of the listed questions probed the perspective of the participants on their best experience with a museum that they previously had, along with inquiring about the factors that made this experience valuable. This was asked to enable an insight into revealing the factors that translated their experience into an engaging one. This was followed by questions pertaining to museum experiences with interactive products and their benefits, as well as the ways in which these experiences can be made better. As the interviews progressed, specific questions relating to preference of interactive or static displays and the underlying reasons were queried. Questions relating to learning, experience with video games and challenges were also asked in the interviews.

The questions from the preliminary study can be found in Appendix A (Interview Guide) 'Smart Voice Recorder V.1.7.1' was used on the Sony Xperia to make the recordings of the interviews, with 'CD-quality' sample rate of 44.1 kHz.

3.2.3 Sampling of Participants

In order to conduct the stages of research, it was necessary to find suitable participants that fell into a millennial age segment. While this was not very challenging in terms of the age groups, there was somewhat difficulty in finding the right people that were able to understand the concepts of gamification and respond accordingly in English.

In terms of selection of participants, one of the requirements was to have a sample of population that had previous experience of visiting museums and of having an interest in areas pertaining to history and were from the millennial cohort. In the course of the investigation, non-uniformity in the responses was observed, with five out of nine subjects responding in detail while four gave limited responses. Among the possible reasons for this variation were differences in the level of articulation of the subjects as well as the language difference being a major hurdle. Nevertheless, the preliminary study offered an insight into what the dimensions pertaining to the user experience was for the sample group.

Purposeful qualitative sampling (non-probability), in which potential information-rich sources are utilized, is considered helpful in conducting this type of study (Patton, 2014) and the participants for the interviews were selected based on their age group falling within the 20 to 30-year age segment, with a reasonable knowledge of technology usage and experience with game-like applications compared to an older cohort. The first key questions involved asking about their age bracket, their profession and the level of comfort they had with technology and game-like applications. The participants fulfilling the initial criteria were then asked the main interview questions. The demographic information of the interviewees is given in Table 5.

Since interactivity does not necessarily equate as engaging or interesting, a fact echoed by the participant responses, the questions moved from general to specific. The questions posed to the participants were initially concerned with the experiences they had with general museum visits and exhibits, whereas the questions that followed were more concerned with interactive experiences.

All the participants of the study were confirmed to understand what user-engagement and interactivity meant before the interviews were conducted and were also sensitized to the research topic by showing them videos and images of interactive exhibits to confirm their understanding of the questions that were to be followed.

Table 5 Demographic information of the interviewees of the preliminary study

Participant	Age	Occupation	Gender
Participant 1	21	student	M
Participant 2	28	designer	F
Participant 3	20	student	M
Participant 4	25	-	M
Participant 5	27	manager	F
Participant 6	22	student	M
Participant 7	22	student	F
Participant 8	24	designer	F
Participant 9	29	architect	F

The interviews with the participants were conducted on a span of two days and they ranged in length with the shortest being seven minutes and the longest constituting 18 minutes of content.

3.2.4 Observations regarding context

The Ankara Etnografya Müzesi (Ankara Ethnographic Museum) was founded based on the desire of the father of the modern republic of Turkey, Mustafa Kemal Atatürk, to establish a state museum and its construction took a year to complete between 1925 -26. The elevated site for the museum was the Namazgah in Ankara, a sacred hill which was used to offer ritual Islamic prayers and was also a site to an Ottoman era Muslim cemetery. Important ceremonies and celebrations were also held in this part of the city during the Republican period. The building of the museum has been designed by the Arif Hikmet Koyunoğlu, a renowned Turkish architect. (Ethnography Museum Ankara, Official Website, 2016)

The museum was also the resting place for Atatürk after his demise for the period between 1938 and 1953. The relatively small but rich museum mainly consists of ten halls containing static displays and dioramas reconstructing aspects of life mostly during the Ottoman era, as well as a rich and diverse collection of manuscripts, cultural items and artifacts from all over Turkey. Photographs from the Republican era adorn the walls of the central hall.

cultural items and artifacts from all over Turkey. Photographs from the Republican era adorn the walls of the central hall.

Figure 17 17 Interactive exhibit at the ceramics section of the Ethnography Museum

The glass and ceramics gallery (Figure 17) contains 13th century Seljuk plates, bowls, pots and vases as well as 15th – 16th century Ottoman and Rakka ceramics dating till the 19th century Çanakkale ceramics. The weapons (Figure 18) hall of the museum contains original swords, lances, axes, bayonets, shields and armour from the Ottoman period and both the galleries feature two exhibits that are interactive, providing information to the visitors while allowing visitors to practice pottery techniques and weapons respectively. The interactive displays have been set up by ReoTek, located in Teknokent, METU (see Section 3.3), design firm specializing in interactive exhibits, mainly for museums.

The first day of visit started at 11:00 am. Although there were not many visitors at the start of the observation, there came a group of adolescent students after around a half hour into the visit. They were accompanied by their instructor and were viewing the exhibits in a single group, following the order layout prescribed by the museum. After viewing the initial static displays of objects and historic photographs, the

students then shifted focus to the interactive displays in the ceramics and weapons galleries.

An interesting observation regarding the conduct of the students was their behavior towards the interactive exhibits; initially, they were apprehensive in starting any kind of interaction with the exhibits, but as one of the students engaged with the interactive exhibits for ceramics, the others promptly followed and were using the displays without hesitation. This way of interaction could emphasize the social-communal aspect of using technology and of the biases and influences that exhibit design would face, as well as the positive facilitation of interactions that can be done.

Figure 18 18 Interactive Exhibit at Weaponry Section

Due to a lack of reactivity and responsiveness from the touchscreen interfaces, most visitors did not have a sustained engagement with the interactive displays. The problems with the screens could be due to high traffic and usage of the interfaces, which may cause the screens to be smudged and thus become less responsive, much less so than an average smartphone interface that almost everyone these days is accustomed to (Figure 19).

Figure 19 19 User interacts with touch screen interface at the ceramics gallery of the Ethnography Museum

3.2.5 Data-gathering procedure

The museum visitor interviews, dependent on the availability of the participants were conducted on two separate days at the Ankara Ethnography Museum. The first taking place on 14th of December 2015 and the second was conducted on the 20th of December 2015.

On the first day, as participants were approached for responses, there was difficulty in getting subjects that fitted the criteria, as most could either not respond in English or if they did fulfill this requirement, being a part of guided tour were unable to allocate their time to answer the questions for more than 5 minutes, a duration not being sufficient to gain valid data. Four of the nine of the interviews were conducted with the participants within the museums, being aware of the interactive exhibits.

On the second occasion, there were participants who had a good ability to communicate in English and were sensitized to the representations of interactive exhibits in videos and images replayed on a digital tablet. These participants managed to provide more in-depth answers for the interview questions.
A total of nine museum-going participants were involved in the study and held a ratio of five female participants over four male counterparts (see Section 3.2.3). The

participation in the interviews was completely voluntary on part of the participants and they had signed a consent form allowing the utilization of results from the interviews.

3.2.6 Limitations in the interviews

There were a few factors that limited the scope of the preliminary study in the current contexts. The first was the unresponsiveness of the museum authorities regarding issues such as statistics and information, as well as delays in the granting of permissions for other venues. A second factor was the non-functionality of the interactive displays, mainly due to technical problems but which could also have been closed as a result of a reduced number of tourists.

There was overall a scarcity of visitors who could respond in English, again a result of the winter off-season period which affected the sample size as well as the quality of responses. Among the available English-speaking participants, many could not commit the time required for a complete interview as they were on a tour group which had little time allocated to see the museum.

3.2.7 Analysis of Interviews

Upon completion of the interviews, all the recordings were transcribed with the aid of a software program, namely 'InqScribe' (Ver. 2.2.1.253 Inquirium, LLC), which were then carried forward to the Microsoft Word and Excel platforms for in-depth analysis.

Within Microsoft Excel, the statements were broken down further, first into answers to each question and then into an adjacent column for listing the 'emergent data' that was found in each part of the answer in the primary coding (see Appendix B).

A set of color-coded cells was assigned to each participant in the first column (A) to assist in easily isolating the statements of each participant. The questions and responses were also added to the following columns (B and C), whereas the column (D) was allocated to summarizing the emergent data.

From the transcribed data collected from the interviews, between one and five statements were then emphasized in bold and codes were used to sum up the concept behind each statement and placed in the 'emergent data' column. Another two columns were allocated to causal and effective phenomena, to be marked where it was relevant (Appendix B). The findings of the study can be viewed in Section 4.1

3.3 Main field research

In order to understand the dimensions of gamified interactive exhibits and to gauge the perceptions of millennial users, an inductive study is needed which elicits spontaneous responses from the participants regarding their perceptions. The generative research is intended to reveal facets of visitor-exhibit interaction that may not directly be apparent in observations and hypotheses. A group of eight persons in the 'millennial' age group were chosen to use two gamified apps which require interaction on the part of the users in two distinct ways. In terms of fact-finding to answer the main research questions, a focus group discussion was moderated after the participants had interacted with the interactive exhibit applications and their views were recorded. The participants were then given a survey regarding their interaction to complete their feedback.

The main reasons for selecting focus groups as a research tool was the elucidation of detailed opinions and views of the participants regarding their experience, which includes their perceptions, feelings and opinions regarding the subject. Besides this, factors of time and resource constraints can be overcome by conducting a focus group instead of directed one-on-one interviews, while generating statements rich in participant insights. There may also exist certain drawbacks to this method such as the lack of participation of some members of the group and domination over them by more vocal participants. An online survey was also generated and disseminated through Google forms to tally much of the views that were expressed in the focus group as well as to gain the contributions of the participants that were less active in the focus group discussion. This second research is seen primarily as an extension of the preliminary study and hopes to present a more complete picture of the dimensions that are inquired in the original research questions.

3.3.1 Research Context

The research focuses on interactive exhibits developed by REO-TEK, an interaction design house that develops exhibits for use in museums. The actions of participants engaging with the exhibits are recorded in a pre-selected area at REO-TEK where an interactive interface consisting of a touchscreen and a Kinect motion and gesture input device are placed. The engagements, lasting 3-6 minutes per participant are then recorded, following which a focus group study is conducted and a survey for the participants was given out. The following museums were initially surveyed for the study and two separate exhibits from the exhibits developed by REO-TEK were chosen for testing:

1. Museum of Anatolian Civilizations, Ankara
2. Ethnographic Museum, Ankara
3. MTA Tabiat ve Tarihi Muzesi, Ankara

The two applications that were finally selected are:

1. Virtual Ceramics Workshop
2. 'Kartal' Virtual Free-flight app

Due to logistical issues and maintaining uniformity with the availability of participants, the interactions were carried out within the space of the REO-TEK office, with the same equipment that is used at the museum space. While the ideal situation would have been to conduct the interactions in the actual settings of the exhibits, it would have been much harder to ensure participation from all participants at both of the venues for the exhibits. Initially, the lighting conditions in the space were a slight impediment to the proceedings and the amount of light in the space had to be reduced to ensure better visibility of the screens by the participants. There were little to no sounds in the background other than conversation of REO-TEK employees.

3.3.2 Population Sample

Target subjects: Millennials (Generation Y)

The target groups for the study are the Millennials and young, adolescent visitors, also known as Generation Y; these are described in detail in Chapter 2. This survey aims at knowing their expectations, perceptions and apprehensions regarding interactive exhibits. The study is organized with eight participants with an equal gender ratio. Although this number doesn't give a substantial enough amount of data to generalize results from the surveys, it can provide us with rich qualitative data regarding their experience with interactive exhibits, as well as insights through the focus group that reveal more dimensions to their interactions. The participants are adults ranging in age from early to late 20s and being undergraduates and fresh graduates, are expected to be highly inclined towards interacting with and using technology.

The main selection method was to approach students within ODTÜ that were currently enrolled and were willing to participate in the research, which included an interaction session and subsequent focus group followed by a survey conducted via Google forms. All the participants could communicate in English, although half of them were more articulate in the language than the others.

Out of the eight participants, seven were students currently enrolled at ODTÜ out of which three were Industrial Design exchange students from Pakistan, three were Turkish Industrial Design students and one from Mechatronics, whereas one among the eight had recently graduated in Psychology from the same university. All but two of the participants were currently interning within Teknokent, which made it easier to source and work with them. A chain-sampling procedure was considered to recruit further subjects but the current time slot allocated with REO-TEK only allowed for a total of 8 participants, which was to be the source of the qualitative data.

Although all the participants have experiences in playing video games, none of the participants had used these particular applications and it was also the first time they were interacting with a gesture input application through Kinect. In order to achieve a holistic and comprehensive result, each of the interactive applications is used by the eight participants individually and with every subsequent participant, the order of

applications is changed to maintain uniformity and a random assigning of tasks. Another crucial requirement from the participants was the ability to converse and provide feedback to the questions in English language.

3.3.3 Analysis of Gamified apps developed by REO-TEK

Located within the Technopolis at the Middle East Technical University (METU) Ankara, is REO-TEK, a design and production company that works with state-of – the-art equipment and delivers unique, interactive experiences specifically tailored to museums and exhibition spaces. Since its inception in 2005, the company has worked on numerous projects at a national level in collaboration with The Scientific and Technological Research Council in Turkey (TÜBİTAK). The company was co-found and is headed by Mr. Refik Toksöz, also an instructor at METU.

As part of the applications available to museum visitors, three separate applications designed by REO-TEK, with varying interaction methods and feedbacks were investigated to be utilized for the main research. They were chosen primarily on the recommendation of REO-TEK and were then assessed on the basis of their interaction method, duration and content to be utilized for conducting a study. The following are the applications that were initially shortlisted:

1. Interactive Virtual Ceramics Workshop
2. Interactive Weapons Training
3. Kartal Virtual Free-flight

3.3.3.1 Virtual Ceramics Workshop

This exhibit is located at the Ankara Ethnography Museum in the ceramics gallery and has been installed in the museum since February, 2012. The application provides a chance to the users to participate in the process of making a product by shaping clay or glass forms with their hands, similar to a real pottery experience.

The physical display is made up of two adjacent screens facing away from each other and angled at a 45 degree (Figure 20), they are in easy access of adults and older

children can also manipulate the main elements although it is not intended or possible to operate with smaller children.

The interface consists of a black background with twelve predefined textures on the left side of the screen corresponding to an equal number of three-dimensional forms made on real exhibited pottery and glassware. In the center is a spinning wheel with a cylinder on top spinning in a clockwise direction, while on the right are four buttons corresponding to the inputs that are possible on the form. The two tool buttons above show a thin tool and a broad tool side by side, whereas the two bottom tools show a clay cylinder with a subtraction and an addition respectively.

Below these four buttons is displayed the actual form of the model with a description on its history. The users are expected to replicate the same form by 'carving' or adding to the cylinder form. Below this are two buttons, one showing an icon of a recycle bin, and the other showing an arrow in a back direction. There is no clear description on the start or end of the experience and what is to be done once the form is completed by the user.

Figure 20 20 Virtual Ceramics Workshop (Design by REO-TEK)

3.3.3.2 Osmanlı Dönemi Silahları (Ottoman Period Weapons) Digital Weapons Testing

This exhibit, also located at the Ankara Ethnography Museum is a part of the armory and weapons section of the museum. It was developed and installed by REO-TEK in February, 2012 and consists of a digital replication of an array of Ottoman and Seljuk period weapons that can be chosen and seen in action by the users. The kiosk-like exhibit is appended to the wall next to the actual weapons displayed with one primary touchscreen to input the selection of weapons and a larger holographic display showing them in action (Figure 21). The users can gain knowledge regarding the history, materials and usage of the weapons through animated models and characters replaying actions. The holographic effect enables the three-dimensional objects to appear suspended in the air and be viewed from multiple directions due to an illusion giving a sense of depth to the exhibit.

The users can scroll both ways left or right in order to see a weapon and its details are also described in text next to the holographic image. This application too does not have a clearly defined beginning or an end and there is no ultimate goal or target that is to be achieved by the users.

Figure 21 21 Digital Weapons testing (Design by REO-TEK)

3.3.3.3 'Kartal' Virtual Free-flight

Figure 22 22 'Kartal' Virtual Free-flight application (Design by REO-TEK)

The 'Kartal' Virtual Free-flight application gives the users a bird's-eye view of Kovada Gölü (Kovada Lake) near Isparta, Turkey and is intended to introduce the users to a variety of trees and plants that are available in the vicinity of the lake.

The system is connected to a Kinect device for physical gesture input (Figure 22). The startup screen consists of an animated background showing a lake, with two circles in the middle showing a dragonfly (Yusufçuk) and an eagle (Kartal), both animated as flying. In the bottom left corner is a thumbnail view of the person in colors to show the position of the user as detected by the Kinect device.

The menu of two buttons gives the user a choice between choosing any one flight mode and the instructions are written in Turkish in a line at the bottom of the screen. The arrow onscreen is controlled as the user moves their hand across the air and once an option is rested upon, it starts to give a circular timer to select that option. Moving the hand would cancel the ongoing selection. This is followed by a screen showing instructions on how to operate the app with both arms, progressing from which the scene starts with the dragonfly or eagle (depending on selection) flying in a highly detailed three-dimensional environment.

Five icons showing the levels to be achieved are given on the left side and a mini-map showing the target direction in the lower right corner. The input method is labor-intensive and flight is controlled by flapping the arms to go higher and keeping

them straight to glide. An illuminated blue net prevents flying off the virtual map. Once the target tree is near, a rectangular selection starts blinking on it and a window opens on the side describing the plant or tree in detail. Upon completion, a message on the screen pops-up congratulating the participant.

3.3.4 Selection Process

After deliberation and initial tests, out of the selected three apps, two were finalized for testing with the users based on two separate interaction methods employed: the Virtual Ceramics Workshop app and 'Kartal' Virtual Free-flight app. The Interactive Weapons Training application was not utilized due to its secondary input method, and too many display options, as well as the difficulty in recreating the experience in the research context.

The goals in utilizing the specific apps include facilitating empirical research, gauging the comprehension of the applications by users, as well as to review the accessibility of the applications to the targeted age group. The selection specifications are given in Table 6.

Table 6 Summary of application features

Application name:	Virtual Ceramics Workshop	Digital Weapons testing	'Kartal' Virtual Free-flight
Interaction method:	Touchscreen input	Touchscreen input on primary screen, holographic display on secondary screen	Gesture and visual input received by KINECT module
Goal:	Completion of a ceramic design working from a basic cylindrical model	To learn about the various weaponry used throughout history, by simulation	To identify plants/trees while exploring the surroundings of a virtual environment
Constraints:	Limitations in tools, lag in responsiveness of interface, inability to share outcome.	Visibility of holographic display is hindered	Some lag in control due to environmental interference, larger space required
Challenge:	Preventing too much change in the form while replicating original form	No real challenge other than cycling through weapon types	Navigating the entire area through flight, Maintaining flight
Reward(s):	A completed, personalized digital vase (sense of achievement)	No tangible or intangible rewards, except completion and knowledge gain	Sense of completion, knowledge of local flora/trees

Exploratory features:			
Visual	3D form and manipulation. Adding textures. 2D environment	2D input screen. 3D holographic forms	Realistic 3D environment and characters.
Functional	Tactile input, no competition/sharing of results	Tactile input, no competition/sharing of results	Gesture input, no competition/sharing of results

3.3.5 Required Tasks

The task for the research involved each of the participants to initiate interactions with both of the two selected applications through the specific input methods defined for the application. The user must move through each of the steps from initiating the application, reading instructions, performing the main activities and subsequently ending and exiting the application. The subjects are also free to explore as much of the application during the interactions.

The first application, Digital Ceramic Workshop (see Section 3.3.1), required an input from the user on a touchscreen interface which is used to manipulate the ceramic form displayed with the virtual tools provided.

The second application 'Kartal' Virtual Free-flight (see Section 3.3.3) required gesture input through Kinect, using the full body to control the movements of the virtual avatar onscreen. There are two options for the user in this app, one is to take the form of a dragonfly (Yusufçuk) and the second option is to take on the perspective of an eagle (Kartal).

The participants of the interactive sessions then had a discussion in a moderated focus group at the end of the interactive session regarding their experiences. They are then also asked to answer a set of Likert scale and general questions in the form of a survey (Appendix D).

3.3.6 Interaction Observations

In order to conduct the interactions, the selected applications were set up at a part of the office at REO-TEK on the same interactive screens intended for the museum displays. The subjects were then brought to the exhibits and one by one were instructed to interact with the exhibit. The touchscreen was a 65" generic LED with an Optical IR overlay and while it was a sufficient size to interact with objects in life-like scale, it had the same semi-reflective surface that presents a common problem in many touchscreens today, namely of reflecting too much light from the room and slightly reducing the visibility of the actual screen. This issue is likely to

be resolved in the actual setting of a museum, where lighting is controlled and relatively dimmer than public or exhibition spaces.

The first task was based on an interaction with the Digital Ceramic Workshop display, and users spent between 2 to 6 minutes each on performing this task. While none of the participants showed any hesitation in initiating the interaction, there was a slight difference in the way they performed the input, with two subjects being slightly more careful and timid, and the others more confidently using the touchscreen. Although all the subjects utilized their right hand to carry out the inputs, four of the users also used the left hand to input where necessary.

The second interaction took place with the Kartal Virtual Free-flight application and this took longer for the participants to complete in comparison to the first app, with a time range of 2 to 9 minutes per participant (Table 7).

Table 7 Durations of Application Interactions

	Duration of App 1 Virtual Ceramic Workshop (min)	Duration of App2 Kartal Virtual Free Flight (min)
Participant 1	1:18	2:28
Participant 2	1:28	3:05
Participant 3	1:48	2:16
Participant 4	1.50	4:43
Participant 5	3.28	6:09
Participant 6	4:33	2:34
Participant 7	5:21	9:02
Participant 8	4:09	5.26

For this app, although the system recognized the presence of the user immediately, there was a slight lag in the input being registered with the onscreen avatar, and hence the feedback was not as precise as the direct touch input application. Although the difficulty and challenge for this application seemed more than the first one, the subjects appeared to be more engaged and immersed in the activity. The goals too for the second application, while defined with markings, seemed to be more elusive

to achieve. The participants were intended to use their upper torso fully to recreate movements of flapping hands and soaring or diving and all managed to perform these steps actively. All the interactions were then filmed with a Nikon D3200 camera for visual and audio record, to be referenced for analysis.

While the interactions for the first application were less defined in terms of a starting or an end, there were far less distractions to the interaction that took place. Also since there was no sign of ending or achievement for this application, the participants just switched to different types of vases mid-way.

The second app had a defined beginning and an end, with an illustrated instructions screen that again was not recalled by some of the participants, although this app had a relatively defined stage level to completion, only two of the eight participants completed the entire game.

3.3.7 Focus Group

Subsequent to the user-tests conducted with the sample of millennials, a focus group was arranged in which all the participants were prompted with questions to talk about their experience with the two interactive museum applications and the feedback that they could give (Appendix C).

The benefit of this research method is the richness of data provided through the interactions of the individuals, whereas the downside to this method may be a lack of participation by one or more individuals. The focus group session lasting quarter of an hour, like the user-tests, was recorded in a 20-minute video session followed by an audio recording of an equal duration.

The participants were seated in a semi-circular arrangement in a conference room and faced each other during the entire proceeding. The session was video-recorded using a Nikon D3200 camera and the audio was also recorded on a Samsung Galaxy Y smartphone, with an in-built application for voice recording.

During the course of the discussion, the participants expressed their opinions regarding the applications they had used in response to the questions posed based on

the earlier research and literature. The statements were processed (Appendix C) and findings of the focus group are discussed in Section 4.2.

3.3.8 Qualitative Survey

At the end of the focus group session, the participants were emailed Google forms to fill out a survey regarding their interactive experiences with the applications (Appendix D). The survey requires an evaluation of different types of applications that are associated with the museums experience and are aimed at improving the engagement of the audience with the content provided.

The aim of the survey is to evaluate the existing applications that are designed for museum visitors and employ game elements and mechanics to deliver an experience. The most common approach to presenting applications and information is through interactive touch-screens and the dynamics of those interactions need to be understood well in order to design better experiences for the visitors. There are two separate applications with different methods of input and interaction that were tested with users and a survey conducted based on the experience of the millennial users.

The survey (Appendix D) comprises of 39 questions in the form of Likert scale statements, with options ranging between 'Strongly Agree' and 'Strongly Disagree'. A total of 21 statements out of these covered the user's perspectives on 'General Perception of Museums', 'Context and Environment', 'Motivations and Rewards' and 'Interaction Experiences', while 18 statements relating to the two applications covered 'Motivations and Rewards', 'Perceived Issues' and 'Perceived ease of Use'.

The results of these findings are provided in Section 4.3.

Findings of the Studies and Implications

4.1 Findings of Preliminary Study

The interviews with the museum visitors revealed important insights into their perceptions of the museum experience, with a description of the best features, the challenges faced and improvements suggested by the visitors.

Best experience

Among recalling their best experiences in museums, one of the participants cited the Naval Museum in Amsterdam, with the best feature being a free audio tour given to visitors which guides through the steps, enabling them to navigate the large spaces in the museum. This preference for audio guides was echoed by two other interviewees, while the statement of the visitor suggested that the audio guide enabled free exploration of the museum space:

> "Normally it takes about one hour but because I stopped at all the exhibits I took like three hours doing only the audio tour and then there were all other parts of the museum that it just like hints at and you're free to explore them on your own, so I really liked that museum."

Also preferred was the freedom to interact with the environment:

> "The best museum that i have seen was in Poland in Dansk, it was a maritime museum because I'm interested in maritime archeology and I liked it a lot because it was very interactive, so you could pretty much touch everything and experience everything firsthand."

Among other characteristics that were valued in the museum experience were, *freedom* to move around and explore independently (Istanbul Modern museum), *illustrations* or low-tech solutions that guide visitors (Catalhuyuk museum), *narrative* and story-telling of the exhibits (Istanbul Archeological museum) *unique collections* and *historical value* associated with the museum (Topkapi Palace museum).

The overall responses show that while *guides* are valued among the interviewed users, whether as an audio tour or whether through an actual person, there is also a desire to be given freedom to explore and to be able to discover the contents given in a museum space. A key feature that seemed to be preferred was how well the displays were organized to be accessed by the public. Another participant described an immersive experience where the space itself played a role in stimulating the senses:

> "they had a room where they wanted you to experience the space, the actual space outside the earth, so what they did was they had projections on the walls, it was a dark room, they had projections of the stars and they were moving in a way that you felt like you're actually in the space and you're actually feeling that everything is moving. So they made you feel that you're actually in that space, through technology, in that sense."

Interactivity

When questioned for their perspective on *interactivity* of the exhibits, most participants thought of it overall as beneficial to engagement. According to one, learning through multiple senses creates immersion, while another showed a preference for "visualized, game-like environments" which are more descriptive as opposed to imaginative. While one participant was of the view that interactivity is more relevant to the current generation, for ease in cognition and understanding, another viewed interactive exhibits as being beneficial for the learning of young and old alike:

> "I mean games are really attractive even if you're young or old, the thing I talked about, when you are interacting more it's better and when you interact you feel llike you're a part of it and you feel like I did this here and I did that there and that makes you able to keep stuff in your head easier."

One participant's views on interactive exhibits was that the space itself should be seen as interactive and should be made discoverable but them emphasis on the original works should remain:

> "if you move those objects or whatever exhibited away then like the space would be meaningless and if you have an interactive thing the objects might lose some meaning too, like I mean they both should be together I think it should not be just like a wall to a show stuff ."

There was one person who did not like *interaction* with digital replications and like the physicality of the real objects displayed: "no, I don't prefer it, because we can also do it on my computer at home, I feel very intimate(d) when I see objects, I always want to touch them actually!"

Improvements

In terms of suggesting improvements, one participant emphasized engagement through sharing and "co-creating the museum experience" which can result in a lasting impact of the experience that sustains long after the visit itself. Another considered the sanctity of the museum space and how exploration of the space can create value as well:

> "I think you know you museum is kind of um... holy, like you don't have to move, you don't like you should be really careful around stuff, but I think with the right design if you protect the objects right, like the experience I had before like kind of a game experience you find stuff and you know just exactly where to go you discovered them by yourself I think it would be valuable as an experience."

The same participant continues about the drawbacks of traditional exhibits:

> "after a while you see lots of things and are you're not being able to differentiate, for example for me when I started to move around the museum I just read everything very like detailed and then through the end I get bored or tired and I just start to look at them and say 'oh this is nice this good but I don't learn actually anything."

One participant emphasized that technology should not overwhelm or dominate the space in the museum and should only play as supportive role relative to the objects displayed:

> "One thing I saw bad in the interactive thing is that usually these days in the museum, they just take a plasma screen and they just put it on the wall and that's all, and it is a touch screen and you can do anything with it, and that's the thing you find in every other museum, but I guess according to the space, the technology should have its own unique identity, so it should not be just the typical plasma screen everywhere (…). I think technology is a barrier for me, but if done in a better way, so yeah of course, if it's more interactive, (there's) more learning."

Challenging Displays

When faced with exhibits that are difficult to comprehend, one participant stated that she would leave it instead of spending time to learn it, whereas another stated that he enjoys challenges and would be curious to know how to use it as technology fascinates him.

Being in a group also motivates the users to try and interact with challenging displays. While one participant said that he would not initiate interaction with a challenging exhibit if they were alone, another stated that she was more comfortable interacting with it alone. Although both of them agreed that being in a group of friends encouraged them more to interact:

> "if there is no one around I would definitely try it or if I have my friends I would try it, or if there is like a paper or something like that to show me what to do then I would feel more relaxed because if you have a paper or somebody explaining to you it says that 'okay it's not just you, people may not understand this so, here is the way to understand it' so I would feel more secure about like trying like if I know it's not common knowledge to use it."

Preferences for Games

Inquiry about the most appealing games for the participants revealed that they valued games which allowed them to compete with their friends, or which allowed an immersive experience through realism and also highlighted the learning value during their experiences: "games have a huge way of teaching you about things, about

environments, about realistic weather effects about historic recreations." though the participant saw the experience as subjective to the person playing it:

> "sometimes games modify history a bit or factual details a bit but I think they're still great as learning tools because their more engaging and again the experience is co-created the way I play a game is different than you would play a game. Maybe I would do the side missions first; maybe I would just go off and explore the world."

According to one participant, the experience when playing a video game is very engaging and immersive:

> "it offers me another space so, like when I'm looking at the screen and I'm able to like transport my brain to another place and it's actually amazes me to see new stuff there and I actually get really excited about the places I see and I prefer that kind of game like first-person games, because as I said I like the new environment offered to me there."

One interviewee revealed that he preferred to interact with real people instead of playing with just the computer: "if it's some other people who I'm competing with, I would be more interested than rather you know, competing with a computer or myself." This preference extends from a desire to interact with people from all over the globe, as well as to boost learning in a fun but competitive way.

The role of games in making the experience memorable was highlighted by one of the participants, stating that: "you have more memories maybe afterwards about this and you'll be reminded maybe a longer time"

Out of the nine interviews conducted, 164 unique statements were isolated from the 59 answers that were received from the participants, and the themes of the statements were categorized into emergent data.

This was then further coded into causal-effective (if any). Out of the derived data, there were 20 themes that were identified and listed in terms of frequency distribution. Table 6 lists the 20 most commonly cited themes from the emergent data. The three terms cited most frequently in the interviews were 'Interaction', 'Engagement' and 'Learning'. 'Exploration' and 'Touch' were the next most cited terms in the interviews.

Table 8 20 cited themes in interviews in terms of frequency

1.	Interaction	10
2.	Engagement	6
3.	Learning	6
4.	Exploration	5
5.	Touch	5
6.	Challenge	3
7.	Curiosity	3
8.	Discoverability	3
9.	Immersion	3
10.	Online games	3
11.	Realism	3
12.	Boredom	2
13.	Ease	2
14.	Environment	2
15.	Game-Like	2
16.	Games	2
17.	Games-Group	2
18.	Guidance	2
19.	Interactive	2
20.	Limitations	2

In order to conduct a theme frequency analysis and visualization, the Network Overview, Discovery and Exploration (NodeXL) plug-in for Excel was used. The coded text was then visualized with theme-effective and theme-causal relationships. Almost all the themes described the positive user experiences that the visitors had in the past.

The study revealed that in view of the visitors, *learning* was enhanced by games, the presence of friends, as well as interactions facilitated by technology, such as guides and multisensory experiences. Projections, special effects and first-person views which put the player in a character's point-of-view in games contributed to an *immersive* experience.

The factors contributing to *engagement* consisted of challenges, shared experiences, audio devices as well as interest generated by a strong narrative. *Motivation* was enhanced in a group, through learning and interactions.

Realism was valued as a factor and reconstruction, digital or through replicas, as well interactive participation and graphics leading to *immersion*, all contributed to a positive experience.

In the results, most participants agreed that the *use of guiding aids* during the museum visits enhanced and enabled a positive experience, while aspects of *discoverability, immersion* and *realism* were considered features that were desired in their visit.

It was also found that a laddering interview technique (Corbridge, Rugg, Major, Shadbolt, & Burton, 1994) where questions are probed deeper with more questions, can greatly benefit studies that are focused towards understanding museum experiences and this strategy can be applied to subsequent studies. These findings provide a basic clarity as to which dimensions are suitable for design of gamified exhibits and can further be utilized in providing the best overall museum experience for the museum visitors

4.2 Findings of Focus Group

The focus group was conducted with six of the participants out of the eight that were tested with the gamified applications and the feedback generated from the discussion was a source of many valuable insights into the perspectives that the millennial users held about interactive exhibits.

The statements of the discussions are categorized under the relevant sub-headings with three main topics: *Virtual Ceramics Workshop*, *'Kartal' Virtual Free-flight* and *General Discussion.*

4.2.1 Findings: Virtual Ceramics Workshop

The Virtual Ceramics Workshop application was the first of the two applications tried by the users; the findings from the app are listed in the following sections under the relevant sub-headings. It was surprising to learn that some aspects of the visuals

were not recalled during the focus group discussion after the interactions, such as the spinning wheel on which the shaping of the pottery took place.

4.2.1.1 Options

The users talked of there being a limited control over the digital product as in real-life and said that having a limited set of tools was not very engaging. According to the participants, more options such as adding clay, exploring different types of clay, adding handles and cutting the pots down in size would have made the experience more lifelike. "Some things were missing, in pottery there is total control over product, but here there was just adding/subtracting, extruding/tucking, there could be adding more material to it."

Different textures and ways of handling the clay would also have contributed to a more challenging experience. "The app could have had different types of clay, different textures and responses to different tools." A positive aspect appreciated by one of the users was the choice of patterns and forms, as well as the accuracy of the fit between the three-dimensional model and the digital texture.

4.2.1.2 Input Accuracy

In terms of input methods, accuracy in using the application also proved to be a point which interfered in having an engaging experience, since there was a lag in the input and feedback from the display, as well as gaps in where the point of contact met the three-dimensional model. According to the participants, input from a single finger, while intuitive, was not entirely necessary and that multiple modes of input could be utilized to make the experience better: "For such a big screen size, one finger is not enough as an input (…). Whoever is a left-handed or a right-handed, they only think of using one hand to input." Even the incorporation of feet input, through pedals could mimic the actual potter's wheel, while using the whole palm as input would enhance the sense of building through the original process: "The original is started with feet and uses both hands to shape it (…). In real pottery there is use of the whole palm." One member noted that even if screens are multi-touch, people scarcely use both hands to interact with the screen: "Even though the screen may be multi-touch, but most people don't think of using the other hand to operate the app."

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Emphasizing that clay involves playfulness, whereas the input method was too serious and thus incompatible with the content. There also needed to be a greater differentiation in what the tools could do.

4.2.1.3 Realism

There was some speculation among the users whether the app was for children or only serious use for adults and that the black background was too monotonous and again took away a sense of realism from the experience.

Adding even slight details like a static background would make the interface more appealing: "It should at least have a shadow or a rotating wheel." The overall feel of the app, according to one participant left one with an emotion of performing a very serious purpose, as opposed to having a free, exploratory experience: "The colors were a bit too serious (…). We went to use the app with a very serious purpose, not with 'let's just do something'."

On the other hand, another member saw the app as allowing for free exploration, with the original pot only for reference, and not as a compulsion to copy it. Referring to a wood-carving app, a participant was of the view that realism and ultimately engagement could be enhanced by showing waste material being shaved-off as the user 'applies' a tool to the clay model: "I used a wood-carving app and it showed that was similar to this (ceramic) but when you carve, a small display of the tool is shown and how it scratches away the material, that can also be applicable.", while another said that an animation of a spinning wheel below the model would enhance the feeling of realism (this was in fact an observation flaw, since there was a wheel during the process) another agreed that the spinning should be more real to life with a traditional material in the background to reflect context.

There was a suggestion by one member to use the real samples of pottery as examples to make the digital models to form a mental link so that visitors can have better recall of the objects in the museum: "If it's educational, there might be cues, 'do it here, do it there' and they might be able to make something, or make it similar to something in the museum, so they can recall 'oh, I made this there'." One participant remarked that overall the graphics were executed well onto the surface of the three-dimensional model.

4.2.1.4 Interface

One of the participants opined that if the app was to be designed for children, it needed to have more color, and if designed for adults, should have more functional aspects and detail. The reason being that children responded better to visual stimuli, whereas adults responded to function and affordance.

> "If it's for kids then I think the basic functionality is fine If it's for kids then it should be more colorful, if it's for adults it needs to have more things to work with…. Because kids respond to colors and what they see, they don't respond to what a thing can do, they look at something and become interested in that. If it's an app for kids, the interface is not suited for kids, it was just blank. Just a black background won't work, there should be something (more)"

In view of one member, if designed for children there should be better ergonomics to enable them to manipulate the big screen. One participant expressed that it was the first time they had used a touchscreen of that size. Another also remarked that the user-friendliness aspect of the interface needed to be improved.

4.2.1.5 Comprehension

The respondents generally held a view that there was no clearly defined beginning or an end to the way the app functioned. With no instructions given, there was also uncertainty regarding the exact purpose of the application: "Also in terms of structure, there were no instructions of how to use it, in the other app, there were just three pictures showing what to do, but they were enough to tell us what to do", although one participant felt that the app was a different experience and that it was a useful tool to learn without the annoyance of getting hands dirty: "Tools and techniques can be discovered in a digital way, instead of getting hands dirty in traditional way"

There was also some confusion in comprehending the functions of the given controls and the participants said that there should be more clear guidance and instructions on the screen for this, as well as a startup screen with instructions:

> "There should be some description on what this tool can do (…). The tools on the lower rows we could understand what they can do, but the upper tools were just showing the picture, I couldn't understand what they do. We didn't know

the function of those buttons, you already knew that….for people who don't
know there should be some (guidance)."

4.2.1.6 Narrative

The participants also emphasized the need for a narrative aspect to the whole
interaction, citing the example of the game 'Angry Birds'. There was a suggestion to
include a scenario at the completion of making the pot:

"We went to use the app with a very serious purpose, not with 'let's just do
something', maybe at the end of making the pot, it just shows a scenario, like in
Angry Birds every time you open a new (scene) it shows why are they doing
it."

4.2.2 Findings: 'Kartal' Virtual Free-flight

The second application 'Kartal' Virtual Free-flight brought more positive reviews
from the participants in terms of the realism involved, while the input method and
objectives were considered to be unsatisfactory, thus detrimental to engagement. The
attributes are discussed individually in the following sections:

4.2.2.1 Realism

The freedom to look all around was liked by the users, as were the realistic graphics:
"There are so many possibilities to explore that, you can do anything, there is no
right and wrong." This app was considered more immersive as participants noted
that they felt a sense of danger of falling when flying: "There was also the factor of
nothing going wrong in the first app, with the second app there was a danger of
falling in the water or crashing into a tree…"

The realistic graphics in the virtual environment were linked to having a more
satisfying experience in comparison to the first app: "The environment was well-
built and it was satisfying, there was more realism." There was greater focus on the
character and immersive quality due to the good graphics, while the first app did not
have the same engaging quality:

"In terms of virtual reality, it succeeded much more than the clay one, because
you were getting a sense of space, even though a virtual space, because you

were focusing so much on the eagle or the other bug, you focused more. With the other app, you knew it's a screen and not a real one."

The purpose of this app was also not well integrated with the dynamics, most of the participants felt that being an eagle, there is a far greater possibility of exploring and doing more exciting tasks like hunting, in comparison, looking for trees was considered mundane: "I ended it early because I was bored, after two trees…because I was an eagle and I was finding trees for watching....There should've been a different objective than that."

4.2.2.2 Rewards

The participants expected greater rewards from using the app, instead of the text information that was shown, even if it was in the form of better satisfaction. A part of the experience that appealed to one participant was the freedom to explore the area in free-flight i.e. there are many possibilities and little room to make mistakes, even if there is a target to achieve, it becomes secondary and you can explore and try different things:

> "When you're doing something as exciting as flying an eagle, finding certain trees is not the reward you should get for flying the eagle, I think it's not equal satisfaction, because you don't read you just read the name and blah, let's go to the next tree, you don't want to see what kind of flowers it has, what colors it has."

Compared to this, the first app was considered intimidating since the process had to be followed exactly with little room for exploration.

4.2.2.3 Comprehension

Moreover, there was no clear indication neither at the start, nor during gameplay on where or how to find the trees. A lack of contrast in the graphics also hindered viewing all the elements on screen during the gameplay. The screen size was considered too big by one user, resulting in a loss of comprehension of options:

> "she pointed out to me that this is a list of trees that you had to find…….it's not that the screen is big, the environment is totally green and blue and the trees were in light-grey color and so small, they weren't even highlighting properly, I didn't notice them until she showed them to me."

A graphical tutorial was suggested to help in comprehending the dynamics of the game. One member suggested that since there were many people coming into a museum, apps should be multilingual to support different people coming in, with clear instructions describing use:

> "Also if it's in a museum, the people who would come would not all be Turkish I guess… He told me that I had to bend, so I bent, I didn't know what the actions would do, so if they were more illustrative rather than written, the actions at least…. Maybe if the instruction screen was been graphically illustrated, it would've been better, obviously you have to write about the trees and everything, how tall they are or whatever, but if the movements were like, if you do this, this would happen, it would have been better."

Guidance such as virtual signs when flying over the virtual map would have helped and consistency in the signs should be made, instead of them switching on and off. According to most users, the accuracy of the input method was not satisfactory and there was a lag experienced in trying to control the avatar.

According to half the participants, the controls and input should be better and more intuitive. Mostly complained of a lag in response from the onscreen avatar, with difficulty in switching direction and the application taking the wrong meaning for unintended gesture input:

> "The controls should have been much better, one thing I found annoying was that when I flapped my wings, I would go higher instead of going faster, so if I wanted to go faster at the height I was on, I couldn't do that, I would just go down or up, I couldn't go straight without increasing my speed. The turns got stuck a lot, when you're turning and you're done turning, it just kept going."

4.2.3 General Discussion

While the first app felt 'real' in dynamics of interaction, the second app engaged the user by immersion into another virtual space. There is a preference for the first method of input, but more body involvement is also desired. There was a view that nothing could go wrong in the first app but a danger of crashing in the second one.

One participant felt that the circulation within the museum spaces should be improved to enable better viewing opportunities to the visitors, also stating that

pictures should be allowed and there should be a balance between the commercial aspects and the desires of the visitors.

> "One thing I always find annoying is the circulation in a museum, like if someone wants to look at a display, they can look at a display for two hours, their whole life, I don't care but there should be proper space in front of the display. Sometimes a person's looking at a display and the other person can't even move around. There should be ample space for two persons to be able stand there at least (and the guards)"

There was an emphasis of more than two participants on the ability to see the displayed objects in detail as opposed to having them in a box or seeing them from just one angle.

One participant says that interactivity would be better for museums depending on context, but not all can be experienced through these exhibits. In view of the participant, children are forced to go to museums, whereas for adolescents, it becomes a choice. According to the participant, museums also give the feeling that time has stopped and are thus not engaging enough to students and adolescents.

> "High school students would be good to test. At our age, it's your decision if you want to go to a museum or not, but when you're in high-school or in grade school, they take you to a museum. (even parents are like 'you have to go') At my age, if I want to go to a museum, I would, if I don't I wouldn't, it's like somehow in my control, but people who are forced to go to a museum, that would be a much better case study, maybe."

There was consensus that exhibits would be more readily acceptable to non-museum goers if interactive elements are incorporated into them. A perception was that if an environment is monotonous to non-enthusiasts, it becomes boring quickly for them and unless you are an enthusiast, you will not engage well with the experience.

One participant states that automatic lighting can sometimes be problematic in a museum setting, giving the perception that the displays are shut off or non-functioning, thus becoming uninviting.

4.3 Findings of Survey

The qualitative survey was conducted with the participants who had interacted with the interactive exhibit applications and results were received from all the participants in the week following the user-tests. The survey aimed to obtain a clearer picture on how the participants perceived their relation with museums, as well as how they viewed their interaction with the applications. Table 9 lists the responses of the participants with regard to the frequency of their visits.

Table 9 Frequency of visits

	User	Statement
Frequency of Visits	1	One or twice a month. Maybe two months.
	2	once in 2 or 3 months
	3	when i visit a new city mostly
	4	once in four months (average)
	5	Mostly when I travel to a new city, which might be around 6 months
	6	Twice a year
	7	once a year
	8	Recently i have visited museums a lot. At least once a month. But before that not so much because there weren't many museums in my home town.

The following series of tables (10 -18) summarizes the responses of the participants regarding the factors pertaining to their engagement and experiences within the museum context. These are further discussed in Sections 4.2.4.2 to 4.2.4.10.

Table 10 Factors inviting users to museums

	User	Statement
Factors that invite user to the museum	1	The type, content, display quality and experience of a museum.
	2	exploring new things, looking at famous things
	3	adversitement or friend advice
	4	Feeling history, understanding today
	5	Interesting artifacts, and good presentation
	6	---
	7	to know about cultural issues
	8	Any particular exhibition which interests me or if I haven't visited it before.

Table 11 Average time spent in museums

	User	Statement
Average time spent in museum	1	2 hours almost.
	2	2-3 hours
	3	2-3 hours depending on the size, sometimes 2 days
	4	two and a half hours
	5	2-3 hours, or until I have seen all the exhibits
	6	1 2 hours
	7	less than an hour
	8	it may wary from one museum to other but in every museum I visited, i atleast spent 2-3 hours.

Table 12 Most engaging aspects

	User	Statement
Most engaging aspects	1	Connection in history.
	2	the displayed objects which can be viewed from all sides
	3	---
	4	details
	5	Intricately designed artifacts, or things with lots of visual detail
	6	---
	7	visual effects
	8	---

Table 13 Most interesting aspects

	User	Statement
Most interesting aspects	1	Differs on historical background, uniqueness, immersiveness.
	2	Displayed objects, especially the materials they were manufactured from
	3	i like to animated scaled models
	4	historical, ethnographic museums
	5	Insight into how life used to be long ago
	6	---
	7	sound effects
	8	The visual display primarily or installations. If it is an historical museum the documentaries are sometimes also interesting.

Table 14 Least engaging factors

	User	Statement
Least engaging factors	1	pieces w/ insuffient information or historical background
	2	car museums
	3	Everyday items that just happen to be old
	4	Things that i dont have muc information about
	5	texts
	6	Too much textual information.
	7	pieces w/ insuffient information or historical background
	8	car museums

Table 15 Attention span within museums

	User	Statement
Attention span within museums	1	when i saw it once
	2	three hours
	3	1-10 minutes
	4	It changes
	5	an hour
	6	depending on the exhibit; 5-10 minutes if i found it boring.
	7	when i saw it once
	8	three hours

Table 16 Usage of information kiosks

	User	Statement
Usage of information kiosks	1	if i think i need more info, then yes!
	2	usually
	3	Haven't come across a lot of those, but probably won't use them if the exhibit is self explanatory
	4	Sometimes
	5	sometimes
	6	I often found them confusing and tend to explore on my own. I only resort to them if there is no other option.
	7	if i think i need more info, then yes!
	8	usually

Table 17 Comfort level with technology

	User	Statement
Comfort level with technology	1	Yes.It helps understand the facts behind a display. To help us realise what the display meant in its time.
	2	yes, it makes it more interesting
	3	always, but laggy displays make me uncomfortable
	4	Yes, virtual reality technologies could be used to enhance the museum experience, im ok with that
	5	Yes, the visualization provided is more immersive and explanatory
	6	Yes
	7	yes i feel comfortable. It eases everything since the staff in the museum is not helping much.
	8	Yes it would be interesting to incorporate technology or virtual reality. it would make the museum experience more convenient and fascinating in my opinion.

Table 18 Experience with interactive exhibits

	User	Statement
Experience with interactive exhibits	1	Helped me understand better what the display is and what its history is.
	2	The exhibits I have come across are not extremely interactive, hence one loses interest quickly.
	3	i dont have much exp. on this topic; mostly i encounter moving robots etc. when you get close
	4	i never been
	5	These were the only interactive exhibit I have come across, but I enjoyed the flight simulator. The visual output was more informative than reading a description
	6	
	7	I should feel as if I live in those places, smell, sound, visuality etc. they all should be real like.
	8	i have just used touch screens to navigate in the museums. I often found those booths very crowded and there is lag in the output or problem in the touch screen.

The age group of the participants corresponded with the intended sample group and seven of the eight participants answered an age bracket of 21-25 years, whereas one answered 18-20, which satisfied the criteria for conducting the user-tests (Figure 23)
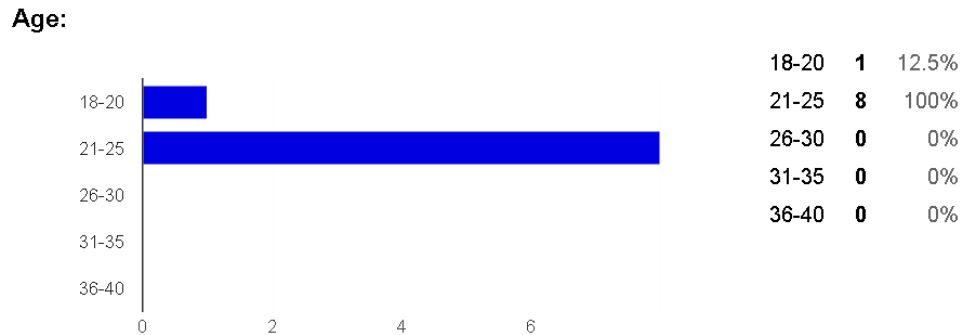
Age:

18-20	**1**	12.5%
21-25	**8**	100%
26-30	**0**	0%
31-35	**0**	0%
36-40	**0**	0%

Figure 23 23 Participant Age groups

In terms of educational background, seven of the eight participants indicated an undergraduate level, whereas one identified as high-school going. All the participants indicated themselves as students (Figure 24).

Educational Background:

High School	**1**	12.5%
Technical College	**0**	0%
Community College	**0**	0%
Undergraduate University	**7**	87.5%
Graduate University	**0**	0%

Occupation:

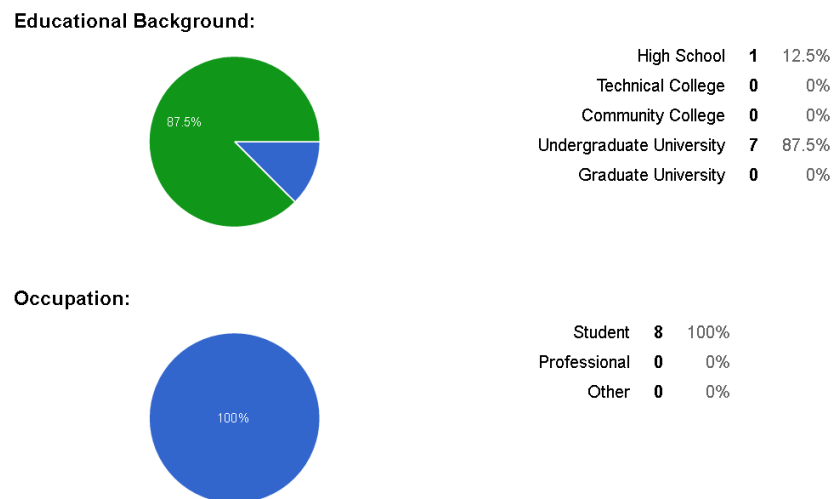|		
Student	**8**	100%
Professional	**0**	0%
Other	**0**	0%

Figure 24 24 Participant education and occupation

For technology literacy, five of the eight participants identified themselves as advanced users, whereas three thought of themselves as intermediate users. In describing the frequency of their visits to museums, the majority responded that they visit at least once every six months, with the breakdown being one participant going
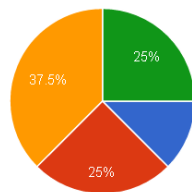
91

every month, two visiting every three months and three claiming to visit within a six-month span. Only two of the respondents claimed to visit a museum only once a year (Figure 25).

Technology Literacy:
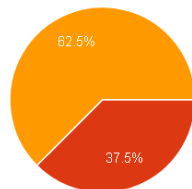
Basic user	**0**	0%
Intermediate user	**3**	37.5%
Advanced user	**5**	62.5%

How frequently do you visit museums?

Once a month	**1**	12.5%
Once every 3 months	**2**	25%
Once every 6 months	**3**	37.5%
Once a year	**2**	25%
Other	**0**	0%

Figure 25 25 Technology literacy and frequency of visits

For describing the amount of time spent in the museum, half the participants responded with a duration of 2-3 hours, whereas the other half was divided between two participants spending 1-2 hours, one spending less than an hour and another spending more than 3 hours in the museum (Figure 26).

What amount of time do you spend in a museum on average?
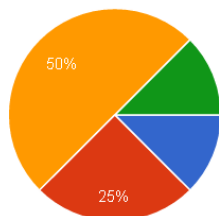
Less than an hour	**1**	12.5%
1-2 hours	**2**	25%
2-3 hours	**4**	50%
More than 3 hours	**1**	12.5%

Figure 26 26 Average time spent in a museum

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4. 3.1 General Perception of Museums

The questions for this section were posed on a Likert scale with a range of one to five, with one corresponding with 'Strongly Agree' and five corresponding with 'Strongly Disagree'. The middle ground (three) was neutral.

Regarding the overall perception of museums, the majority agreed with the statement that museums are interesting for them, with 3 out of 8 strongly agreeing, and 4 agreeing, whereas one responded by strongly disagreeing with the statement.

As a learning opportunity, the majority again agreed that museum visits provided them with a good learning opportunity, with 2 strongly agreeing and 5 agreeing. One disagreed with the statement.

In terms of enjoying museum exhibits more when they are interactive, the majority agreed with an equal number of 3 agreeing strongly and agreeing, whereas 2 were neutral in their response.

An equal number of participants agreed and disagreed with the statement 'I do not go to the same museum again after visiting it once', with 2 strongly agreeing, 1 agreeing and 3 participants disagreeing. Two of the participants were neutral in the response.

In terms of liking all types of museums, the majority, 5 out of 8 agreed with one strongly agreeing and one strongly agreeing. Two of the participants were again neutral to this question.

When asked 'I only like specific types of museums', an equal number of 1 strongly agreed, agreed and stayed neutral whereas 3 disagreed and 2 strongly disagreed with the statement.

The question about their sustained engagement with the statement 'I feel that visits to the museums become boring after a short while' came with an almost equal response of 1 strongly agreeing, 3 agreeing and 2 disagreeing while 1 strongly disagreed. One of the 8 respondents was neutral.

In showing a preference for an immersive experience, half of the 8 participants responded positively, with an equal number strongly agreeing and agreeing, whereas 3 remained neutral, while 1 did not respond.

4.3.1.1 Context and Environment

When inquired about whether they perceived signage provided in museums to be helpful, 4 out of eight agreed, whereas 2 disagreed while 2 remained neutral.

In terms of sufficiency of guides for facilitating movement in the museum, 3 agreed, 2 disagreed and 3 remained neutral.

In the perception of lighting adequacy within the museum space, half of the participants gave a neutral response whereas the other 3 agreed, with one strongly agreeing and one disagreeing.

Regarding the role of audio effects in enhancing the experience of the participants in the museum, the majority agreed with 3 strongly agreeing, 2 agreeing, 2 remaining neutral and 1 disagreeing.

Inquired about having touch screen interfaces as a good option in the museum spaces, all the participants agreed with an equal number of 4 strongly agreeing and agreeing.

With respect to the helpfulness of information kiosks provided in the museum, the majority responded positively with 4 agreeing, 1 strongly agreeing and 1 disagreeing, while another 1 stayed neutral.

4.3.1.2 Motivations and Rewards

To the question 'I only like certain types of museums', the majority disagreed while 2 remained neutral and 1 strongly agreed.

In terms of being more motivated to go to the museum with friends, 3 remained neutral, 3 strongly agreed, 1 agreed while 1 strongly disagreed.

In terms of sharing their museum experience with friends, a clear majority agreed with 3 strongly agreeing, 4 agreeing, while one strongly disagreed.

To the statement 'I would go more often to museums if there are more interesting displays' the majority agreed with 4 out of 8 strongly agreeing, 3 agreeing and 1 remaining neutral.

4.3.1.3 Interaction Experience

In perceiving touch screens as a good way to interact, the majority agreed with 2 strongly agreeing, 4 agreeing, and 1 remaining neutral.

In perceiving the gesture input as a good way to interact with objects onscreen, the majority agreed again, with 4 strongly agreeing, 2 agreeing and 1 remaining neutral while 1 disagreed.

In showing a preference of gesture over touch screen interaction, 3 strongly agreed, 1 agreed, whereas 2 remained neutral and 2 strongly disagreed

4.3.2 User Feedback: Ceramic Workshop App

The following sections outline the results of the survey regarding the first app. The questions for this section were posed on a Likert scale with a range of one to five, with one corresponding with 'Strongly Agree' and five corresponding with 'Strongly Disagree'. The middle ground (three) was neutral.

4.3.2.1 Motivations and Rewards

When enquired about whether a points system would make the app more engaging, a slight majority of 5 people agreed, whereas 2 disagreed and 1 strongly disagreed.

In terms of the app motivating the users to learn more about the topic, the opinion was divided among the 8 respondents, with 2 strongly agreeing, 2 agreeing, 2 disagreeing, 1 strongly disagreeing and 1 remaining neutral.

On defining the app as a good learning experience, 2 strongly agreed, 2 agreed, 1 strongly disagreed and 2 remaining neutral.

When asked if they would play with the app for a longer time, one half strongly disagreed, 1 strongly agreed and 3 remained neutral. Although to the statement 'I

would complete the app just to see the ending', 4 strongly agreed, 1 agreed, 1 remained neutral and 2 strongly disagreed.

Regarding exploring all the options of the app, the majority replied affirmatively with 3 strongly agreeing, 3 agreeing and 1 disagree while 1 was neutral.

4.3.2.2 Perceived Issues

In perceiving the feedback as unresponsive, a majority of 7 out of 8 agreed with 2 strongly agreeing and 1 remaining neutral. When asked if there were too many options on the screen to use, most of the respondents disagreed with 1 strongly disagreeing, 2 remaining neutral and 5 disagreeing.

On the complexity of the interface, all disagreed with 5 strongly disagreeing. One the question 'the app is difficult to start using and to adapt to', most disagreed with 2 strongly disagreeing, 5 disagreeing, and 1 agreeing.

On the question regarding the scarcity of information on using the app, the opinion was divided, with 2 strongly agreeing, the same number agreeing, disagreeing and remaining neutral.

For the statement 'I will need to learn more to use this app well' 1 agreed, 4 disagreed, 1 strongly disagreed, and 2 remained neutral. In perceiving a lag in the touch feedback for the app, most agreed with 3 strongly agreeing, 3 agreeing, and 2 remaining neutral.

In perceiving a lag in response from on screen objects, 2 strongly agreed, 5 agreed, while 1 was neutral.

4.3.2.3 Perceived Ease of Use

For the statement 'The instructions on using the game/application are easy', most responded positively with 4 strongly agreeing, 2 agreeing, 1 remaining neutral and 1 disagreeing.

All the respondents agreed that learning the interaction system was easy with 5 strongly agreeing.

Most agreed that the system is flexible to interact with, with 2 strongly agreeing, 3 agreeing, and 3 remaining neutral.

When asked if they can improve their skills by using the system more, 3 strongly agreed, 1 agreed, 3 remained neutral and 1 strongly disagreed.

4.3.3 User Feedback: 'Kartal' Virtual Free-flight App

The following sections outline the results of the survey regarding the second app. The questions for this section were also posed on a Likert scale with a range of one to five, with one corresponding with 'Strongly Agree' and five corresponding with 'Strongly Disagree'. The middle ground (three) was neutral.

4.3.3.1 Motivations and Rewards

On the statement of a points system making the app more engaging, most of the 8 participants agreed, with half strongly agreeing and 2 agreeing, while 1 disagreed and 1 remained neutral.

In terms of being motivated by the app to learn more about the topic, 3 remained neutral, while 2 strongly agreed, 1 agreed, and an equal number of 1 disagreed and strongly disagreed.

On the statement that the app was a good learning experience, the opinion was divided, with 2 strongly agreeing, 1 agreeing, 2 disagreeing, 1 strongly disagreeing, and 1 remaining neutral.

Most of the participants agreed that they would play the app for a longer period of time, with 3 strongly agreeing, 2 agreeing, while 1 participant each was neutral, disagreeing or strongly disagreeing.

On completing the app to see the ending, half of the 8 participants strongly agreed, 1 agreed, while 2 strongly disagreed and 1 disagreed.

In terms of exploring all the options in the app, a clear majority felt they had, with 4 strongly agreeing, 3 agreeing and 1 strongly disagreeing.

4.3.3.2 Perceived Issues

In terms of the unresponsiveness of the gesture feedback, while 3 remained neutral, 3 agreed, 1 strongly agreed and 1 disagreed.

The respondents mostly disagreed with the statement that there are too many options on the screen to use, with 4 disagreeing, 1 strongly disagreeing, 2 remaining neutral, and 1 agreeing.

Most disagreed that the interface is too complex to use, with an equal number of 3 strongly disagreeing and disagreeing, while 2 remained neutral.

The app was found to be easy to nearly all the participants as 5 responded with agreeing, 1 strongly agreeing, and 2 remaining neutral to the statement 'the app is difficult to start using and to adapt to'

For the statement 'the information on using the app is scarce', 3 remained neutral, 2 agreed, 1 strongly agreed, while 1 each disagreed and strongly disagreed.

In response to the statement of learning more to use the app well, mostly disagreed, with 3 strongly disagreeing, 2 disagreeing, 2 remaining neutral and 1 agreeing.

In terms of a lag in the gesture feedback of the app, 3 disagreed, 2 agreed, while 2 strongly agreed and 1 remained neutral. While for the lag in the response of screen objects, 3 remained neutral, 2 strongly agreed, 1 agreed, and 2 disagreed.

4.3.3.3 Perceived Ease of Use

In assessing the instructions for the app as being easy, a clear majority agreed with the statement with 5 strongly agreeing, 2 agreeing and 1 remaining neutral.

On the statement 'learning to use the interaction system is easy for me' all agreed, with 7 strongly agreeing, and 1 agreeing.

In terms of the flexibility of the system to interact with, 3 strongly agreed, 2 agreed and 3 remained neutral.

Almost all agreed with the statement 'I can improve my skills by using this system more', with 4 strongly agreeing, 2 agreeing and 2 choosing to remain neutral.

4.3.4 Responses to Open-ended Questions

The final section of the survey consisted of qualitative responses to open-ended questions that the participants responded to. They are based on the frequency, inviting factors, time spent, most and least engaging aspects along with attention span, and interaction with technology. Also described in the section is the overall experience of the participants with the interactive exhibits.

4.3.4.1 Frequency of visits

Among the responses from the survey participants, while two participants cited visiting between one to three months, another cited going once every four months, where as another two cited going twice a year and once a year, respectively. Two respondents mentioned that they visit a museum every time they come to a new city, with one stating an interval time of 6 months. One participant revealed a recent increase in museum visits to almost monthly; the reason cited is a greater access to museums, which were earlier scarce in the participant's home town.

4.3.4.2 Factors that invite users to the museum

Among the factors described by the respondents, for one it was the '*type, content, display quality and experience*' that mattered the most, while another described exploring new things and seeing famous things. Advice from friends or an advertisement was also cited as a factor, while a desire to feel history and 'understand today' were given as motivations behind one visitor. A good presentation and interesting artifacts were cited as factors by one, while another expressed a desire to know of cultural issues. Any exhibition that can capture the interest of one user was a factor cited along with the prospect of visiting a new site.

4.3.4.3 Average time spent in a museum

Regarding the average time spent in a museum, more than half the participants listed between two to three hours, one out of the six mentioned seeing all the exhibits while another mentioned that it varies from museum to museum. One participant spent between one to two hours, while another less than an hour.

4.3.4.4 Most engaging aspects

According to the participants, the most engaging aspects of the experience include a connection to history, exhibits that can be viewed from multiple sides/angles, details, and an abundance of visual details, such as intricately designed artifacts.

4.3.4.5 Most interesting aspects

Among the most interesting aspects found in the museum, one of the participants listed a variation in 'historical background, uniqueness, and immersiveness'. Another mentioned 'displayed objects', emphasizing the materials they were manufactured from. 'Animated scaled models' were also considered an interesting part. One responded with historical, ethnographic museums, while another echoed this by stating an insight into how life used to be lived long ago. Sound effects were important to another respondent while another mentioned the visually engaging displays, especially documentaries when viewing a historical museum.

4.3.4.6 Least engaging factors

The exhibits were found to be boring or least engaging when the displays couldn't be viewed properly by one participant, or when the text was considered unnecessarily long to be read entirely, according to another three. Contrary to this, two other respondents mentioned insufficient background information or history as being reason to find the exhibit boring. 'Car museums' was surprisingly mentioned as another least engaging place, while another participant mentioned everyday items from the past as not being worthy of seeing.

4.3.4.7 Attention span within museums

The time taken to lose interest in an exhibit ranged from a minimum of 15-30 seconds for one participant, to three hours for another. In between this range, 1-10 minutes, a few minutes, and an hour were given. Another mentioned seeing an exhibit once, while two mentioned a changing duration depending on exhibit, with 5-10 minutes dedicated if the exhibit is found boring.

4.3.4.8 Usage of information kiosks

In terms of using the information kiosks, two replied with 'sometimes', another two with 'yes' and 'usually' while another used them if more information was required. One respondent claimed to have not come into contact with a kiosk and stated that there would be no need to use it if the exhibit explained everything itself. Another claimed to explore on their own, stating that the kiosks were confusing and were only approached if there was no other option.

4.3.4.9 Comfort level with technology

In responding to the question of feeling comfortable with technology, all participants were positive, with one stating that it makes the experience more interesting, one describing the ease it provides when the museum staff is not helpful, another mentioning the assistance in understanding facts and history of an exhibit. Two of the participants mentioned that virtual reality technology would enhance the museum experience, making it more fascinating and convenient, while one claimed that the visualization through technology is more immersive and explanatory. Only one stated that while technology always assists, it can become uncomfortable if the display has some amount of lag. One agreed but did not give reasons.

4.3.4.10 Experience with interactive museum exhibits

In describing their experience with using interactive exhibits, one claimed that it helped them in understanding a display and its history, another claimed to only use it for navigation around the museum, but finding problems such as crowded booths, lags in output and issues with the touchscreens. While one claimed on not using any, another described a lack of experience with the topic and claimed that most exhibits experience do not have a very high level of interactivity, thus interest is lost. Another claimed that the exhibits in the user-test sessions were the only ones they had come across, but it was a very enjoyable to use the flight simulation app as the visual provided far more information than text could. One respondent expressed a desire to be in a completely immersive environment when using interactive exhibits: 'I should feel as if I live in those places, smell, sound, visually etc. they all should be real like.'

CHAPTER 5

Conclusion

5.1 General Outcomes

This chapter summarizes the results of the findings to the questions posed in the first chapter, as derived from the literature search, preliminary study and the main research. The chapter concludes with a general discussion on the limitations faced in the study along with suggestions for further areas of exploration. The following sections discuss the implications of the findings with reference to the main research questions.

5.2 Research Questions Revisited

After conducting the research, it would help to reflect on the starting point of the study. These initial questions have been analyzed in light of a literature review covering the topics of gamification, user-experiences and interaction design, among other sub categories. Besides this, a sequence of studies has been conducted for revealing the dimensions gauging the perceptions behind the millennial cohort, through which the key questions are attempted to be answered.

The following sections aim to address the research questions posed at the beginning of the study, with a focus on the dimensions of interaction found to be relevant to the visitors and the factors that museum visitors find most important. After these issues have been addressed, the section follows with proposing strategies to enhance the museum experience of visitors, with an emphasis on gamified exhibits.

5.2.1 The dimensions in a museum context that visitors find interesting

The primary aim of this thesis study was to investigate the perceptions of millennials regarding museum exhibits and the dimensions that they find engaging in interactive exhibits. The literature review gave an insight into the types of visitors, or more specifically, the *roles* assumed by visitors once they visit a museum space, changing with the emotional state of the person, from an *explorer* to a *facilitator*, from a *professional* to an *experience-seeker* or just someone looking for a way to recharge.

Among the experience dimensions discovered through the literature, there are those that mainly encompassed high emotional content, constituting positive feelings of *spontaneity, fun, and interactivity*, while the aspects of *novelty* and *authenticity* also encourage involvement of the visitors.

Another dimension revealed in the literature was that of who constitutes the museum-going population, the main audience of museum visits are families and the children accompanying them, whereas the average visitor has been from the affluent and well-educated segment of society. This fact was corroborated by at least one of the participants of the focus group study, who stated that since they, as children are compelled to visit museums, many no longer hold the interest to go there as adolescents. In other words, the *curiosity* as a driving force to see museums has diminished when they grow older, and perceive the museum space as a boring and dull environment where "time seems to have stopped".

The most frequently cited theme among the preliminary study interviews was *interaction,* which was either directed to the other visitors or carried out with the exhibits, but regardless had an immense influence over *learning* in a museum environment.

Within the museum context, *engagement*, another frequently cited term, was enhanced by *narrative* themes, *challenges*, *devices* that assisted in the experience and through the interactions in *experiences shared* with friends. Most of the participants interviewed in the preliminary study cited that their *learning* was also enhanced by interactions with friends in a group.

5.2.2 The factors most important to museum visitors

During the course of the studies, it was discovered that most of the millennial users considered themselves to be apt at using technology and thus showed a preference to have more interactive and immersive experiences when visiting museums.

The results pertaining to the key factors for museum visitors resulting in a positive experience, as deduced from the preliminary study are summarized in table 19.

Table 19 Best experience in a museum

Visitor perception	Factors
Best experience in a museum	Audio guides / Tour guides / Illustrations
	Freedom to interact
	Freedom to explore
	Narrative
	Unique collections
	Historical Value

Among factors that constituted the best experience for the visitors, the role of guides, both in terms of equipment and through assigned persons, was indispensible, while freedom to interact and explore led the visitors to make new discoveries in the museum space.

Narrative or a story-telling approach holds a key preference among the visitors and respondents from both the preliminary study, as well as the focus group cited preference for having scenario or story driven experiences.

Rare and *novel* objects, the building block of most museums were also cited as a factor for having a positive museum experience, whereas the *historical value* associated with a museum or its contents was also cited as generating the best experiences.

The perceptions of participants as stated in the preliminary study interviews are summarized in Table 20.

Table 20 Perceptions of participants

Aspect	Perception
Interactivity of exhibits	Creates sense of immersion
	Game-like environments
	Beneficial to old and young alike
	Relevant to current generation only
	Interactivity should not dominate actual objects
	Physicality preferred over interactivity
Improvements suggested	Co-creating of museum experience
	Encourage discovery within the space
	Reducing the role of text to access exhibit
	Prevent technology from dominating space
Challenging displays	Would avoid using it
	Would be curious to know how it works
	Being in a group motivates to interact
	Would be encouraged by instructions
Preference for games	Games can teach you a lot
	Realism is preferred
	Way of playing is unique to individual
	Enable mental transference through immersion
	Better to interact with a real person
	Enable stronger memories

As demographics other than the 'millennial' factor were not directly relevant to the experience of the museum visitors and the role of the visitor was dynamic, switching between one or the other, it is not easy to establish which factors are more important to a user at any given time, however, among the factors that were described by the participants of both the preliminary and the main study, the one factor most cited as contributing to a positive experience was realism. Most of the participants cited that immersive and realistic experiences contributed the most to their engagement levels and enabled them to have a fun and engaging experience. On the other hand, it is the

minor drawbacks and shortcomings such as lags in interaction, delays in visual and audio feedback, all of which are problems that can be easily overcome with better, more refined technology. Within museum environments, reconstructions and replicas, both digital and physical were valued among the participants interviewed and contributed to their engagement.

While realism is one facet that is desired by the millennial user-group, they have also shown a preference for assistive graphical elements such as blinking signs, guidelines or specific instructions to conduct their experience with the interactive exhibit. This factor is most likely influenced by their affinity with digital interfaces, which they have grown up with.

Another important factor that was cited was discoverability, which gave the users a sense of autonomy and most likely appealed to their instincts as an *explorer* user type, searching for 'easy fun'. While others emphasized their dependence on guidance of some sort, either in the form of audio-guides, or actual tour guides to facilitate their learning. This approach may be synonymous with the s*ocialiser* gamer type, looking towards Relatedness and 'People fun'. Most participants to the study have shown a higher level of motivation to visit the museum when they are accompanied by friends.

While there was inconclusive data on the millennial perception of museums in the literature search, the feedback from the participants in the focus group revealed that there was a substantial level of interest with museums and exhibits among this millennial cohort, in particular with interactive exhibits, although a general overview can only be highlighted with a study on a bigger scale. Most of the millennial participants cited that they visit all kinds of museums as opposed to only particular ones.

5.2.3 Strategies to promote visitor participation

While gamification in the business and service marketing perspective is seen as encompassing phases such as deployment, onboarding and scaffolding, processes that are intended for long-term customer retention, there exists a small window in terms of time to engage museum visitors and this has to be kept in mind when designing exhibits.

In order to create visitor appeal regarding the museum content exhibited, a gamified experience should consider the following factors:

Understanding the visitors

It is essential to ensure understanding the role that is assumed by a visitor and museums should aim to at least be prepared to cater to all these roles as a default instead of having a 'one-size-fits-all' approach. While actual involvement of the visitor comes at a later stage, the initial challenge is to attract the potential visitors by keeping in view the five categories of visitors defined by Falk and to address every role that a visitor may assume. Museums must also consider and try to facilitate groups better, allowing for multiple visitors to engage among friends and have shared experiences with the exhibits

Narrative

Storytelling has always fascinated us as humans and may be the most original method of keeping people engaged. The research has shown that this dimension has proven to be one of the most desired aspects of an interactive experience. This would also be the most effective way of imparting the learning aspect of the topics depicted by the exhibits.

Freedom and Possibilities for Socializing

According to the studies, interactive exhibits that allow for exploration and greater virtual affordances are preferred by the millennial users, rather than having limited options. Through the studies, subjects have shown a pronounced partiality for co-engaging in the museum experience with friends and this is an important aspect of living in the Social Media age. Today's generation has grown with abundant experiences of playing multiplayer games and are constantly in touch with one person or the other. They seek similar experiences in more areas outside of the digital world and while an app with a single purpose is less engaging, applications that allow for multiple options and possibilities are considered more engaging and immersive. Another finding in the research is that the social aspect also facilitates learning and encourages visitors to engage more readily with exhibits, even if they seem challenging and difficult to use.

Challenge Level

While the apps should engage the visitors, they should neither be too easy so as to be dismissed by the players and neither too hard for them to give up on the challenge. The applications designed for the museum exhibits need to ascertain a fine line between a challenging experience and between effortless play. The mechanism of selecting a skill level (easy, medium, hard) that many video-games have employed since long ago can play a crucial role in determining the optimum level of engagement to the user. With current technologies, it may even be possible to adjust difficulty of the tasks during live gameplay, thereby keeping the user engaged and even creating some incentive to return to engage with the app.

Time

While it might be easy to engage and retain visitors to gamified exhibits, one factor that museum visitors would be wary of is the visitors taking up too much time on a single exhibit, and an optimal time to use the app can be predetermined, especially depending on the flow of visitors. Participants have shown a preference to visit and to return again to exhibits that are interesting and engaging in nature.

Novelty

Taking curiosity as a core drive for gamified systems, visits to museums would be greatly enhanced if there is a factor of experiencing a spontaneous and novel perspective to an existing exhibit. With current technology and recognition of individuals through AI (Artificial Intelligence), it may be possible to provide content that changes every time the same user interacts with the exhibit.

Realism

Achieving levels of realism would entail a high demand for detail and extensive dedication to design among the interactive exhibits and preferably systems stimulating the most varied of situations and conditions, but with the advent of virtual reality (VR) technology, this doesn't seem as far-fetched and the possibilities of immersive experiences are far more easier to achieve through this.

Despite all the technology involved, there should be an effort on part of the museum exhibitors to keep the experience as natural as possible, with user interactions corresponding to the real-life interactions, instead of unnatural, simulated, inputs.

Rewarding Experience

The experience with the interactive exhibit should leave the visitor with intrinsic feelings of achievement and accomplishment. The studies with the participants have shown that while they showed a preference for incorporating point to the applications, the commonly held practice of applying points and badges is not a necessity in a gamified experience. Most participants were satisfied with the applications even without any point reward system.

5.3 Concluding Remarks

Reinvention of the museum space through new ways of experiencing the history, artifacts and content offered to the visitors is a promising approach to attracting more visitors and engaging them in 'free-choice' learning.

A greater incorporation of narrative, elements of easy fun and ensuring facilitation of participation by groups can help in creating more meaningful, engaging and interactive experiences.

The user-tests with the applications have shown that while extrinsic rewards are not a compulsion to entice and engage the users of interactive exhibits, even intrinsic motivation and satisfaction of curiosity can play a rewarding role for the users, this in fact is the essence of gamification and the kind of engagement that is intended for in a gamified experience.

5.3.1 Limitations of the study

This research attempt in no way can encompass the breadth of the subjects that fall under museology and the vibrant scope of gamification encompassing every facet of life. The study, while examining interactive exhibit applications and the interactions carried out by the millennial cohort, excludes the attributes of the whole museum

space as an interactive environment, which holds immense potential for further research.

One limitation to this study was the restricted number of participants that would affect the generalizability of the research. Among one of the main problems behind this limitation was access to millennial subjects who were willing to participate in the study and to find English speaking subject among the intended demographic. A bigger study with a greater number of participants would help in obtaining more concrete results.

A second limitation in the study was the relatively limited capability of the technologies employed, which although is considerably advanced when compared to many countries, especially when considered in a museum context, the experience cannot be matched with for instance, an Imagineered experience, which is far more immersive and realistic to a larger degree, but requiring substantial investment of resources and expertise.

Also not included in this study are the analyses that were conducted for the two interactive museum applications through the Octalysis tool (see Section 2.4.1). The main reason for omitting the outcomes was the ambiguity and lack of clarity that the tool provided in the analysis of a gamified museum exhibit. Another component omitted consisted of visualizations of preliminary and final study data due to constraints in processing the information.

The dynamic nature of gamification will leave many areas that will change and develop further in the coming years and a wider implementation of its principles to more and more areas of life.

5.3.2 Suggestions for extended research

This study was a brief glimpse into the perceptions of millennials as a user group and their preferences and apprehensions regarding museums and interactive exhibits. As a topic of study, gamification provides an endless scope of possibilities that can be explored in terms of user-experiences. With the current transformation in the way of immersive experiences such as Virtual Reality (VR) and Imagineering, there is no limit to where technology will lead us in creating new experiences, although one

concern with new technology is the rising expectations with each new generation. If a greater number of people are to be attracted to spaces of informal learning, such as museums, then there will be a need to transform the role of the museum from a stationary relic from the past, to a dynamic learning environment facilitating interactions.

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APPENDIX A

Interview Guide

Question categories:

- Past experiences with museums
- Experience and perceptions of interactive products
- Learning and interactive products
- Suggestions on improvements
- Perceptions of interacting with technology
- Exposure to gaming involving digital displays

List of interview questions:

1. Can you please describe your best experience with a museum exhibit? - What makes this experience the best?
2. Can you explain your museum XP with interactive products?
3. What do you think about for instance, interactive digital displays in learning?
4. What else do you think can be done to improve that museum experience?
5. In what ways do you prefer to see exhibits that are interactive, that you are able to touch and experience or static displays?
6. If a display seems difficult for you to use, do you take it as a challenge to start using it or do you avoid it, if so why?
7. Describe your favorite computer games that you have played and the reasons as well.
8. In terms of museums, how do you feel if more of these game like exhibits are placed there, do you think it would be better, and in what sense?
9. Do you think there is any learning that you achieve through using interactive displays that are digital?
10. How do you feel about accomplishing challenges, if you do a task and it goes really well, do you feel a sense of accomplishment, for example, specifically in something digital, like computer games?

11. If you're competing with other people, socially like there are certain social games as well on Facebook, so how do you feel in competing with other people, is it more interesting for you or is it more challenging?

12. Do you feel hesitant in initiating a new (technological) device that you encounter?

APPENDIX B

Preliminary Study Results

Serial #	Statement	Question	Emergent data	Act
3	Okay I went to it's called the **Naval Museum it's in Amsterdam** it has some other name in Dutch, the **best thing was that use free audio tour** and it can guide you through the whole building because the building is really big there is the central courtyard and it has three galleries around the courtyard you enter from the south and then you get a audio tour like a guide which is a machine and you can plug in your earphones and it guides you so it has like 22 stop points and the first point is you just like take the device up to the panel on the wall and then you swipe it and it gives you an overview of the museum and the courtyard and galleries and then it tells you how to proceed which staircase to go to, which rooms to start with and then it kind of guides you through the exhibits from 1 to 22. Normally it takes about one hour but because I stopped at all the exhibits I took like three hours doing only the audio tour and then there were all other parts of the museum that it just like hints at and you're free to explore them on your own, so I really liked that museum.	Describing best experience	Free being Incentive to use interactive device	
4		Describing best experience	Ease of use of device	
5		Describing best experience	Guidance in clear terms	
6		Describing best experience	Engagement is enhanced due to device	
8	I think they're more helpful as tools of knowlege as well because it's more difficult to like kind of go up to a panel and read the information, its easier to take it in when you have it fed to you in ambient and subtle ways like in the Naval museum that I was talking about, they had different audio relating to	Interactive Learning	Learning through multiple senses	
9	Okay, more engaging and interesting, I think in this era you have to kind or **engage the audience**, the experience is as **meaningful as long as they can relate to it** as long as they can like I said, its about **co-creating the museum**	Interactive Learning	Immersion in an experience due to effects	
11	Okay, more engaging and interesting, I think in this era you have to kind of engage the audience, the experience is as meaningful as long as they can relate to it as long as they can like I said, its about co-creating the museum	Improvements	Engagment through sharing	
12	Okay, more engaging and interesting, I think in this era you have to kind of engage the audience, the experience is as meaningful as long as they can relate to it as long as they can like I said, its about co-creating the museum	Improvements	Responses on the experiences	
13	Okay, more engaging and interesting, I think in this era you have to kind of engage the audience, the experience is as meaningful as long as they can relate to it as long as they can like I said, its about co-creating the museum	Improvements	Lasting impact of visit	

User 1 / User 2 / User 3 / User 4 / User 5 / User 6 / User 7 / User 8 / Pos-Neg / Glossary of terms / Coded Data / Frequency

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	A	B	C	D
1	Serial #	Statement	Question	Emergent data	Act
20		I think as a solo person people would tend to avoid it because I tend to avoid it, it looks awkward that you're standing and you're trying to figure out some technological or something and **there are other people waiting** in line maybe	Reaction to challenging displays	**Influence with the prescence of others**	
21		I think as a solo person people would tend to avoid it because I tend to avoid it, it looks awkward that you're standing and you're trying to figure out some technological or something and there are other people waiting in line maybe to get the equipment and use it, but in a **group I think it's more convenient**	Reaction to challenging displays	**Learning through social interaction**	
22		I think as a solo person people would tend to avoid it because I tend to avoid it, it looks awkward that you're standing and you're trying to figure out some technological or something and there are other people waiting in line maybe to get the equipment and use it, but in a group I think it's more convenient	Reaction to challenging displays	**Experiencing alone not preferred**	
76		recently I've started playing other **role-playing and strategy games so GTA** has been an all time favourite, i've played like all the episodes from the first, like top down to the latest one which my system doesn't support. But yeah, i think	Favourite types of games	**Learning through games is positive**	
77		**games have a huge way of teaching you about things, about environments, about realistic weather effects about historic recreations.** For example in Assassin's Creed 2, they recreate the cities of Venice and Florence what they	Favourite types of games	**Realistic aspects are appealing**	
78		did was they hired actual architectural historians as consultants for their projects. What they found out was that in that era, during the 15- 16th century Florence and had just one or two-story buildings, like ground story plus one	Favourite types of games	**Authenticity of games is authentic in some cases**	
79		story, so the details of the facades and the buildings accurate but they needed taller buildings for as part of their game because the character had to scale rooftops and walk across and jump across from buildings so in the game they made four story buildings but they kept the architectural features and the	Favourite types of games	**Method of exploring a game is subjective**	
80		elements the same. So sometimes games modify history a bit or factual details a bit but I think they're still great as learning tools because their more engaging and again the experience is cocreated the way I play a game is different than you would play a game. Maybe I would do the side missions first, maybe I would just go off and explore the world. So it depends on the kind of personal bond			

	A	B	C	D	
1	Serial #	Statement	Question	Emergent data	Act
25		Actually I dont know if this counts as a museum, but there is this **biennial of design at Istanbul** and it was kind of a place like **mazelike and you had a map of your own and you are able to see whatever you want to see** so there is not like a tour guide or something or anybody to tell you where to go and you were like able to go and see what your interested and also it was like enjoying by yourself just going somewhere and then you are saying 'oh, there is this' and just go there and see those stuff and the good part is it may not be available in a museum but there were people standing by and you are able to ask them what they did and like their pasts etcetra and there were some scripts like you have in a museum and you were able to read them if you want but if you dont want you could like just ask those people and I think the best part was that you are able to discover the place by yourself so it was not like so in your face one were to go or what to do you are just wandering around it was kind of crowded so nobody was watching you while you were doing stuff and I think one of the most important thing is the exhibited stuff were not through the walls so you are able to see them in many angles so when one person looks at them, like you can also look at them you have more chances of seeing it in different angles and so I liked it, it was the best experience I think, I dunno if it counts as a museum or no.	Describing best experience	Free movement	
26			Describing best experience	Independent Exploration	
27			Describing best experience	Interaction with other people	
28			Describing best experience	Discoverability	
29			Describing best experience	Multiple, unobstructed views	
31			Other museum Experience	Viewing from multiple angles	
32		I think Istanbul Modern museum, because it had the same thing like you are able to see stuff from many angles and I think it attracts me the most because like, I know when you have **something very old you have to preserve it** and you you **may not be able to show it in many angles** but when its new or you	Other museum Experience	Preservation limiting display possibilities	
33		I think Istanbul Modern museum, because it had the same thing like you are able to see stuff from many angles and I think it attracts me the most because like, I know when you have something very old you have to preserve it and you you may not be able to show it in many angles but **when its new or you find**	Other museum Experience	Unique ways of displaying exhibits	
		I think Istanbul Modern museum, because it had the same thing like you are			

Tabs: User 1 / User 2 / User 3 / User 4 / User 5 / User 6 / User 7 / User 8 / Pos-Neg / Glossary of terms / Coded Data / Frequency

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Serial #	Statement	Question	Emergent data	Act
31	I think **Istanbul Modern museum**, because it had the same thing like you are **able to see stuff from many angles** and I think it attracts me the most because like, I know when you have something very old you have to preserve it and you may not be able to show it in many angles but when its new or you find	Other museum Experience	**Viewing from multiple angles**	
32	I think Istanbul Modern museum, because it had the same thing like you are able to see stuff from many angles and I think it attracts me the most because like, I know when you have **something very old you have to preserve it** and you you **may not be able to show it in many angles** but when its new or you	Other museum Experience	**Preservation limiting display possibilities**	
33	I think Istanbul Modern museum, because it had the same thing like you are able to see stuff from many angles and I think it attracts me the most because like, I know when you have something very old you have to preserve it and you you may not be able to show it in many angles but **when its new or you find**	Other museum Experience	**Unique ways of displaying exhibits**	
34	I think Istanbul Modern museum, because it had the same thing like you are able to see stuff from many angles and I think it attracts me the most because like, I know when you have something very old you have to preserve it and you you may not be able to show it in many angles but when its new or you find	Other museum Experience	**Audio aids providing independence to discover**	
36	Actually I didn't have many. At the **Anadolu Mediniyet Muzesi,** yes yes, there is **something like, gamelike** thing and **you can walk in an ancient era and in the ancient city so it's really good to visualise** what it's like to live in there and you see people doing their daily job and stuff like that when you look at the museum any object you can like imagine what they used to do but its more descriptive so it was fun, it was a gamelike experience and I mean, good.	Interactive Experience	**Game-like environment leading to visualization**	
37		Interactive Experience	**More descriptive as opposed to imaginative**	
38	Actually I didn't have many. At the Anadolu Mediniyet Muzesi, yes yes, there is something like, gamelike thing and you can walk in an ancient era and in the ancient city so it's really good to visualise what it's like to live in there and you see people doing their daily job and stuff like that when you look at the	Interactive Experience	**Fun, 'gamelike' resulting from descriptive experience**	
	I'm **highly supporting them** actually because aspects especially when you're learning in a young ages it is hard to make kids like to sit in front of you and say, this is that and that is that, even if I'm an adultish person, I mean games	Interactive	**Support for interactive learning**	

User 1 / **User 2** / User 3 / User 4 / User 5 / User 6 / User 7 / User 8 / Pos-Neg / Glossary of terms / Coded Data / Frequency

Edit   Filter Mode   100%

	A	B	C	D	
1	Serial #	Statement	Question	Emergent data	Act
41		The best one that I've been to was in **Catalhuyuk,** it was **not that high-tech** and stuff **but they had like tiny drawings** like when they had back **when they lived, the drawings they had on the walls**, and they were telling how you are supposed to use that stuff. And for example, they had a tiny door and there was	Describing best experience	Illustrations helping to guide	
42		a tiny man on the side, it said that 'you're entering from this door, but I usually don't enter from this door, you have to go inside and look for the entrance itself	Describing best experience	Encourages discoverability	
43		and like you could go inside and touch all the things, they were not the originals, they were made later but it was more interactive in that sense. It was not on the screens or anything, you could actually touch the things.	Describing best experience	Physical replicas promote tactile interaction	
44		The best one that I've been to was in Catalhuyuk, it was not that high-tech and stuff but they had like tiny drawings like when they had back when they lived, the drawings they had on the walls, and they were telling how you are supposed to use that stuff. And for example, they had a tiny door and there was	Describing best experience	Absence of digital screens	
46		I **get bored very easily** so when I'm in a museum **with glass-enclosed things, I just walk by** and I'm like 'ok, never mind, I'll just walk by'. But when I can actually touch the things and use them, its like I start to think why they use them, why they made them, so it gives me more knowledge personally,	Preference for interactive	Boredom stemming from static displays	
47		I get bored very easily so when I'm in a museum with glass-enclosed things, I just walk by and I'm like 'ok, never mind, I'll just walk by'. But when I can **actually touch the things and use them**, its like I **start to think why** they use them, why they made them, so it gives me more knowledge personally,	Preference for interactive	Physical-tactile stimulates thought	
48		I get bored very easily so when I'm in a museum with glass-enclosed things, I just walk by and I'm like 'ok, never mind, I'll just walk by'. But when I can actually touch the things and use them, its like I **start to think why** they use them, why they made them, so it **gives me more knowledge personally,**	Preference for interactive	Tactile interaction gives more knowledge	
50		**If other people are using it then yes,** I would **like to see what else it can do,** for example, in the museum of Anatolian civilizations, the pot that was rotating, I like tried to hit it and break it, just because I wanted to see what else it could do.	Technology Hesitance	Hesitance in using tech in presence of others	

User 1 / User 2 / **User 3** / User 4 / User 5 / User 6 / User 7 / User 8 / Pos-Neg / Glossary of terms / Coded Data / Frequency

Edit   Filter Mode   100%

Prelim Data Analysis.xlsx - Microsoft Excel

File | Home | Insert | Page Layout | Formulas | Data | Review | View | Add-Ins

B74 | In South Africa, there was this museum that I don't remember the name of but it had the development of human beings since the beginning of time, the development of the

	C	D	E	F	G	H	I
1	Question	Emergent data	Themes/Nodes	Causal	Effective	Positive XP	Negative
2	Describing best experience	Free being Incentive to use interactive device	Affordability				
3	Describing best experience	Ease of use of device	Ease of use		Convenience	Positive XP	
4	Describing best experience	Guidance in clear terms	Guidance		Comprehensibility		
5	Describing best experience	Engagement is enhanced due to device	Engagement	Audio Device			
6	Interactive Learning	Learning through multiple senses	Learning	Multisensory			
7	Interactive Learning	Immersion in an experience due to effects	Immersion	Special Effects			
8	Improvements	Engagment through sharing	Engagement	Sharing			
9	Improvements	Responses on the experiences	Responding		Meaningful		
10	Improvements	Lasting impact of visit	Lasting Impact				
11	Preference for interactive	Guiding aids	Guidance	Audio Device			
	Preference for	Circulation methods	Circulation				

User 2 | User 3 | User 4 | User 5 | User 6 | User 7 | User 8 | Pos-Neg | Glossary of terms | Coded Data | Frequency List

Ready | 85%

Focus Group Statements

App 1: Digital Ceramic Workshop
Participant 1 MA:
• First time was using such app, not sure about purpose/intent of that app,
• Different and gave an insight into how pottery is done.
• Tools and techniques can be discovered in a digital way, instead of getting hands dirty in traditional way
• Some things were missing, in pottery there is total control over product, but here there was just adding/subtracting, extruding/tucking, there could be adding more material to it….
• Accuracy was a bit off, small gap could not be manipulated
• Additional option, adding handle etc.
• We were just changing the colors I think….
• Shape shouldn't be pre-defined, should be up to us
• There were only 4 tools we could use
• If it's for kids then I think the basic functionality is fine
• If it's for kids then it should be more colorful

- If it's for adults, it needs to have more things to work with

- Because kids respond to colors and what they see, they don't respond to what a thing can do

- They look at something and become interested in that (Visual stimuli, opposed to function)

- The **interface** would be better with more things to work with,

- If it's an app for kids, the interface is not suited for kids, it was just blank

- Just a black background won't work, there should be something

- We can also control the speed of the wheel with feet movement

- There should be some description on what this tool can do

- The tools on the lower rows we could understand what they can do, but the upper tools were just showing the picture, I couldn't understand what they do **(comprehension)**

- We didn't know the function of those buttons, you already knew that….for people who don't know there should be some (guidance)

- For slightly younger people, it's difficult to reach, they will have to move their entire body to reach (**size**)

- In the interface there should be some changes, the controls and other things should be more properly organized, rather than just being on the top end

- The graphics were ok, but still a lack of….environment?

- Even if they just had a potter's shop in the background…

- I used a wood-carving app and it showed that was similar to this (ceramic) but when you carve, a small display of the tool is shown and how it scratches away the material, that can also be applicable

- There should be an additional function like pinching the clay instead of just touching it

- Also in terms of structure, there were no **instructions** of how to use it, in the other app, there were just three pictures showing what to do, but they were enough to tell us what to do

- There should be something right before the app starts, some introduction on how to do this.

- The two apps were totally different, in the ceramic app, it's similar to real-life where you have to physically touch the pot to make it.

Participant 2 MH:

- Could have had different types of clay, different textures and responses to diff. tools

- There were patterns as well as colors….

- I don't think it should be suspended in a black background

- The colors were a bit too serious

- We went to use the app with a very serious purpose, not with 'let's just do something'

- Maybe at the end of making the pot, it just shows a scenario,

- like in Angry Birds every time you open a new (scene) it shows why are they doing it (**Narrative**)

- If it's educational, there might be cues, 'do it here, do it there' and they might be able to make something, or make it similar to something in the museum, so they can recall 'oh, I made this there'….

- It should at least have a shadow or a rotating wheel (**Realism**)

- The original is started with feet and uses both hands to shape it

• In real pottery there is use of the whole palm
• Maybe the effect of the two tools should be more differentiated
• It also depends (realism) on the display size in the museum
• The size is alright for us but if it was slightly younger people…(its difficult)
• It's the first time I have used a touchscreen of that size
• The application of the designs on the forms was nice, it overlaps exactly onto what you had created, the graphics were pretty nice
• But the interface wasn't very friendly
• Even a rotating wheel, just the feel of it (would have helped)
• For such a big screen size, one finger is not enough as an input….(**scale**)
• Whoever is a left-handed or a right-handed, they only think of using one hand to input
• Even though the screen may be multi-touch, but most people don't think of using the other hand to operate the app
Participant 3 MZ:
• Didn't touch the exact points, it was annoying then
• Some pots were long, some short, no option to cut in half or make smaller…..you were trying to remove the top, but it didn't…..
• It was for serious use, I think
• Clay is more about having fun and playfulness, but with the app it was a bit serious

• I think the pots in the app were there on display
• It's just rotating in mid-air
• A problem was shaping just one point, it should be a whole area that you can do
• I think the interface was not that friendly or approachable in a way
Participant 4 H:
• I think the picture only gives a clue about what we can do, we don't have to copy it exactly
• I think the designer thought like that,
• that the application is for kids and they have to learn fast
• Maybe an ancient music app that children will like
• The traditional wheel rotates several times
• They can use a traditional material in the background
Participant 5 B:
• Using the other hand would also help

• Didn't really understand the difference between the two tools, they weren't very different
• We still can't see much difference between the tools, I tried the bigger one but it didn't make much of a difference (More pronounced differences preferred)
Participant 6 E:
• Maybe it can be controlled with the feet,
App 2: Kartal Virtual Free-flight
Participant 1 MA:
• The second app is totally based on motion, you can look down and around.
• There was one thing, even in the most advanced games nowadays, on the map you can see your objective, as a dot or a pointer where you have to go, but there are some hints at least to tell you where to turn, in case you get lost or in case you can't find the right direction to that point.
• We were flying but there should have been some waypoints or something highlighting the point in some way, like if the trees were bigger or having fruits on them
• But it was really distracting and fluctuating all the time, on and off, and when you make a turn it disappears and when you're just near it, it

pops up open again, that was wrong with it
• The controls should have been much better
• One thing I found annoying was that when I flapped my wings, I would go higher instead of going faster, so if I wanted to go faster at the height I was on, I couldn't do that, I would just go down or up, I couldn't go straight without increasing my speed
• The turns got stuck a lot, when you're turning and you're done turning, it just kept going (**lagging**)
• There was also the factor of nothing going wrong in the first app, with the second app there was a danger of falling in the water or crashing into a tree…
• For me in the back of my mind, I wanted to avoid the drowning into the water or crashing into the tree
• The environment was well-built and it was satisfying, there was more **realism**
• If you're an eagle you can hunt….
• she pointed out to me that this is a list of trees that you had to find….
• …it's not that the screen is big, the environment is totally green and blue and the trees were in light-grey color and so small, they weren't even highlighting properly, I didn't notice them until she showed them to me…..(**contrast & scale**)
• I ended it early because I was bored, after two trees…because I was an eagle and I was finding trees for watching....There should've been a different objective than that…
(General Discussion)
• One thing I always find annoying is the circulation in a museum, like if someone wants to look at a display, they can look at a display for two hours, their whole life, I don't care but there should be proper space in front of the display. Sometimes a person's looking at a display and the other person can't even move around. There should be ample space for two persons to be able stand there at least….(and the guards)

• …..pictures should be allowed……they should allow pictures, it's not like we're stealing the damn thing!
• Like in the Harem of Topkapi palace, the displays they've put in intricate boxes…..they should take it out but no, that picture is in the book they are selling outside for 500 Liras…
• If it's a museum, it's already in a glass protected case just put it, why are you putting it in a box……it's just enticing people….
• Interactive is better for people
• I think you would also go to museums if there was something like interactive, I don't like museums…..but people would be more interested then….
• Unless you're some really big art enthusiast or really into what that experience is, you get bored after a while, not bored but (you don't feel like
• I want to see how a kid would react to this….
Participant 2 MH:
• It was not that accurate…
• Sometimes when I changed the direction, it started detecting my palm as a function for going home instead of detecting as turning so it was bit distracting unless you let go of one hand
• In terms of virtual reality, it succeeded much more than the clay one, because you were getting a sense of space, even though a virtual space, because you were focusing so much on the eagle or the other bug, you focused more. With the other app, you knew it's a screen and not a real one
• I also didn't notice half the options because the screen is so big…

• When you're doing something as exciting as flying an eagle, finding certain trees is not the **reward** you should get for flying the eagle, I think it's not equal **satisfaction**, because you don't read you just read the name and blah, let's go to the next tree, you don't want to see what kind of flowers it has, what colors it has…
• It could have a graphic tutorial, a figure doing this and this (…like they show in Angry Birds)….
•
(General Discussion)
• I know this museum which is in front of the Blue Mosque and that museum has a lot of automatic lights and sometimes when you enter its black, then the sensors detect. And sometimes if you stay there for too long and trying to read it just closes, and then you have to move to switch it on again
• Another idea could be that sometimes something is displayed like this, that you can see the front but you can't see it in detail, so there could be screens in which you could turn it around and see, or zoom in like a 3D model, there could be some interactions also. Because sometimes you want to see details, you can't take a picture, you can't take too long because there are other people, that way could be more nice
• When you go to a museum, it's like time has stopped, everything is so quiet there are so many static things around you, it just feels like time has stopped and you are in some
• I would like to see the reaction of someone who's not a designer or a psychologist, after your education you are sensitive to certain things, so we had problems with graphics and things, I want to see how a kid or a college student who has average knowledge about all things would react to this, we have very specialized knowledge and it really applied to those things, so we came up with different things, we are biased.

Participant 3 MZ:
• There are so many possibilities to explore that, you can do anything, there is no right and wrong
• You have to achieve a target, but even if you don't achieve it, you can just explore around and try different things
• In the other app it was intimidating in a way, that you have to do that, in the back of the mind, it was that it doesn't look like that….
• I don't know if it was my movement but I think it was slow, I would have turned and it wouldn't have done anything, then after a while it turned (**lagging**)
• Also if it's in a museum, the people who would come would not all be Turkish I guess…
• He told me that I had to bend, so I bent, I didn't know what the actions would do, so if they were more illustrative rather than written, the actions at least
• Maybe if the instruction screen was been graphically illustrated, it would've been better, obviously you have to write about the trees and everything, how tall they are or whatever, but if the movements were like, if you do this, this would happen, it would have been better, except for the
• --
• But if it's written that no pictures, then people shouldn't take pictures, half the time they are saying 'no pictures!'….
• If you want to stand there, you cannot just stand there, I mean the people will start looking, why are you standing here, I just want to stand here!
• I think it would be so much better than the documentary going on, so much more interactive
• Yeah, if it's a museum about herbs and trees and things like that, it would be better, it's enjoyable to just go and look, if you go to Hagia

Sophia to see the history, I think I would sit and watch a movie, but if it's about herbs and everything I don't think…..pottery maybe
• I've been to Topkapi palace with a few people and they were people from different ages, not really old people, but kids and stuff, I think those benches around there are for a reason, people who are getting bored just go sit there and use their mobile phone, something like that could also engage the kids to actually interact with it….there was this display of the kitchen and the old crockery and cutlery and stuff like that , so the girls would go and want to watch the section, I mean it's stereotypical but the boys are not interested in that
• High school students would be good to test. At our age, it's your decision if you want to go to a museum or not, but when you're in high-school or in grade school, they take you to a museum. (even parents are like 'you have to go') At my age, if I want to go to a museum, I would, if I don't I wouldn't, it's like somehow in my control, but people who are forced to go to a museum, that would be a much better case study, maybe.
Participant 4 H:
• But it (signaled) when you got close to it….
• There are some stores, they sell capes, old capes if you're interested…
• (using the apps in the museum context) I would definitely use that
• Maybe a war game would be more fit in Hagia Sophia…you are just sword-playing…
Participant 5 B:
Participant 6 E:
• ….But nothing happens….

• Maybe we can die in the second one
• And what is the point of searching for trees, why are we looking for trees
• …No one reads those texts……
• At the beginning, it is only showing the movements, not (the objectives) that you should find trees….
• Maybe some actions in a museum

Survey Questionnaire

1.

Survey Questions												
Category: **Museums: General**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A						
Museums are interesting for me												
I find museum visits to be a good learning opportunity												
I enjoy museum exhibits more when they are interactive												
I do not go to the same museum again after visiting it once												
I like all types of museums												
I only like specific types of museums												
I feel that visits to the museums becoming boring after a short while												
I would prefer to have an immersive experience in a museum												

2.

Survey Questions												
Category: **Context and Environment**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A						
The signage provided in museums is usually helpful												
There are sufficient guides for facilitating movement in the museum												
The lighting provided in the museums is usually adequate												
Audio effects enhance my experience in a museum												
Having touch screen interfaces is a good option in museums												
The information kiosks provided in the museum are helpful												

3.

Survey Questions	App 1						App 2					
Category: **Motivations and Rewards**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A
I only like certain types of museums												
I am more motivated to go the a museum with my friends												
I would like to share my museum experience with my friends												
I would go more often to museums if there are more interesting displays												
Having a points system in the app would make it more engaging												
The app motivated me to learn more about the topic												
The app was a good learning experience												
I would play with the app for a longer period of time												
I would complete the app just to see the ending												

4.

Survey Questions	App 1						App 2					
Category: **Perceived Issues**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A
The touch screen / gesture feedback was unresponsive												
There are too many options on the screen to use												
The interface is too complex to use												
The app is difficult to start using and to adapt to												
The information on using the app is scarce												
I will need to learn more to use this app												

5.

Survey Questions	App 1						App 2					
Category: **Interaction Experience**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A
Touch screens are a good way to interact onscreen												
Gesture input is a good way to interact with the objects onscreen												
I prefer gesture over touch screen interaction with onscreen objects												
There was a lag in the touch/gesture feedback in this app												
There was a lag in the response of the screen objects												
I explored all the options available in the app												

6.

Survey Questions	App 1						App 2					
Category: **Perceived Ease of Use**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N.A
The instructions on using the game/application are easy												
Learning to use the interaction system is easy for me												
The system is flexible to interact with												
I can improve my skills by using this system more												

7.

Survey Questions												
Category: **Open-Ended Questions**												
How frequently do you visit museums?												
What are the factors that invite you to visit a museum?												
Which displays do you go to first in visiting a museum?												
What amount of time do you spend in a museum on average?												
Where do you spend the most time inside the museum?												
Which aspects of the museum visit do you find most interesting?												
What aspects hold your attention for the longest span of time?												

Question												
Which aspects of the museum visit do you find monotonous or boring?												
How long does it take before you lose interest in an exhibit?												
What is your view of the information kiosks provided in the museum?												
Do you feel comfortable in using technology to assist you in your museum experience? Give reasons for your answer.												
Have you ever used any interactive exhibit in a museum?												
What are your views on the use of interactive tools (apps and exhibits) in a museum?												

Survey Results

General Perception of Museums

Museums are interesting for me
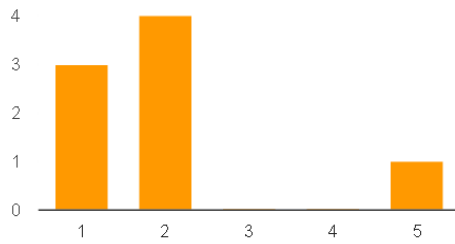
Strongly Agree: 1	**3**	37.5%
2	**4**	50%
3	**0**	0%
4	**0**	0%
Strongly Disagree: 5	**1**	12.5%

I find museum visits to be a good learning opportunity
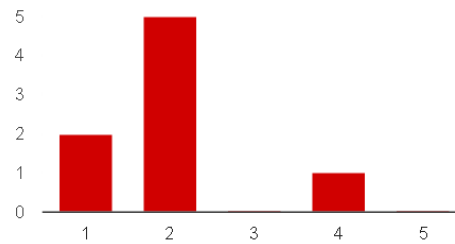
Strongly Agree: 1	**2**	25%
2	**5**	62.5%
3	**0**	0%
4	**1**	12.5%
Strongly Disagree: 5	**0**	0%

I enjoy museum exhibits more when they are interactive
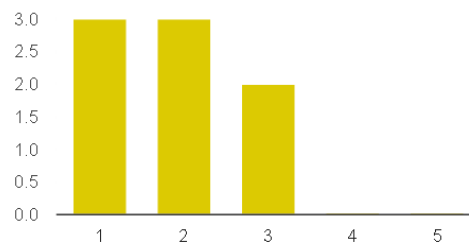
Strongly Agree: 1	**3**	37.5%
2	**3**	37.5%
3	**2**	25%
4	**0**	0%
Strongly Disagree: 5	**0**	0%

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I do not go to the same museum again after visiting it once
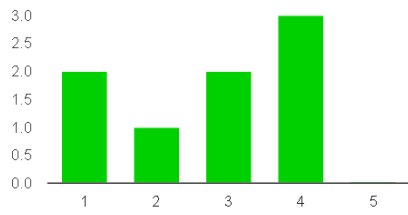
Strongly Agree: 1	**2**	25%
2	**1**	12.5%
3	**2**	25%
4	**3**	37.5%
Strongly Disagree: 5	**0**	0%

I like all types of museums
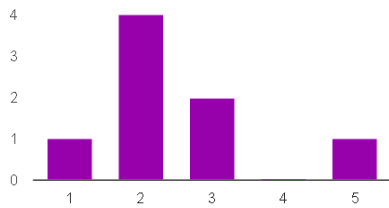
Strongly Agree: 1	**1**	12.5%
2	**4**	50%
3	**2**	25%
4	**0**	0%
Strongly Disagree: 5	**1**	12.5%

I only like specific types of museums
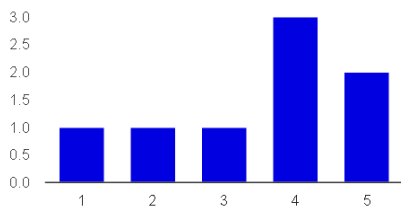
Strongly Agree: 1	**1**	12.5%
2	**1**	12.5%
3	**1**	12.5%
4	**3**	37.5%
Strongly Disagree: 5	**2**	25%

I feel that visits to the museums becoming boring after a short while
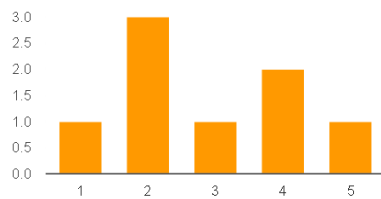
Strongly Agree: 1	**1**	12.5%
2	**3**	37.5%
3	**1**	12.5%
4	**2**	25%
Strongly Disagree: 5	**1**	12.5%

I would prefer to have an immersive experience in a museum
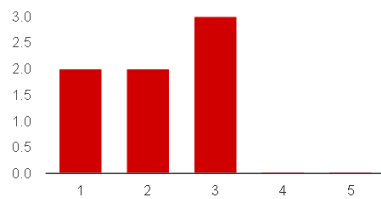
Strongly Agree: 1	**2**	28.6%
2	**2**	28.6%
3	**3**	42.9%
4	**0**	0%
Strongly Disagree: 5	**0**	0%

Context and Environment

The signage provided in museums is usually helpful
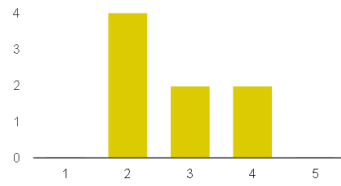
Strongly Agree: 1	0	0%
2	4	50%
3	2	25%
4	2	25%
Strongly Disagree : 5	0	0%

There are sufficient guides for facilitating movement in the museum
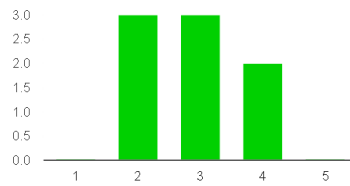
Strongly Agree: 1	0	0%
2	3	37.5%
3	3	37.5%
4	2	25%
Strongly Disagree : 5	0	0%

The lighting provided in the museums is usually adequate
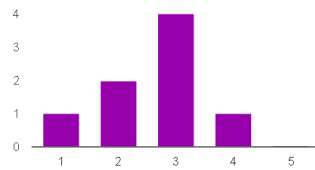
Strongly Agree: 1	1	12.5%
2	2	25%
3	4	50%
4	1	12.5%
Strongly Disagree : 5	0	0%

Audio effects enhance my experience in a museum
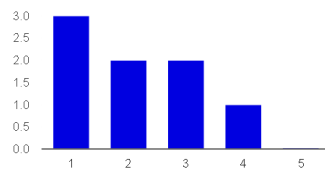
Strongly Agree: 1	3	37.5%
2	2	25%
3	2	25%
4	1	12.5%
Strongly Disagree : 5	0	0%

Having touch screen interfaces is a good option in museums
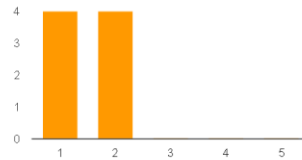
Strongly Agree: 1	4	50%
2	4	50%
3	0	0%
4	0	0%
Strongly Disagree : 5	0	0%

The information kiosks provided in the museum are helpful
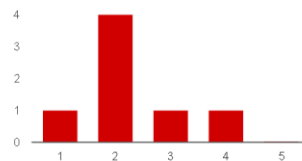
Strongly Agree: 1	1	14.3%
2	4	57.1%
3	1	14.3%
4	1	14.3%
Strongly Disagree : 5	0	0%

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Motivations and Rewards

I only like certain types of museums
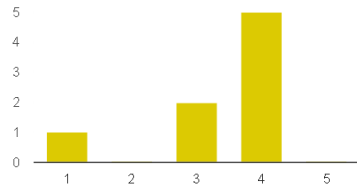
Strongly Agree: 1	1	12.5%
2	0	0%
3	2	25%
4	5	62.5%
Strongly Disagree : 5	0	0%

I am more motivated to go the a museum with my friends
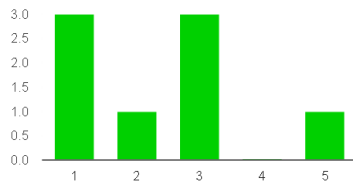
Strongly Agree: 1	3	37.5%
2	1	12.5%
3	3	37.5%
4	0	0%
Strongly Disagree : 5	1	12.5%

I would like to share my museum experience with my friends
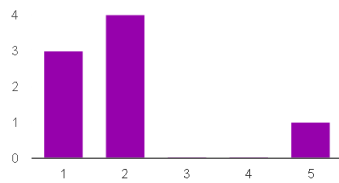
Strongly Agree: 1	3	37.5%
2	4	50%
3	0	0%
4	0	0%
Strongly Disagree : 5	1	12.5%

I would go more often to museums if there are more interesting displays
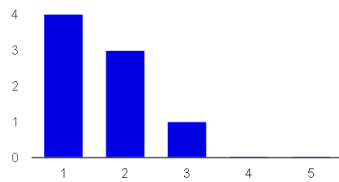
Strongly Agree: 1	4	50%
2	3	37.5%
3	1	12.5%
4	0	0%
Strongly Disagree : 5	0	0%

Interaction Experience

Touch screens are a good way to interact onscreen
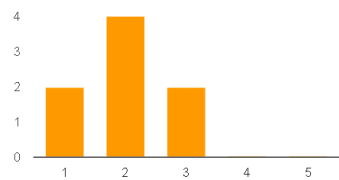
Strongly Agree: 1	2	25%
2	4	50%
3	2	25%
4	0	0%
Strongly Disagree : 5	0	0%

Gesture input is a good way to interact with the objects onscreen
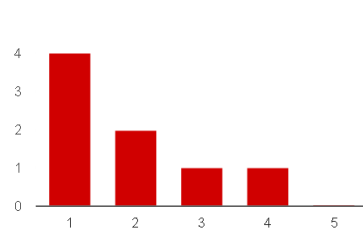
Strongly Agree: 1	**4**	50%
2	**2**	25%
3	**1**	12.5%
4	**1**	12.5%
Strongly Disagree : 5	**0**	0%

I prefer gesture over touch screen interaction with onscreen objects
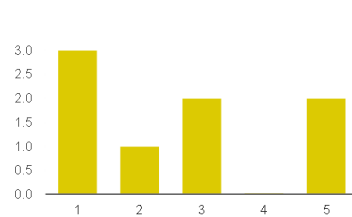
Strongly Agree: 1	**3**	37.5%
2	**1**	12.5%
3	**2**	25%
4	**0**	0%
Strongly Disagree : 5	**2**	25%

Ceramic Workshop App

Press F11 to exit full screen

Motivations and Rewards

Having a points system in the app would make it more engaging
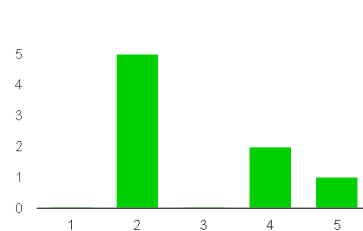
Strongly Agree: 1	**0**	0%
2	**5**	62.5%
3	**0**	0%
4	**2**	25%
Strongly Disagree : 5	**1**	12.5%

The app motivated me to learn more about the topic
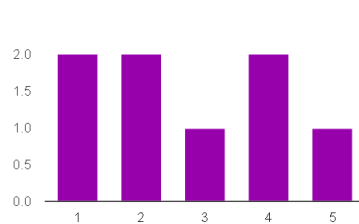
Strongly Agree: 1	**2**	25%
2	**2**	25%
3	**1**	12.5%
4	**2**	25%
Strongly Disagree : 5	**1**	12.5%

The app was a good learning experience
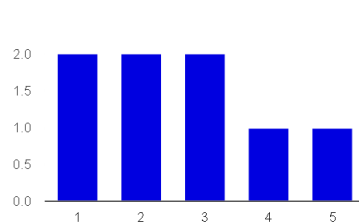
Strongly Agree: 1	**2**	25%
2	**2**	25%
3	**2**	25%
4	**1**	12.5%
Strongly Disagree : 5	**1**	12.5%

I would play with the app for a longer period of time
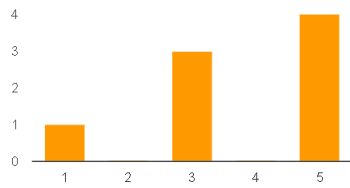
Strongly Agree: 1	1	12.5%
2	0	0%
3	3	37.5%
4	0	0%
Strongly Disagree : 5	4	50%

I would complete the app just to see the ending
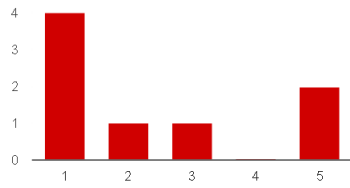
Strongly Agree: 1	4	50%
2	1	12.5%
3	1	12.5%
4	0	0%
Strongly Disagree : 5	2	25%

I explored all the options available in the app
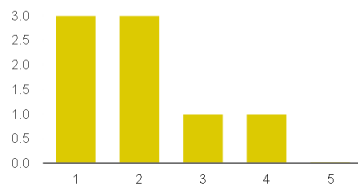
Strongly Agree: 1	3	37.5%
2	3	37.5%
3	1	12.5%
4	1	12.5%
Strongly Disagree : 5	0	0%

Perceived Issues
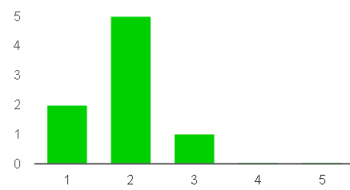
The touch screen / gesture feedback was unresponsive

Strongly Agree: 1	2	25%
2	5	62.5%
3	1	12.5%
4	0	0%
Strongly Disagree : 5	0	0%

There are too many options on the screen to use
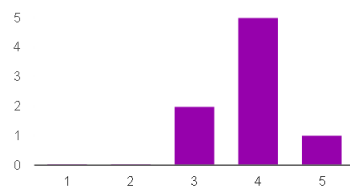
Strongly Agree: 1	0	0%
2	0	0%
3	2	25%
4	5	62.5%
Strongly Disagree : 5	1	12.5%

The interface is too complex to use
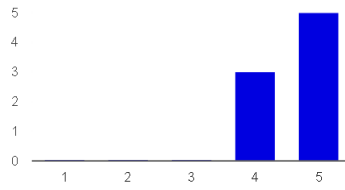
Strongly Agree: 1	0	0%
2	0	0%
3	0	0%
4	3	37.5%
Strongly Disagree : 5	5	62.5%

The app is difficult to start using and to adapt to
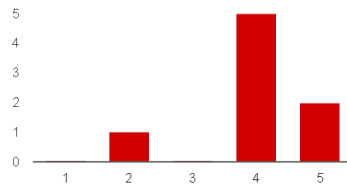
Strongly Agree: 1	0	0%
2	1	12.5%
3	0	0%
4	5	62.5%
Strongly Disagree : 5	2	25%

The information on using the app is scarce
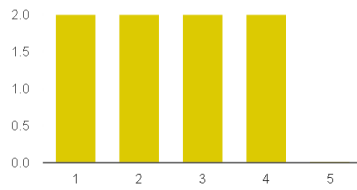
Strongly Agree: 1	2	25%
2	2	25%
3	2	25%
4	2	25%
Strongly Disagree : 5	0	0%

I will need to learn more to use this app well
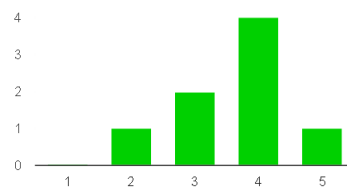
Strongly Agree: 1	0	0%
2	1	12.5%
3	2	25%
4	4	50%
Strongly Disagree : 5	1	12.5%

There was a lag in the touch/gesture feedback in this app

Strongly Agree: 1	3	37.5%
2	3	37.5%
3	2	25%
4	0	0%
Strongly Disagree : 5	0	0%

155

There was a lag in the response of the screen objects

Strongly Agree: 1	2	25%
2	5	62.5%
3	1	12.5%
4	0	0%
Strongly Disagree : 5	0	0%

Perceived Ease of Use

The instructions on using the game/application are easy

Strongly Agree: 1	4	50%
2	2	25%
3	1	12.5%
4	1	12.5%
Strongly Disagree : 5	0	0%

Learning to use the interaction system is easy for me

Strongly Agree: 1	5	62.5%
2	3	37.5%
3	0	0%
4	0	0%
Strongly Disagree : 5	0	0%

The system is flexible to interact with
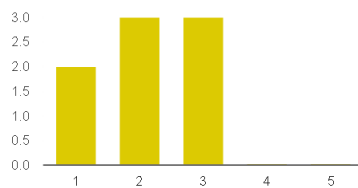
Strongly Agree: 1	2	25%
2	3	37.5%
3	3	37.5%
4	0	0%
Strongly Disagree : 5	0	0%

I can improve my skills by using this system more

Strongly Agree: 1	3	37.5%
2	1	12.5%
3	3	37.5%
4	0	0%
Strongly Disagree : 5	1	12.5%

156
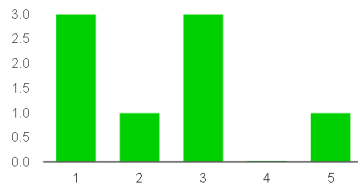
Kartal Flying Simulation App

Motivations and Rewards

Having a points system in the app would make it more engaging
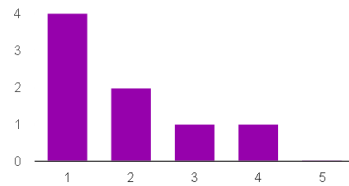
Strongly Agree: 1	**4**	50%
2	**2**	25%
3	**1**	12.5%
4	**1**	12.5%
Strongly Disagree : 5	**0**	0%

The app motivated me to learn more about the topic
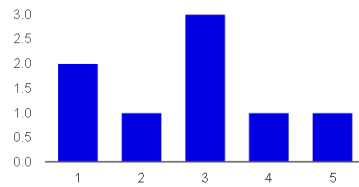
Strongly Agree: 1	**2**	25%
2	**1**	12.5%
3	**3**	37.5%
4	**1**	12.5%
Strongly Disagree : 5	**1**	12.5%
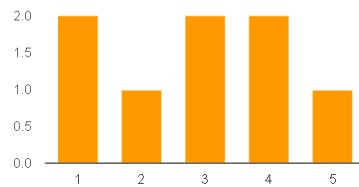
The app was a good learning experience

Strongly Agree: 1	**2**	25%
2	**1**	12.5%
3	**2**	25%
4	**2**	25%
Strongly Disagree : 5	**1**	12.5%

I would play with the app for a longer period of time

Press F11 to exit full screen
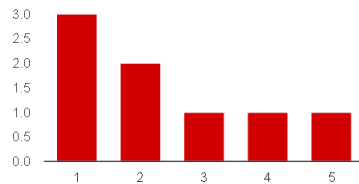
Strongly Agree: 1	**3**	37.5%
2	**2**	25%
3	**1**	12.5%
4	**1**	12.5%
Strongly Disagree : 5	**1**	12.5%

I would complete the app just to see the ending
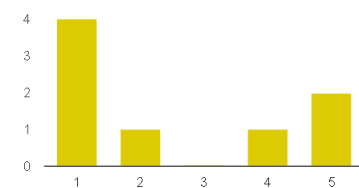
Strongly Agree: 1	**4**	50%
2	**1**	12.5%
3	**0**	0%
4	**1**	12.5%
Strongly Disagree : 5	**2**	25%

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I explored all the options available in the app
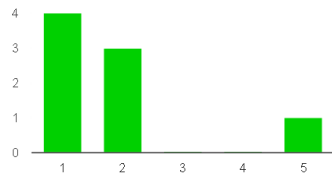
Strongly Agree: 1	**4**	50%
2	**3**	37.5%
3	**0**	0%
4	**0**	0%
Strongly Disagree : 5	**1**	12.5%

Perceived Issues

The touch screen / gesture feedback was unresponsive
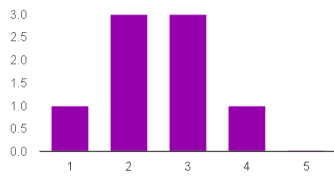
Strongly Agree: 1	**1**	12.5%
2	**3**	37.5%
3	**3**	37.5%
4	**1**	12.5%
Strongly Disagree : 5	**0**	0%
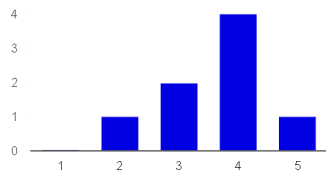
There are too many options on the screen to use

Strongly Agree: 1	**0**	0%
2	**1**	12.5%
3	**2**	25%
4	**4**	50%
Strongly Disagree : 5	**1**	12.5%

The interface is too complex to use
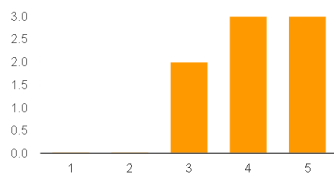
Strongly Agree: 1	**0**	0%
2	**0**	0%
3	**2**	25%
4	**3**	37.5%
Strongly Disagree : 5	**3**	37.5%

The interface is too complex to use
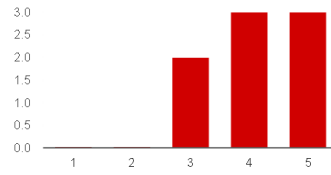
Strongly Agree: 1	0	0%
2	0	0%
3	2	25%
4	3	37.5%
Strongly Disagree : 5	3	37.5%

The app is difficult to start using and to adapt to
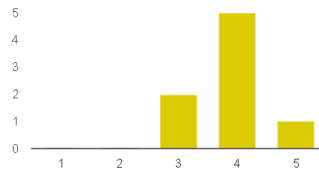
Strongly Agree: 1	0	0%
2	0	0%
3	2	25%
4	5	62.5%
Strongly Disagree : 5	1	12.5%

The information on using the app is scarce
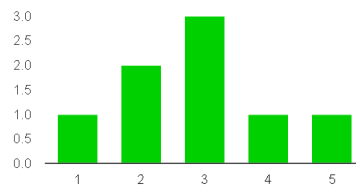
Strongly Agree: 1	1	12.5%
2	2	25%
3	3	37.5%
4	1	12.5%
Strongly Disagree : 5	1	12.5%

I will need to learn more to use this app well
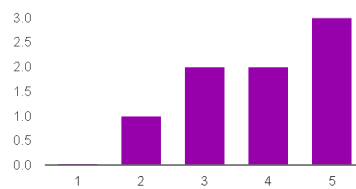
Strongly Agree: 1	0	0%
2	1	12.5%
3	2	25%
4	2	25%
Strongly Disagree : 5	3	37.5%

There was a lag in the touch/gesture feedback in this app
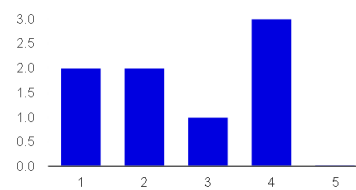
Strongly Agree: 1	2	25%
2	2	25%
3	1	12.5%
4	3	37.5%
Strongly Disagree : 5	0	0%

There was a lag in the response of the screen objects
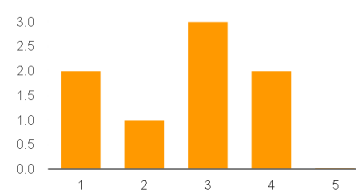
Strongly Agree: 1	2	25%
2	1	12.5%
3	3	37.5%
4	2	25%
Strongly Disagree : 5	0	0%

Perceived Ease of Use

The instructions on using the game/application are easy
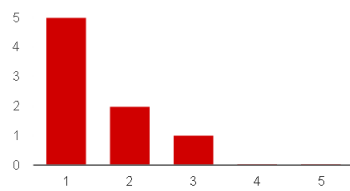
Strongly Agree: 1	**5**	62.5%
2	**2**	25%
3	**1**	12.5%
4	**0**	0%
Strongly Disagree : 5	**0**	0%

Learning to use the interaction system is easy for me
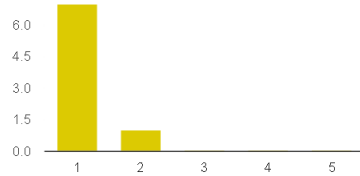
Strongly Agree: 1	**7**	87.5%
2	**1**	12.5%
3	**0**	0%
4	**0**	0%
Strongly Disagree : 5	**0**	0%

The system is flexible to interact with
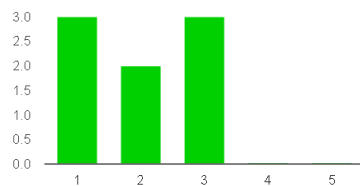
Strongly Agree: 1	**3**	37.5%
2	**2**	25%
3	**3**	37.5%
4	**0**	0%
Strongly Disagree : 5	**0**	0%

I can improve my skills by using this system more
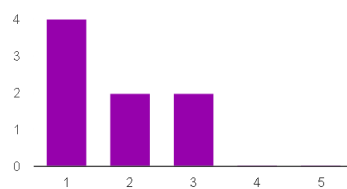
Strongly Agree: 1	**4**	50%
2	**2**	25%
3	**2**	25%
4	**0**	0%
Strongly Disagree : 5	**0**	0%