Museums as part of the network of digital culture:

A comparative study between the Republic of Korea and the UK

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I, Juhee Park, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

This thesis explores the networks of digital culture surrounding six national museums in the Republic of Korea and the UK. Via qualitative research methods, it answers the following research questions: 1) How do the dynamics between the key actors in the museum sector affect the use of digital technology as a foundation of visitor experience? 2) How have museum practices evolved to accommodate digital technology? This study also draws comparisons and contrasts between the two countries' different approaches to digital culture in museums.

Based on Actor-Network theory (ANT) and activity theory (AT), this research identifies actors who have influenced the digital projects of the case museums, for example, government, the museum itself, museum practitioners, digital industry, the public, and so on. The ways they have interconnected with each other are analysed also, as is tracing the actors. The research also highlights the importance of communities of practice (CoP) for museum practitioners' professional development because of the rapid evolution of technology and the nature of museum digital projects that are situated between the digital and museum sectors. A comparative analysis between the two countries' national museums is also presented through different actors, their roles and their relationship with the museums.

The research also identifies how communication and learning theories adopted in digital projects are dependent on the museums' overall missions, working processes, and the actors involved in the development of the digital projects. Most digital projects seem to adopt one-way communication and focus on knowledge delivery. However, game-like digital exhibits, maker spaces and online crowdsourcing projects that further consider learner-centred and sociocultural learning approaches are also found, although the museums in the two countries have different approaches.

Based on the research findings, this research provides a holistic context for understanding the digital phenomenon in museums and the degree to which the museums have shaped/been impacted by digital culture. I also suggest that museums develop digital projects through a collaborative process and harness digital technology to empower the public.

Impact Statement

This is a timely doctoral thesis that deals with a very important contemporary development in the museum. It attempted to compare the professional networks, digital projects, learning approaches and organisational changes of six South Korean and British national museums, using a blend of three theoretical tools (ANT, AT and CoP). The case studies demonstrate interesting policy, institutional, organisational and technological dynamics in the museums' digital development. This type of research has not been done in Korea before, nor in the UK. The comparative element is also unique.

This study contributes to the theoretical and practical aspects of museums. First, there was no existing literature that provided a historical discussion on digital projects in Korean museums. By examining museum practices in three Korean national museums since the 1990s, this study showed the general trend of the development of digital projects in Korean museums. This study also showed that it is necessary to reconsider the roles of the Korean government and museum policy regarding museum digital culture. The current role of the government might not be enough to encourage the museums to become involved in digital culture. Investing in human resources (e.g. digital experts) and supporting professional development opportunities regarding digital culture, which involve not only digital skills but also social learning opportunities to empower museum practitioners and to link them to others, is recommended.

The UK cases showed the importance of social learning for museum practitioners regarding museum digital culture. The boundaries of the community of digital experts in cultural sectors could be extended further to include theorists and practitioners in the field of digital humanities, media design, etc. Moreover, forming digital departments, which is a way to respond a digital age, is understood not only as a benefit for the museums to be active actors by showing its leadership in the field, but also a benefit for individual museum digital experts by supporting their voice to be heard. Therefore, the institutional level change can be further beneficial by engaging individuals to be actors actively expressing their voice. This study also showed the importance of involving educational departments in the development process of digital projects as a bridge linking content experts (e.g. curators) to the public.

In terms of theory, the complementary theoretical framework of ANT, AT and CoP theory of this study provides a new lens for understanding the complicated networks of museums in digital culture. By analysing the collective and the individual, human and non-human actors at the same time, this approach contributes to connecting museum practitioners' individual contexts to wider social situations. In so doing, a holistic understanding can be made possible. Moreover, in practice, the link

of pedagogic roles of digital technology to communication and learning approaches can help museum practitioners who take charge of digital projects understand the potential of the technology, and can help design digital experience towards social activities beyond content delivery.

Additionally, the comparison of the museum networks of the two countries contributes to the emerging Asian museology and Asian museum studies. This contribution is based on the theoretical frameworks I developed that are based on social theory (e.g. ANT) and museology, which are mainly discussed and developed by Western researchers. However, these frameworks might not be well suited for analysing and interpreting Asian museums. By addressing issues regarding this theoretical perspective, the research potentially incorporates non-Western perspectives on museums and their networks with other actors.

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Chapter 1 - Introduction

1.1 Research Background and Context

We are living in a digital age, and our behaviour and experience cannot be isolated from digital technology. The museum profession and museum visitors' experiences have both been influenced by digital culture. We can find various types of museum practice in which digital technology has been embraced, for example, from emerging museum websites in the mid-1990s to launching museum mobile applications today. The employment of automation technology in museums in North America and the UK has allowed museum practitioners to manage collections since the early 1960s (Jones-Garmil 1997), while more recently, digital technology has provided further opportunities for the public to enrich their museum experience. Moreover, there are several active international conferences and museum professional groups concerned with exchanging recent digital museum projects, or with discussing new research findings with other museum practitioners, researchers or technology developers. Given these developments, digital interpretation in and beyond museums has become a widely-recognised issue.

Digital museum projects are positioned in a boundary between digital sectors and the museum field. Thus, studies on digital museum projects have been made in various academic discourses. Research from computer science and engineering fields has addressed the technological aspects of the projects, for instance, introducing new technologies and applications for digital interpretation and for digitising museums' collections and cultural heritage (see, for example, the conference proceedings of the international Digital Cultural Heritage conference[1]). Researchers and museum practitioners whose works are based on informal learning have investigated the learning outcomes and the impact of digital interpretations on learning and museum experience (see, for instance, Baek 2007; Hsi 2003; Gammon & Burch 2008; Drotner et al. 2008; Meisner et al. 2007; Kang 2011a and among many others).

Most of the research dealt with individual projects as a case study, however, and only a few studies have looked at the holistic contexts of digital museum projects by addressing social or individual factors, for instance, policy, funding, and museum practitioners' perspective on digital tools that affect the development of digital projects (Knell 2003; Kéfi & Pallud 2011; Camarero et al. 2011). Therefore, there remains an open question as how to investigate the stories of the development of digital museum projects; particularly linking social factors to the individual factors of museum practitioners. This is one of contributions of my research.

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[1] http://dch2017.net [Accessed 21 August 2017].

This PhD considers the relationship of museums with other actors, and how this has influenced digital museum projects. In contrast, the original focus of my research was on the role digital resources developed by museums to facilitate visitor interpretation play in visitor museum experience. So, it is worth briefly explaining why my research direction changed, to provide background and context for what follows.

First, my working experience in various museum projects, mostly planning exhibitions for museums, and my academic background in computer science and engineering prepared me for research interests about how digital technology can foster museum experience. Before embarking on this PhD, I worked for three years as a curator at a Children's Museum near Seoul, in the Republic of Korea (hereafter Korea). During that period, I planned and managed permanent and temporary exhibition projects and relevant education programmes. I was involved in the development of various types of digital exhibits for children and family visitors through a collaborative process with an in-house designer and external exhibit fabrication firms. In some cases, such as an exhibition about multicultural communities, children and their families also participated in the exhibition development process. This experience particularly influenced my perspective on museum learning based on a sociocultural learning approach that considers visitors' various cultural and social backgrounds. I return to this learning approach and discuss it further in Chapter 3.

On the other hand, I encountered various issues with developing and managing the digital exhibits; exhibit fabrication firms struggled to implement ideas that needed to employ new digital technology, and as a museum practitioner there was a lack of opportunities to develop my expertise in digital museum practice in Korea. Fortunately, I had opportunities to visit many museums in the USA, Western Europe and Asia for benchmarking. The museums I visited included not only children's museums but also art museums and science museums (and science centres). From the experience, I could observe diverse types of digital museum projects, and could discuss them with the museum practitioners working at the museums. In so doing, my research interests on how digital technology can be harnessed to foster visitor museum experience gradually emerged.

Since the beginning of my PhD research, I attempted to discover how digital technology has influenced museum experience. First, I reviewed what components affect museum experiences. I then examined how digital technology has historically been embraced by museums in terms of interpretation tools, digital collections, Information and Communications Technology (ICT) for learning activities and social media. Yet, after reviewing relevant research papers, and thinking about the reasons for the lack of well-designed digital recourses/interpretation/learning programmes in Korean museums, I came to realise that I needed to study the networks of the museums and digital technology to understand this apparent lack of focus on the digitally facilitated visitor experience on

the part of Korean museums. This is despite the fact that Korea is recognised as one of the leading countries in digital technology, producing pioneering digital devices and providing well-developed digital infrastructure, such as network systems, and investing in the development of digital content and technology at government level.[2] Moreover, many Koreans are familiar with using digital devices, such as smartphones, and Korean pupils have a relatively high digital literacy (OECD 2011).

Despite the strong will of the Korean government to extend digital culture across the nation, there is less discussion at the levels of museum policy, academic research and museum practice about how to embrace digital technology for the public in Korean museums. Bae (2007) points out that one of the reasons several digital projects in Korean culture sectors have failed is the lack of a systematic design. Lee (2012) proposes a collaborative process among Korean museums, libraries and archives to integrate cultural heritage information in a digital way. However, through this PhD project, I argue that it is necessary to embrace digital culture in museums to change not only museum policy and museum institutional factors, but also the mindset, attitudes and perspectives of individual museum practitioners towards digital culture. Thus, the collective and the individual should be considered together to understand why and how digital museum practices have been shaped in a certain way.

The situation around embracing digital culture in UK museums seems to have emerged differently compared with the Korean cases. Although support from the UK government is a significant factor, there have been greater efforts at the museum institutional level as well as the museum practitioners' individual level. For instance, some UK museums have recently formed and extended their own digital departments. Digital has become normative within the organisational structures and strategies of the museums (Parry 2013). Therefore, my research interests developed into investigating the roles of the newly-established departments and how they interact with other departments and museum practitioners. Moreover, there are various seminars, workshops and conferences concerning digital culture, digital heritage and digital humanities organised by UK museums, museum professional bodies and universities. Through these events, individual museum practitioners who are interested in digital culture can meet other practitioners working on digital projects. Linking and networking people are significant functions of these events and attending social events strengthens and stabilises the professional identity of the individuals as digital museum experts. By attending these events, my research interests further developed to investigate how museums and museum practitioners work with external actors (including the public), what their roles are, and how they impact digital museum projects. Thus, I decided to change the direction of my research to investigate the relationship of

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[2] For example, the Korean Government recently legislated a special law to encourage the research and development of ICT (MSIP 2014b) and form a 'digital contents fund' that supports individual content creators and companies who specialise in developing digital content using digital technology such as computer graphics and virtual reality, and that supports the establishment of Digital Contents Korea Labs across the nation (MSIP 2014b).

Korean museums with other actors in a digital age and compare them with the UK museums and relationships.

There are several reasons why I chose to compare Korean national museums with those of the UK (see Section 4.1.2 for further detail). First, Korean culture policy-makers tend to refer to UK cultural policies as good examples, and many Korean museum professionals visit UK museums for benchmarking. Moreover, the role of government is important in both Korean and UK museum policy and funding, although the government-museum relationship and the extent to which government affects museum practices differ between the two countries. In short, Korean national museums as government organisations have a much stronger relationship with their government in terms of museum management (Lee 2002; Yang 2002a; Park 2012b). National museums in the UK, which are non-government bodies and operated based on the government's arm-length principle, are more independent and less affected by their government in terms of museum practices (Kawashima 1997). However, the museums in both countries tend to implement new museology that places the public at the centre of museum practices (Baek 2005; Kang 2011b; McCall and Gray 2014). Therefore, in this study, I examine the power relationship between government, museums (and museum practitioners) and the public in the national museums of the two countries.

At the beginning of the study, I consider US national museums also, because Korean museum practitioners often visit US museums for benchmarking and invite US museum professionals to exchange knowledge on museum practices. National museums in the US could form a part of the network of Korean museums, as discussed in the Korean cases in this research (see Sections 5.4.1.2, 6.4.2.1 and 7.4.3). However, the US museums, whose budgets mostly come from commercial/private funders, have a very different relationship with their government. Thus, I selected UK museums for comparison because one of my research interests is understanding the influence of government on museum practices in a digital age (Research Question1-1).

My analysis of changes in museums, their actors, their relationship within digital culture, and my exploration of how these have impacted on museum practices are distinctive and innovative features of the project. My research aims to understand not only the effect of the collective but also of individual museum practitioners. This is because I regard a museum to be not only an institution regulated by systems but also a network developing its context by interacting and disputing with other actors. Therefore, networking of all the relevant actors who influence digital museum projects is considered significant in this research. Furthermore, I consider that the network directly or indirectly affects the underpinning communication and learning approaches of digital museum projects. Thus, this research contributes to rethinking the pedagogical roles of digital technology in projects.

This type of research has not been done in Korea before, nor in the UK. The comparative element is also unique. I expect this comparative study to benefit both countries because they have unique characteristics: Korea is digitally and technologically enhanced, and the UK has generally been considered as having well-developed cultural sectors and creative industries. Korean museums can learn from this research how to empower museum practitioners, and why this is particularly important regarding digital culture. Museums in the UK can see how secure funding from the government can have positive or negative effects on museum practices. They can reconsider their network with the government and/or commercial sponsors. Moreover, both countries can learn how the public as actors can be empowered by digital technology, and why this is significant for museums in a contemporary society relating to new museology. Additionally, the comparison of the museum networks of the two countries contributes to the emerging Asian museology and Asian museum studies (Sonoda 2016). This contribution is based on the theoretical frameworks I developed that are based on social theory (e.g. Actor-Network theory) and museology, which are mainly discussed and developed by Western researchers. However, these frameworks might not be well suited for analysing and interpreting the data I collected from Korean museums. By addressing issues regarding this theoretical perspective, the research potentially incorporates non-Western perspectives on museums and their networks with other actors.

1.2 Research Questions

The overarching question that my study explores is: How have museums, as part of the network of digital culture, interconnected with other actors? I divided this question into three research questions, as presented below. Research Question 1 and its subsidiaries investigate the network of actors behind museums using digital culture. Research Question 2 and its subsidiaries consider the perspective of museum practice. Research Question 2-2, in particular, examines the underpinning communication and learning approaches of digital museum projects, helping me answer and understand the reasons digital projects in Korean museums seem to take a school-like approach, despite the employment of innovative cutting-edge digital technology. Research Question 3 synthesises the discussions from Research Questions 1 and 2 and examines them comparatively. Through these research questions, I develop my argument on how the relationship of museums with other actors has influenced their digital projects, and what is necessary for museums and museum practitioners to be active actors. I particularly focus on the period post-1990 because the internet and personal computers were more widespread at that time, and museums also launched their first websites in the mid-1990s (Parry 2007). Therefore, I assume that the use of digital technology facing visitors has increased, and internal organisational change might have been made, since 1990.

Research Question 1) How do the dynamics between key actors in the museum sector affect the use of digital technology as a foundation for visitor experience?

This can be broken down into:

- o (RQ1-1) What is the impact of government policies promoting personal digital devices on museums?

- o (RQ1-2) How do museums work with government agencies and external actors to promote the use of digital technology for interpretation?

- o (RQ1-3) How do funders' requirements influence digital projects?

- o (RQ1-4) What is the balance of influence between government agencies, public and industry funders for digital museum projects?

Research Question 2) How have museum practices evolved to accommodate digital technology?

This can be broken down into:

- o (RQ2-1) What types of digital projects have been developed by museums since 1990?

- o (RQ2-2) What communication and learning approaches have been adopted for digital projects?

- o (RQ2-3) What internal organisational changes have been made to deliver digital projects?

Research Question 3) How do Korean national museums compare with the UK?

This can be broken down into:

- o (RQ3-1) How are the networks of Korean national museums with other actors different from/similar to the UK?

- o (RQ3-2) What are the similarities and differences regarding the types of digital projects developed by the two countries' national museums since 1990?

- o (RQ3-3) How are the communication and learning approaches of digital projects in Korean national museums different from/similar to the UK?

- o (RQ3-4) How are the ways that the Korean national museums have made internal organisational changes in response to digital culture different from/similar to the UK?

1.3 Definition of Key Terms

Before setting out the structure of the thesis, this section presents the definition of several key terms used in this research, including museums; digital culture and digital technology; and network.

According to the definition of museums by the International Council of Museums (ICOM), 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.' I have adopted this definition for this research because it broadly covers the definitions of museums defined by the UK Museums Association and by the Museum and Art Gallery Support Act in Korea. In so doing, I have included art museums (art galleries) with collections of works of art as well as museums with historical and scientific collections of objects. Libraries and archives have been excluded.

Depending on the research subject, some researchers define 'digital culture' as having a narrow meaning concerning online platform culture (Deuze 2006). When the term 'digital technology' is used in a museum context, it is also sometimes defined as specific to technology or media, such as a handheld guide (Tallon & Walker 2008), digital heritage and computing information (Parry 2007). However, I consider the word 'digital' can stand for a particular way of life of a group or groups of people (Gere 2009). This is because, relating to activity theory that I adopt as a conceptual framework for this research (see Section 2.4), employing digital tools in museums means not only changes the tools but also influences museum practices and the ways to enjoy and interact with museums. Therefore, digital technology can also refer to a broader concept of being a product of digital culture (Gere 2009), for example, digital interpretation media, websites and mobile applications.

Finally, 'network' in this study is used from the Actor-Network theory point of view, which considers a society networked with human and non-human actors (see Section 2.3). I was inspired by this perspective and use it selectively as one of the theories for this research.

1.4 Thesis Structure

This thesis has 12 chapters. In Chapter 1, I outline the background and context of this research and present the research questions. Chapter 2 and Chapter 3 review existing literature to validate the need for my research and build a theoretical framework for it. Chapter 2 performs two functions: reviewing literature about digital museums and demonstrating social network theories. Digital museums are a rapidly evolving area with the development of digital technology. A section about digital museums in

this chapter presents a brief history of digital museums, the distinctive features of digital technology, the general rationale of the employment of the technology in museums, the benefits and challenges of this, and a brief explanation about emerging new practices to provide overall views on digital museums. The social network theories I adopt for this research, Actor-Network theory, activity theory and communities of practice theory, guided me to answer Research Question 1, in general, and Research Question 2 and 3. Although these theories were developed in different academic discourses, they fundamentally view society as complicated and dynamic, rather than pre-structured and static. This commonality supports a complementary approach I took to examine different aspects of the networks of museums in a digital age.

In Chapter 3, I discuss new museology and communication and learning theories that might have been adopted by digital museum projects. These theories are particularly relevant to Research Question 2-2. I review how museology has evolved from a traditional, old temple-type to a new, forum-style reflecting postmodern contemporary society, which considers various cultural and social elements that visitors bring, and views knowledge subjective. I then discuss how a link between the new museology and communication and learning theories can be made by employing digital technology.

Chapter 4 explains the methodology and methods I chose for this research. First, the reasons I adopted qualitative multiple case studies are presented. I justify why I chose Korea and the UK, and how I selected six museums and their digital projects. I explain also the data collection process using three methods: secondary data, interviews (mainly with museum practitioners) and visual data and the data analysis process. In addition, the ethical issues I was concerned with throughout the research are discussed.

The following 6 chapters, 5 to 10, present my analysis of the six case museums. Each case museum is presented in its own chapter consisting of two parts: identified actors and their network and digital projects, with an analysis of communication and learning theories. The reason I structured the chapters in this way is because I attempted to consider each museum from their point of view, and to find relevant actors by tracing their activities. By doing so, I attempted to keep and understand the identity of, and the unique context of, each museum.

Chapter 11 brings together the preceding six chapters, and comparatively examines my analysis of the museums in the two countries. To address Research Question 3, I draw comparisons between the Korean museums and the UK museums regarding the following findings: the identified key actors and overall communication and learning theories adopted in digital museum projects. Through the comparison, I examine similarities and differences among the museums, and the context within and between the two countries.

Finally, Chapter 12 concludes the thesis with a short summary of my findings, the limitations of the research, the contribution this research makes to the existing literature on digital museums, and practices and directions for future research.

Chapter 2 - Literature Review and Theoretical Framework (1): A Way to Understand Museums in a Digital Age

2.1 Introduction

My research investigates how museums, as part of the networks of digital culture, are associated with other actors. In order to provide an overall background to this research, this chapter begins by reviewing the literature on museums in a digital age, and then describing the first part of theoretical framework, which is adopted for understanding the dynamics between key actors who have affected museum practices in the digital age, and power relationships between them. This is mainly associated with Research Questions 1, 2-3, 3-1, and 3-4 (see Section 1.2). I adopt three theories: Actor-Network theory (ANT), activity theory, and communities of practice (CoP) theory. First, I was inspired by ANT, which regards society as a complex network of human and non-human actors. Selectively adopting this theory to examine power relationships between actors enabled me to consider individual museum practitioners and digital technology as actors at the same level as other social structures. While, activity theory, which focuses on the viewpoint of human actors (i.e. museum practitioners), will be used as a conceptual tool to understand the roles of actors and rules, for instance, laws and contracts with suppliers, which should be followed by human actors. In order to uncover the ways in which museum practitioners develop their professional skills in terms of digital culture, CoP theory will be utilised. The theoretical framework takes an overall complementary approach in order to examine different aspects within the digital networks of museums.

The second part of theoretical framework, which illustrates communication and learning approaches that could be adopted for museum digital projects, is presented in Chapter 3. This is related to Research Questions 2-1 and 2-2, and 3-2 and 3-3 (see Section 1.2). In this research, digital museum projects are seen as the result of continuous negotiations between the actors involved in the projects; thus, it will be seen how the actors and their perspectives on museums and digital culture have influenced the communication and learning approaches. In so doing, this looks at how a public-facing aspect of digital offerings is designed and developed towards new museology that places the public at the centre of museum practices.

2.2 Museums and Digital Culture

To provide the background for this research, this section will address several aspects of how digital culture has influenced museum practices to facilitate the visitor experience. First, I will introduce how

digital practices in museums have evolved and why this has occurred. This section also provides the distinctive features of digital technology and media in comparison to analogue equivalents. Furthermore, adopting a digital culture seems to cause changes to work processes and the work skills expected/required of museum practitioners. By considering digital museum projects as part of the whole digital networks of museums, we can understand museums in the digital age from a holistic point of view.

2.2.1 Evolution of Digital Practices in Museums

The employment of digital technology in museums has increased, and Parry and Sawyer (2005) have analysed the evolution of in-gallery ICT in UK national museums as a six-phase process. Although my study not only involves in-gallery experiences but also a whole museum's digital experience, including online learning, and it focuses on digital projects that have been developed since 1990, their analysis of the evolution process is still relevant to my study and can aid in understanding the general trend in digital museum projects from the 1950s to today. The ways in which museums have embraced digital technology have evolved, as can be seen Figure 2.1, in the categories proposed by Parry and Sawyer (2005).
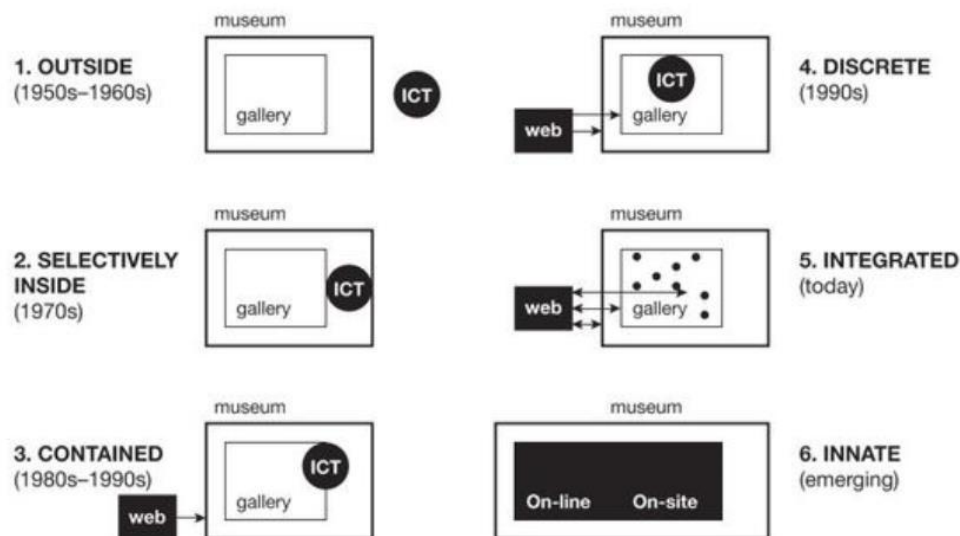
Figure 2.1 The evolution of in-gallery digital interactivity
(Parry & Sawyer 2005)

During the first phase from the 1950s to the 1960s, ICT remained outside not only the space of the gallery but also the museum. However, some pioneering handheld devices that adopted radio systems and tape-recorded devices were developed at that time. The mobility and personality features of these devices may have affected approaches to current mobile guides (Tallon 2008).

ICT peripherally entered museums in the 1970s, but only in relation to certain practices, such as collections management, documentation and specific research. Since the late 1960s, collections in US and UK museums have grown extensively due to the changing notion of what museums should collect in order to reflect social change (Parry 2007). The rapid development of computing research and industry have made it affordable for museums to adopt computing and data processing systems, which have enabled museums to organise and manage their collections logically and systematically. Network systems have also allowed research institutions, including museums, to exchange their resources more efficiently than ever before. The important role of museums as educational institutions has been emphasised since the late 1960s, and providing access to the rich collections and resources of museums for public learning purposes has become one of their core roles (ibid.). Consequently, how to digitise collections and establish standards for efficient data sharing have become important issues, and the subject of research in both the museum sector as well as computer science and information studies (Keene 1998).

Since the 1980s, the exhibition space has contained ICT, but usually in separate rooms to the museum collections; for example, the Micro Gallery at the National Gallery, London. In the 1990s, ICT began to be presented within galleries as stand-alone interactive devices, such as a kiosk. This new type of digital exhibit sometimes had a connection with the collections displayed. Increases in this type of display have been associated with the emergence and extension of science centres, which encourage young visitors' interest in science through the provision of diverse interactive exhibits (Allison-Bunnell & Schaller 2005). However, in many cases, these devices remained both physically and conceptually disconnected from their surroundings. In parallel, there was a rapid development in online applications following the launch of the World Wide Web to the public in the mid-to-late 1990s, and subsequently, many museums launched their first websites.

Today, digital media is more physically integrated with the content of exhibitions and sometimes enables a dialogue between the on-site and online museums. The later phase to emerge is where digital media is conceived during the initial design of exhibitions to provide an interpretation strategy, significantly shaping the exhibition space. Digital media is now placed at the centre, rather than as an 'add-on' feature, and creates an immersive environment for visitors to be engaged with in a familiar form.

Finally, digital media has been hidden from view, as it has become an integral element of the gallery environment. Parry and Sawyer (2005) provide examples of this situation, such as the projectors for the Imperial War Museum North's 'Big Picture', the Digitopolis exhibition at the Science Museum, London, and a digital table in the Cabinet War Rooms, the Churchill Museum.

More recently, when considering online offerings, for example, digital games, crowdsourcing projects, and social media in museum settings, these seem to extend the boundaries of museums further into the digital world. The digital presence, such as 3D models of museum objects, even offers opportunities to recreate physical things and lead building new relationships between the digital and real world. For instance, Pokémon Go, one of the most successful mobile application games based on Augmented Reality (AR) technology, shows that a digital offering has potential to approach the public in different ways and to attract them into museums (Sullivan 2016).

Additionally, digital offerings are expected to attract young people who are familiar with digital culture. The younger generation are defined as 'digital natives', as they have used digital technology, such as the internet, computers and mobiles, from an early age, and have unconsciously integrated them into their daily lives (Prensky 2001). Based on this understanding, some educational researchers have argued the necessity of new pedagogies for digital natives, instead of traditional methods; however, others claim that there is not enough evidence to support the identification of distinctive characteristics between 'digital natives' and others (Bennett et al. 2008). Even though it remains uncertain as to how 'digital natives' are different from other generations, there is an undoubted challenge for educators to understand the change of educational approaches for young students in order to harness the benefits from technological innovations. Museums as educational institutions are expected to respond to this situation, and a game-like approach might be one of the pathways that museums consider in the digital culture. I further discuss the game-like approach in terms of its perspective on learning in Chapter 3.

Moreover, digital technology has been recently highlighted as an essential skill for the younger generation, and digital literacy means not only consuming digital technology, but also creating content and communicating by using digital technology (Hague & Williamson 2009). This is considered especially important for participation in the digital world (Hague & Williamson 2009; McShane 2011), and museums tend to perceive this as an opportunity to provide digital learning sessions that offer young visitors the chance to explore the museum collections via digital technology.

The study of Parry and Sawyer (2005) only analysed UK examples, and the papers I refer to here were written by Western researchers, which may be different to Korean cases, but no historical review of Korean museums' digital projects could be located. The general trend and phenomenon to employ digital technology within museums could be similar in both countries, while potential differences also can be anticipated, owing to cultural and social differences of the two countries. Therefore, ANT, activity theory and CoP theory as a theoretical framework will guide me to uncover how the digital networks of museums has been constructed, who the actors are, and how they have influenced museums digital practices.

In summary, the important point that Parry and Sawyer (2005) highlight is that digital exhibits should be intertwined with other physical elements of galleries and the space within them, not simply an add-on element. The function of digital elements is maximised when their boundary is extended into the online space for additional connections. This could contribute to linking museum visitors' experiences to their ordinary life beyond the museum walls. I investigate how digital technology facilitates building this link by analysing the communication and learning approaches of digital museum projects (Research Question 2-2).

2.2.1.1 Digital Art

The art museums chosen for this research are dedicated to modern and contemporary art works (see Chapter 4 for the selection of case museums). Although my research interest is in digital interpretative media rather than art media itself, it is worthwhile introducing digital art as part of contemporary art because its distinctive features have resulted in the involvement of different actors. In this section, the definition and categories of digital art will be explained, and the relationship digital artists have with other actors will be examined.

Digital art is an umbrella term that covers a broad range of artistic works and practices (Paul 2015). Paul (2015) categorises digital art into two forms, with the first using digital technology as a tool for the creation of more traditional art works, such as a photograph, print or sculpture, and the second using digital technology as a medium. The latter form is commonly understood as 'new media art', and takes various forms, for example, installations, film, video and animation, internet art and networked art, software art, virtual reality, and sound art (Paul 2015). The boundaries of digital art are continuing to extend, with the further development of digital technology (Paul 2015).

It is obvious that the history and evolution of digital art is associated with the history of science and technology (Paul 2015). Early experimentation of the artistic application of computing systems was led and conducted by universities and at the research centres of large companies, such as Bell Laboratories (Wands 2006, pp.24–25). Moreover, digital art was mostly exhibited at conferences, festivals, and symposia devoted to technology or electronic media, and it was perceived as peripheral in the art world until the late 1990s (Paul 2015). Paul notes that digital art 'collapses boundaries between disciplines – art, science, technology, and design – and that originates in various fields, including research-and-development labs and academia' (Paul 2015, pp.21–22).

The characteristics of artists who create digital art also differ from traditional artists; some are computer programmers who can use code to create their work, while others collaborate with programmers and engineers as a team to realise their works (Wands 2006). The complex collaboration process of digital artists with computer programmers, engineers, scientists, and designers is easily founded (Paul 2015). These artists commonly have an understanding of digital tools, as well as a high

level of technical knowledge, and possess the technological curiosity to create artworks using new tools and techniques (Wands 2006).

Digital art and digital artists are positioned between art and digital technology, and in Chapters 5 and 8, the ways that art museums have introduced digital culture through digital art will be further investigated.

The section above explained how and why museums have embraced digital technology, which is now involved in every museum practice, from collection management to exhibitions, learning programmes and marketing. However, museums still seem to struggle to embrace technology as expected, and so it may be helpful to consider the fundamental differences between digital technology to analogue methods.

2.2.2 Distinct Features of Digital Technology

Negroponte (1995) stated that computing is now not about computers but about living. Digital media has changed our daily lives as a result of several distinct features of digital technology. A fundamental aspect is that because digital items exist numerically, they can be programmable, algorithmic and automated (Manovich 2001; Miller 2011). Digital technology allows data to be calculated and facilitates automatic functions in response to pre-encoded programmes. The information obtained from digital systems already exists in databases where data is structured systematically, and the stored data is retrieved in meaningful ways when demanded by a user. This automatic system allows us to be a unique individual (Negroponte 1995), and consequently, we can now access more personalised services via digital media.

This programmable feature is also associated with interactivity, which Miller (2011) noted is a widely used term to describe digital media but is difficult to define. According to Miller, it is generally defined as 'responsiveness', referring to the ability of media to respond to a preference, need or activity of a user. Manovich (2001) argues that 'interactivity' is the most basic fact about computers and denies that it is a feature of digital media because previous media could also respond and interact with a user, promoting them to do some sort of work. Therefore, it may be more articulate to define 'interactivity' as a capacity that allows users to add value and revise existing content, rather than only responding to it (Lister et al. 2009). For example, when using social media, we can express our thoughts and ideas, such as by posting something or leaving our own comments on existing posts, or simply by clicking the 'like' button. Thus, 'interactivity' is not just scrolling down computer (or mobile) screens; this feature allows users to actively participate in society by having the opportunity to express their thoughts. The way in which museums understand 'interactivity' may affect the communication and learning approaches of digital museum projects. When museums only consider

interactivity as 'responsiveness' then the role of digital media may be minimised to react to input based on the behaviourism point of view; I will come back to this in Chapter 3, when communication and learning theories are described.

Being digital, in theory, allows unlimited copies and the manipulation of originals without any damage to them (Manovich 2001; Miller 2011). This feature can provide further opportunities for museums to share resources via networks and to allow everyone to remix and reuse digital material infinitely (ICOM 1996). Different media, such as text, images and video, can also be combined as digital content and later be deconstructed relatively easily. This makes digital media dynamic, and enables museums to cater for visitors who have different demands and expectations, as multiple resources and various interpretations of museums objects can be offering concurrently (Tallon 2008).

Poster (1995) examined the internet model (new media) in terms of its communication approach. While a message is sent hierarchically from the top level to the bottom within the broadcast model (old media), the internet model is less hierarchical, and networks between senders and receivers enables two-way communication. In this manner, the audience is considered to be more active and can afford to participate in building the network. Moreover, this model causes the blurring of producers and consumers, and as a result, anyone can now be a producer via his/her personal media, as well as a consumer. This point of view will be linked to the communication approaches of digital museum projects when discussing how museums consider the public. When museums harness and highlight this aspect of digital media within their digital projects, the projects may offer an opportunity for the public to present their ideas and share them with others.

The hypertextual structure of digital media also allows users to explore and choose content in any order (Miller 2011). Digital content exists like a node and is linked to other nodes; thus, via this structure, digital content can take various non-linear paths. For example, a mobile guide allows visitors to control the interface and choose what they want to know and learn. Instead of following a pre-structured guided tour, visitors can construct their own experience and learning in a self-directed manner using a digital device (Falk & Dierking 2008; Gammon & Burch 2008).

In summary, the distinctive features of digital media, such as digital, networks, interactivity, hypertextual, automated and use of databases, provides users with more choice to explore content and express their thoughts. Using digital media, which is characteristically much more horizontal than analogue alternatives, with multiple choices, means that more diverse stories and ideas from different points of view can be shared. In other words, digital technology can be harnessed to make the various voices of the public heard in museum practices more than ever before. Thus, this is not only about the change in media, but also the change in direction of society and museums. The methods by which digital technology can facilitate the diverse public interpretations are further discussed in Chapter 3,

along with communication and learning approaches, particularly a cultural approach to communication, social constructivism and a sociocultural approach to learning and critical pedagogy.

2.2.3 New Practices and New Actors

Developing digital museum projects does not only require an additional process to implement it in practice, but also needs new human actors with the skills to apply the technology (Keene 1998). This can be accomplished by employing people with specific skills, outsourcing technical tasks to an IT services company, or be provided by a local authority or other umbrella organisation. Although museums may decide to outsource the task, they still need people to communicate with the contractor and make decisions concerning what is required (ibid.). Consequently, new jobs, such as digital managers, have emerged within the museum sector.

This new practice causes another issue, which is that developing digital projects requires the various stakeholders, for example, curators, digital experts, designers, educators, the public, etc., to work together. This collaborative working process may be not linear but instead, dynamic and complicated in order to negotiate the various requirements. Curators, who have specialist knowledge of collections and subject matters are expected to work as a member of team with those who have expertise in digital production (Keene 1998). Developing digital projects is an interdisciplinary area where diverse points of views can and should be encompassed. Therefore, open-minded museum practitioners with a variety of backgrounds may be required, and a collaborative working environment should be encouraged.

However, there is a gap between this anticipated change and real practice. There may be difficulties to fulfil the expected collaborative work processes due to constant conflict among the various stakeholders. Therefore, it is crucial to understand the ways in which the various actors within digital museum projects interconnect in order to obtain a holistic understanding of museums and digital culture. ANT, activity theory, and CoP theory are adopted as the theoretical framework for this research to aid investigation into this issue. The following sections will discuss the theories, starting with ANT.

2.3 Actor-Network Theory

Museums and museum practices might be shaped by the society or government under which they operate (Bennett 1995; West & Smith 2005; Fyfe 2006; Newman 2013). In particular, national museums have a tendency to come under pressure from the government, thus, it is necessary to investigate government policies and societal culture in order to understand museums within macro

society. Museums as an active actor are developing in their context by interacting and disputing with other actors (Lavine & Karp 1991). Therefore, it is also essential to investigate museum practitioners' context and efforts in order to understand the point of view of museums as an active actor who is willing to produce and present their voice. I was inspired by ANT, which suggests a link between social structure and agency. This theory is selectively adopted to consider the power relationship between actors of museums in a digital age. However, the theory does not provide a conceptual tool that can be used to analyse the centrality of state actors or the hierarchical process of policy-making. I discuss this limitation later in this section.

The aim of ANT is to describe 'how' relationships collectively assemble, while classical social theory attempts to explain 'why' something happens within a pre-structured society (Law 2009). In other words, in order to explain what has happened, ANT applies a bottom-up approach, using empirical case studies rather than starting with assumptions (Law 1992). ANT is particularly useful to describe situations where innovations grow, where works and group boundaries are unclear, and when the range of entities to be considered alters continuously (Latour 2005, p.11).

This research, which investigates how digital museum projects have been dynamically developed, does not begin with the assumption that museums are set in a certain social structure. Instead, museums are perceived as various networked associations. For example, it is not assumed that the power of government influences national museums, yet a government could be approached and uncovered as an actor by tracing the actors who have been involved in the development process of a museum's digital projects. Moreover, embracing digital technology in museum practices is still a growing area, and digital technology itself has evolved rapidly, with constant negotiation among the actors involved. The ANT viewpoint is regarded as reliable for understanding dynamic networks that change with multiple actors and their unstable power relationship in contemporary society (Fenwick & Edwards 2012b). However, it could also be true that this approach better suits describing Western society than non-Western societies, although recent Korean research has adopted ANT (Hong 2010). I return to this issue below.

ANT emerged in the early 1980s and was proposed by sociology of science and technology researchers (Latour 2005). It is now widely applied in various academic discourses, including sociology, technology, feminism, cultural geography, organisation and management, environmental planning, health care, and education (Fenwick & Edwards 2012b). In museum studies, relating to my research, Kéfi and Pallud (2011) investigated the role of ICT in cultural mediation in French museums from the ANT perspective. Their findings revealed that museums tend to employ ICT as content-driven mediation where the curator's authoritative view on objects and collections is dominant, instead, harnessing it as visitor-orientated one where enjoyable experience for visitors is offered. They

also highlight the necessity and importance of rethinking about ICT and improving understanding of its potential in museums.

In the following subsections, the concept of the actor in ANT will be explained and how this is adopted in this research. In addition, the translation, the process of building a network, which was developed by Callon (1986), will be described. This will deal with how different human and non-human entities are assembled, and obtain and lose power over time. By so doing, this theory enables me to examine power relationships between actors.

2.3.1 The Actor in ANT

An actor in ANT terminology is not limited to a human being (Callon & Latour 1981). The only criterion needed in order to be classed as an actor is that an actor must bend the space around them to represent their power and boundary, make other elements dependent upon them, and translate their will into a language of its own (Callon & Latour 1981; Latour 2005). In order to be recognised as an actor by ANT, an entity's endeavour to interact with others to achieving its goals should be identified.

ANT seeks to place each of the entities on a level field, where a macro actor is viewed as no larger than a micro actor (Latour 2005). For classical socialists, macro forces such as social systems determine the actions of individual micro actors. Yet, ANT ignores the predetermined social structure and social order, which can control the action of individual actors (Latour 2005; Law 1992). ANT makes macro actors easy to analyse in 'flat ontology' by considering them as the same level as micro actors, and having as much power to construct networks with other actors (Callon & Latour 1981). This does not mean that the power structure of macro and micro actors, such as class and nation state, is not real and does not exist (Law 2000), but ANT denotes that they offer no framework for the explanation of complicated societies.

Furthermore, ANT is against the dualistic framework that separates human and nature (Latour 2005; Law 1992). It clearly states that heterogeneous actors are networked. Heterogeneous actors can include a human, an organisation or even an object, and it is a key principle within ANT that analyses that human actors are not treated any differently from nonhumans, called 'symmetry' (Latour 1987). Through this principle, each entity should be addressed as equally having agency and analysed with the same terms. Thus, non-human entities, such as objects and technology, which are usually excluded from being an actor in classical sociology theory, can be an actor in ANT. This perspective may be more appropriate than classical sociology theory to explain contemporary society, where non-human entities, such as technology and tools, have mediated and shaped human behaviours. In addition, the emphasis on artefacts and mediation is one of commodities within post-cognitive theories (Kaptelinin

& Nardi 2006, pp.195–236). This is an important point that links ANT to activity theory, which is also adopted as part of the theoretical framework and is discussed in Section 2.4.

An actor in ANT is a network, which means that an actor has a relational effect on interrelations between other actors (Law 1992). The distinction between large and small actors is also a relational effect (Law 2009), and an actor only can be seen through the process of order making via constant negotiation and resistance to other actors. If there is no continuous interaction with other actors, then an actor is no longer an actor in the network. Thus, in ANT, tracing the changing network of an actor is only one way to define an actor (Latour 2005). Considering a museum as an actor, it has an effect on heterogeneous actors, for example, museum objects, museum practitioners, visitors, spaces and so on, which have been assembled in a certain way and are continuously interacting with other actors so that the network can be altered at any time.

In fact, a society and organisation that appears stable is in reality a place of resistance that is subject to change (Law 1992). It is always in a constant process of negotiation with other entities, and a network is liable to break down or makes off on its own (Law 1992). In other words, when one of the associated actors resists the existing order and attempts to build a new identity, negotiation between actors is required or the network might break down. For instance, when museum visitors want to make a new relationship with museums by making their voices louder, it is necessary for museums to reconsider their identity.

In employing ANT in this research, I am considering digital technology as an actor who has its own voice, life and characteristics, and who intends to extend its boundary. For example, internet technology has evolved and affected museum practice further since the mid-1990s. Recently developed mobile technology has expanded more into our daily lives, and is simultaneously associated with other actors. By embracing digital technology in museums, the concept of museums has also been enlarged; for instance, virtual museums available on the web without any physical collections, and museum practices have been developed in a variety of ways. New jobs, such as digital managers, have emerged within museums, and I trace the association and network changes among actors based on ANT in order to understand museums and digital culture. To accomplish this, it is helpful to understand the way a network is created.

2.3.2 Translation: The Process of Network Making

Describing a network among actors is the most significant concept when applying the ANT (Latour 2005). Following an actor makes it possible to see how it constructs and deconstructs a network with other actors, and how the power and relationships change within a specific setting. Callon (1986)

proposes four steps for the process of 'translation' in making a network, problematisation, interessement, enrolment and mobilisation, although in reality, these steps can overlap.

The first step of translation is problematisation. In this step, an actor attempting to construct a new network aims to disturb a previous network by addressing problems within it. The identities of entities are defined, and the goals and tendency of each actor are recognised. This means every actor might have different concerns and priorities within the same problem situation because ANT accepts the plurality of a view. Therefore, in order to achieve what each actor wants, it is necessary for them to work collectively. The obligatory passage point (OPP) is the point of access into this collective action. A focal actor brings all the other actors to pass through an OPP, and all actors have to agree this point to achieve their own goals. For example, in my research, developing a digital project in a certain way can be an OPP, so that the actors involved in the projects achieve their own goals.

In the next step, interessement, the actor attempts to impose and stabilise the identity of the other entities determined in the first step, by interrupting other potential constructions of associations. In order to consolidate the relationships among entities, various devices, for example, written reports and meetings, can be used. Through this process, some identified entities may be incorporated into the network, while others might not be (Fenwick & Edwards 2012a). In museums, a range of events, for instance, conferences and seminars, may be planned in order to attract the interest of policy-makers and museum professionals to a museum's digital initiative. However, there is a possibility that some entities, such as the public, may be excluded. The entities that are still involved in a network will have a voice to present their goals, while omitted entities are no longer able to indicate their interests. Therefore, only the selected entities can ultimately influence the communication and learning approaches of digital museum projects. I especially consider how and to what extent the public participate in the development process of digital projects.

Through multilateral negotiations and resistance, an actor then coordinates and defines a set of interrelated roles of entities and enrols them into a network. This enrolment step confirms that the agreement among entities is carried out and is dependent upon transaction, discussion, and consent without discussion. If the process is successful then the entities become engaged in new identities and behaviours, and are orientated in particular directions. It is also necessary to note that negotiations are continued and roles are tested. In the case of museums, funding agreements and contracts with companies can exemplify this. In some cases, this form of agreement and negotiation between actors may be less complicated than others, depending on the relationship. For example, if government has more power than museums, an agreement between the two actors can be easily made.

Finally, in the mobilisation step, the actor becomes the representative who makes it possible to render other entities mobile. The actor now can present the opinions as a spokesperson for its association,

while a network persists. Depending on the power relationship between the actors, the spokesperson can be the government, museum practitioners or the public in this research. However, networks are not fixed, are fragile, and can always change. When an actor in a network resists the current order, then a network may change its shape or might be destroyed, unless negotiations succeed.

2.3.2.1 Stable and Durable Networks

Networks that consist of actors can take different forms, and some might be more elastic, tenuous or long-lasting than others (Fenwick & Edwards 2012a). Strategies for making a more stable translation can be applied, although every network can be assembled differently (Law 1992). A network which embodies more durable material than others may last longer and be more stable over time (ibid.); for example, texts and buildings may be more durable than speech and thoughts. When considering space, if a network has the possibility to control its entities at a distance, from centre to marginal, then it may become stronger (ibid.). Finally, the process of network building can be more effective if there is a repeated pattern, for it can be found and anticipated in the future (ibid.). I investigate what strategies have been applied by the actors of museums to make their digital networks stable and durable (Research Question 1 and 2-3).

When a network of actors is in a stable state then the assembled network can be recognised as an actor, a 'black box', until it is unfolded (Latour 1991, p.287). For instance, a museum might be understood as a black box, a wholly concrete institution, yet when it is unfolded, it is actually a network of different actors, which are constantly negotiating with each other. Thus, by tracing the relevant actors within museums, the way they have constructed and deconstructed their networks for digital projects can be uncovered.

2.3.3 Criticism and Limitations of Actor-Network Theory

There is continuing discussion and criticism of ANT (Law & Hassard 1999; Law 2009). The most relevant discussion to my research has been made by Miettinen (1999), who proposes that there are three problems with the generalised symmetry of ANT, while partially agreeing with the significance of the active nature of artefacts, based on the activity theory point of view. According to Miettinen (1999), ANT has difficulties in structuring the analysis of a network and selecting the relevant actors, due to a lack of clear criteria for defining actors. This problem results in the issue of silent actors (e.g. the public). In empirical case studies, prominent actors, those who speak most loudly, tend to be selected, while silent actors are hardly recognised.

Moreover, regarding the comparative element of this research, it is doubtful that ANT provides a good basis for understanding the power relationship in which one actor, such as the government in the Korean case, has dominated the network of museums. The Korean government has a relatively stable

relationship with its national museums because the museums are government agencies, which means most funding for the museums comes from the government and museum practitioners must follow the rules it sets. In this research, I discuss how the centrality of state actors and this hierarchical relationship affects museum practices (Research Question 1-1 and 1-4) and, theoretically, contribute to building Asian museology.

Finally, ANT cannot explain cognitive processes and the intentionality of individual human actors, as well as the sociocultural aspects that might impact upon human actors. Therefore, it is necessary for me to consider activity theory, which can address the social and personal contexts of museum practitioners and lead to the uncovering of hidden and silent actors. However, I will focus more on the perspective of ANT in order to investigate the power relationship among actors, rather than activity theory.

2.4 Activity Theory

Activity theory is a conceptual and cross-disciplinary framework that aims to understand the unity of consciousness and activity of people on both an individual and social level at the same time (Kuutti 1996; Nardi 1996a; Kaptelinin & Nardi 2006). Activity theory, cultural psychology, has been mainly developed in northern Europe by those who hold the Soviet psychologists' point of view regarding human cognition (Leontiev 1978; Vygotsky 1978). Unlike cognitive psychological approaches, which see the human mind as an individual's cognitive process, activity theorists fundamentally argue that consciousness is not a set of discrete disembodied, cognitive acts, and cannot be entirely explained by understanding an individual's internal cognition. Rather, it is necessary to consider social and cultural dimensions of human actors when studying human development and the mind. Thus, they consider consciousness to be located in everyday practice, which is embedded in the social matrix that is composed of people and artefacts.

Society and culture are not only external features that influence the human mind but are the principles that form an individual's mind, due to shared contexts through collective practice (Vygotsky 1978). This results in revolutionary implications for how humans are controlled (Engeström 1999). Because of the traditional division between social sciences and psychology, the former only explains humans controlled from the outside by society, while the latter considers humans controlled from inside themselves (Engeström 1999). Through emphasising the role of mediation in activity, humans can be understood as having their own intentionality, and the mediating of artefacts can be an integral component of human activity. In the following subsections, the main notions of activity theory are explained, the evolution of the theory, and the seven elements of an activity triangle relating to my

research. In this research, I adopt this theory to address the activity of museum practitioners involved in the development of digital museum projects.

2.4.1 Activity and Artefacts

An activity, the basic unit of analysis in activity theory, is a minimal meaningful context for understanding individual actions (Kuutti 1996; Nardi 1996b), as opposed to a one-time single, isolated action. Instead of understanding the subject and the object of an activity separately and then making an inference about their interaction, the concept of activity in this theory is understood to be a 'purposeful interaction of the subject with the world, a process in which mutual transformations between the poles of 'subject-object' are accomplished' (Kaptelinin & Nardi 2006, p.31). In addition, activities are not static or rigid entities, and should be understood as being under continuous change and development (Kuutti 1996). Each activity has its own history, and thus, in order to understand the current situation, a historical analysis of the development of activities is needed.

As the context of activities is included in the unit of analysis, activities should be understood through understanding the role of artefacts in everyday existence. Because activity theory is derived from the work of Vygotsky (1978), it maintains that the mind emerges through interaction with the environment and artefacts. Vygotsky believed that artefacts are cultural products created by societies, and using artefacts can bring about human's behavioural transformation and influence individual development. Artefacts here can be technical or psychological. Technical tools may be used to help people affect things, while psychological tools are signs intended to help people affect others or themselves (Vygotsky 1978). By highlighting the importance of artefacts in activities, activity theory allows the researcher to ascertain a significant role for them when an individual actor (the 'subject' in activity theory) chooses artefacts in order to achieve his/her goals. This is a difference between activity theory and ANT, and was explained earlier. Although both highlight the importance of artefacts in human activities, activity theory insists on asymmetry between human actors and artefacts (Nardi 1996a), while ANT denies the difference and places the two entities in the same ontological space. This results in activity theory exploring the human view of the relationship between people and artefacts.

Activity theory evolved from Vygotsky's original ideas and has developed through three generations. The following section will address this evolution and explain why I chose the second generation for use in the research framework.

2.4.2 The Evolution of Activity Theory

Activity theory has evolved through three generations (Engeström 2015), with the first derived from Vygotsky's idea of mediation (Vygotsky 1978). This model consists of three elements: subject, object,

and mediating artefact. The 'subject' is a primary agent and can be a person or group engaged in an activity. The 'object' is the motive of an activity, which is held by the subject and gives it a specific direction. The 'artefact' mediates the subject and the object, and can be tangible, like tools, or intangible, like signs. Artefacts are integral and inseparable components of human activity, and all human activity is shaped by the artefacts we use. By using and creating artefacts, humans can 'control their own behaviour – not "from the inside" on the basis of biological urges, but "from the outside"' (Engeström 1999, p.29). However, although this model can explain the importance of artefacts and individual's agency in human activity, it cannot depict the complex interrelations between an individual subject and the communities around then by analysing an activity only from the aspect of the individual (Engeström 1999; Lektorsky 1999).

The second generation, led by Leontiev's work, overcomes the limitation of the first generation by expending the analysed elements of activity to subject, object, mediating artefacts (tools and signs), rules, community and division of labour (Cole & Engeström 1993; Engeström 2015). This model can provide a conceptual framework that features the dynamics of an activity system. The relationship among the elements can be visualised as an activity triangle, as shown in Figure 2.2, where the connection lines indicate possible interactions between the components. Each element of the triangle will be explained next, in Section 2.4.3.
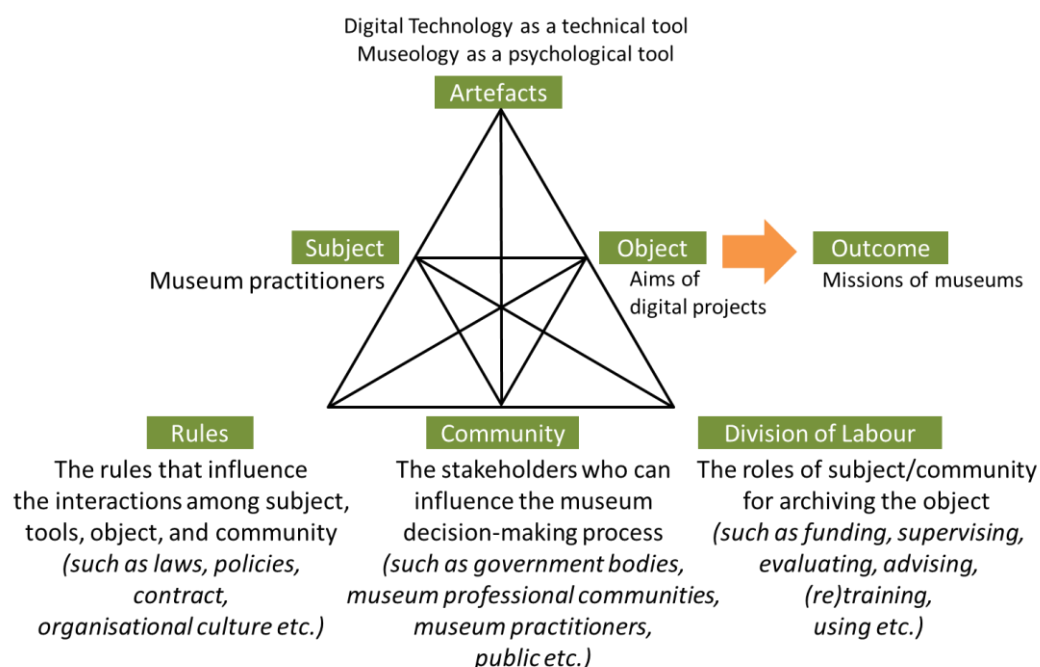
Figure 2.2 The theoretical framework adapted from activity theory

The third generation of the theory further considers the networks of activity systems that partially share objects and is concerned with different aspects of subjectivity, such as emotion (Engeström

2015). However, the third generation model carries a risk of splitting the analysis of activity into the study of system and a subject's point of view (Engeström 2015). Thus, I have adopted the second generation of activity theory for my research, as the network of activity systems can be further addressed through ANT. This means that in order to investigate power relationships between actors, the ANT perspective will be adopted, while activity theory provides a lens through which to understand activities of museum practitioners when developing digital projects.

Activity theory has been mainly applied as psychological theory in learning and teaching and in human-computer interaction studies (see, for example, Kaptelinin & Nardi 2006). The broad approach of activity theory for developing conceptual tools for analysing complex interactions and relationships within social science subjects, such as organisation studies (Blackler 2009), is more relevant to my research approach. By adopting activity theory, this research investigates the perspective of museum practitioners (individual and sociocultural elements) when planning, developing and maintaining digital projects.

2.4.3 The Seven Components of an Activity Triangle

An activity triangle consists of seven components: subject, object, artefact, community, rules, division of labour, and outcome. As Figure 2.2 is presented above, in my research, developing museum digital projects can be an activity, while the subject of the activity would be museum practitioners, and the object can vary, according to the aims of a museum's digital projects.

The third component of the activity triangle is artefacts, which mediates between the subject and the world. In this research, I considered both technical and psychological tools. Regarding technical tools, digital technology is one of them that can lead us to shape our activity. Therefore, embracing digital technology in museums is not only about changes to tools; it is also about changes to museums and museum practices. Because digital technology has distinctive features, such as networks, interactivity, automation and databased (see Section 2.2.2), if museums employ digital technology then this can provide multiple opportunities for them in terms of the interpretation of museum objects in multiple horizontal ways. Drawing on activity theory, Frohberg et al. (2009) analysed digital mobile learning projects developed for formal and informal learning environments and devised a framework to evaluate pedagogical role of digital technology in the projects. They scaled the degree of the pedagogic role of mobile technology in five categories: 1) content delivery; 2) interaction for motivation and control; 3) reflective interaction; 4) reflective data collection; and 5) content construction. According to their findings, most of the mobile learning projects fell into the first two categories, content delivery and interaction for motivation and control, which are based on a didactic or behaviourist learning approach. Very few projects were in the categories' reflective data collection and content construction. I will come back to their study in methodology because I partially adopted

the categories they developed when I analysed my data. The digital projects in my study are, however, not only mobile learning projects but also static ones installed in museums, and websites. Thus, I further developed the framework based on my theoretical framework.

Concurrently, I consider museology a psychological tool, regarding artefacts in the activity triangle. This can influence the direction of the work of museums and the consciousness of museum practitioners. I have investigated the models that museums adopt as their philosophy and have examined them from a new museology point of view. The extent to which museums have developed new museology in their practices can be captured through an analysis of the communication and learning approaches they have adopted. By further analysing the 'subject', 'object' and 'artefacts', I examine the communication and learning approaches of museums' digital projects, and how and why the features of digital technology are highlighted (see Section 1.2, Research Questions 2-1 and 2-3). By doing so, how museums approach knowledge and knowledge constructions can be answered. For example, when a museum aims to actualise new museology that further considers various interpretations from the public's point of view, rather than fixed knowledge from an expert's point of view, a digital project developed by the museum might allow the public (visitors) to present their ideas and discuss them with others, based on a cultural model of communication and social constructivism and sociocultural learning theory. The notion of new museology will be further explained and linked to museum communication and learning theories in Chapter 3.

The next component of the activity triangle (Figure 2.2), 'community' is the large environment and people who share common objects. In this research, it is expected that government bodies, museum professional bodies, and the public have a role as stakeholders. This is partly because of the funding relationships between government and national museums, particularly in Korea, as museums have been strongly associated with the power of the government (Yang 2002a). In terms of a cultural policy, governments legislate in order to enrich its society's culture. Due to changes in the direction of a government cultural policy, museum practices may be impacted in both Korea and the UK (Yang 2002a; Miller & Yúdice 2002). Because the government controls and normalises the culture of society through education, what is seen and enjoyed in museums cannot be isolated from the power of a government. Therefore, I trace the cultural policy and relevant museum policies in order to understand how museums have been influenced by governments with respect to digital culture (see Section 1.2, Research Question 1-1). On the other hand, the public are now widely recognised as important actors since the rise of new museology in the late twentieth century (Weil 1990; Hein 1998; Hooper-Greenhill 1999d; Silverman 2010; Simon 2010), and the general public, rather than the elite, have been expected to be a central part of museum work (see Section 1.2, Research Question 1-4).

Before explaining the next component of the activity triangle, it may be helpful to reinforce the notion of 'community' in activity theory and 'network' in ANT. A 'network' can be defined by actors associated at a certain time because it is fundamentally flexible and easily deconstructed. The 'community', however, can be a wider notion, including any significant actors who have been assembled in the network at any time, past or present. This concept of 'community' enables me to focus on potential or hidden actors who may be missed through the ANT approach.

'Rules' is the fifth component of the activity triangle, which influences the interactions between subjects, tools, community, and objects. These can be explicit, such as laws, museum policies, funding agreements, and contracts with suppliers, or can be implicit, such as an organisational culture. It is difficult to define what organisational culture means; however, I have applied the definition whereby it usually refers to the way of life within an organisation and to something held in common or shared among group members (Hatch & Cunliffe 2006). An organisation also belongs to a society, and its employees bring with them their societal culture into an organisation; thus, it is difficult to separate an organisational culture from larger cultural concepts (ibid.). In addition, a museum also has its institutional norms, values, and practices, and museum organisational culture is one of the contingent factors in establishing collaborative relationships between museums and other communities (Harrison 2005). Therefore, in this research, I look at the history of museums, their organisational structure, their working conditions, and communication methods, in order to uncover the rules which might have affected museum practices. For example, museums that have relatively horizontal organisational structures and are perceived by museum practitioners as a workplace in which every employee feels free to present their opinions and experimental approaches are allowed might be more willing to work collaboratively with others and develop new practices, such as innovative digital projects (Hein 2012, pp.196–198), compared to those with hierarchical structures that are hesitant of new approaches. Although culture has overall uniting features, it is also important that culture can be changed and has fragmented features, such as different subcultures within an institution (Hatch & Cunliffe 2006). I assume that there may be cultural gaps between curators and educators, and curatorial staff and digital experts. Through interviews with museum practitioners holding different roles within their museums, the existence of cultural gaps and subcultures will be investigated. These gaps can even influence digital projects because museum practitioners who belong to different subcultures may have a different understanding and perspective of a digital project, even though they are working on the same project. This point of view also relates to CoP theory, which will be addressed in the following section.

The next component of the activity triangle, 'division of labour', describes how subjects share or distribute work, either among themselves or with the rest of their community. Different departments in a museum have different roles regarding employing digital technology in the interests of facilitating visitor experience, and each stakeholder plays a different role, such as supervising, advising or

training. When applying activity theory in organisation studies, Blackler (2009) highlights the growing importance of non-hierarchical ways of working in a modern complex working environment. In this sense, I look at the extent to which the distributed works have been undertaken collaboratively for the development of digital projects across museum departments and beyond museums. I also assume that some existing CoP may be influencing the development of digital museum projects in a certain direction by providing opportunities to exchange working experience with other museum practitioners.

The final component of the activity triangle is 'outcome', which is the ultimate goal of a museum as a cultural, educational and social institution. This could be different, depending on the mission of each museum, and therefore, I look at the mission statements of each museum examined.

In summary, activity theory framework is applied in order to understand the holistic context in which different stakeholders impact museums and fulfil their roles when a museum practitioner has installed a digital project. Activity theory also allows me to analyse museum practitioners' personal histories, such as their academic background or personal attitude towards digital technology, as one of factors that can impact on digital projects.

Museums in different countries are run in different social and cultural contexts. Although all the museums in this research are national museums, and are operating in the twenty-first century, in which digital technology dominates every aspect of daily life and the economy, Korean and UK museums have different cultural and historical backgrounds, and may have different social roles. Thus, it is crucial to consider the sociocultural approach. In doing so, this research is trying to uncover how and why digital museum projects have developed in a specific way. Activity theory is used to support this aspect of my research in providing a conceptual framework with the seven components that should be considered to understand and analyse an activity.

Before continuing, it is helpful to compare activity theory and ANT, although both are considered to be post-cognitive theories that draw attention to the vital role of artefacts in human life and claim that individuals are an extended concept beyond their body (Kaptelinin & Nardi 2006). Through a critical perspective on mind-body dualism, they focus on the connection of physical and social distribution of phenomena (Kaptelinin & Nardi 2006). However, ANT treats human and non-human actors as symmetrical nodes within a network, while activity theory places a greater emphasis on the individual subject. Thus, by using activity theory human intentionality in selecting and using tools, the sociocultural contexts of human actors can be determined. This is why this complementary approach has been taken to examine different aspects of the digital networks of museums. However, in order to uncover the ways in which human actors (i.e. museum practitioners) develop their professional identity and skills relating to digital, communities of practice theory is adopted, as discussed in the

following section. This theory particularly helps me explore how museum practitioners learn through a social process that affects shaping their professional identity and works.

2.5 Communities of Practice Theory

The previous sections have described how the activities of museum practitioners are not only shaped by their individual cognitive processes, but also by societies and cultures that they are interconnected with. By using this sociocultural lens to understand museum practices, the ways in which museum practitioners develop their professional skills and knowledge of digital culture can also be explained through a learning process in the social dimension. To accomplish this, I have adopted the CoP theory as a theoretical framework. Thus, I assume that social learning can occur within a museum internally, as well as with support from external actors, for example, museum professional bodies (see Section 1.2, Research Questions 1-2 and 2-3). CoP theory, a social theory of learning, was originally developed from situated learning theory, which understands learning as a socially mediated process (Lave & Wenger 1991). While situated learning theory will be further addressed in Chapter 3, this section focuses on explaining some important concepts of CoP and how they can be applied in my research. The reason I present CoP theory and situated learning theory separately is that the focus on the use of CoP here as an organisation theory concentrates on museum practitioners, while in Chapter 3, the focus is on its use as a learning theory, with an emphasis on how it can be used with museum visitors.

CoP are 'groups of people who share a concern or a set of problem, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis' (Wenger et al. 2002, p.4). This is not a new concept in human history and exists everywhere, not only in organisations but also beyond them in societies. This is especially considered to be important in knowledge-based social structures, especially when handling cutting-edge technologies (Wenger et al. 2002). From the CoP perspective, learning arises from participation and nonparticipation[3] in actual practices with members of the communities learners interact with (Wenger 1998). In other words, workers of an organisation, for instance, museum practitioners, learn through their practices. The more they learn about such practices, the more they gain membership of a community, which causes changes in their identity, from novice to expert.

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[3] Here, non-participation means being an outsider, being a peripheral participator, and being marginalised (Wenger 1998).

2.5.1 The Three Fundamental Elements of Communities of Practice Theory

The three fundamental elements of CoP theory are domain, community, and practice (Wenger et al. 2002). The domain of knowledge defines a set of problems that are shared and are commonly experienced by all members of a community; it is what brings people together as a community and defines the identity of a community. A well-developed domain can make a community more visible, and its expertise and capability can be easily acknowledged within an organisation and beyond. A domain is not usually static and evolves together with the world and community. Sometimes, newcomers and members of a community may bring new insights and topics to a community and attempt to extend the domain, although negotiations with other members are required, concerning whether to accept and include these new ideas within their domain (Wenger 1998). For instance, the expansion of digital technology usage in museum's learning can be a result of a community of museum educators extending its interests to the potential of digital technology.

A community consists of people who care about a domain, resulting in them interacting regularly and learning together (Wenger et al. 2002). For community membership, trust is necessary. A successful community offers a safe and comfortable place where difficult questions can be asked and critical aspects of practice can be debated by members. A diversity of community members can also make its learning richer and more interesting through the provision of multiple perspectives (Ash et al. 2012). A healthy community does not depend on the leadership of one person, and participants of a community feel that their contributions are reciprocated. Therefore, it can be said that the success of a community depends on each member and their membership.

Because members of a community share histories of learning within the community, this creates boundaries that distinguish those who are involved and those who are not (Wenger 1998). Although boundaries sometimes cause conflict and misunderstanding in practices, boundaries are important to learning systems, connecting communities to the rest of the world, and offering learning opportunities in their own right (Wenger 1998). At boundaries, there are challenges to explore and new competences to experience. If the interactions of a community only occur within the community, then it is losing its dynamism and practice could become stale. Innovative potential often arises at boundaries between communities and with peripheral members (Wenger 2010). Connections between communities are possible via boundary objects, such as documents and concepts, and with brokering by people who introduce elements of one practice into another (Wenger 1998, pp.104–110) For example, digital museum projects generally require competences which are relevant to museum and digital sectors. The two different sectors have their own perspectives and languages that only members of a community can understand and agree. Therefore, during the development of digital museum projects, negotiation and readjustment are needed across those involved in the projects. The

extent to which a project is successful may depend on how museums and museum practitioners address the connection between the boundaries of the two sectors. I investigate how existing CoP in and beyond museums foster this.

The last element of CoP theory, practice, refers to a set of socially defined ways of doing things in a specific domain (Wenger 1998; Wenger et al. 2002). This is an ongoing, open, social, and interactional process with members of a community. Through practice, members negotiate meanings and learn together. In other words, 'what they learn is their practice' (Wenger 1998, p.95). An effective practice evolves within a community and reflects its participants' perspectives. Practice includes the explicit, such as books, articles, knowledge bases, and other repositories that members share, and the tacit, a certain way of behaving, a perspective on problems and ideas, and a thinking style (Wenger 1998; Wenger et al. 2002). The implicit is crucial to forming membership of a CoP, although it is unarticulated.

From the CoP perspective, learning is a social participation (Wenger 1998). Here, participation refers not only to engagement in certain activities, but to active involvement in the practices of social communities and building identities with respect to communities. Therefore, participation reflects the mutual constitution between an individual and a collective.

2.5.2 Identity in Communities of Practice Theory

'Identity' is an important concept in CoP, and who we are can be understood from a social perspective beyond self-image (Wenger 1998). Building identity is a constant negotiation by interacting with the world and accumulating experience. Becoming a member of a community shapes our identity (Wenger 1998), and participating in a specific practice and sharing a culture with members of a community leads participants in a certain direction. As newcomers become 'old-timers', they can improve their competence and a community develops together. They know how to engage with other people, how to contribute to the community, and how to negotiate via a repertoire of practices. Through this participation, their membership translates into identity.

Another aspect of identity is temporality (Wenger 1998), as it connects the past, the present and the future. Through this, we understand what is important to our identity and what is not, what matters and what does not. Different trajectories result in different perspectives on participation and identities at work, and depending on identities, some of workers (e.g. a digital manager of a digital project) may view a new project as an opportunity to develop their profession, while others (e.g. curator) may have no interest in it. Therefore, it is important to consider the identity of workers, museum practitioners, in order to understand how and why they fulfil their projects in a certain manner.

Identity is not a unity as it combines multiple forms of membership (Wenger 1998). We can belong to many CoP concurrently or in different time periods. All the communities we have belonged to influence the building of our identity differently, and our identity is integrated from the multi-membership of these different communities. Therefore, when we move from one community to another, this does not only require the learning of information, but also a process of reconciling is required. The work of reconciliation involves the construction of an identity by dealing with conflicting forms of individuality and competence, as defined in different communities. This is challenging and may involve ongoing tension.

In order to cultivate learning capability in social systems, Wenger (2010) proposes learning citizenship as the personal side, where the notion of learning citizenship refers to the ethics of how we invest our identities as we travel through landscapes of practices. Individuals can fulfil learning citizenship by connecting boundaries, becoming brokers via multi-membership, and providing transversal connections in a context where vertical and horizontal accountability structures are incoherent and so on (Wenger 2010). Forming an informal learning group within a museum, aiming cross-departmental approach to exchange working experience and current issues regarding digital culture could be an example of the implication of learning citizenship. This may also be one of ways of empowering individuals within an organisation.

2.5.3 Forms of Communities of Practice

There are various forms of CoP (Wenger et al. 2002, pp.24-27), which depend on the number of community members (small or big), the life span of a community (long-lived or short lived), the extent to which community members live close together (collocated or distributed), the diversity of members' backgrounds (homogeneous or heterogeneous), the boundary of a community (within businesses, across business units or across organisation boundaries), how a community is formed (spontaneous or intentional), and the level of relationships the community holds with organisations (unrecognised to institutionalised).

In this research, diverse types of CoP can be identified. For instance, members working in cross-functional teams within a museum but with the same interests, or beyond a museum formed from a group of museum practitioners who oversee digital projects in their museums. Examples of communities which are intentionally founded are museum professional bodies, such as museum associations. One of the functions of a museum association is to train museum practitioners and provide opportunities to develop their professional skills (Teather 1990). A community could foster conferences, seminars and workshops, in which people who have similar interests can meet each other. Through interviews with museum practitioners, I investigate the ways in which museum practitioners have developed their professional knowledge of digital culture.

CoP do not sit easily within traditional hierarchical organisations (Wenger 2010), and it is not uncommon to find the function of vertical and horizontal accountability almost completely separated. Digital technology is evolving rapidly, and applying it not only requires the latest knowledge that can be learnt from written materials, but also practical experience or specific know-how from experts who have faced similar situations. In museums, embracing digital technology is still relatively a new approach, and there is a lack of formal training for museum practitioners to develop their professional skills in this area. This is why informal networks, like CoP, are important for museum practitioners when developing their understanding of how to employ digital technology within museums for their visitors. Therefore, part of my research investigates the ways to cultivate CoP with support from external actors, such as museum associations, and within a museum, formally or informally (see Section 1.2, Research Questions 1-2 and 2-3).

2.6 Summary

In Chapter 2, I firstly review existing literature of digital museum in order to provide the background of this research and I then develop the first part of the theoretical framework, underpinning this research by discussing three theories, ANT, activity theory and CoP theory. Each theory provides a unique lens to see the dynamics between actors who have affected museum practices in the digital age, and the power relationship between them.

In Section 2.3, I discuss ANT (Callon 1986; Law 1992; Latour 2005) point of view to understand museums as institutions within a society. This theory allows an understanding of the dynamics of complicated networks via a bottom-up approach, and provides a lens to analyse human actors and non-human actors, such as digital technology at the same level. The process of how diverse actors have constructed and deconstructed networks with other entities to achieve their goals is particularly reflected in my findings with developing actor-network maps of the museums studied. I acknowledge also that this theory has several limitations, especially when used to analyse stable power relationships between actors. From this perspective, I further discuss an Asian museology in which government plays a significant role to develop museum practices.

In Section 2.4, I look into activity theory (Cole & Engeström 1993; Engeström 2015) and turn to focuses on human actors' perspectives to analyse human activity. By adopting this theory, I can address museum practitioners' perspectives, attitudes, and personal backgrounds at the same time. It also highlights the importance of artefacts (e.g. digital tools) in activities. In so doing, this theory enables me to explain why museum practitioners chose the tools. Basically, the theory provides a

conceptual framework with seven components of activity triangle (see Figure 2.2). The components of activity contributed to develop the interview theme and analytical framework as well.

In Section 2.5, I review CoP theory (Wenger 1998; Wenger et al. 2002) to explore the ways in which museum practitioners develop their professional skills regarding digital culture. Digital practice in museums is an emerging domain, and social learning with members of a community can be one of ways to update and develop their expertise. Moreover, professional identity, which is developed with the participation of a community, can affect their works. There are various types of CoP; it could exist in and beyond museums. It also could be formed informally by individuals and formally by organisations. This theory particularly guides me to investigate roles of digital departments of museums, relating to Research Question 2-3, and of external actors, such as museum professional groups, regarding Research Question 1-2.

Figure 2.3 shows the relation of the three theories and how they are adopted in my research. In brief, activity theory is adopted as a conceptual and analytical framework, which helps me to investigate human activity (e.g. the development of digital projects), with seven elements of it (see Section 2.4.3 and Appendix 4). With the theory, I could assume potential actors (subject, communities) and explain the factors (roles, rules, tools) affecting the relations of actors. Moreover, I could make a link of mission statements of museums (outcome) to museology (tool) that the museums adopt. On the other hand, ANT is selectively adopted for identifying actors by tracing them, and for understanding the ways they construct the network with others. By so doing, I could investigate the power relationship between actors. CoP theory is particularly adopted to address how museum staff learn within and beyond the museums with others and to discuss how their professional identity affects digital projects. This complementary approach enabled me to address different aspects of the digital networks of museums and to answer Research Questions 1, 2-3, 3-1 and 3-4 (see Section 1.2).
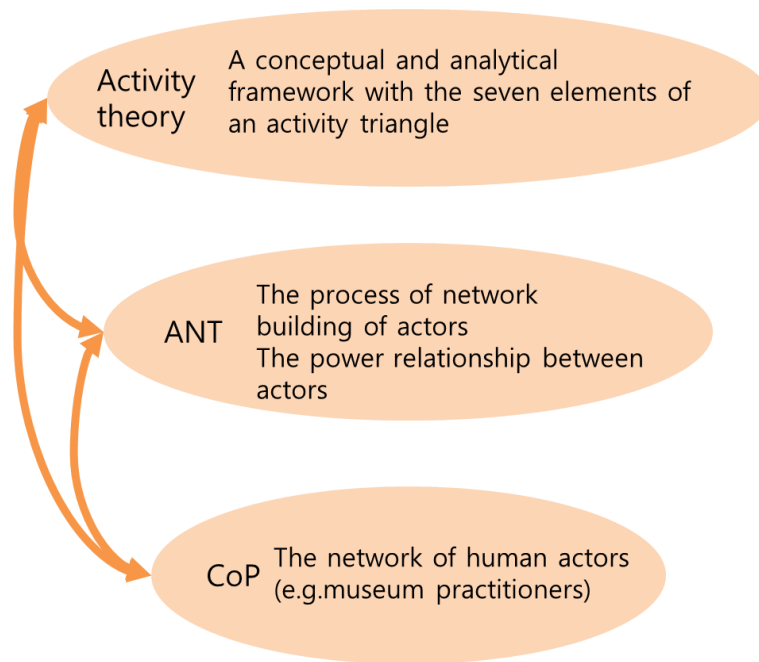
Figure 2.3 The relation of the theories adopted

Chapter 3 - Literature Review and Theoretical Framework (2): Museum Communication and Learning

3.1 Introduction

The previous chapter mainly covered three theories: ANT, activity theory and CoP theory, which provide a theoretical framework for understanding the dynamics between key actors who have influenced digital museum projects to answer the Research Questions 1, 2-3, 3-1 and 3-4 (see Section 1.2). This chapter considers the second section of the theoretical framework of this research, which discusses communication and learning theories relating to Research Questions 2-1, 2-2, 3-2 and 3-3 (see Section 1.2).

Museums have attempted to engage people in various ways, and digital projects are one of the approaches utilised. Depending on the underpinning communication and learning theories of the projects, the ways museums present knowledge and see the process of knowledge construction could be varied. For example, a digital project embracing cutting-edge technology might look just like a textbook written by a museum when the museum sees that knowledge is fixed and visitors only consume the content of the project. Therefore, through communication and learning theories, I attempt to understand museum practitioners' intention and motivation (object in activity theory) during the development of digital projects (technical tools in activity theory).

This chapter begins by explaining the changing concept of museology (a psychological tool in activity theory), reflecting the functions and roles of museums as expected by contemporary society, and then considers the potential of digital museum projects with respect to new museology (Research Question 2-1). I postulate that digital projects can be one of a number of possible approaches to implement new museology. Communication and learning theories will be then be described in Section 3.3 and 3.4 in order to examine the extent to which digital projects meet the expectation of new museology (Research Question 2-2).

When considering museums communicators, digital projects can be one communication interface between museums and the public. Communication theory, particularly mass communication theory, can guide this research to understand what communication approaches have been adopted in digital museum projects. Meanwhile, digital museum projects can be considered new learning tools when museums are viewed as educational institutions. Learning theories will be discussed to provide a theoretical framework to understand learning approaches of digital museum projects. I will then suggest that a cultural theory of communication, social constructivism and sociocultural learning theories are more appropriate approaches within museums to implement new museology.

3.2 New Museology: From Objects to People

Since the birth of modern museums established during the Age of Enlightenment in Western countries, museums have mainly been considered as authorised and privileged institutions for elite groups (Bennett 1995). Museums have been believed to have the authority and expertise to legitimise what is valuable and meaningful to be preserved and how it is to be treated (Smith 2006). With their intentions of certain things, they have worked to exclude the other things and non-expert views about them. Additionally, museums have been an extended concept of curious cabinets full of valuable artefacts for research purposes, with the artefacts perceived as the centre of a museum. Museum curators and academic scholars, who have been permitted access to and have researched the artefacts, have produced knowledge, and only they used to have the authority to interpret the meanings of collections, which were regarded as a universal truth, consistent, value-free and neutral (Weil 1990). According to this view, if visitors cannot understand an exhibition then this is not recognised as a fault of the museum curator who produced it; rather it is considered as a lack of capacity of visitors to understand 'high' culture artefacts. Therefore in 'old' traditional museology, Harrison (1993) notes that museums are considered 'venerated authority, purveyor of truth, and another form of school where knowledge is doled out in digestible amount'. They also seem to target particular types of social groups whose members can digest the contents of museums (Harrison 1993). Cameron (1971) calls this notion of museums a temple type.

This old temple concept does not meet the changing functions and roles of museums that have come to be expected in contemporary society. The change to a 'new' museology is related to the economic and social philosophical changes since the 1970s. Following the global recession during the 1970s, museums and cultural institutions were faced with funding issues, especially in Western countries (Harrison 1993), where grants and stable sponsorship significantly declined. Museums were frequently asked to justify the effectiveness of their work and their value in society. This was a big change for museums, from being considered objective places like a sacred temple, to having to justify the reason for their existence. This situation resulted in a focus on museum management and market research, as well as visitor studies, in order to understand the expectations and needs of the public regarding museums. Since this period, the general public, rather than museum objects, have been placed at the centre of museums, and the educational roles of museums have been further highlighted. Moreover, museums have attempted to reach potential audiences who usually are not interested in visiting museums.

The philosophical change in society towards post-modernism accepts and values the existence of various voices from a range of ethnic, racial and religious minority groups against the predominant ideology of the Western, white and male culture, which have influenced museums (Harrison 1993;

Hooper-Greenhill 2000; Marstine 2006b). This philosophy has raised doubts concerning knowledge and facts that were believed to be true and neutral (Hooper-Greenhill 2000). In this sense, museums are also no longer supposed to be neutral, and instead, their world view and interpretation of objects reflect the socio-political ideologies of those who run and support them, mainly the dominant culture (Tawadros 1990; Merriman 1991). In other words, the process, judging and defining of the value of museum objects have been performed by a few privileged museum curators, and the majority of the public was disempowered in the meaning-making process (Ames 1985). Therefore, if we view society from a post-modernism angle and museums are a reflection of this society, the values and meanings of objects cannot be single and objective. Instead, multiple and problematic interpretations should be allowed, which involve the public with its various sociocultural backgrounds (Jordanova 1989; Smith 1989; Hooper-Greenhill 2000).

Relating to this study, I would like to further emphasise two significant aspects of new museology compared with traditional museology, namely understanding visitors, and accepting diverse interpretations of collections. In general, while visitors in traditional museology are viewed as passive, that is they only absorb a message from museums, visitors in new museology are considered to be active actors who bring their contexts and identities to museums and construct their own meanings through museum experience. Therefore, we can assume that the interpretation of museum objects in a digital project may be subjective and can accept more than one truth, or even encourage creative thinking if new museology has been adopted. Moreover, learning departments in museums create a further link to the public through visitor studies and diverse types of education programmes. In other words, learning departments are a representative of the public, presenting their various voices. Therefore, to consider the extent to which the public are considered actors, the methods of the departments and how the departments have affected the development process of digital projects are investigated (Research Questions 1-4, 2-2 and 2-3).

However, practising new museology is not as easy as the theoretical suggestions propose. McCall and Gray (2014) investigated the degree to which museums have adopted new museology and examined 23 publically funded museum services, including national, local authority, university and trust services in the UK. Through 112 qualitative interviews with museum staff and observations within 17 of these museums, they found that museum practices indicated fewer changes than the museology literature might anticipate. Over the past 30 years, although the number of education programmes increased for targeted visitors, there are few examples which allow the diverse interpretations (ibid.).

In order to implement new museology, Stam (1993) suggests a range of changes to organisational structure, staffing and management/business practices concerning power distribution, which holds curatorship as being central to a museum. Similarly, Ross (2004) highlights the change of identity of

museum professionals from 'legislator' to 'interpreter' towards more visitor-orientated views. However, as McCall and Gray (2014) found, there is evidence of polarisation and an unbalanced power relationship between collection-related curators, who generally represent traditional museology, and others, including education officers, who believe in the new museology. By excluding education officers from the decision-making process, curators and high-ranking managers tend to have more influence and control which messages are presented based on traditional museology (ibid.).

In the Korean context, there are several elements that might result in a challenge to implementing the new museology. First, although the notion of new museology was introduced from the West to Korea through books and researchers who studied in Western countries, Korean museums have not experienced an economic crisis (e.g. funding cuts) such as that which partially caused Western museums to justify their social roles since the 1970s. Secure government funding, however, appears to make Korean national museums less competitive and less responsive to rapidly changing society, especially in terms of technology.

Moreover, museum learning/museum education is a relatively new discourse in Korea, which is supposed to lead the new museology. Since learning departments in Korean museums have formed only in the past 30 years (Kook 2013a), the professionalism of museum education officers has been not well recognised (Yang 2000; Kook 2013b). The roles of museum educators have been limited to planning educational programmes/events that might take place in the learning centres/rooms of museums, not in gallery spaces (Kook 2013a). Interpreting museum collections is considered the work of curators, and education officers are excluded from the process (Yang 2000). Moreover, the discourse of museum visitor studies is not well developed by Korean academics nor embedded in museum practices. If a visitor study was conducted in museums, it mainly adopted a quantitative approach and its results were rarely reflected in practice (Hwang 2013). Additionally, despite the emphasis of Korean education policy on developing the creativity of pupils, which began in the early 21st century, museum learning programmes, which are supposed to be an alternative approach to formal school education, were still designed to support the official narrative of the school curriculum, rather than taking critical and democratic approaches (Yang 2000).

Thus, museums in Korea still tend to be regarded as factual and neutral without any conflict in their content. Or, they may be supposed not to have any conflict. This situation might be associated with the relationship between the government and its national museums, which is further investigated in this study. According to Lee (2012; 2014), because of the dependence of the Korean arts sector on government, the sector has been relatively less affected by the philosophical change towards post-modernism, which Korean society has experienced since the 1980s. Additionally, because the national museums are government bodies, their directors are appointed by the government. Thus, since

museum practitioners in the museums are essentially civil servants, museums face a severe challenge from the government when they attempt to be critical and democratic in their content. This challenge may well affect the decision-making process of museum practitioners and force them to be fact-orientated and politically 'neutral' as civil servants.

Nonetheless, I postulate that an investigation of communication and learning theories adopted digital museum projects will be one of the ways to unfold the extent to which museums have implemented new museology. When considering museums communicators and knowledge storage, the ways in which museums communicate with the public (users and learners) can depend on how museums perceive their public and knowledge. If museums consider public active actors who have an agency to construct meanings for museums objects, and view knowledge as plural, unfixed and subjective, depending on the sociocultural background that people bring with them, then new museology may be further actualised within their digital projects. In the following sections, communication and learning approaches that have been adopted in digital museum projects are discussed relating the Research Question 2-2 (see Section 1.2) and the link of the approaches to new museology will be made.

3.3 Museums as Communicators

The relation between museums and their visitors can be considered as a special type of communication system, especially in terms of mass communication (Lumley 1988; Hodge & D'Souza 1979; Hooper-Greenhill 1999a). In a mass communication, the sender who has the authority to organise content or a message is often a media organisation itself, professional communicator or another agency, given access to mass media (McQuail 2005). In contrast, potential audiences, the receiver, are commonly regarded as anonymous consumers (ibid.). In perceiving museums as a sender with a source of information within a communication system, the ways in which museums conduct their practices, such as developing exhibitions, can be understood as a communication process. Museum visitors are then the receivers in the communication system.

In this section, four communication approaches will be examined and linked to museology regarding the ways that museums see their visitors within the communication system and message producing process. For example, when museums aim to practice new museology that sets people rather than museums' objects at the centre of a museum, their communication approaches with people may consider people's (receivers') points of view via a cultural approach of communication. This means that message senders with authority, such as museums, come to share their authority with people by allowing them to redefine the meanings of the messages they receive and even produce their own messages based on their culture. I will come back to this after discussing a transmission model, an

encoding/decoding theory, and a circular model of communication, and finally, a holistic approach to museum communication will also be described. All the communication approaches are used in museums still today and they have been applied in the digital museum projects I researched.

3.3.1 Transmission Model

Mass communication between a sender and receivers can be understood as a one-way communication in which audiences receive fixed messages sent via mass media (McQuail 2005). This concept of a transmission model considers communication as a simple linear sequence, transferring information from an authoritative source to an undefined receiver (ibid.). In this model, only the sender has the authority to define values and meanings of information and can produce messages, while the anonymous audience is considered to have no individual differences and to simply consume the messages received. Hooper-Greenhill (2000) links this transmission model to modernist museums that view knowledge of objects as objective, singular and value-free, and aims to enlighten and educate the public who are supposed to absorb it without any doubts. This is similar to the traditional museology point of view.

There are still many museum practices which adopt this linear communication model (Miles 1985; Hooper-Greenhill 1999c). Hooper-Greenhill (1999c) sees this is why many of exhibitions fail. Curators who are experts on his/her subjects define the messages which will be delivered, and then pass all the fixed elements to exhibition designers who design and install exhibits, while educators develop public education programmes to make sense of the exhibition for them. Target visitors are not considered; rather, it can be said that it is an exhibition 'for the general public' (Miles 1985). Similarly, in digital museum projects which harness digital technology only to disseminate information and knowledge that museums produce with subject experts (e.g. curators), the public may not be allowed to add content and may not be involved in the development process. The public may also be assumed to have a knowledge deficit, which needs to be addressed via accurate knowledge provided by museums.

If museums adopt this model, it may be rare that they ask visitors about their museum experience, use visitor evaluations, and collaborate with external stakeholders during and after the development process (Hooper-Greenhill 1999b). When visitor studies do take place when using this communication model, the form of quantitative research investigates whether they received and responded correctly to the messages predetermined by the museum (Stylianou-Lambert 2010).

However, this model has limitations in explaining the reality of museum practice. Messages are not always imparted straightforwardly and the audience tends to interpret the meaning differently, depending on their background (Stylianou-Lambert 2010). Moreover, if museums take this linear

process then it may be difficult to improve their work performance and may result in museum practitioners working in silos due to a lack of a feedback loop and cooperation among those who are involved in the different stages of the communication process (Miles 1985; McManus 1991; Hooper-Greenhill 1999b). Without cooperation, museums practices involving the development of digital projects cannot reflect visitors' whole experience.

3.3.2 Encoding/Decoding Theory and a Circular Model of Communication

The second approach can be understood using the encoding/decoding theory of Hall (2006). This approach holds that communication can only succeed in an intended way when the message which is encoded by a dominant cultural order is delivered to an audience who have the capability to decode it. Unlike the transmission model, the audience is perceived to be empowered so that the encoded message can be accepted, negotiated, or rejected, depending on how the receivers decode it. It is totally dependent upon the audience as to whether the initial purpose of a communication is achieved or not, as they may decode a message differently due to what they bring to the media, their background and interests (Hall 2006).

With respect to museums, it can be said that the messages encoded by museums are decoded successfully and enjoyably by visitors who have ability to do so, and this could explain the reason why some groups of people frequently come to museums while others do not. Frequent museum visitors, in general, are middle class, white and well educated, and are only supposed to have the capability to decode messages sent from museums (Hood 1983). In other words, the messages tend to be encoded to be easily decoded by certain groups of people. Therefore, those who feel welcomed and comfortable when they encounter museum content are encouraged to visit museums again.

In order to reflect the public's interests and understanding of messages sent by museums, museums can adopt a circular model of communication with a feedback loop. In this model, the meanings of content are negotiated before finalising them through a circular process shared between senders and receivers. This can be implemented with visitor advisory groups and focus group research, through front-end visitor research before starting projects, and formative research during projects (Hooper-Greenhill 1999a). Although this model utilises a two-way process to reflect visitors' points of view, an unequal distribution of power still exists. Only the senders, like museums, have the authority to produce messages, and can control and define them, although feedback from receivers is considered within the whole communication process (Stylianou-Lambert 2010). What are acceptable ideas and what is more valuable is decided by senders. In addition, there is a tendency to overlook any change to an audience's identity over time. The same individual may have a different interpretation of the same message in a different situation because of a different identity (ibid.). A cultural approach of

communication, which is discussed in the following section, seems to address these limitations as understanding communication with culture context.

3.3.3 Cultural Approach of Communication

A cultural approach of communication considers the impact of cultural and social factors on communication when sending, receiving, consuming, and producing messages (Hooper-Greenhill 1999a; Hooper-Greenhill 1999b; Hooper-Greenhill 2000). Communication is understood as 'a cultural process that creates an ordered and meaningful world of active meaning-makers' (Hooper-Greenhill 1999b, pp.16–17). Thus, when an individual receives messages and actively constructs meanings from the messages, his/her society and culture influences the meaning-making process. The process of meaning-making is continuously negotiated through a circular action between the whole and the parts of communities that they belong to, and between the past and the present (Hooper-Greenhill 2000). Thus, it is necessary for museum professionals to consider the possibility of the diverse interpretation of their collections, and that an open meaning-making process reflects the culture that visitors bring with them (ibid.). This perspective is relevant to new museology as well as accepting the coexistence of multiple meanings/interpretations of museum objects and content.

In this approach, the individuals who receive messages (visitors in museum context) are considered active actors who want to present their voices and share with others through participation in the content production process. This not only means participating in programmes which are predefined by content producers (e.g. museums) and offer only limited activities to participants, but also includes the co-production process of content through constant dialogue and discussion between message senders and receivers in order to understand each other. Digital technology can foster this public participation process in new ways. Technology allows new connections, not only between message senders and receivers, but also between receivers (e.g. internet), and can support a true forum in which every participant can make their voice heard. Although the number of people who create new content may be fewer than expected (Simon 2010), if an individual can add value to existing content by, for example, pushing a 'like' button, then this can transform a personal experience into a social experience and affect other participants' experiences and perspectives.

There are several challenges to implementing this two-way communication model that empowers audiences as co-producers in museum context. First, there remains a power issue and unequal authority, although the audience is anticipated to make their own meanings actively (Stylianou-Lambert 2010). However, they are not absolutely free to interpret museum objects, rather, an audience may already know of the existence of a more valid and preferred interpretation, which can make their active participation uncomfortable. Shared authority is based on trusting an audience as co-producers; however, there is still a fear held by museum professionals regarding inappropriate views of the public

when there is no moderation by museums (Russo et al. 2008). Second, the expected audience activity that encourages critical reflection may not be achieved; in reality, their own assumptions and knowledge could only be reinforced, and sometimes, they may even tend to ignore messages sent (Stylianou-Lambert 2010). Finally, museums face a dilemma between encouraging the identity formation of an active audience and achieving the outcomes and goals expected as an agent within a certain political and economic environment (ibid.).

Before discussing the last approach of communication, I would like to highlight that the communication approaches presented above are not an 'either-or' relationship, and instead, should be treated as part of a continuum (Moussouri 2014). Museums might adopt approaches as combined and depending on the goals of communication for its audience; the transmission model of communication even can suit specific settings. Therefore, what museum practitioners should do is to adopt the most appropriate communication model which fits their setting, although I believe that the cultural approach supports the new museology.

3.3.4 Holistic Approach to Museum Communication

Museum communications in the literature tend to discuss only the communication approaches of museum exhibitions (Hooper-Greenhill 1999a). Hooper-Greenhill (1999a) proposes a holistic approach for museums communication which considers communication in the broader context of museums. This is because museums with a physical space differ to the general mass media; museums still have the option of natural modes of communication, such as face-to-face encounters.

Museum communication can start on-site at museums, off-site away from museum buildings, and via museum websites or other media. The increased use of mobile devices makes the boundary of a museum where the public can encounter the content of a museum unclear. For example, people can watch a video that was filmed in a museum whilst on public transport, and can enjoy a mobile game app when walking down the street. Digital technology can also be applied to form a visually dynamic environment. The combined experiences of a museum result in an image of that museum, which may influence the perceptions and attitudes of potential and actual museum visitors (Hooper-Greenhill 1999a).

Through the sections above, I have discussed communication approaches in order to understand possible underpinning theories for digital museum projects. The transmission model explains communication from the technological point of view and sees communication as a linear process to impart a message from a transmitter to a receiver, and fails to explain active receivers. The encoding/decoding theory and a circular model of communication also limit the capacity of receivers and hold that messages can only be defined by senders with authority, like museums. A cultural

approach of communication based on post-modernism reflects the complex concept of active receivers who consume the messages sent while producing new meanings for them. Museums' communication should be understood within their cultural and social contexts and involve visitors with different backgrounds. This is strongly related to the new museology view. Lastly, a holistic concept of museum communication, not only exhibitions but also the broader aspects of museums also can be adopted in digital museum projects to engage the public affectively.

The next section will see museums as educational institutions and discuss learning theories, which might be adopted in digital museum projects. Depending on underpinning learning theories of the projects, the ways learners participate in the projects can differ. Understanding learning theories adopted in the projects also provides me with the extent of which museums consider public active actors and learners.

3.4 Museums as Educational Institutions

The role of museums as educational institutions has evolved from the notion of public museums created during the Age of Enlightenment in Western countries (Hooper-Greenhill 1992), and has gradually been enlarged, alongside the social value of museums, which has been proposed in the USA and UK since the 1990s (Hooper-Greenhill 2007). This role has been further enhanced by museum professionals and policy-makers. Research with visitors has shown that education is also regarded as an important purpose and motivation for visiting museums (Falk et al. 1998; Kim & Han 2011; Kong & Bae 2015; Park 2016).

Most digital museum projects have been considered to be part of the educational function, and the underpinning learning theories of the projects can be linked to museology, particularly in how museums see themselves and the public within learning systems. To provide a theoretical framework for this relating to the Research Questions 1-4 and 2-2 (see Section 1.2), I will discuss several learning theories. Firstly, the basic education theories will be explained using the interpretation of Hein (1998): didactic and expository; stimulus-response; discovery; and constructivism. Next, theories from a constructivism point of view will be further explored due to their wide adoption in contemporary museum learning. Sociocultural learning approaches, especially situated learning theory, and serious leisure theory, which provides an insight for understanding of the motivation of learners, will be discussed. Critical pedagogy will then be explained. In the last section, digital games will be highlighted as one of learning approaches that many educational institutions, including museums, consider beneficial.

Although each learning theory will be presented separately, it is imperative to bear in mind that there are overlapping areas within learning theories, depending on how they are interpreted (Hohenstein & Moussouri 2018). For example, discovery learning can be understood as a branch of constructivism, and some social constructivists even consider their perspectives to be sociocultural (ibid.). Therefore, it may be helpful to consider learning theories as a continuum, which shares commonalities, rather than clearly separate categories.

3.4.1 Learning Theories

Before explaining learning[4] theories, it is crucial to acknowledge that different ways of learning are recognised, meaning that learning is not singular, but ambiguous and complex (Hooper-Greenhill 2007; Hooper-Greenhill & Moussouri 2002). What learning is can be understood differently, depending on its definition and the underpinning assumptions. This also results in different approaches to learning and the expected learning outcomes. In this section, following Hein's categories of education theories, four basic learning theories will be explained.

Hein (1998) details two continua; a theory of knowledge and learning theory, which are fundamental concepts for explaining what education is. The theory of knowledge is classified via two positions describing what knowledge is: realism and idealism. Realism explains that there is absolutely true knowledge, whilst idealism considers knowledge to exist only in the minds of people. Thus, it can be said that traditional museology, which only accepts authentic interpretation approved by museums, has a similar point of view to realism, while new museology tends to be closer to idealism. I assume that if museum practitioners follow new museology, then the digital projects they developed may allow visitors, as actors, to participate in diverse meaning-making processes, and might provide more chances for visitors to explore and build their own meanings.

Learning theory examines the process through which people acquire knowledge. One end of the continuum of learning theory represents the transmission-absorption concept of learning, and considers learners as passive people who absorb content. This side focuses more on the content that should be taught. The opposite end of the continuum considers the aspects of learners, who are seen as active actors who can construct knowledge. Thus, this aspect is more related to the new museology perspective.

As presented in Figure 3.1, based on these two continua, Hein (1998, pp.25–36) suggests that there are four domains, each describing a particular education theories type: didactic and expository education; stimulus-response education; discovery learning; and constructivism.

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[4] In this section, the terms 'education' and 'learning' are used interchangeably. However, learning tends to indicate a more learner-centred perspective than education.
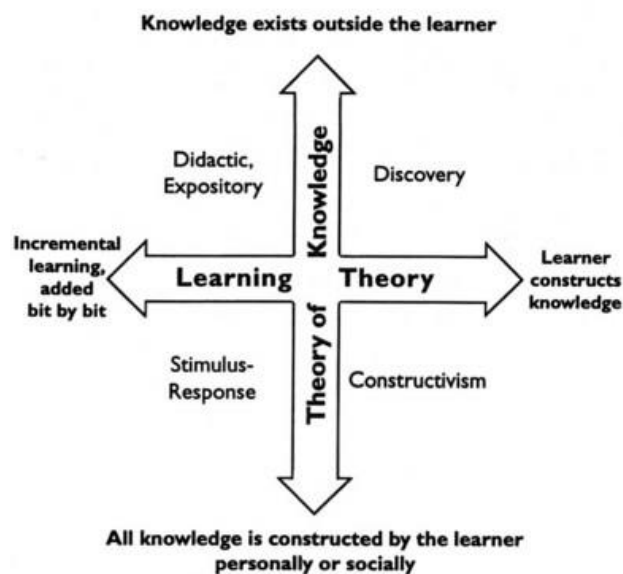
Figure 3.1 Education theories
(Hein 1998:25)

Didactic and expository education theory: This theory tends to regard learners as empty vessels that need to be filled with knowledge, which is provided by experts who have control on what should be taught. This type of education method can be easily be identified in traditional schools, where it is the teacher's responsibility for understanding the knowledge first and then presenting the domain of knowledge to students. Museums that apply this educational approach in their practices, termed systematic museums by Hein (1999, pp.76–77), believe that 'the content of the museum should be exhibited so that it reflects the 'true' structure of the subject-matter, and the content should be presented to the visitor in the manner that makes it easier to understand'. Their content may be displayed in a particular order, and not allow alternative explanations. A continuous use of questions, quizzing or mini-lectures during the learning process exemplifies this method (Ash et al. 2012). Similarly, I assume that if museum practitioners adopt this approach for their digital projects, the role of digital technology may be limited in its delivery and share only closed knowledge of and fixed meaning of collections and content, and the visitors (and the public) may be assumed to have no agency to produce knowledge.

Stimulus-response educational position: This theory supports the early behaviourist point of view and defines learnt behaviour as 'a relatively permanent change in behaviour that results from practice or experience' (Vasta et al. 1999, p.34). This approach tends to be concerned with teaching methods that reinforce a stimulus for learners, rather than content. Learners are expected to find out new knowledge through a trial-and-error type approach during their learning process (Jarvis et al. 2003, pp.24–31). If this results in the right outcomes then they receive positive reinforcement, but when the outcomes are

incorrect, negative reinforcement is provided. An exhibition that adopts this approach probably impresses conditioned stimulus on learners repeatedly and rewards appropriate responses. In terms of digital projects, digital activity, for example, persistently pressing buttons on a monitor or responding to digital movement on a screen, are examples of this approach.

Discovery learning: Unlike the two education theories above, discovery learning approaches consider learning as an active process (Bruner 1961). The followers of this approach believe that actual physical activity and experience are crucial for learning, rather than being told by others (Hein 1998). This physical activity is commonly referred to 'hands-on' learning, for instance, solving a puzzle, handling objects, or other interactions with objects that might engage and encourage learners to think. Learners are expected to discover predefined correct knowledge and conclusions at the end of learning, although not being able to discover the appropriate findings is understandable. Museums that adopt this approach will have a wide range of physical activities that visitors can explore for themselves, and there may be no specific intended path for exhibitions, so that visitors are allowed go back and forth. However, visitors may encounter some means so that they can assess their own interpretation against the correct one provided by the museum. Digital projects based on discovery learning may also lead visitors to find correct knowledge after exploring content in a diverse way. In this case, the learners have less agency than the museums.

Constructivism: Constructivism education recognises that learning is achievable when learners actively participate in it (von Glasersfeld 2005; Fosnot & Perry 2005). From a constructivist position, it is necessary for learners to experiment in order to see the range of possible and acceptable situations that can be produced. The active individual learner as actor might construct knowledge with reference to his/her own background and experience. Hein (1998, 1999) states that a constructivist museum provides a wide range of active learning methods that are suitable for the learning situation. Moreover, it will present a range of points of view as a result of the acceptance of different conclusions and interpretations of collections, depending on the diverse backgrounds and previous experience of visitors.

In particular, constructivism is a widely-adopted learning theory in museums today (Hooper-Greenhill 1999c; Koo 2014). Therefore, it may be helpful to look at constructivism in more detail. In the following section, the scholars who are frequently mentioned in relation to constructivism, John Dewey, Jean Piaget, and Lev Vygotsky, are described. Although it is difficult to separate learning theories clearly, their approaches to learning are different. Jean Piaget's perspective on learning is dedicated to the individual's cognitive process, and his studies lead to the development of cognitive constructivism, which sees human development from an individual point of view. On the other hand, Lev Vygotsky is more concerned with the social and cultural aspects that influence learners so that his

arguments became a base of social constructivism, which understands learning relating to sociocultural elements. Dewey's perspective is in between these two.

3.4.2 Constructivism and Museum Learning

3.4.2.1 Prior to Constructivism: John Dewey's Perspective on Education

John Dewey is a key figure in education philosophy, whose ideas affected the development of constructivism. He considered that education is the development from within individuals through experience (Dewey 1938), and experience is acknowledged as fundamental to his educational philosophy. Here, experience not only refers to 'actual' experience of doing but is also embedded in a personal continuum of experience, from those which have gone before to the consequences of the current experiences (Dewey 1938; Ansbacher 1998). Hein (2012, p.19) sees two broad concepts within Dewey's overall arguments on education: 1) visitors/students must be actively engaged (have experiences) in order to learn; and 2) educational activity must be associated with experiences that enhance a capacity in the learner for living in harmony with an ever wider and broader community. These concepts can be further linked to museums and museums' digital projects.

The first concept concentrating on learners' experience and active participation in the process of learning is relevant to hands-on exhibits that have been widely adopted in museums, especially in science centres for children (Ansbacher 1998). In particular, digital elements can bring benefits to museums in specific ways, for instance, the provision of a virtual experience that cannot be a reality. Regarding the second concept, Dewey, as an empiricist, believed that all education subjects must be liked to experience, and is reflected by society (Hein 2012). Here, society is not perceived to be static and singular but to be moveable and diverse, therefore, education also should reflect this. This thinking can be easily linked to new museology, through introducing and accepting multiple perspectives of sub-groups and subcultures in museum collections and objects, museums can be an open space where a variety of people's voices are heard. The potential of digital technology to enhance this aspect is endless (Hein 2012, p.184), for instance, technology can connect people all around the world to present their opinions and share them with others.

3.4.2.2 Cognitive Constructivism: Jean Piaget's Perspective on Education

Jean Piaget's educational theory presents a cognitive perspective on how individuals come to know their world. He did not consider an individual's intellectual structure to be ready-made and innate. Rather, it was perceived as being constructed through continuous interactions between an individual and their environment (Piaget 1952; Bybee & Sund 1982; Fosnot 2005).

He described this intellectual development process as having an equilibrium, which encompasses two intrinsic polar behaviours; assimilation and accommodation (Piaget 1952). When learners encounter

new information, they attempt to understand it with the knowledge they already have, and if it can be easily matched and assimilated to the existing knowledge structure, learners are in a state of equilibrium. In contrast, when information is not easily assimilated then they encounter an imbalance, which may require changing or accommodating the existing knowledge structure to deal with the new information and fit the external reality. Through this process, the learner simultaneously organises and integrates his/her intellectual structure into coherent systems of a higher order, and the learner regains their cognitive equilibration (Piaget 1952). With regard to museums and museums' digital projects, Piaget's emphasis on learning as the interaction between learners and their environment has influenced the design of museum spaces and participatory exhibits (Black 1990).

Additionally, Piaget's study of children's cognitive development[5] has influenced museum learning, as well as school education (Piaget 1952; Bybee & Sund 1982). It is important for teachers to present and expose the appropriate level of learning materials and questions that suit the developmental stage of learners. In a museum context, depending on the age range of the target visitors for exhibitions or digital offerings, different approaches can be applied and the depth of contents and activities should be appropriate.

3.4.2.3 Social Constructivism: Lev Vygotsky's Perspective on Education

Constructivism can be interpreted in different ways (Hohenstein & Moussouri 2018). Cognitive constructivists, including Piaget, see learning as a result of the process of individual cognition, while social constructivism places more emphasis on the environment of learners and understands learning as what is structured and determined socially and culturally. Lev Vygotsky is a key educational philosopher who many advocates of social constructivism follow. In this section, I will present his main ideas on learning, although it should be considered together with part of activity theory, which also addresses his perspective on human relationships with their environment (artefact).

Vygotsky (1978) understood that the human mind is social in its very nature, and is innately related to the whole context of interaction between human beings and the world. Based on these concepts, he maintained that culture and society are directly involved in the formation of mind. He viewed human development, including higher mental functioning (e.g. learning), as the process of internalisation; 'the internal reconstruction of an external operation' (Vygotsky 1978, p.56). He explained this through a child's development of pointing, where internalisation begins by representing an external activity, for example, the attempt of a child to grasp something by stretching their hand towards an object

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[5] The infant in the sensorimotor period (0-2 years of age) mainly interacts with his/her environment through physical actions and senses, but cannot connect external objects to mental images. The child in the pre-operational period (2-7 years of age) can form mental images and think in the broadest sense, although their thought may be pre-logical and egocentric. A child with concrete operations (7-11 or 12 years of age) is able to perform mental operations, although the presence of actual objects is required. The adolescent in formal operations (11-15 years of age) is even available to undertake reasoning about abstract ideas and problems.

placed beyond their reach. This activity becomes meaningful when others, such as his/her mother, realise and help a child to establish the link. This interaction between people on the social level is now transformed to inside the child, and the child can develop the concept of pointing. In brief, human mind development is both social and individual at the same time.

Vygotsky (1978) claimed that people who might be able to facilitate the development and improvement potential of learners hold a significant role. To explain this, he introduced two different developmental levels: actual development and zone of proximal development. When a learner can perform a task individually without any assistance from others then the task is within the actual developmental level of the learner. However, if a learner cannot complete a task individually, this does not directly mean that they do not have the capability to do so. Instead, if a learner successfully completes the same task in cooperation with others, we can say that the task is within the zone of proximal development. Only through cooperation with others can a learner develop and learn more. Those who can facilitate learners include not only adults such as teachers and parents, but also peers who have a higher development than the learner. This scaffolding to an upper developmental level can also be achieved through systems with artefact fostering and assisting the learner (Moll 1990).

Regarding this aspect of learning, museums' digital offerings could be designed to be a scaffolding element to foster museum visitors. It is also recommended that designers of exhibitions and digital exhibits should be concerned with the social behaviours of users of the exhibits, such as allowing groups of people to gather around an exhibit to look at it and talk together (Crowley & Callanan 1998; Heath & vom Lehn 2010; Gammon 2010). Therefore, if this aspect of learning is considered during the development of exhibitions and digital projects, a wide, flat screen that can be used by multiple users may be designed rather than a physically isolated monitor only for use by a single user.

In summary, constructivism learning theory considers learners as the centre of the learning process, although in cognitive and social constructivism, the relationship learners have with their surroundings is perceived differently. Constructivism theory allows the learner enough time to explore and discover knowledge on their own, and the responsibility and role of educators and adults is minimised in facilitating the learner. If museum practitioners intend to enable the open interpretation of exhibitions and museum objects, depending on visitors' social and personal backgrounds, and to consider visitors as active learners, then digital projects would follow the constructivist perspective. This type of digital project will empower visitors to participate in museums and encourage them to present their points of view through active participation. Thus, the visitors become actors in the knowledge-production process.

Vygotsky's works on learning has been studied and expanded by a number of scholars. Sociocultural learning theory, which will be discussed in next section, takes his emphasis on the importance of

social and cultural contexts on human development further. The next section will discuss situated learning theory, one of sociocultural learning approaches, and serious leisure theory, which makes a link of intrinsic motivations of learners to social aspects.

3.4.3 Sociocultural Approach to Learning

A sociocultural perspective of learning considers the human mind to be a sociocultural and historical construct and learning is strongly influenced by cultural factors (Rogoff 1998; Wertsch 1985). Thus, learning from this perspective is the interdependence of social and individual processes (John-Steiner & Mahn 1996), and learners from different cultural and social contexts will have different learning approaches and construct different meanings when they encounter the same content. A museum is a place in which people with different sociocultural backgrounds come together to view museum objects. If museum practitioners hold this perspective on learning, digital museum projects may also be concerned with being appropriate for the various visitors, by acknowledging their agency, with different cultural contexts, and again, this can be a way to actualise new museology.

There are various branches of sociocultural learning theory, including activity theory and CoP theory, which have already been discussed in Chapter 2. In the following subsection, situated learning theory will be further discussed, and especially to link the theory to maker spaces. Because learning in maker spaces is supposed to occur through active interaction between newcomers with old-timers (e.g. experts), maker spaces in museums can contribute to build new types of relationship between museums and visitors. This is associated with answering my research questions, not only regarding learning theory, but also the dynamic power relationship between actors. This is because learners in situated learning theory are considered as having agency to produce knowledge the same way experts do. This theory is further discussed below.

3.4.3.1 Situated Learning

When we learn and know something then we become experts in a certain practice, but Lave and Wenger (1991) consider that this cannot be established without actual participation in a practice with experts. They provide a sociocultural view of learning, namely situated learning, and hold that people should be engaged in socially organised and situated activities in order to learn practice. Activities do not only include the core ones that experts really undertake, but also refer to activities as legitimate peripheral participation. In other words, novice learners, the apprentices in a CoP, gradually acquire new skills, actions, beliefs, and knowledge by practising minimal roles assisting experts. As their participation is recognised within the community over time, they can obtain full membership of that community. CoP theory, which is discussed in Chapter 2, is a theory extended from situated learning.

What I would particularly like to highlight within situated learning theory regarding my research, are the roles of experts in the learning community and issues concerning access to the community, especially in maker space contexts. This is because I consider that the role of experts (e.g. curators, interpretation staff, or educators in my research) and their relationship with learners are associated with actualising new museology. Maker spaces, originally from the US (Halverson & Sheridan 2014), are where members can use diverse tools to create their projects, and have now been extended to museums. Studies show that educators of maker spaces who are experts in their practice are expected not only to teach technical aspects of tools but also to be a co-worker who can explore and discuss with learners as a part of learning unit, to foster establishing a trajectory of visitors in becoming a maker (Brahms & Crowley 2016a).

From the situated learning perspective, newcomers should obtain access to resources and experts in order to learn practice (Lave & Wenger 1991). The extent to which a CoP welcomes or sequesters newcomers is different. Becoming a full member with the same agency as an expert of a CoP means not only learning how to use a tool but also connecting with the history of the practice and being familiar with the culture of the community (ibid.); therefore, it takes time to be granted full membership. When maker spaces are considered as a learning environment in which newcomers and experts work and learn together, the ways to welcome and accept newcomers and to foster them in becoming members should be considered (Sheridan et al. 2014). In other words, when a maker space adopts situated learning then it may facilitate knowledge sharing among members and encourage them to produce knowledge from the co-working process. Therefore, the relationship between newcomers and educators (or members of a community of a maker space) and the anticipated learning process of the maker space will be investigated.

In the next section, I move on to serious leisure theory. I particularly adopt this theory to explain the motivations of learners because it makes a link of intrinsic motivations of learners to social elements.

3.4.3.2 Serious Leisure: Motivation and Learning

Visiting museums in free time is a voluntary activity. There are various motivation theories/models that explain why people visit museums (Bourdieu 1984; Csikszentmihalyi & Hermanson 1999; Falk & Dierking 2013). Serious leisure theory contributes to make a link between motivation and learning by explaining this voluntary activity as leisure activity from a sociological point of view. In other words, this theory explains the motivation of those who visit museums constantly as not only from an intrinsic perspective, but also from a social one. In my research, I particularly adopt this theory to discuss the motivation of participants in crowdsourcing projects of museums. This is because this theory principally explains well the motivation of volunteering.

Crowdsourcing[6] projects; one type of digital museum project can only be completed by the voluntary participation of the public. The participants and contributors of crowdsourcing projects are volunteers; they are undertaking the work in their free time and it is basically unpaid labour. Considering volunteering from the economic definition fails to explain why people engage in unpaid activities, although they have the option to accept or reject it on their own terms (Stebbins 2009).

Based on the sociological point of view, Stebbins (2001) explains volunteering as a leisure activity. He sees leisure can be divided into casual leisure and serious leisure. Casual leisure refers to 'an immediately, intrinsically rewarding, relatively short-lived pleasurable activity, requiring little or no special training to enjoy it' (Stebbins 2001). Most people, when they think of leisure, think of casual leisure, for example, watching television, while serious leisure refers 'the systematic pursuit of an amateur, hobbyist, or career volunteer activity that captivates its participants with its complexity and many challenges' (Stebbins 2001).

Stebbins (2009) maintains that the volunteering experience makes participants feel involved in a community and interact with society as being given social rewards, while also developing their personal interests in the volunteering area as personal reward. Rotman et al. (2012) further develops the motivation of volunteers' and scientists' involvement in citizen science projects, noting that volunteers are motivated by a complex framework of factors that change throughout their cycle of work on a project. The initial decision to participate in a project tends to be more motivated by personal interests, while the ensuing decision to continue their engagement once an initial task is completed tends to be influenced by external factors, such as attribution and acknowledgement. As Rotman et al. (2012) noted, providing feedback and recognising volunteers' contributions to projects and research can maintain participants' interest and attention. This may allow participants at all levels to feel like full members based on a CoP theory perspective (Wenger 1998).

Yet in terms of crowdsourcing projects, the most important issue can be building trust into the existing power balance between experts and volunteers (Rotman et al. 2012). Although such projects tend to allow the public to actively participate and empower their agency, it is also important for museums to ensure the quality of data that the public provide. In many crowdsourcing projects, activities limit participants to collecting data for research which experts set, rather than inviting the public into all research areas in order to co-create it together (ibid.).

Therefore, I will look at the extent to which museums empower participants of crowdsourcing projects to produce knowledge (e.g. analysing data, creating contents) and how museums nurture the

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[6] Crowdsourcing projects are defined as 'the act of a company or institutions taking a function once performed by employees and outsourcing it to an undefined network of people in the form of an open call' (Howe 2006).

volunteers working on a project to become members of a community. This can be linked to new museology if museums perceive the public as co-workers who also have the authority to produce content as museums do.

In the sections above, I discussed learning approaches, which consider and study the ways in which learners develop their knowledge and skills. In the next section, I turn to critical pedagogy, which rethinks what knowledge is taught (e.g. the curriculum) and for what purpose knowledge it is constructed. Critical pedagogy also addresses structures of power that exist within society and institutions like museums. This is related to new museology in terms of what aspects of knowledge are selected and presented in museums, for what reasons, and from whose point of view. With critical pedagogy, we can see which actors' voices are included in museums and which are not. The following section is also linked to the ways to adopt this pedagogy in digital museum projects.

3.4.4 Critical Pedagogy

Critical pedagogy was developed by critics of schooling and its content, which is considered to be structured in order to present and maintain existing unequal social orders (Darder et al. 2009). Advocates of critical pedagogy, including Henry Giroux and Paulo Freire, hold that the development of human cognition can be understood through the relationship between sociohistorical contexts and individuals' thought and actions (Vossoughi & Gutiérrez 2017). Although they understand that human development can be expanded by using tools, similar to Vygotsky and his followers, they consider human activity to not be politically neutral. In particular, they raise problems with school education, referring to it as 'banking education', whereby teachers deposit knowledge in the heads of students. They also argue that the knowledge taught in school often helps to represent and reproduce unequal social conditions. Thus, students are only perceived as focusing on memorising facts which are believed to be true, rather than encouraging alternative possible perspectives (Darder et al. 2009). Advocates of critical pedagogy place an emphasis on identifying dominant cultural myths, which are told and celebrated without any doubts or reflecting critically on the ways they are presented, which may ignore or marginalise other cultures (Darder et al. 2009).

In terms of how knowledge is produced, critical pedagogy holds that knowledge is constructed and the role of teachers is in engaging leaners to actively construct knowledge, just as Vygotsky considered teachers to be facilitators (Vossoughi & Gutiérrez 2017). However, Freire and Macedo are aware of teachers' political responsibility and contend that 'the educator who dares to teach has to stimulate learners to live a critically conscious presence in the pedagogical and historical process' (1995, p.379). Therefore, teachers and students are supposed to work within a dialogical relationship, for example, through conversation and debate, in order to produce knowledge via an active process.

Lindauer (2007) linked critical pedagogy to new museology and museum exhibition development by focusing on the social role of museums. Because critical pedagogy sees knowledge as not being neutral but which can be interpreted with multiple meanings, depending on the different cultural backgrounds of the learners, museum exhibitions, which adopt critical points of view on knowledge production and presentation, can exemplify new museology. From a critical pedagogy point of view, she analysed exhibitions presented in the US, and showed that many of the written text panels have dominant (white male) cultural points of view. As an alternative approach, she suggests using a language of hope (e.g. implicitly enquiring, 'what do you think?'), as well as a language of critique. This is likely to echo Witcomb's (2013) suggestion for using affective forms of knowledge when producing a critical pedagogy for history museums. With examples of history exhibitions in Australian museums, she postulates art works as interpretation methods that can contribute to visitors critically thinking through an emotional and imaginary experience. The element of surprise with art works can foster them recognising something (e.g. the past believed to be factual) from different angles (ibid.).

Linking to my research, digital elements have a positive potential to actualise critical pedagogy in museum settings because it is relatively easy to set the digital environment so that it allows visitors to produce alternative knowledge and present their own thoughts about the content provided by museums and share them with others to continue the conversation. Multiple meanings on the same content can be accepted and exist within the digital environment. Therefore, in my research, I will look at content and the interpretation of digital projects from the critical pedagogy point of view, and examine the extent to which museums allow and accept various points of view on knowledge in terms of race, gender, class and other aspects of identity. This can also be associated with the extent to which visitors as actors are allowed to produce knowledge.

In the next section, lastly, digital games will be discussed regarding informal learning. Because of the context of my research, which investigates digital culture in museums, the rise of the development of digital games in the museum context is very important. For example, many museums have adopted game-like approaches for digital exhibits, and the development of online/mobile digital games also has been increased in museum contexts. This is why I have a separate section for digital games, although I have realised that it is not quite at the same level with the rest of the sections of this chapter. I just wanted to highlight digital games in the museum context as one type of digital offering.

3.4.5 Digital Games in Learning

Museums can embrace digital technology through the creation of digital games. A game-like approach can be found in gallery exhibits, as well as online and mobile games. Recently, games and

gamification[7] have been considered as 'important developments in technology for museum education and interpretation' (NMC 2015). In this section, I will look at what features of digital games bring about benefits as a learning method and what type of museum games can be considered to be a good game, before linking gaming to learning theories.

A game can be defined as 'a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome'[8] (Salen & Zimmerman 2004). In the cultural heritage and museums sector, various types of digital games are developed, from complicated strategy games to simple puzzle games (Mortara et al. 2014). Although each museum game has different goals, Birchall et al. (2012) found some common objectives between museum games, including increasing brand awareness for a museum, enticing non-visitors to come to a museum, engaging players with museum themes or collections, encouraging visitors to a museum to familiarise themselves with the institution and exhibitions, deepening enjoyment at a museum, deepening observations of collections and exhibition subject matter, and changing visitor behaviour in some way.

Schaller (2014) categorises museum games into two types: extrinsic games, for example, pattern matching and memory skills games that separate game content and gameplay, and intrinsic games, where the game mechanics organically represent the content. Game approaches may reflect a museum's learning goals. For example, if museums intend game players to learn details from artworks, such as subject, style, and colours, through concentrated observation, the extrinsic approach could be adopted to develop players' visual skills (Schaller 2014). Similar to Schaller, Whitton (2014) interprets digital games which direct players to acquire facts and information, as adopting behaviourism learning theories, because memorisation and recall activities are main aim of the game. This type of game is easy to design and build, and it is less problematic to evaluate the intended learning goals (Whitton 2014). Games that adopt constructivism learning and understand players as actors can create an engaging and critical learning experience, and encourage reflective talks after the playing the game (Whitton 2014; Gee 2007). Moreover, game players tend to remember more knowledge related to task completion than information directly provided by a game (Mortara et al. 2014).

Digital games are perceived as an effective learning environment. Games not only adopt a level system of players and reward them differently as extrinsic motivators, but also good digital games allow players to be active producers who can customise their own learning experience (Gee 2007).

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[7] 'Gamification' refers to 'the use of game mechanics in traditionally nongame activities' (Jagoda 2013).

[8] By following the definition of a game provided by Salen and Zimmerman (2004), I consider all puzzles are a special type of game, although they only allow limited answers. Open-ended games, such as role-playing games, can also be games depending on how quantifiable outcomes are framed.

Because games provide virtual contexts in which players are situated and need to deal with, they are likely to analyse information, develop strategies, and apply skills to solve the problems they encounter (Whitton 2014). Unlike real situations, a virtual game context is also a safe place to try challenges, and players learn gradually from failures, thereby increasing their competence (Gee 2007, p.122). Remixing and reproducing is another benefit of games in developing players' creativity (Whitton 2014). Cooperation and competition are easily found in gameplay, and these types of social elements of gameplay further help players to learn (Gee 2007; Whitton 2014).

Digital games that are developed by museums tend to have educational purposes. In this research, I consider digital games as one type of digital projects that are designed to facilitate visitors' museum experience based on museums' learning philosophy.

3.5 Summary

In Chapter 3, I, firstly reviewed the change of museology from old museology, which focuses on museum objects, to new museology, which considers the public at the central of museums. Although there are several challenges to implementing a new museology, contemporary society requires museums to play an educational role and to have social value; therefore, I argue that museums must actualise a new museology by practising in critical and democratic ways. The ways in which museums actualise museology can be captured by analysing their practices with communication and learning theories. Throughout Section 3.3 and 3.4, I discuss communication and learning theories in order to provide a theoretical framework with which to understand the underpinning assumptions during the development of digital museum projects. For instance, if a museum considers visitors to be active learners and co-producers, with agency to construct their own meanings, then its digital projects can offer visitors more opportunities to participate in the meaning-making process.

I adopt a cultural approach of communication, and sociocultural learning theories and social constructivism, as these understand human activity as an integral system of the individual and the social, and are appropriate for facilitating museum-based learning and implementing new museology. These approaches have been clearly linked to the theoretical framework developed in Chapter 2 indeed. This is because ANT, activity theory and CoP theory, which were discussed in Chapter 2, also see a society as complicatedly networked systems that the collective and the individual are interconnected. Therefore, these two frameworks well support my perspective on museums and individuals as not only independent and having agency, but also as being socially shaped and interconnected with each other.

There may be a gap between museum practice and museum literature, based on theories. In addition, various education theories may be combined within museum practices, rather than only choosing one theory. The underpinning theory of digital museum projects can be uncovered through examining the human actors who have been involved in a project. Interviews with museum practitioners will reveal their thoughts and thinking about knowledge and learning, and enable an analysis of the communication and education theories that underpin digital museum projects.

Overall, the theoretical frameworks developed in Chapters 2 and 3 takes a complementary approach in order to investigate different aspects of the digital network of museums. The framework developed in Chapter 2 with ANT, activity theory, and CoP theory guides me to identify relevant actors and their roles, and to understand their relationships regarding digital museum projects. While, the framework developed in Chapter 3 with communication and learning theories helps me answer why the projects are developed a certain direction. In other words, a digital project might be shaped due to its sociocultural context and the human and non-human actors involved in its development process. This holistic approach can provide a better understanding of museums functioning within a rapidly changing society.

Chapter 4 - Methodology and Methods

This chapter outlines the methodological approach and methods chosen to address my research questions (see Section 1.2). It clarifies why a qualitative and collective case study was appropriate to the research and how cases were selected. The research design and data collection methods used to answer the questions are also explained. Based on the theoretical frameworks discussed in Chapters 2 and 3, analytical frameworks were developed and they are presented in this chapter. Finally, the ethical issues of concern during the research, and the contributions and limitations of the study from a methodological perspective, are explained at the end of this chapter.

4.1 Qualitative Approach

As presented in the above section, my study attempts to understand the social and cultural factors interconnecting (or not interconnecting) with museums in the digital age, and how these have influenced digital museum projects, in order to implement new museology. My theoretical framework recognises various potential actors who might have affected the projects and provides an understanding of human consciousness and activity influenced not only by the individual but also the collective. Therefore, it was crucial to ensure that my methodology and methods enabled me to investigate these complicated interconnected situations of museums and museum practitioners.

Consequently, I adopted a qualitative methodology, which is appropriate for understanding 'holistic' and 'complicated' contexts (Mason 2002). It also enables the researcher to deeply explore precise matters, such as people's understandings and interactions in their particular contexts (Mason 2002; Silverman 2005). These understandings are, however, from the interpretivist approach, which seeks subjective meaning and individuals' perceptions of the external world (Mason 2002). Taking an interpretivist stance helped me reconstruct and understand the stories behind digital museum projects and their connections to social and cultural factors, as well as the influence of individual museum practitioners.

However, a key challenge that interpretivist researchers face is that their studies should be trustworthy (Guba 1981; Silverman 2014). Regarding this issue, Guba (1981) proposed four criteria: credibility, transferability, dependability, and confirmability, which qualitative researchers should consider. I adopted the strategies that Shenton (2004) suggested, based on Guba's criteria, to make my research more trustworthy. The first criterion, credibility, means the findings of a particular inquiry should be the 'truth' in the context in which the inquiry was undertaken (Guba 1981). To ensure this, I followed

systemically designed research processes in five stages, and I also attempted to reduce the shortcomings of using one method by using three different methods for data collection. This is explained in detail in Section 4.2. I also made preliminary visits to the case museums and conducted a pilot study to develop early familiarity with the culture of the museums. The study of multiple cases, which I adopted, is also one of the ways to enhance credibility by building in variation (Corbin & Strauss 2008, p.306; Stake 2005, p.459). During the data analysis process, I also revisited my data several times to confirm my findings. The second criterion, transferability, seeks to determine the extent to which the findings of one study can be applied to other situations (Guba 1981). Qualitative research, including mine, is carried out in a specific context and a period of time. Therefore, to give readers a proper understanding, and to enable them to compare the findings with those they have in their own situations, sufficient contextual information about the methodology and the cases researched should be offered. I have attempted to provide rich information about the case study methodology I adopted and the methods I used to collect data in the following sections, and thick description regarding the case museums is presented in the finding chapters. Dependability, the third criterion, means that research should enable a future researcher to repeat the work (Guba 1981). For this, I present in detail in the text every step of the research I conducted. Finally, to enhance confirmability, qualitative researchers are recommended to check and recheck their findings with others. Although the intrusion of the researcher's biases is inevitable, these biases can be reduced via confirmation of one's findings by others. I had regular meetings with my primary and secondary supervisors throughout the research process, and the comments they gave me are reflected in this study. Moreover, the experience of delivering a presentation and a poster in conferences also helped me validate my interpretation and findings by obtaining feedback from researchers and museum professionals, especially regarding the power relationship between governments and museums and how this shapes digital museum practices. By doing so, I attempted to decrease any potential biases, while I was also aware of my predispositions stemming from my professional identity and sociocultural background.

The following subsections further explain why I adopted case study methodology and discusses the methods I used to collect data.

4.1.1 Qualitative Case Study

I adopted a qualitative case study approach that strongly supports naturalistic, holistic, cultural or phenomenological interests (Stake 2005). Yin (2009, pp.8–14) provided precise guide lines about when to use a case study. According to him, a case study can be considered when the main research questions are 'how' and 'why' forms; researchers do not wish to control participant behaviours; and the research focuses on contemporary events. While ethnography requires the researcher entering into

the particular settings for a period in order to observe people and their surroundings (Tedlock 2000), a case study with various methods, such as secondary data, interviews and visual data, allows researchers to understand the case. A case study was, therefore, a suitable approach for my research because of the forms of the research questions, and because of the concentration on the continuous situation in museums regarding digital culture. Nor did my research require any control of behavioural events, but rather examined the current contexts of museums and museum practitioners.

More specifically, I adopted a multiple case study methodology in which a number of cases are jointly studied to inquire into phenomena, populations or general conditions (Stake 2005). The cases are chosen because it is believed that understanding them will lead to a better understanding (or theorising) about larger cases (ibid.). In the following sections, I explain the reasons I selected the two countries, Korea and the UK, three national museums in each country, and the process and reasons I chose the digital projects of the museums.

I generally started from the Korean case museums at each research stage because I, as a Korean researcher, was more familiar with the museums and their sociocultural contexts. The experience of data collection in the Korean museums guided me to deal with the UK cases efficiently, although I also needed different approaches to collect data in the UK cases, especially for interview data (see Section 4.2.4). Of course, during the research, I was concerned with my own inherent biases, which are crucial for interpretivist researchers to be aware of (Corbin & Strauss 2008, p.303). My identity as a Korean made it easier for me to gain access to, and build rapport with, Korean museum practitioners during interviews. Yet, this identity may cause an unequal perspective concerning the Korean and UK cases also.

I am also in between two key CoP: museum sectors (I worked in a museum as a curator) and digital ones (I worked in a software firm as a computer science and engineer undergraduate). Inevitably, having been within the boundaries of the two communities may have influenced my research and a certain way of thinking about museums in the digital age. Conversely, my multiple memberships facilitated my critically considering the relationship of museums with the digital world. They also gave me an advantage when interviewing museum practitioners, especially digital experts who have a computer engineering background. They were more likely to express their opinions once they perceived me as a museum 'insider' with a computer-related academic background. These concerns and awareness were addressed throughout the research process.

Additionally, case study researchers are recommended to follow systemically designed processes in order to make the research more trustworthy and stable (Mason 2002; Yin 2009). Regarding this, the process of data collection and data analysis for this research was divided into five stages. The process, however, was not linear. It can be open, dynamic and circular (Yin 2009). I therefore went back and

forth between the stages, if necessary. The research design and data collection process is explained in Section 4.2, following the explanation of the cases selecting process.

4.1.2 Criteria for Selecting the Two Case Study Countries

The reasons I chose Korea and the UK stem from my personal background and the social contexts of these two countries. First, being a Korean researcher, and having worked in a children's museum near Seoul as a curator, I was involved in a permanent exhibition development project, which included curating hands-on (mechanical and digital) exhibits. Various digital exhibits, for instance digital games and short video animations, were developed during that time. Additionally, my academic background as a graduate in an interdisciplinary department of Culture Technology at Master's level, and in computer science and engineering at undergraduate level, led to me having further research interests in the meaningful uses of technology in informal learning settings, such as museums.

Second, the Korean government, which provides the bulk of the financial support for its national museums, has frequently referred to the UK as a leading example of innovative cultural policies, creative industries and museum practices. For example, the annual plan document, published by the Ministry of Culture, Sports and Tourism in February 2014, mentioned the Arts Council England (ACE) strategy document, *Achieving Great Art for Everyone* (2010), as providing common ground for culture policy in the twenty-first century. This provided a good basis for comparing Korean museums and those in the UK. Thus, I decided to conduct my PhD research in the UK to investigate the UK cases more efficiently.

Digital culture increasingly impacts our lives. The cases of the museums of Korea, which is an advanced, technology-friendly country, could provide new insights into how to address the digital experience. However, engaging the public in museums might be less related to the extent to which innovative digital technology is adopted in the museums, and more about the communication and learning theories embedded in the projects. That is why Korean national museums seem to have struggled to employ digital technology to satisfy the various actors. Therefore, it is interesting to investigate how museums have performed with various actors to facilitate museum visitor experience. The case studies could also be beneficial for understanding the relationship between museums and actors, especially the power and impact of government bodies on museums (Research Questions 1-1, 1-2 and 1-4).

The context of national museums in Korea and the UK is explained at the beginning of Chapters 5 and 8, before the case museums are discussed.

4.1.3 Criteria for Selecting Case Museums

In collective cases, Yin explained the concept of 'replication' design as an opposite of 'sampling' design (Yin 2009, pp.53–54). When researchers select cases, the cases must have either 1) predicted similar results (a literal replication), or 2) predicted contrasting results but for anticipatable reasons (a theoretical replication). Thus, multiple cases are not to be similar to the multiple respondents in a survey. They should be justified in why they are selected.

In my research, I selected three large national museums in each country. Because I categorised government as one of the important actors, I investigated the impact of government policy on the embracing of digital technology in museums (Research Question 1-1). Thus, national museums are regarded as having stronger connections with central government policy, especially in Korea, than local authority/university/private museums. Also, national museums generally have stable annual budgets and professional staff. These conditions might make the museums able to reflect new phenomena of digital culture.

In the case of Korea, according to the Museum and Art Gallery Support Act, the National Museum of Korea (NMK) and the National Museum of Modern and Contemporary Art (MMCA) are officially stated as representative national museums. Thus, I focused on what this official description means. In general, however, science is one of the most popular subjects for museums. Therefore, a national science museum, the Gwacheon National Science Museum (GSM) near Seoul, was selected. Because both the MMCA and the NMK are in Seoul, the science museum was selected for the efficient collection of data. Based on these Korean national museums, I decided upon three UK national museums – Tate Modern, the British Museum (BM), and the Science Museum (SML), all in London – whose subjects are similar to the Korean ones. In particular, the Wellcome Wing's exhibitions in the SML, which have been planned to present contemporary science and technology, were chosen to reflect the GSM's subject matter. Finally, the case museums chosen in this research are presented below in Table 1.

Main Subject	Korea	UK
Modern / Contemporary Art	National Museum of Modern and Contemporary Art (MMCA)	Tate Modern
History / Archaeology	National Museum of Korea (NMK)	British Museum (BM)
Science and Technology	Gwacheon National Science Museum (GSM)	Science Museum, London (SML)

Table 1: **Case Museums**

4.1.4 Criteria for Selecting Digital Projects in the Museums

The cases are the six museums chosen and presented in the previous section. To determine the extent to which the museums' practice has evolved to accommodate digital technology (Research Question 2), however, it was necessary to select digital projects of the museums as examples. Each example has different unique characteristics, depending on its purpose. Yet, analysing a project alongside other projects in a museum can provide a holistic understanding of the museum, in terms of why and how the museum has employed digital technology. Finally, we can understand how the museum has interconnected with other social systems in the digital age.

Digital museum projects can mean a range of different types of projects embracing digital technology. In this research, digital museum projects broadly refer to any projects that visitors can interact with, are digitally originated and digitised museum resources through digital media, for instance, personal computers, smartphones, tablets and screens in and beyond the walls of museums. The 'case' in case studies should be specific and bounded (Stake 2005), and in order to be analysed, it should be bounded in terms of time and place (Creswell 2014), time and activity (Stake 1995), and definition and context (Miles & Huberman 1994). When screening the websites and annual reports of the museums published since 1990, I found many digital projects with the potential to be chosen. I then narrowed them down using three aspects.

First, I chose digital museum projects from a visitor perspective rather than from management purposes. This is because my research interests more relate to visitor experience with digital technology (see Section 1.2, Research Question 1) rather than behind-the-scenes digital technology. Therefore, any projects that focused purely on management, such as ticketing systems, and behind-the-scenes digital systems used in workplaces, for instance, infrastructure and digital communication methods among internal museums staff, were excluded. Also, those projects developed for their own sake, such as digital artworks, were not addressed. However, if a digital artwork was displayed for visitor engagement and functioned as an engaging element, it was included.

Second, digital projects that were 'recently' developed and launched were chosen. Because my research motivation began from understanding current museums' circumstances, recent projects are more relevant to my research interests. Moreover, analysing the projects is associated with the investigation of what internal museum organisational changes have been made recently, and their impact on digital projects. Furthermore, there is a practical reason I decided to examine recent projects. I intended to look at and use them by myself directly if I had time, and if I could access them.

I expected that this could provide me a chance to analyse them from my point of view without filters. Therefore, the projects that I could not access and collect data from were excluded.

Third, if projects were developed in third-party service, such as Facebook, Twitter and Minecraft, they were not selected. Although museums might have actively been involved in the projects, and social media is one of important issues regarding digital museums, they might have only used the predefined functions of the existing service, rather than developing new elements for the museums' own purpose.

4.1.4.1 Six Categories

There are various types of digital museum projects, and these may be extended further with new technology in the future. With respect to museum visitor experience, I categorised the digital projects based on a journey of museum visitors as mobile learners who are continually on the move (Sharpies et al. 2007). Based on a holistic approach to communication (see Section 3.3.4), the museum communication process can begin from any place in which visitors meet museum content. It is therefore necessary to consider not only static/situated digital projects in the physical space of museums, but also mobile projects that can be used regardless of the place where users are. Although the existence of virtual space on the internet seems to be equally important, and activities and projects on the internet have increased, museums, unlike other mass media, have a physical space that visitors can visit and communicate face-to-face in. This is why I covered and started the digital projects in the physical space of museums.

Table 2 presents the digital projects selected in each case museum. First, the digital projects are divided into two parts: static/situated and mobile. The projects grouped into the first category are fixed and situated in a certain circumstance in a museum. This does not mean the digital devices adopted in the projects are installed physically. Some are installed (e.g. digital exhibits) but others could be portable. The meaning of 'static/situated' in this context is that the projects are location-dependent and only meaningful in the predefined environment in the museum. On the other hand, the projects grouped into the second category, 'mobile', independently exist, regardless of the location of users. Therefore, informal learning and free-choice learning can happen in any circumstances, such as at home or on the street with mobile devices.

I then divided the static/situated digital projects into four further categories based on visitors' physical journey in a museum: (a) orientation space; (b) in galleries; (c) programmes/events; and (d) multimedia guides. Museum visitor experience can begin from their arrival at museums.[9] After passing through an entrance gate, visitors arrive at an orientation hall. The hall is a space where

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[9] Of course, museum communication might start before visitors arrive at museums through various media and previous relevant experience. In this research, however, physical environments that can influence museum visitor experience, such as museum buildings, are exclusive.

museums can intentionally deliver their current exhibitions, events, etc., as well as where visitors are potentially motivated to discover the rest of the museum (Cohen et al. 1977; Wolf 1986). Therefore, it can be said that the hall has an important role for museum visitor experience. All the case museums have digital elements in their orientation space in some ways.

Visitors then might move in a certain direction and possibly enter a permanent gallery. Most of the digital projects of the museums can be founded in galleries, although there are differences among the museums. Visitors then might have a chance to participate in digital programmes/events,[10] which are prescheduled by the museum educators. This category involves both simply using a digital tablet in an activity, and programmes in a facility that has cutting-edge technology devices. What I would like to highlight particularly in this category is the role of museum educators.

Many museums have developed multimedia guide systems. Some museums lend their devices to visitors who pay for it; others have developed downloadable apps. Because of their fundamental function to provide rich content for museum objects, the multimedia guides tend to take a one-way communication approach. However, new interactive approaches could be possible with digital technology.

Next, I then divided the mobile digital projects into two further categories based on the target users: researchers and children (and young adults). Although it might be difficult to clearly separate between them, it is also true that digital projects that generally target school pupils are more likely to adopt a digital game approach. Also, 'researchers' refers not only to academic researchers, but also to those who consider themselves researchers from a serious leisure point of view (see Section 3.4.3.2). Therefore, it seems worthwhile to divide the projects based on expected main users. I examined all the digital projects based on an analytical framework, which is discussed in Section 4.3.2, to answer which communication and learning theories have been adopted (Research Question 2-2).

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[10] Some examples of category (c) can be considered 'mobile'. For example, the Digital Maker programmes of Tate Modern are actually part of Tate Kids. The reasons I include the programmes in category (c) are because the programmes are planned and prescheduled by the museum rather learners accidentally encounter, and the role of facilitator of the programme might be important for engaging learners further. Therefore, the programmes are separated from Tate Kids in category (f).

		Korea			UK		
		National Museum of Modern and Contemporary Art (MMCA)	**National Museum of Korea (NMK)**	**Gwacheon Science Museum (GSM)**	**Tate Modern**	**British Museum (BM)**	**Science Museum, London (SML)**
Static/ Situated in museums	**(a) Orientation Space**	-Digital Information Display -MMCA Friends	-Kiosks	-Kiosks	-Digital Drawing Bar -Timeline of Modern Art	-Digital Signage	-Digital Signage -The Worm wall
	(b) Digital Exhibits (in galleries)	-A children's gallery	-AR Curator -A children's gallery	-DNA exhibition -ICT Experience hall	_[11]	-Virtual Autopsy in Early Egypt gallery	-Wellcome Wing exhibitions
	(c) Programmes/ Events	-Digital learning programmes -Art Fab Lab	-Smart Curator	-Idea Factory	-Digital Maker	-Samsung Digital Discovery Centre	-Latest event -Coding workshop
	(d) Multimedia Guides	-A mobile guide app	-A mobile guide app	-	-Mobile guides	-Audio guide	-
Mobile	**(e) Online-Research (researchers)**	-	-Oegyujanggak Uigwe website	-	-Archive & Access project	-MicroPasts	-Craving project
	(f) Online-Learning (children)	-	-Online games	-Digital Learning Centre	-Tate Kids	-Time Explorer	-Online games

Table 2: The selection of digital museum projects

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[11] At Tate Modern, the Bloomberg interactive zone had been developed and offered to visitors when I visited there in early 2013. However, the zone has since been replaced to create a relaxing place without exhibits.

4.2 Research Design and Data Collection Methods

While selecting the case study museums, and more intensively afterwards, I collected data to answer my research questions. A complementary approach was needed to examine different aspects of the digital ecosystem that the Korean and the UK national museums have associated with, and to compare the museums of the two countries. Three methods – secondary data, visual data and interviews – were the main approaches I used for my data collection. They were combined to corroborate each other. Depending on the research questions and expected data, more suitable methods were adopted. The data collection and analysis process of this research were divided into five stages that are explained in the subsections below.

4.2.1 Stage One

First, I considered the propositions of my research questions. A study's propositions are the directions in which that researcher should pay attention to answer the research questions (Yin 2009). They could reflect important theories and come from the literature, personal or professional experience, or generalisations based on empirical data (ibid.). In the case of my research, because of its exploratory nature, the propositions mainly stem from my working experience, as well as literature from museum studies, sociology, learning sciences and general phenomena in museums, as explained in Chapters 2 and 3. In addition, the informal interviews with Korean curators, as a pilot, were conducted at a personal level to obtain general ideas about my research topic in the Korean context. Based on the propositions, I aligned the research questions with suitable methods, as presented in Appendix 2. However, I was always concerned with unpredicted and rival situations throughout the research.

4.2.2 Stage Two (Secondary Data)

Collecting (and analysing) relevant secondary data was the second stage of data collection (and analysis). Because the data provided general information about the museums, including mission statements and the context of museums in each country, this was beneficial for me to prepare interviews and field work. Secondary data are considered a significant source for qualitative researchers. Documentation is especially recognised as a social factor that is constructed in its society and organisations that represent a particular reality (Silverman 2014). Thus, documentation should be understood in its unique context, rather than as true or false facts (ibid.). Moreover, researchers should understand how documentation is produced, circulated, read, stored and used (Atkinson & Coffey 2011).

In my research, secondary data produced by the case museums, government bodies, museum professional bodies, and media were collected mainly as electronic formats via the websites (see Appendix 3 for the list of secondary data). If the annual reports of the museums were not accessible via the website, I visited the museums' libraries and copied the pages needed with the permission from the museums. I collected the annual reports/reviews of the museums published since 1990 because the internet and personal computers began to become widely available to the public at that time, and museums also launched their first websites in the mid-1990s. Therefore, I assumed that the use of digital technology aimed at museum visitors increased, and internal organisational change might have been made, since 1990 (Research Question 2-1 and 2-3).

During this stage, once I acknowledged the digital projects through the secondary data collected, I traced potential actors of the projects to identify active actors (humans and nonhumans) based on ANT. This is associated with finding the ways the actors attracted others for the further extension of their network and power. Through this, I was able to describe the dynamics between the actors (Research Question 1). I also explored the changes in the roles/aims/attitudes of museum stakeholders, regarding digital technology in the museums, based on activity theory. In addition, internal organisational changes related to digital practices, for example, a new formulation of departments/teams handling digital technology in the museums, could be found (Research Question 2-3).

4.2.3 Stage Three (Field Work and Collecting/Generating Visual Data)

Before the interviews, I visited and used the digital projects that the interviewees have been involved in their development process; this included visiting the physical and virtual space of the museums. It helped me to understand the projects in depth, so that specific interview questions could be developed further. However, some projects, and most of the educational programmes, which are categorised as (c) in Table 2, I was unable to access due to several reasons, such as a limited time schedule and unoffered service at the time I conducted the research. For example, the online service Young Explorer at the BM was not accessible at certain times in 2014/15, when the museum restructured its website. In those cases, I attempted to collect more secondary data and interview data.

During the field work, I also collected/generated visual data, for example, photographs of digital projects. In the past decade, interest in 'the visual' as research data has increased in interdisciplinary academic discourses, as well as the social sciences and humanities (Mason 2002; Banks 2007; Emmison 2011; Pink 2013). In particular, it could have much potential and possibility in terms of a study of museums mainly based on visual culture. Furthermore, visual data provided me with different types of data beyond self-report methods.

In my research, the visual data were mainly employed to answer the Research Questions 2-1 and 2-2, which investigated the types of digital projects and communication and learning theory adopted in the projects. The visual data used in this research were mainly collected by myself, but some images and photographs taken by the museums were also collected if necessary. In some cases, especially when I could not find any relevant images on the museums' websites, I asked the interviewees if they can share images of digital museum projects. Visual images are expected to help readers understand better how the digital projects function, rather than only providing a verbal explanation. They also provide the contexts that projects were located in, both physical and virtual contexts.

4.2.4 Stage Four (Interviews)

My research investigated the museums as complex institutions, where various actors interconnected. I considered museum practitioners as one of important group of actors by adopting activity theory (see Section 2.4). To know their perspectives and attitudes on digital technology, and how they have worked with other actors to develop the digital projects, it was necessary to interview them.

Interviewing is a widely-adopted method for qualitative researchers (Silverman 2014). The reasons that many qualitative researchers use interviews vary by research topic, which makes it possible for interviewees to speak directly about the topics (ibid.). Thus, researchers can explore the voices and experiences of the interviewees.

I adopted semi-structured interview methods with interview themes that are explained in the following subsection. My interviewees mainly included museum practitioners, but also a researcher and a senior member of staff in a culture organisation. The profiles of all the interviewees are presented in Appendix 5. To anonymise the interviewees, I assigned a code to each of them using a combination of the name of the museums (ex. MMCA) and an identifier (ex. A, B). For instance, MMCA_A, refers to an interviewee I conducted an interview with in the MMCA. This form is used throughout this thesis when I refer to my interview data. Overall, I conducted 36 interviews, 21 in Korea and 15 in the UK. Most of the interviews were conducted one-to-one, except in two cases, and were face-to-face, except one interview, which was done via Skype. Because museum practitioners have a responsibility to fulfil the work of museum, they can be a significant actor who can connect to other actors. Thus, my primary interviews began with museum practitioners. With the snowballing technique, which is useful for gathering interviewees through the identification of an initial subject who is then used to provide the names of other actors (Atkinson & Flint 2004), I asked the interviewees for more contacts who might be relevant to my research.

Meanwhile, I identified possible interviewees, who might have been involved in the digital projects I selected, using several methods. In the Korean cases, organisation charts of the museums and brief job descriptions of each museum practitioner with official contact numbers can easily be found on the museums' websites. If I could find their official email addresses, I initially sent emails to them with a brief explanation on my research. My personal connecting points also helped me to access them.

For the UK case museums, however, that kind of information was not openly available on their websites. So, I then referred to publications, such as the museums' blogs, press releases, conference proceedings, papers and annual reports, to identify relevant museum practitioners for the digital projects. After having identified potential interviewees, I sent emails to them to introduce my research and attempted to conduct interviews, but it was hard to obtain responses from them. Thus, I changed my strategies to contact them. I attended museum conferences, seminars and events whose topics were relevant to my research, expecting to have a chance to meet potential interviewees. In fact, some of the potential interviewees were speakers and delivered presentations. I was able to approach the potential interviewees personally and interview schedules could be arranged. After having an interview in a museum, finding the next interviewee in the museum was easier with the snowball technique. For example, in the case of Tate Modern, an interviewee invited me to attend an internal meeting of the Digital Learning Group. She introduced me to other members of the group, so the next step to approaching potential interviewees did not take much time. In some cases, I also collected interview data recorded/written by other researchers, with the interviewees, and relevant to my research[12]. It also helped me to develop my interview questions more precisely.

At the beginning of the interviews, I showed interviewees a diagram that helped explain my research and helped them to recall and think about the development process of the digital project, involved stakeholders, and other relevant elements. The interviews lasted just under one hour, and generally took place in a quiet space, such as a meeting room in the museum. Most of the interviews were recorded using a digital voice recorder with the permission by the interviewees. During or after the interviews, if the interviewee had time, the interviewee and I went to look at the digital project together. Further conversation and discussion could be made and recorded during this visit. Sometimes I took photographs of the digital projects into the interviews. The images helped the interviewees recall the project with more certainty. In the Korean museum cases, my work experience helped the interviewees develop a rapport with me; while language barrier could be an issue in the UK cases. After the interviews, any relevant documents provided by the interviewees were collected.

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[12] I discovered the interview data that researchers shared on the internet, for instance, the INTK's web site (http://www.intk.com/en/ideas/interviews). I did not analyse the data, but they indirectly/directly helped me prepare the interviews.

4.2.4.1 Interview Themes

The interview themes were developed based on the theoretical framework, and are divided into seven categories (see Appendix 4 for details). They are mainly based on the seven elements of activity theory (Engeström 2015): subject, object, tool, community, rule, division of labour and outcome, while ANT, CoP theory and communication and learning theories are partially adopted. These interview themes were also used as an analytical framework later.

Theme 1 – the context of museum practitioners: This theme focuses on understanding the personal (sub-theme 1-1) and societal contexts (sub-theme 1-2) of museum practitioners. In terms of the personal context of museum practitioners, their profile, identity and work experience were dealt with. The ways they develop their professionalism can be understood with CoP theory. In terms of their societal contexts, the expected or forced work of museums, and their qualification as a museum practitioner were investigated. These aspects were also linked to other actors, for example, the government and sponsors from an ANT point of view, because this could be in a process to extend their network to others.

Theme 2 – the object of the activity: This is to find the purpose and motivation of the digital projects that the museum practitioners have planned or already done. This could be further understood by using communication and learning theories.

Theme 3 – mediating artefacts: This defines the digital technology the museum practitioner has employed (technological tools) and the museology underpinning the digital projects (psychological tools). I asked interviewees about the significant functions and features of the digital tools. This could be the point that digital technology as an actor, from an ANT point of view, attracts and negotiates with human actors to adopt it in their projects.

Theme 4 – community: This theme concerns the link between museums and internal and external human actors. I attempted to determine which were strong/hidden/non-actors, and their relationships with/among others. During the development process of digital projects, some actors' power might extend, while others are excluded. This can be understood with the translation of ANT, the network building process and OPP that every actor should pass to achieve their goals. Also, I can understand which devices were used by the actor to keep attracting other actors (members of the community) in its network. The sub-theme 'relations (4-1)' with community can be understood with CoP and communication theories.

Theme 5 – rules: Rules are sets of conditions that a museum practitioner must abide by when doing an activity. For example, these may include the decision-making process, budget and policy. A point of view of CoP can be associated with understanding organisational culture.

Theme 6 – division of labour: This theme is concerned with the ways the community works together to fulfil their roles as distributed/expected. Depending on the change of actor network, the roles could be changed. The sub-theme 'social learning (6-1)' specifically seeks the roles of museum professional bodies that are assumed to provide opportunities for museum practitioners to develop their skills relevant to their practices. This aspect can be linked to CoP.

Theme 7 – ultimate goals/values/beliefs: This concerns the broader purpose of the activity. Museum practitioners may carry out their work in line with the museum's overall vision.

4.2.5 Stage Five

The final components suggested by Yin (2009) for case study research design are the logic linking the data to the prepositions, and the criteria for interpreting the findings. These components can be better developed in the data analysis step (ibid.). In the design phase, however, being aware of the main choices of analytic techniques for linking the data to the propositions is recommended (ibid.). I linked my data to the prepositions by using matching patterns based on the theoretical frameworks presented in Chapters 2 and 3. Nonetheless, some research questions, for example, Research Question 2-1, can be answered by analysing time-series data to find the digital projects developed in the museums.

4.3 Data Analysis

The data analysis of this research was mainly driven by the literature, which was discussed in Chapters 2 and 3. Two different analytical frameworks were required to relate to the theoretical frameworks. The interview themes presented in Section 4.2.4.1 were used as an analytical framework to determine the relationships of the museums with actors (generally concerning Research Question 1), while I developed another analytical framework to answer Research Questions 2-2 and 3-3, which consider the communication and learning approaches of digital projects. The analytical frameworks are discussed in the following subsections.

Data analysis began with coding based on the analytical frameworks. The transcribed interview data and secondary data (e.g. documents) were partially coded using NVivo. NVivo, one of leading software packages for the analysis of qualitative data, enables researchers to synthesise data into

interconnected categories. Also, it enabled me to create a hierarchical structure of categories. For example, under the category 'community', I developed the following subcategories: government, digital industry, public, etc. Although I drew my main categories from the frameworks, their subcategories were reshaped several times during data analysis process.

There were several practical reasons why I partially used the software in the data analysis. First, some secondary data I collected is not in a digital format. Thus, the additional step of digitising the data was needed to use the software. Also, some documents did not work appropriately in NVivo because of a technical issue recognising Korean in documents. Using software in qualitative research can bring many benefits (Weitzman 2000); however, this does not mean that the research is systemically done only with software (ibid.). Although I coded also by hand with colour pens and markers, I maintained the analytical categories and indicators throughout the data analysis process.

4.3.1 Analytical Framework 1: The Relationships Between Museums and Actors

The analytical framework regarding the relationship between the museums and actors (generally Research Question 1) was basically developed from the interview themes presented in Section 4.2.4.1. Each interview theme became the main analytical categories along with several subcategories.

The analysis of the relationship of museums and their actors is presented in the first section of each museum's chapter. Also, as a summary of the analysis, actor-network maps for each museum, for example, Figure 4.1, were developed from my data analysis. By tracing their network, I identified relevant actors, not only human actors and organisations, but also non-human actors, and presented them in the maps. The lines between actors indicate their connection. This visualisation is supposed to make it easy to acknowledge the actors associated and mentioned in text, and to compare them with other networks, especially to answer Research Question 3-1.
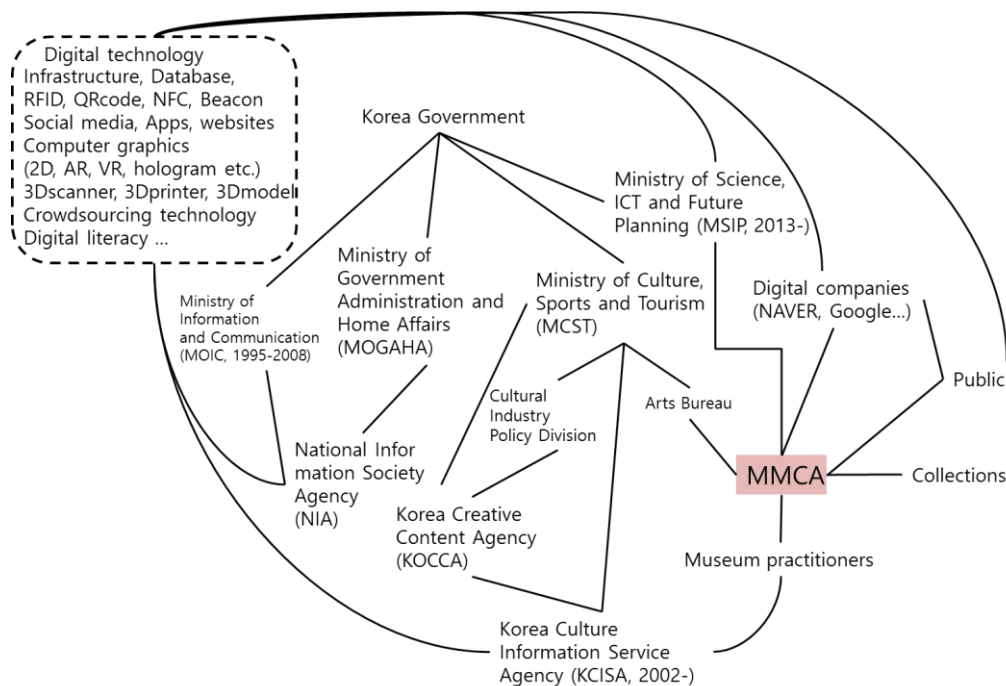
Figure 4.1 Actor-Network map of the MMCA

4.3.2 Analytical Framework 2: For the Digital Projects

To answer the research questions about the types of digital projects developed by the museums (Research Question 2-1) and the communication and learning approaches adopted in them (Research Questions 2-2 and 3-3), first, a six-phase process by Parry and Sawyer (2005), discussed in Section 2.2.1, was adopted as a guideline.

After reviewing the past digital projects, I then investigated seven aspects of the digital museum projects I selected above (see Table 2). The seven aspects are: target visitors; the motivations of the projects; active/hidden actors during the development process (community); the roles of the actors (division of labour); intended communication and learning goals and outcomes; activities that visitors can do with the digital projects; and the highlighted roles of digital technologies. Essentially, these analytical categories were driven by activity theory (Engeström 1999), because the activity of developing digital projects can be influenced by the museum practitioners who take charge of the projects and his/her circumstance. I attempted to deal with each category in every digital project.

It can be argued that the activities visitors can do with a digital project, the highlighted roles of digital technology in the project and the expected/intended roles of educators are all associated with the underlying communication and learning theories of the project. Also, the overall mission and the aims

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of learning of each museum might result in the communication and learning approaches of each project. Therefore, I developed an analytical framework based on the theoretical framework of communication and learning theories discussed in Sections 3.3 and 3.4. The categories that Frohberg et al. (2009) developed to examine the pedagogic role of digital technology also guided me (see page 40 for an explanation of their study). This framework is presented in a table in Appendix 8, and I explain how I linked the theories and indicators to digital projects, and how I analysed them, below.

A key concept of the transmission model of communication (see Section 3.3.1) is that knowledge is fixed by message producers (e.g. museums). If the content and knowledge of digital projects is fixed by museums, and users can only consume it, it can be argued that a transmission model of communication has been adopted in the projects. In this case, digital technology only has the role to deliver content, which is produced by museums, to users (visitors). Users are then considered to passively absorb what they receive through the projects. Thus, the process of knowledge construction follows a didactic learning approach (see Section 3.4.1). Whereas, when a digital project mainly concentrates on the provision of the automatic feedback about right/wrong answers, or on the simple physical reaction, it has taken a behaviourism approach to learning (see Section 3.4.1). In these type of projects, digital technology is harnessed to interact for control. The transmission model of communication, the didactic learning approach and the behaviourist approach can also fall into the old, traditional museology that considers the interpretation of museum objects as objective.

If digital projects deliver less fixed content, and provide learners with more activities, for instance, exploring the given environment/stories to find out 'right' answers, these projects might have adopted a discovery learning approach (see Section 3.4.1). Similarly, some digital projects are designed for particular groups of people (e.g. experts) for research, and it is expected that only they can correctly understand the content of the projects. If this is the case, it can be argued that encoding/decoding communication theory (see Section 3.3.2) has been adopted in these projects. During the development of the projects, there might be a feedback loop from target audiences to reflect their opinions, as well as to see if intended messages are delivered well. In this case, we can say that a circular model of communication has been adopted (see Section 3.3.2). Therefore, digital technology facilitates learners to assess their own interpretation against the 'correct' interpretation intended by museums in these projects, which are adopted either through discovery learning theory, encoding/decoding theory or a circular model of communication.

If constructivism learning approaches are adopted in digital projects, digital technology might have a role to offer users to construct and create their own content that reflects their experience. Particularly projects based on a cognitive constructivism learning approach may provide many entry points and a

range of activities; there would be no correct answers predefined (see Sections 3.4.1 and 3.4.2.2). If the digital technology adopted in a project makes it possible to collaborate or cooperate with others, and to acknowledge the existence of various points of view on a subject, depending on each learner's social/culture background, the projects can be understood through social constructivism (see Section 3.4.2.3).

From a sociocultural learning perspective (see Section 3.4.3), if digital technology is situated within authentic environments, in which experts fulfil their works and learners are supposed to participate in expert performances via apprenticeships, for example, maker spaces and lab styles, the underlying learning theory is situated learning. Furthermore, the motivation of participants in digital projects can be understood from a serious leisure approach by linking their personal interests to social elements. In terms of communication theory, similar to social constructivism and sociocultural learning approaches, if museums consider knowledge can be subjective, depending on the culture that visitors bring with them, the projects might provide open and diverse interpretations by adopting a cultural approach towards communication (see Section 3.3.3).

One of the advantages of embracing digital media is that it can store and present a range of content in various ways. If digital elements are harnessed to present multiple voices and meanings at the same time, and make it easier for the public to participate in debate and discussion, it can be said that critical pedagogy has been adopted (see Section 3.4.4). Moreover, digital technology can be embraced to build immersive environments that influence visitor experience from a holistic communication approach by museums (see Section 3.3.4).

In sum, the main points addressed are that the intended pedagogical roles of digital technology in the projects can be unfolded with activities designed for the public. Depending on the extent to which museums consider the public as active learning participants, the expected roles of educators, and whether museums consider knowledge to be objective or subjective, the underpinning communication and learning theories of the projects are different.

4.4 Ethical Concerns

I was concerned with several ethical issues regarding the data collection process before the start of collection. First, given that my research only involved adults with the full capacity to consent, the Institute of Archaeology's Research Ethics Committee waived the need for an ethical review as long as the interviewees provided informed consent. Therefore, for the interviews, I provided a copy of the

information sheet (see Appendix 6) and a consent form (see Appendix 7) in Korean or English to interviewees before starting the interview sessions. All the interviews were conducted in a public space in museums. Interview data was anonymised; however, museum practitioners could be identified because of their specific occupation. I took the opportunity to emphasise this to the interviewees. In terms of secondary data, I collected this mainly from the public domain and in official ways with permission. In terms of visual data, I only took photographs that were permitted by the museums. When I selected the photographs I used in my research, I attempted to select ones that do not include people's faces in the frame. Also, I considered the ownership of the visual data. When I needed to use a photo that other people took and published somewhere, such as an annual report, I contacted the museums and asked the original producer, who holds the copyright, for their approval to use it for research.

4.5 Contributions and Limitations of the Study from a Methodological Perspective

In terms of methodological perspective, there are several contributions and limitations of my study. First, via a qualitative approach, this study provides a holistic understanding of the case museums using rich data. Selecting cases was necessary and intended to better understand museums in a digital age. To increase trustworthiness, especially credibility, multiple cases were selected and studied.

Second, adopting three methods for data collection (secondary data, interviews and visual data) enabled me to address different aspects of digital museum projects. This was also for the purpose of triangulation, to enhance credibility (Mason 2002). The methods have limitations at the same time, however. For example, spoken words and written text have limitations when presenting complex and multi-dimensional social phenomena (Mason 2002). In the case of visual data, although it allows the researcher to capture the 'real' world visibly, an approach using visual data does not produce objective reality (Pink 2013). It is also a result of selection by the producer. Thus, visual data in my research might have reflected my subjective point of view. However, it is also true that visual evidence provides readers with a rich context of digital museum projects so that they can judge the author's analysis for themselves.

Finally, interviews with museum staff enabled me to gather their personal perspective and represent their voices directly, although this self-reporting method has a limitation as it focuses on only the thoughts and feelings the interviewees are able to articulate. A semi-structured interview method suited this research well by dealing with specific interview themes as well as encouraging

interviewees to tell their stories freely. I attempted to conduct interviews with museum practitioners about all the digital projects chosen for this research. However, I could not do so in some cases due to the lack of time and no response from the potential interviewees. To analyse these cases, for example, the multimedia guide of the BM, I referred to relevant secondary data.

In sum, despite several limitations regarding my methodology, this qualitative, multiple case study methodology, using a combination of three methods (see Appendix 2), enabled me to address and study the complicated situation that museums face in the digital age.

4.6 Summary

My research methodology was a qualitative case study. Six national museums were selected in Korea and the UK. Also, the digital projects of each museum were chosen based on the expected visitors' journey in/out of the museums.

I mainly collected secondary data, visual data and interview data. In terms of analysing data, the theoretical frameworks explained in Chapters 2 and 3 jointly guided me to develop the analytical frameworks. While activity theory provided a conceptual framework with seven components I should address, ANT was specifically employed to understand the progress the network made with museums, external human actors and digital technology. Furthermore, I explored the relationship among human actors from a CoP theory point of view. From the projects chosen, I analysed the communication and learning approaches that the museums might have adopted in general.

Chapter 5 - National Museum of Modern and Contemporary Art

5.1 Introduction

In Chapters 5 to 10, each chapter covers the findings of an individual case study of a museum. The selected three national museums of Korea are presented first, followed by the UK cases. The context of the national museums in Korea is explained in this chapter, followed by the four sections of the National Museum of Modern and Contemporary Art (MMCA): overview of the museum; identified actors; digital projects; and summary.

Section 5.2 explains the history, the mission statement, and the learning goals of the MMCA. This section helps readers to understand the general context of the museum. By analysing its mission statement and learning goals (outcome in activity theory), the way the museum considers its roles in society and the museology that underpins the museum practices will be uncovered. This is important because the museology is a conceptual tool of an activity of museum practitioners (Cole & Engeström 1993; Engeström 2015) which affects museum practices (e.g. developing digital projects).

Section 5.3 identifies the dynamics between key actors who have affected museum practices in the digital age, as well as the power relationship between them, which helps answer Research Questions 1 and 2-3. Furthermore, how the central government and its agency retain their power over the MMCA and museum practitioners is discussed. The various barriers at the museum which might discourage it from embracing digital culture are discussed also, for instance, linear working process, curator-dominated organisational culture, and frequently rotated job positions. The data I analyse in this section are 55 pieces of secondary data, for example, annual reports and policy papers (see Appendix 3), and interview data generated from six museum staff working at the MMCA and one at a government agency (see Appendix 5 for their profiles). As noted in Chapter 4, the interviewees are anonymised for ethical reasons and, in the text, they are referred to using their codes, such as MMCA_A. As a result of the data analysis, I developed an actor-network map of the MMCA (Figure 5.1).

Section 5.4 further focuses on the analysis of the digital projects of the MMCA, which were selected based on the criteria presented in Chapter 4 (see Table 2). This section identifies how the power relationships between actors result in the underpinning communication and learning approaches adopted in the projects, which help to answer Research Questions 2-1 and 2-2. The recent projects resulting from collaborative approaches between different professions (e.g. museum educators and digital experts, artists and engineers) exemplify why boundary activities and brokering (Wenger 1998)

are important for digital museum projects. Also, how the MMCA can incorporate new museology into its practices by acknowledging the public as an actor is discussed. The data I analyse in this section involve visual data regarding the digital projects, mainly generated from my field work, interview data with those who worked on the projects, and secondary data. Finally, I summarise the findings in Section 5.5.

Before beginning a discussion on the MMCA case, the section below helps the reader to understand the overall context of national museums in Korea.

5.1.1 National Museums in Korea

The formation history of national museums in Korea is relatively short. The oldest national museum, the National Museum of Korea, which is one of my case museums (see Chapter 6 -), was established in the early twentieth century during the Japanese colonial period (1910-1945), and the number of national museums increased gradually during the latter part of the century. Several national museum building projects remain under construction (or are planned to be established). Generally, the formation and management of national museums have not been community based (bottom-up approach), but from the government's museum-building policy strategy (top-down approach) (Park 2012b). Additionally, most of the annual budgets of the museums come from the government. As a result, the museums might have a strong relationship with the central government's intention.

The majority of museum practitioners are civil servants with a high level of job security. However, they are subject to the Decree on the Appointment of Public Officials, so they are regularly rotated to other teams or government departments, sometimes regardless of expertise. How this matter negatively affects museum digital projects is further discussed later in this thesis.

Learning departments in the national museums began to be formed only about 30 years ago (Kook 2013a), and discussions and research on museum learning have been growing as the number of museum learning programmes has increased. However, the work scope of the learning departments is limited to planning programmes and events in museum classrooms and outreach programmes (ibid.) rather than broadly being involved in museum projects.

In terms of policies relating to digital technology, these noticeably changed with the new President in 2013. Korean society has been encouraged to become more technologically innovative. The national museums are supposed to employ innovative digital technology to facilitate the museum visitor experience, for example, through the formation of maker spaces and by museum collection digitising projects (Research Question 2-1). Again, these projects are funded by the government; it is rare to find

private commercial sponsors in the Korean museum sector. The power relationship of the museums with the government and the role of government as a significant actor are further discussed, below.

5.2 Overview

The MMCA is the only national art museum in Korea. It opened in 1969 in part of Gyeongbokgung, a palace dating from the Joseon Dynasty era in the centre of Seoul, with the aim of collecting and exhibiting modern and contemporary art works by Koreans and international artists (MMCA n.d.b). Now the MMCA consists of three branches; Gwacheon, Deoksugung and Seoul.[13] They have different characteristics with respect to the range of artworks they collect and display; the newest branch in Seoul is located in a metropolitan area and tends to focus on contemporary art, such as digital art, while the Gwacheon branch is an art museum devoted to various genres of the visual arts, such as design, crafts and architecture, and the Deoksugung branch, within a historical site, tends to focus more on modern artworks (MMCA n.d.c). These different characteristics seem to govern how the branches have responded to digital culture, and I will further explore the ways they have associated with other actors in terms of digital technology in the Section 5.3.

According to the MMCA 2015 annual report, it has three missions: it should collect, conserve, exhibit, and research art works and resources; it should deliver art activities and educate the public in order to improve their understanding of arts and culture; and it should contribute to the development of Korean art culture and enable it to become recognised globally through international networks. I postulate that the first mission follows traditional museology because it targets experts and put objects at the centre of it, while the second mission focuses more on new museology, in terms of its educational purpose for the public (see Section 3.2). In addition, the MMCA seems to recognise globalisation in the arts, as well as representing Korean art. Thus, using these missions as the overall outcome of museum practices, I have analysed how this museum has embraced digital technology in order to achieve the missions outlined.

In terms of the overall approach to learning in the MMCA, I could not find any official statements. However, according to a paper written by a senior member of staff from the MMCA's learning department, learning activity in an art museum refers to the 'active participation of learners that interpret and understand exhibitions and collections of the museum with their own meaningful ways' (Cho 2009). Learning not only aims to educate about art but also addresses it as an integrated subject

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[13] In 1986, the MMCA moved to Gwacheon, which is located close to Seoul, which enabled the MMCA to provide suitable facilities as an art museum, and more diverse programmes. In 1998, it was extended via a branch opening at Deoksugung, another palace from the Joseon Dynasty era in Seoul, and in 2013, a third branch in Seoul was opened.

and part of cultural education that links art works to the local community, as well as the global society (ibid.). The MMCA attempts to encourage the public to not only consume art which is produced by artists but also to make art themselves through constructing a new perspective on the understanding of others and other cultures (ibid.). Thus, it can be said that social constructivism (Vygotsky 1978) underpins the overall learning approach by acknowledging the impact of culture on active learners. I will further investigate how this approach has influenced their digital projects in Section 5.4 after examining the actors who are interconnected with the projects within the MMCA in following section.

5.3 Identified Actors: Their Network and Roles

There are various types of digital projects within the MMCA, and the related actors vary in the different projects. Thus, in order to investigate the actors and their network, I began by tracing the museum practices within the MMCA's annual reports. I then explored the way in which actors make, keep and extend their network, or the reasons why some staff members are not part of the network. As noted in Chapter 2 and 4, activity theory (Engeström 2015) was adopted as a conceptual and analytical framework, which helped me to investigate human activity (e.g. developing digital projects) with seven elements of it (see Section 2.4.3 and Appendix 4). ANT (Callon 1986; Law 1992; Latour 2005) was used for identifying actors and understanding the ways they construct the network with others. CoP theory (Wenger 1998; Wenger et al. 2002) was particularly adopted to address how museum staff learn within and beyond the museum with others and to discuss how their professional identity affects digital projects. Based on the analysis of my data, I constructed an actor-network map for the MMCA (Figure 5.1). The key elements of the map, including government bodies, the MMCA, museum practitioners, digital technology, and the public will be explained in detail in the following subsections.
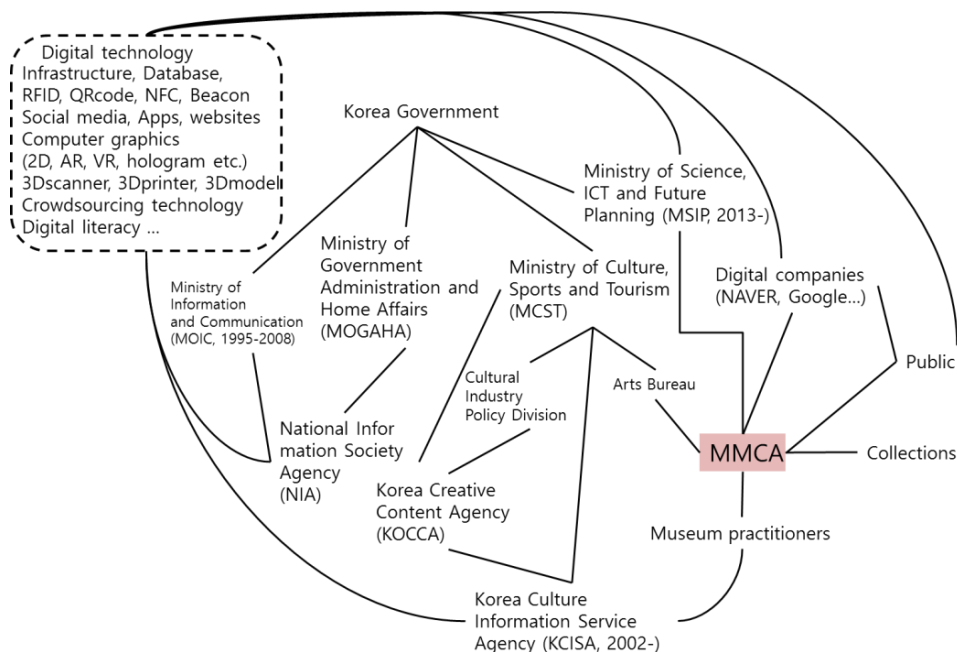
Figure 5.1 Actor-Network map of the MMCA

5.3.1 Government and Government Bodies

This section will cover information about the Korean cultural policy and its impact on museum practice and public provision in the digital age. The MMCA is operated by the Ministry of Culture, Sports and Tourism (MCST) and is directly affiliated to the Arts Policy Division in the Arts Bureau. Because of this structure, the government naturally is an actor in the MMCA and takes several roles, such as legislator, funder, policy-maker, and administrator. I will explain how the Korean government has invested in digital projects through laws with strong political wills, as explicit rules in activity theory (Engeström 2015) and device of ANT (Callon 1986). By tracing its ways to extend the network, I will explain the relation between government bodies and the MMCA in the digital age.

The MMCA's annual report 2014 (pp.264-267) has a subsection entitled 'informatisation'[14] in the section 'visitor services'. This subsection lists informatisation projects since 1995, and explains how the MMCA has created them. The mid-1990s is the period when the internet service was widely

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[14] 'Informatisation' in a Korean context has evolved according to relevant policies (NIA 2014a, p.8). The document, *National Informatisation: Past, Present, and Future*, explains how the definition of the term evolved over time (ibid.). From 1975-1986, informatisation only meant employing computer systems in administration for efficiency, and in 1987-1995, this was slightly extended as 'employing computer systems not only in administration but also main public sectors in order to communicate effectively'. Informatisation was extended further in 1996-2000 into individual areas, as 'extending high-performance computer system into personal areas and networking across the entire society in order to deliver information more rapidly'. Further expansion of its boundary occurred in 2001-2012, as 'using digital information in daily life of publics and expanding the boundary and tool of this'. Today, it means 'employing ICT in creative ways for creating new demand for ICT and for solving social issues' and 'leading creative economy and creative Korea as enriching creative ability of public and enhancing national core infrastructure', emphasising the significant function of digital technology in society.

expanded to the public in Western countries, and was also the time when the Korean government began focusing more strongly on developing the digital industry. Even though the government has supported the digital industry and relevant research since the 1980s, there was a noticeable change in 1995, when the government introduced the Framework Act on Informatisation Promotion. This Act mainly dealt with the establishment of infrastructure across the nation from public services into homes, which was supposed to be necessary in the future digital age (NIA 2014c).

Based on this Act, the government launched the Informatisation Promotion Fund, and as one of the represented organisations within the culture sector, the MMCA was funded and participated in the Public Application Service Development Project[15] in 1995, and the Public Work Programme on Informatisation from 1998 to 1999 (NCA 2001), building a database of collections, artists, and exhibitions, developing software for collection searching services, and designing a cyber-art museum for educational purposes using multimedia (NCA 2001, pp.176-177; MMCA 2014a, pp.264-267).

These projects were managed, controlled and evaluated by the National Information Society Agency[16] (NIA), whose role was to support specialised technologies for national informatisation, and to be a specialist organisation for constructing Korea's information infrastructure. Thus, from my analysis, it is obvious that the government and the NIA, actors identified in ANT (Latour 2005), actively created a network and expanded their power through laws and policy, rules, according to activity theory (Engeström 2015), right from the early era of digital projects.

Networks have been continuously extended through the Knowledge and Information Resource Management Act[17]; in 2000, more specific strategies have been implemented. One result was that the government succeeded in setting up a new agency in 2002, the Korean Cultural Information Service Agency (KCISA),[18] which specialised in cultural informatisation (KCISA n.d.). The KCISA has

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[15] The Public Application Service Development Project aimed to improve working efficiency and service by promoting informatisation in the public sector, and to encourage the establishment and use of the information super-highway by providing the hardware and software needed in advance (NCA 1995, p.7). It covered 12 fields, including culture, medical, environment, education, industry, traffic, transportation, labour, disaster prevention, agriculture and fisheries, public security, and administration (NCA 1995, p.7). In the culture field, MMCA, NMK and the Cultural Heritage Administration were selected as priorities, and the MCST managed them (NCA 1995, pp.53-56).

[16] The National Computerisation Agency was established in 1987 as a result of the Act on Expansion of Dissemination and Promotion of the Utilisation of Information Systems. In 2009, it changed its name to the National Information Society Agency, merging with the Korean Agency for Digital Opportunity and Promotion, based on the Framework Act on National Informatisation. Today, it comes under the Ministry of Government Administration and Home Affairs (NIA n.d.).

[17] Knowledge and information resources are defined as 'the data for academic research, culture, and science and technology, which is digitalised, or is supposed to be digitalised essentially, because it should be preserved and it has useful value for our nation' (Kim 2000, p.3).

[18] In order to manage the digital project within the culture field efficiently, the MCST argued it was necessary to enlarge the functions and roles of the executive organisation for culture informatisation, which originally was a

undertaken digital projects such as building databases, making films on Korean cultural heritage, and generally working with museums. KCISA_A stated:

> 'Informatisation is based on computing, but cultural informatisation is a bit different because it is about "culture". … the problem is that computer experts from the NIA could not understand well the unique characteristics of cultural informatisation that might require some creative thinking rather than rational thoughts based on computing technology. That is the reason the KCISA was founded, to actively respond to digital culture.'

The KCISA has professionally supported technical issues within informatisation projects also, and the system management of the MCST and the bodies it operates, such as the MMCA. This agency has held classes for digital experts within national cultural organisations about new technologies and trends, for example, big data, and has hosted regular meetings where the experts can meet and talk about their recent projects and issues (MMCA_A 2015; KCISA_A 2015). The regular meetings are cultivating CoP (Wenger et al. 2002). The members of the community have similar interests in digital culture relating to cultural organisations and share what they have learnt from their digital projects and discuss difficulties encountered, thereby learning together. Yet, the members of community are limited to those who work as digital experts in the national cultural organisations like the MMCA and the NMK. They seem reluctant to welcome newcomers from other communities/domains. This can cause limitations of the community to interact with other potential actors by extending its boundary.

The government has intentionally attracted other actors, such as the MCST and MMCA, in order to create a common ground for embarking upon huge digital projects, posing problems for public services in the twenty-first century, which is frequently cited as a knowledge-based society. Based on the analysis of my data, this is the first step in the process of translation, problematisation, within ANT (Callon 1986). By highlighting problems with the existing network, the actor, the government, makes the first step in attracting other actors. With the government's catchphrase at the time of 'culture for everyone and everywhere', its goal was to become an advanced cultural welfare country through improvements to the quality of public life through cultural promotion (Lee, 2014). Therefore, the digital projects providing museum collection information via the internet were supposed to generally align with the direction of the cultural policy, making the information accessible to everyone everywhere via the internet. Thus, the digital projects became an OPP in ANT (Callon 1986), which is the concept whereby every actor converges on a certain issue, even though they have different ultimate goals. By passing the OPP, the government supported and extended the digital industry,

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small team within the Korean Creative Content Agency (MOCT 2002a, pp.7-9). Consequently, the KCISA was founded in 2002.

which was supposed to lead the Korean economy, while the MMCA could open and access its resources to many more visitors with the goal of 'improving their quality of life'.

Even though the actors agree with the OPP, there were significant barriers to completing the digital projects in the MMCA, including limited time, contract conditions, and human resources. The first two barriers relate to the rules in activity theory, and human resources with the subject in activity theory (Engeström 2015). My analysis showed that the MMCA only allowed limited periods, which can have a negative impact on the quality of a digital project because of the lack of sufficient discussion between professionals and users. Furthermore, the projects were not aligned with long-term strategies and future plans, and the MMCA had to complete the projects, regardless of their quality and usefulness. This is a strict rule which the national museums had to follow. My analysis of human resources will be presented in Section 5.3.3 on museum practitioners.

When the MMCA opened its Seoul branch in 2013, this was an important time because the Korean government as the Ministry of Science, ICT and Future Planning (MSIP) had announced the 5th Plan of National Informatisation 2013-2017 (MSIP 2013). This plan reflected the recent paradigm shift in national informatisation from 'the growth and enlargement of ICT' to 'adopting ICT in every social field' (MSIP 2013, p.18). The new national informatisation plan is expected to create a new demand for ICT by applying ICT in creative ways and is also expected to contribute to an increase in the creative thinking capacity of the public, and to enhance ICT infrastructure (MSIP 2013, p.21). Through these activities, the government finally expects that ICT will transform Korea into a creative economy. In doing so, ICT, a broadly digital technology, will politically become a more important actor with support from the government, and is widely recognised as a tool that mediates the economy's development. A result of this policy is that the government has provided funding to establish maker spaces across the nation, and the Art Fab Lab in the Seoul branch of the MMCA is part of them. Details of the Art Fab Lab and its learning programmes will be provided in Section 5.4.3.2.

In summary, the government and government bodies as an actor are visible and their network with the MMCA is stable and durable (Law 1992), and based on laws. However, there is a continuous discussion regarding the incorporation of the MMCA (Baek 2010; Ryu 2010; Sim 2012; Jung 2015), and if this happens, the stable network may be disrupted and further negotiations between the actors might be necessary.

5.3.2 The Museum Itself

With the rapid growth of the economy and the level of public education in Korea, the interests and demand of the public in arts and culture has also increased (Park 1994). A new role of the MMCA as an educational and social institution, was expected (Choi 1993). However, the MMCA was the only national art museum in Korea, and in the 1990s, was located in Gwacheon. This physical limitation was criticised by Choi (1993), and it is in relation to this context that digital projects, such as a cyber-art museum, were supposed to help the MMCA to encourage the public to enjoy and experience the museum and its collections via the internet (Yoo 1996). In a museum policy research report, the museum online service was even considered as one of ten issues in the museum policy for the twenty-first century (Yang 2002b). Therefore, from ANT point of view (Latour 2005), digital technology successfully has attracted the MMCA by encouraging it to launch digital projects.

However, according to an annual report (MMCA 2012, p.68) and research reports (Hwang 1995; Ryu 1996; Kim 1997; Kim 1999; Ryu 2012), the approach of the MMCA towards online content tends to be limited to the delivery of information and knowledge about its art collections and archives through developing a digital archive and documentation system. As a result, the only relevant activity that an online visitor can do is to search and look at digitised collections on the website of the MMCA. The Digital Library and Archive where visitors can search this digitised archive resource was established in the Seoul branch, and the establishment of this physical space can be understood as a further stable and durable device to maintain its power within the network (Law 1992).

Since 2010, digital technology has been more embraced within the on-site space of the MMCA. The reopened and extended children's museum in the Gwacheon branch in 2010 (see Section 5.4.2) focused on digital art works, and aimed to provide an interactive experience (MMCA 2011, p.94; Park 2012). By doing so, digital technology as a technical tool (Engeström 2015) has been further harnessed in its exhibitions, especially to attract young visitors who are potential actors. However, digital learning programmes have not been developed further. According to interviewee MMCA_E, this is due to the fact that the main art genres for exhibitions in the Gwacheon branch are not digital art, so adopting digital technology in learning programmes is not usually considered.

In contrast, the grand opening of the MMCA Seoul branch in 2013 was a springboard for extending digital projects into diverse areas. The master plan for MMCA Seoul highlighted the embracement of digital culture as a unique character of the Seoul branch, compared to other branches of the MMCA (MMCA 2013b, p.4-5). With respect to the relationship with its visitors, a visitor-centred digital service was also planned in the new branch (Lee 2013). The MMCA Seoul branch aims to be predominantly an art museum with innovative and experimental characteristics, rather than traditional

and conservative ones, based on traditional museology that usually concentrate on professional research and are targeted to experts (Yang 2004; MMCA 2013b). The new branch is expected to be an actor that could create and lead culture, rather than only preserving and presenting arts (Yang 2004; Jung 2009).

In addition, the genre of artworks that the Seoul branch generally exhibits is contemporary art, including digital art, for example, interactive media art, and exhibitions in the branch generally involve artworks that embrace digital technology. This branch is supposed to plan and provide digital learning programmes related to the digital art exhibitions (MMCA_A 2015, MMCA_D 2016). Fundamentally, these learning programmes use digital media, such as smartphones, and are intended at the institutional level to establish an identity for the Seoul branch as an 'art museum in a metropolitan area' (MMCA 2013b; MMCA 2014a, p.158). The Art Fab Lab in the Seoul branch, a maker space, is also expected to cultivate a digital culture (MMCA_D 2016; MMCA 2015b), and its location seems to bring the benefit of attracting more young makers, artists and engineers (see Section 5.4.3.2).

Based on the analysis of my data, this unique characteristic of the Seoul branch seems to be possible because of its organisational structure. When the Seoul branch opened, its organisation had a separate structure and was independent of the other branches. The education team of the Seoul branch was part of the Information Service (and Education) Department, which meant that educators, archivists, and a digital expert were in the same department together. I propose that this exceptional makeup of the department may result from the idea of establishing the Seoul branch with the aim of being a new art museum as well as an information centre (Kim 1999), where art information can be combined and people from all around the world are linked and can create different meanings. This new concept of art museum is aligned with new museology that considers the public at the centre of museums and sees knowledge presented in museums as subjective, depending on the culture visitors bring with them (see Section 3.2).

In order to make this idea possible in practice, museum practitioners should not be isolated from other departments but should work collaboratively. Being in one department with others who have similar interests, in this case digital culture, can create a further synergy through informal meetings or conversations with team members. This also can lead to cultivate a CoP (Wenger et al. 2002) for digital learning or digital culture in the museum. The interviewees MMCA_B and MMCA_D, who had belonged to the Information Service (and Education) Department, mentioned that informal meetings at work with those who have personal interests in digital culture/technology profoundly helped them plan digital programmes, although it is still hard to collaborate with other practitioners in

the same team. More interestingly, the members of staff in the department have different perspectives on digital because they have different professional identity (e.g. educators, archivists, and digital experts) by having different trajectories and belonging to different communities (Wenger 1998). Wenger (1998) explains a community can be more dynamic, and innovative approaches often arise when its members take challenges at boundaries. According to my analysis, the department became a dynamic community in which the members of staff can be brokers by introducing elements of one practice to another. Through the informal meetings, they learnt perspectives and languages of different communities. MMCA Friends, which will be discussed in Section 5.4.1.2, is one of the cases made at boundaries between communities of museum learning and digital.

In 2016-17, the MMCA changed its organisational structure, and currently, the museum consists of two offices; the office of the secretary general of planning and management, and the curatorial office. Members of staff at the three branches have been combined and belong to a specific department/team, depending on their work. Thus, the former Information Service (and Education) Department has been disbanded. Depending on their work, former members of staff from this department now belong to either the department of planning and general management (for museum computing), the department of collections and archives (for digitising collections), or the department of education and cultural programmes (for digital learning). While disbanding this team does not mean that the collaborative working environment cannot exist anymore, belonging to different teams can cause other barriers in cooperating or collaborating with each other because of the different work priorities. In addition, according to an evaluation report of the MMCA, which was produced by the government (MOI 2016), the MMCA has not inadequately encouraged and cultivated its members of staff to organise and participate in a CoP. To enhance the professional capability of every staff member, the report also suggests creating an organisational culture, which shares knowledge among staff (MOI 2016).

The Seoul branch recently attempted to extend its network further via a specific purpose. When the Seoul branch launched, the MMCA Friends, which is explained in detail in Section 5.4.1.2, hosted a public seminar at the museum on how a data-driven approach to visitor engagement could help the museum reach a large audience effectively (MMCA 2015c). The vice director of the Dallas Museum of Art (DMA), US was invited to the seminar, which was also open to the public. I also attended this seminar, but it consisted of a short talk on a digital project at the DMA and active discussion was not encouraged. Almost all of the participants seemed to be university or post-graduate students, and only a few museum practitioners attended. This means that this seminar as a device of ANT (Callon 1986), which is expected to attract other actors to a network, was unsuccessful. In other words, only opening the seminar to the public does not mean that they are invited to get involved in the network as actors.

There was no proper process and approach to include and reflect opinions of the public to the MMCA practice. There was even no further connection of the MMCA to the participants of the event.

In summary, the MMCA has associated itself with digital technology mainly in order to increase public access to artwork information and knowledge, and to overcome the physical limitation. Although various approaches have been attempted on-site at the Seoul branch, there seems to be barriers that the MMCA has actively extended its network into digital culture. According to the Code of the MMCA, it is necessary for the MMCA to obtain approval from the government before any project is planned. Thus, as a body operating under the government, digital projects of the MMCA can also be restricted by the government. The next section turns to museum practitioners' points of view on the MMCA's digital culture.

5.3.3 Museum Practitioners

Although the government is deeply associated with the MMCA, the practitioners who have a responsibility for the museum practice definitely have power in the decision-making process, and their professional identity (Wenger 1998) could also impact the practice. In this section, the ways they construct their networks and the challenges or barriers they encounter to the extension of the network will be explained.

Museum practitioners who are specialised in computing have been allocated to national museums in Korea since the 1990s, mainly in order to support the establishment of the ICT infrastructure and to deal with issues on using computers in this workspace (MMCA_A 2015). While previous digital projects, such the building of databases, were run by the Education and Cultural Affairs team under the Secretary General for Planning and Management until 2010 (MMCA 2010). According to the Code of the MMCA, it is the practitioners and their seniors who have the responsibility for projects, which may be administrative officials rather than those who have expertise in a specific area, for example, museum studies.

The lack of digital experts in the MMCA is also an issue. According to a white paper, there are only two members of staff who have responsibility for culture informatisation in the MMCA (KCISA 2013). This means that staff has to handle a range of digital projects at the same time, from managing the ICT infrastructure, the museum's website, and online security, to collection digitising projects (MMCA n.d.d). This prevents them from deeply concentrating on a project.

Thus, the work scope of the digital experts, in general, has been fixed within the administration and management of digital infrastructure and projects. For example, although the Information Service (and Education) Department in the MMCA Seoul branch employed a digital expert with a degree in

computer science, his work scope was limited to managing the computer system, rather than planning digital projects (MMCA 2013c). The retraining programmes offered for digital experts of the MMCA are mainly concerned with new technology (MMCA_A 2015; KSICA_A 2015). Consequently, based on my data analysis, there is no connection linking new technology to museum practice due to these museum practitioners' limited work scope and to the fact that their voices are rarely heard.

My interviewees, MMCA_A and MMCA_C, who are digital experts in the MMCA, even said that they only consider the digital projects they are involved in as this is what they need to do as their 'work'. They regard their work as marginal and believe that they need to study art in order to understand and support other museum practices, rather than the other museum practitioners learning how to employ new technology into the museum (MMCA_A 2015; MMCA_C 2015). MMCA_A even mentioned that:

> 'Everyone thinks that digital work in the museum is not the main focus; it exists to support curatorial works.'

MMCA_C, another digital expert, stated:

> 'In fact, I think I have to make a greater effort to learn and understand art to communicate with other museum practitioners. I think that the technicians like me should learn it for the curators.'

Based on the analysis of my data, there are several reasons for this situation. Firstly, the lack of well-developed CoP (Wenger 1998) regarding digital within the MMCA leads the voices of digital experts less recognised and art-related community of curators even dominates the organisation. Additionally, these two different domains (Wenger 1998), digital and art, are not well interconnected in the MMCA and the museum staff in each domain rarely cross the boundary of them because of a linear working process. Moreover, there is a possibility that the digital experts are regularly rotated to other government bodies, according to the Operational Rule of a Public Servant. Thus, it could be difficult to establish long-term strategies from the digital experts' point of view. In fact, my interviewees, MMCA_A and MMCA_C, the only two digital experts of the MMCA, have now moved to other organisations, and it appears hard for digital experts to remain a constant actor. This indeed causes another limitation to cultivate a CoP regarding digital culture within the museum.

On the other hand, museum practitioners' personal interest in digital culture and digital learning in the MMCA Seoul branch has resulted in various digital learning programmes. At an institutional level, one of the learning approaches intended of the Seoul branch is embracing new media in learning programmes (MMCA 2013b; MMCA_B 2015). However, according to my interviewee, MMCA_B,

there have been no specific plans and systemically strategies for digital learning. It was entirely her role and responsibility to arrange and negotiate with external actors and the digital technology required when establishing the programmes.

Professional development is another issue in Korean art museum practice (Kim, 2010), especially when employing digital technology in museums. The interviewee MMCA_B mentioned that the International Museums and Web Asia conference, which was held in October 2014 in Korea, was a good learning experience about outstanding digital museum projects in overseas countries.[19] I think that this issue could be associated with the function of museum professional bodies, especially relating to digital culture. I could not find any specific museum professional community which is concerned with digital issues which could be considered a CoP (Wenger 1998), while there are several communities of museum professionals in Korea. As the interviewee MMCA_C said, this may result from the fact that digital expert jobs in Korean museums are not common. Furthermore, the definition of digital experts in the Korean museum context is too narrow so that a CoP regarding digital museums (e.g. a group organised by the KCISA, see page 102) only involves those who actually have an academic degree in the computer field, and not embracing peripheral participants (Wenger 1998) who can build a connection to other domains (e.g. museum learning).

Another interesting example of retraining is the Advanced Museum Management Leadership Programme, which the MMCA hosted for Korean museum practitioners in 2014. This mainly dealt with issues of sustainability and transfiguration within art museums. Some speakers came from outside the arts and culture field, such as digital archives (delivered by a professor in information sociology); big data and museums (by NAVER, a Korean internet portal company); and understanding human-computer interactions (by a professor in cognitive science). I consider this recent trend in retraining programmes an important change. Although there have been relatively few opportunities to develop museum professionals in relation to digital culture to date, some museum practitioners now seem to realise the new challenge of digital technology in museums. By inviting the speakers coming from different fields, there is a potential to cross the boundary of the domains (Wenger 1998) and to construct the network (Latour 2005) of museum practitioners with other actors, such as digital companies. Turning to digital technology and digital companies as actors in following section, I will further trace their networking.

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[19] As a participant at the conference, I noted that whilst there were a few Korean museum practitioners as participants, unfortunately, none as speakers. Several factors may have led to this situation, such as a language barrier (English), location (not Seoul), expensive registration cost, marketing, time, or interest.

5.3.4 Digital Technology and Digital Companies

According to my analysis of the data, digital technology is considered a crucial actor and has been strongly associated with the Korean government as a new source of economic growth since the 1990s. As digital technology has spread into people's everyday lives in the form of personal computers, the internet and smartphones, its power has increasingly grown. Since the central government developed the infrastructure during the initial phase, digital technology and its associated industries have rapidly extended into every Korean's life.

The power of digital technology has also affected museum practices in the MMCA. In addition to collection digitalisation, building databases, and managing websites since the mid-1990s, recently the MMCA has embraced more diverse digital technology, such as social media for marketing and 3D printers for learning programmes. This embracing of digital technology is closely associated with the identity of the MMCA Seoul branch and is now expected by younger visitors (MMCA_F 2016). Based on the MMCA's mission statement, digital media is considered an efficient tool for attracting both a national and global audience. Thus, the technology has continuously extended its network into human society and the lives of individuals (Latour 2005) .

The relation of the MMCA with digital companies also has been enhanced. For example, the MMCA signed a memorandum of understanding with NHN, to cooperate in creating an Online Virtual Museum of Art and linking it to NAVER[20], a well-known internet portal site of NHN in Korea, thus indicating that the MMCA has actively attempted to be involved in digital culture (MMCA 2012, pp.175-176). Moreover, with NAVER as an online platform, the MMCA is available to present short videos about artists, exhibitions and education programmes to the Korean public (MMCA 2015a, p.254). In order to approach a global audience, the MMCA also participates in the Google Art Project (MMCA 2015a, p.256). Using Google's technology, two collections of the MMCA have been digitised and made available.

Digital technology has evolved rapidly and it has been necessary to allocate funds to update systems repeatedly. However, according to interviewee MMCA_A, the museum's digital budget only covers the existing system management and it is not easy to access additional funding for developing new projects unless there is special funding from the government. Thus, the network with giant digital companies could bring a potential for the MMCA to initiate new digital projects by collaborating with them.

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[20] NAVER is likely to be the dominant portal site in Korea, and Korea has been described as 'a republic of NAVER' (Kim & Son 2007).

5.3.5 The Public

It can be said that the public has been perceived as an actor by the MMCA. During the planning phase of the MMCA Seoul branch, this new visitor-orientated management approach was strongly emphasised (Yang 2004; Jung 2009; Lee 2013; MMCA 2013b). Moreover, from the beginning of the informatisation projects, the aim was to encourage the general public to enjoy arts and culture in the MMCA and on its website. An official annual survey of visitor satisfaction has also been conducted (MMCA_E 2016), and the results influenced the overall evaluation of the MMCA by the government (MOI 2016). Consequently, the MMCA must consider visitors in order to obtain high scores in these surveys.

There are several ways that the public's voice can be heard. Recently, the MMCA recruited an audience panel consisting of 26 members of the general public (MMCA 2013a, p.203; MMCA 2014a, p.272). Group members report their opinions of exhibitions, educational programmes, facilities, service, marketing, and online services of the MMCA, and their opinions will be reflected in the MMCA's future plans. Programme participants are generally required to complete a form afterwards and provide comments and a score of their satisfaction of programmes (MMCA_D 2016). Yet, according to the MMCA museum practitioners MMCA_D and MMCA_E, they do not normally include the public when planning exhibitions and programmes, although the participation of children and their parents in the planning of children's exhibition and programmes will be considered in the future.

Overall, the public still remains as a hidden actor of the MMCA. This may result from the lack of an in-depth study of visitors, because their importance is less well recognised and a relevant strategy has not yet been developed (MMCA_F 2016). As one of approaches, the MMCA Friends, a digital platform of MMCA membership (see Section 5.4.1.2), is expected to help the MMCA understand their visitors better.

5.3.6 Summary

This section identified the key actors of the MMCA and their relationships. The central government strictly regulates museum practices through the funding of annual budgets and digital projects. Recently, the government has tried to encourage ICT adoption in every aspect of Korean life to aid the national economy's development. Thus, digital technology has continuously increased its power in the MMCA through the associated laws, policies and agencies. However, previous culture informatisation projects and relevant policies have been frequently criticised because of the lack of long-term and holistic strategies for digital projects within the culture sector (Shin 2003; The Chosun Ilbo 2015).

Online digital companies, such as NAVER and Google, are also been identified as visible actors through collaborations with the MMCA, which has a limited budget for digital projects and a lack of technology. The online services of these companies are also strongly related to the public. The public is widely recognised as an actor, but appear to be hidden and their voice is rarely heard.

Another interesting point is that I could not find any relevant museum professional bodies which are setting an agenda and retraining museum practitioners for the digital age. It may be that there are few museum researchers and practitioners who are interested in this digital area (Hong 2011), even though it has recently grown in the context of Korean museums. The establishment of the Information Service (and Education) Department in the MMCA Seoul branch can be understood as indicating that the MMCA has attempted to reflect the trend of museums in the digital age, and the active museum practitioners could become active actors in the future, although this department has now been disbanded.

I now turn to next section, which presents the analysis of digital projects of the MMCA. I further discuss how the identified actors shape each project and how they affect communication and learning approaches of the projects.

5.4 Digital Projects

In this section, the digital projects of the MMCA will be presented and analysed. Six categories of digital museum projects have been developed, based on the visitor journey (see Section 4.1.4.1). The MMCA's digital projects in the six categories (orientation space, within galleries, programmes and events, multimedia guides, online research, and online learning) were investigated and the underpinning communication and learning theories analysed. This enables an understanding of why and how digital technology in these projects has been embraced, and how they can be matched to the overall learning approach of the MMCA, social constructivism (Vygotsky 1978).

5.4.1 Orientation Space

5.4.1.1 Digital Information Display
The MMCA Seoul branch has several public entrances, where visitors are greeted with a digital information display (DID) (Figure 5.2). The interactive DID system has been designed and installed across the museum to deliver museum information to visitors in a convenient and effective way (Lee 2013, p.42).

Figure 5.2 Digital Information Display at the MMCA Seoul

This project is an initial result of the MMCA Seoul branch's strategic plan[21] for informatisation, which includes developing the collection management system and improving the digital learning experience, which was devised during the planning stage of the Seoul branch (Lee 2013). The DID was proposed by the appointed IT consulting companies (Lee 2013). The project was overseen by a digital expert from the MMCA, and the curatorial and education departments were only involved by providing relevant content (MMCA_A 2015). It is now managed by the department of planning and general management with support from an external IT company.

Due to its initial purpose as a medium to provide information, the highlighted role of digital technology in this project is mainly for content delivery based on transmission communication theory (Hooper-Greenhill 1999a; Hooper-Greenhill 1999b). Most of knowledge presented in the DID is determined by the MMCA and sent to visitors as a fixed one. Thus, what visitors can do with the DID is touching the screen of it to find out information about current exhibitions, educational programmes, facilities, and recommended books, and watching short videos that introduce the museum.

However, a Tag Cloud service of the DID (Figure 5.3), which visitors can participate in, takes a different approach. It asks visitors questions like 'how was your museum experience today?' and 'what does the museum mean to you?'. The words of visitors are then presented on the screens. In so doing, it encourages visitors to make their own meaning of their museum experience through presenting and sharing their feelings and thoughts, based on social constructivism (Vygotsky 1978). An initial project, which collects this data generated by the visitors, would be beneficial. Yet, according to my interviewee, MMCA_C, whose role was managing the DID, the museum has no

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[21] The strategic plan was developed in response to several needs and demands identified during the planning stage of the Seoul branch in order to match the emerging new information technology conditions and the possible services to offer (Lee 2013). The scope of the plan includes how to manage informatisation projects, how to respond to new technology, how to manage information for various services, how to integrate information technology with cultural technology, and how to improve conservation technology for information on visual art.

plans to analyse the data, and the MMCA and the museum practitioner do not even seem to consider this data as 'data'. This might be associated with how museum practitioners see their work as reflecting their professional identity (Wenger 1998). Although the interviewee is a digital expert, he considers his work marginal in the museum. Thus, this new approach of the Tag Cloud service cannot be extended further.

Figure 5.3 The Tag Cloud service presenting visitors' thoughts

5.4.1.2 MMCA Friends

Another digital offering in the MMCA Seoul's orientation space is the MMCA Friends (Figure 5.4). It is a digital platform for a museum membership programme that is based on the DMA Friends[22], which was developed by the Dallas Museum of Art, USA. The MMCA Friends has been localised to suit the MMCA Seoul. This project was led by a digital expert and an educator from the Information Service (and Education) Department (MMCA_C 2015). The digital expert managed the technological parts with external developers, while the educator created content. In other words, this innovative project was made possible with the collaboration of museum practitioners who crossed their original boundaries (Wenger 1998) and were willing to explore a new approach. According to an official brochure for this project, it is a 'missions led participation educational programme that encourages visitors to explore diverse cultural, educational, leisure content in the MMCA Seoul'.

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[22] https://www.dma.org/visit/dma-friends [Accessed 21 August 2017].
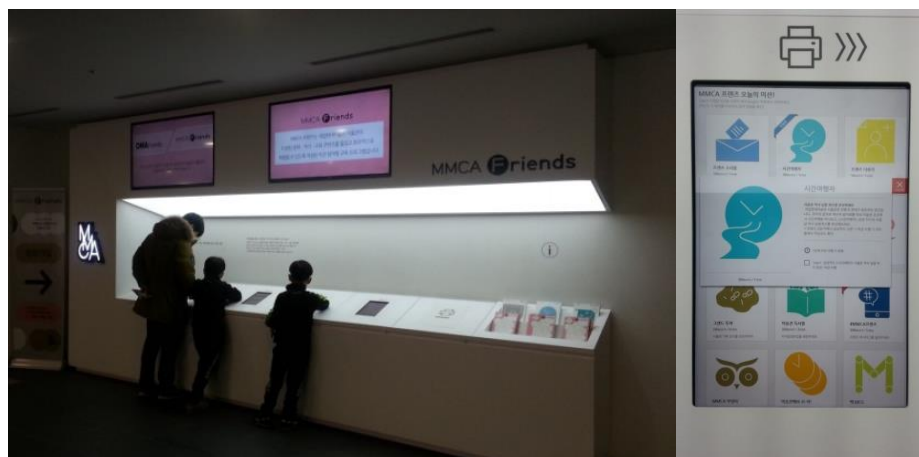
Figure 5.4 MMCA Friends providing its members with diverse activities to explore the MMCA

This project has adopted the holistic approach of museum communication (Hooper-Greenhill 1999a). This is because the content of the project covers all of the MMCA Seoul, from exhibitions to museum shops. Visitors who sign up to this membership programme can collect points by completing museum activities, for example, visiting exhibitions, participating in educational programmes, attending events, drawing on a worksheet, exploring the museum building to find historical meanings, and so on. By doing so, this project links visitors to various elements of the MMCA that contribute to visitor experience and the museum's image. In terms of learning approach, cognitive constructivism (Hein 1998) has been adopted. There is no intended order, and visitors can choose activities they want in the programme. The process of knowledge construction is open to visitors through participating in the activities. Based on the analysis of my data, it can be said that these communication and learning approaches to the project are made possible by involving an educator in the development process, because museum educators tend to consider visitors' point of views.

With the points collected, the members of MMCA Friends can obtain several benefits, for instance, an opportunity to participate in special events, a discount at the museum shop and for parking, and so on. This is an example of gamification (Jagoda 2013; Silva et al. 2013). By applying game concepts, points, rewards and levels as an extrinsic motivator, the project attempts to further promote visitors to experience and participate in museum activities by themselves. Compared to other membership programmes that provide prestigious opportunities for those who pay to become a member, this programme tends to make members be more active and gain valuable experience. Furthermore, from this project the museum can collect visitor data, such as the pattern of visitors' preference for activities (MMCA 2015e). By analysing the data collected, the MMCA anticipates that they will be able to understand visitors' diverse needs. This analysis can also contribute to the planning of future

programmes. Overall, an increase in the number of return visits is expected (MMCA 2015d).[23] Thus, in this project, digital technology acts not only to present content but also to generate data.

Yet, the success of the project depends on how much the other teams in the MMCA Seoul branch are willing to collaborate (MMCA_B 2015), as it will not be successful if teams do not work together. Analysis of the visitor data and reflecting the results in museum practice will be crucial.

5.4.2 In Galleries

The only gallery in which I found digital exhibits as an interpretation tool in the MMCA was the children's museum in the MMCA, Gwacheon. The gallery is a learning space dedicated to children and family visitors, was opened in 1997 (MMCA 2004 p.53), and extended in 2010 (MMCA 2010, pp.106-107). It is run by the education department in the Gwacheon branch and aims to be a multi-functional space for 'not only appreciating art works but also offering creative experiences and learning programmes with IT technology and digital art' (MMCA 2010, pp.106-107). Since opening, renovations have been undertaken almost every year (MMCA 2012, pp.120-123; MMCA 2014a, pp.197-200; MMCA 2015a, pp.202-206). However, the children's museum, in general, has no intended path to follow and no right answers to locate. Visitors can explore the exhibition space in any order that they want and can take as much time as they need to discover and learn through various hands-on activities. Thus, it can be said the constructivism learning approach (Hein 1998) has been adopted. I have only analysed the exhibitions that were presented in 2014 and 2016 when I visited the gallery in order to collect data.

The subject of the exhibition in 2014 was the elements (point, line, and plane) and materials of work of arts (MMCA 2014b). The exhibition was divided in six areas: orientation and reading space; interactive digital art exhibits; exploration materials of the museum's collections; understanding points, lines, and planes; a space for presenting artworks made by children; and an open space for workshops (MMCA 2014b). The 'participatory learning' approach was further enhanced in this exhibition so that 'child visitors are encouraged to communicate with artworks and discover meanings of and stories about them through activities using five-senses' (MMCA 2014b), and it aimed to encourage the young generation to cultivate artistic values in their daily life. Digital technology in this exhibition is embraced in two ways, by presenting digitised collections that visitors can explore further and visualising visitor activity through making points, lines and planes with objects in space to

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[23] I cannot find any research paper on the MMCA Friends, yet several studies on the DMA Friends, which has a similar platform, have been published (Stein & Wyman 2013; Stein & Wyman 2014). These report the geographic distribution of members, main motivations to encourage members to participate in the membership programmes, how often they visit the museum and so on.

it on a screen in real time. The later approach, shown in Figure 5.5, could lead to a new learning experience thinking about flat two dimensions and the three dimensions of space, and potentially, a group activity or working with others could be encouraged in the open area.

Figure 5.5 MMCA children's museum in 2014, showing visitor activity visualised with digital technology

The exhibition, which opened in 2016, was planned to present and explain the main functions of the MMCA as an art museum: collecting; research; conservation; exhibition; and education (MMCA 2016a).[24] The exhibition starts with a projection of moving images of digitised collections on a wall of the exhibition space, and children are encouraged to select five everyday objects on tables based on their own criteria, and then take a picture of 'their collection (the objects)'. This picture is then projected next to the MMCA collection projection (Figure 5.6). This is the only digital element in this exhibition. MMCA_E, who planned this exhibition, stated:

> 'I think everyone has different criteria for selecting their collection; likewise, the MMCA only collects specific artworks. With this activity, visitors can acknowledge the existence of different perspectives on the same objects and understand others who have different opinions. So, the digital technology in this exhibit is particularly used to make sharing their ideas easy and efficient.'

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[24] This exhibition was planned as part of a special series for the 30th anniversary of the opening of the Gwacheon branch (MMCA 2016a).

Figure 5.6 MMCA children's museum in 2016, projecting pictures of visitors' collection next to the MMCA collection projection

The current education philosophy of the children's museum is that 'it encourages learners to look at the world from wider point of view as understanding openness and multiplicity of contemporary art' (MMCA n.d.e). In doing so, it aims for learners to recognise the coexistence of diverse cultures and values within society (MMCA_E 2016). This education philosophy is aligned with social constructivism (Vygotsky 1978), as it acknowledges the influence of different cultures and social backgrounds on learning. Furthermore, scaffolding elements (Moll 1990), which facilitate learners to further develop their status, are found in the exhibitions, based on the analysis of my data. For example, the exhibition in 2014 seems to be designed to encourage group work with others, such as parents and peers, and the digital exhibit in the 2016 exhibition makes it possible for children to understand that different people can think differently, based on their own culture and values. Reconsidering and questioning the existing collection acquisition system of the MMCA also can be linked to a further discussion about the role of a museum (MMCA_E 2016).

5.4.3 Programmes and Events

5.4.3.1 Digital Learning Programmes

There were several digital learning programmes and public events in the MMCA Seoul branch, such as tag clouds, sound visualisation technology, and a 3D marker with tablet PCs. According to one interviewee, MMCA_B, who planned the programmes, they were designed to offer visitors different ways to enjoy the museum. Most of the digital programmes target children and family visitors rather than groups of adults. Three programmes explained by the interviewee are described and their learning approaches are analysed.

As a first case, at an art appreciation class for elementary and middle school students, attendees learnt about an exhibition, and then visited it and appreciated the exhibition via a workbook (MMCA 2014a, pp.178-179). They then shared their thoughts about the exhibition using a tag cloud system that

visualised their answers in the workbook on a screen (Figure 5.7). In this programme, digital technology acts as an immediate platform responsible for presenting and sharing.

Figure 5.7 An art appreciation class using a tag cloud system to share participants' thoughts

The next case is an artist-led workshop-style programme for visualising sound (MMCA 2014a, p.186). This aimed to improve the understanding that participants have of new media art and new medium practice. During the programme, participants made their own digital instrument with recorded sounds, and by using software, the sound of playing their instrument could be visualised (Figure 5.8). Digital technology has a significant role in this programme to collect sounds, create a new approach to sound, and generate new visual elements.

Figure 5.8 An artist-led workshop where participants learn new media art from real practice

The last programme was a playful, game-based media artwork event where participants made a sentence which was meaningful for them, by interacting with virtual blocks in the artwork (MMCA_B

2015). This programme took place in an open space in the MMCA Seoul, neither within a gallery nor in an education room, and welcomed every visitor (Figure 5.9).

Figure 5.9 A family game event that allows everyone to participate

All of these programmes adopted social constructivism learning theory (Vygotsky 1978) by emphasising working together. The programmes were designed so that learners could actively express their thoughts, ideas and feelings, instead of absorbing taught content. The adopted digital technologies make these new learning experiences possible. By locating the interactive, game-based media artwork in an open space, a playful museum experience was created from a holistic perspective (Hooper-Greenhill 1999a). Another interesting point here is the artist-led workshop style. One interviewee (educator MMCA_B) mentioned that workshops led by artists who use similar technology for their work tend to make the learning programmes a more authentic experience. These programmes can then be understood through situated learning (Lave & Wenger 1991), which generally takes place in art studios, learning professional skills from real practice with experts. Situated learning can occur over time and newcomers can obtain membership by becoming familiar with the culture of the member group (Lave & Wenger 1991).

5.4.3.2 Art Fab Lab

The Art Fab Lab is a maker space which provides all visitors with free access to a range of high technology machines, such as 3D scanners, 3D printers, and a laser system. The initial project to establish the facility within a public organisation was funded by Korea Foundation for the Advancement of Science and Creativity (KOFAC), an agency of the MSIP (KOFAC 2015). The MMCA Seoul was then appointed as a centre for linking artists, young creator communities, small

ateliers/workshops and the public. The space aims 'to be a platform of STEAM education[25] for cultivating creative talented people of the twenty-first century' (MMCA 2015b). Anyone who books a machine in advance for their individual purposes can use the facility. The museum also offers diverse programmes, for example, workshops for school pupils and university students, and public events such as a 3D fashion show that can introduce the facility to a wider audience. The overall goals of the learning programmes of the facility are to learn how to use and apply technology as a language of art, to learn ways to present creativity, to enlarge creative ability, and to support and cultivate a maker culture (MMCA 2015b). This section will examine how these goals are related to actual practice.

A recent workshop for school pupils was creating a kinetic artwork (Figure 5.10). First, they draw their idea on an iPad and then cut their drawing using a 3D laser cutter, before connecting it to an electronic circuit, littleBits (MMCA 2015f). This workshop was planned to educate learners about digital art, as well as new media technology, thereby stimulating the emotions and creativity of learners through cultivating an adventurous spirit (MMCA 2015f). Throughout the workshop, digital technology functioned as a new tool and media to express artistic ideas in a different way and through digital literacy skills. However, it is unclear whether learning in this workshop is as expected for literacy within maker spaces. This is because learning in a maker space is generally known as situated learning in an authentic environment, where learners explore, test and combine various things for their purpose with help from professional experts and members of the space (Brahms & Crowley 2016b). Yet this workshop was run in a classroom and was a pre-structured programme. Thus, one-way communication (Hooper-Green 1999a) is adopted in the workshop by delivering experts' knowledge to learners. There was a lack of opportunities that experts and learners could explore and discuss matters together. Learners might experiment and explore new technology throughout the workshop (MMCA 2016c), which underpins a discovery learning approach (Hein 1998). Yet, the programme and educators seem to concentrate exclusively on teaching how to use the new technology.

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[25] STEAM is a reformation of STEM education for Arts that uses Science, Technology, Engineering and Mathematics as access points for student learning (Bequette & Bequette 2012; Maeda 2013).

Figure 5.10 A workshop for pupils in the Art Fab Lab is more likely a lecture-type

On the other hand, various workshops and events have been organised for adult users of the maker space. The MMCA has attempted to match those with ideas for creating new media artwork to those who have the skills to handle the digital technology, which might be needed to produce the artwork (MMCA 2016b; MMCA_E 2016). By connecting artists and engineers, the Art Fab Lab aims to be a platform where they can continually develop ideas and make them possible through the technology available (MMCA_D 2016). In this case, a cultural model of communication (Hooper-Greenhill 1999b) is adopted by accepting different culture that the participants (e.g. artists and engineers) bring with them and by considering the difference in communication. Potentially, this approach can cultivate a CoP (Wenger 1998), which has an interest in digital art. Thus, based on the analysis of my data, it can be clearly seen that different learning approaches have been adopted depending on the participants of the facility. In other words, situated learning principles (Lave & Wenger 1991) are applied in the case of adult users' programmes, while a discovery learning approach (Hein 1998) is applied in the pupils' ones. These different approaches might be a result of the different attitudes and understandings of museum practitioners towards adult learners and pupils. Adult learners are supposed to have full agency to construct knowledge, while pupils need help to learn new things.

5.4.4 Multimedia Guides

A multimedia guide system, Guide-on, has been adapted since the Seoul branch opened in 2013[26] (MMCA_F 2016; Kim 2015). Visitors can borrow a guide device from the MMCA information desk, or can download the app onto their own smartphone. The content of the app contains all the current exhibitions of the MMCA Seoul branch.

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[26] I could not find any information or descriptions on this guide app system in the MMCA annual reports.

However, this app was not designed only for the MMCA. Guide-on, which was developed by MT System Korea, is a system platform for cultural organisations to provide content to on-site visitors (My System Korea n.d.). Thus, if visitors have downloaded the app once on their devices, then it can also be used at other places. After selecting the MMCA on the app, visitors need to pay to use it, before being able to find and read further text description on exhibits and listen to audio files on them.

The guide system has only one mode for the 'general' public, and curators in exhibition teams decide which artworks are included in the guide and write the content for the app. This is passed to a museum practitioner in the customer support and development team (former operation support team), who checks if the level of content is suitable for the general public (MMCA_F 2016; Kim 2015). The written text is then conveyed to an external company for text editing and voice recording (ibid.). The working process is linear with a limited circular loop. According to one interviewee, MMCA_F, due to the tight schedule they have when developing the content for a special exhibition, it is not possible to obtain feedback from the public before launching the guide. Thus, this communication approach is only concerned with content delivery and is a transmission model of communication (Hooper-Greenhill 1999a); the function of digital technology is limited to conveying the content. Additionally, a didactic learning approach (Hein 1998) is adopted in the guide by assuming that its users absorb the knowledge provided by the museum.

Based on the analysis of my data, the use of a platform designed by an external company for general usage makes it impossible for the MMCA to design and apply its own unique features. According to the museum practitioner MMCA_F, the MMCA has a plan to develop a new guide system employing Beacon technology. Yet, she tended to emphasise the embracing of new technology, rather than how the museum is going to design the visitor experience using a new guide system.

5.4.5 Online Research

There is no online offering available on the website of the MMCA for researchers. The website seems only to deliver general information on the MMCA, digitised collection information, a web magazine, and research papers. A service that online visitors can actively participate in is not present.

5.4.6 Online Learning

No online learning programmes developed by the MMCA could be found; only learning resources such as worksheets for exhibitions have been uploaded to the main website. An online learning programme about architecture is being developed by the children's museum team, which targets online child visitors (MMCA_E 2016). Interestingly, no mobile application has been developed by the MMCA. According to one interviewee, MMCA_F, it is difficult for the MMCA to obtain government

approval for developing a mobile application. This is because the government has strict guidelines to prevent public organisations developing too many mobile applications.

5.4.7 Summary

Most recent digital projects of the MMCA have occurred within the Seoul branch, and this is probably related to its main aim of introducing digital art. Although various attempts have been made on-site at the MMCA, online programmes are missing from its website. Thus, it is not easy to find links between on-site and online projects, which is anticipated in museum practice today (Parry & Sawyer 2005).

Based on the analysis of my data, it can be said that the extent to which the learning department is involved in digital projects has influenced their communication and learning approaches. The projects that are planned by or involve a member of staff with the learning department in a central position, for example, MMCA Friends, are more likely to consider visitors as active participants and attempt to see the museum experience from a holistic point of view (Hooper-Greenhill 1999b). These projects have more open approaches to learning than those planned by curators, and encourage visitors to make personal meanings and to cultivate social learning (Wenger 1998). Digital technology can have roles in sharing different ideas and linking people so that they recognise that diverse cultures and opinions exist. Overall, the MMCA utilises social constructivism learning in its education approach and this is one of the ways to actualise new museology.

5.5 Summary of the National Museum of Modern and Contemporary Art

In this chapter, the digital projects of the MMCA and the related actors have been analysed. The Korean government and other government bodies have actively extended their network into digital culture and attracted other actors, like the MMCA. The government has constantly invested in developing digital technology and encouraging a digital culture. However, this top-down approach seems to limit the establishment of a long-term digital strategy from the MMCA's point of view. Staff positions rotate and there is a lack of opportunities to develop their expertise on museum digital engagement, which results in challenges for the museum practitioners responsible for digital projects. The process between curatorial departments and educational department is minimally collaborative, and this influences the communication and learning approaches adopted when developing digital projects. Curator-led projects tend to focus on conveying content, while educator-led projects engage visitors to make their own meanings via digital technology, dependent upon their culture. However,

diverse visitor opinions are not well reflected in the projects. The MMCA Friends, a membership programme, could be utilised to collect visitor data in order to better understand MMCA visitors.

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Chapter 6 - National Museum of Korea

6.1 Introduction

I now turn to the second case museum, the National Museum of Korea (NMK). The case study of the MMCA in the previous chapter, particularly the Seoul branch, revealed the possibility of an additional connection of the museum to digital culture via embracing digital art as one of its main subjects. Digital artists have roles as facilitators and participants in the learning programmes. The NMK, however, as an archaeology and history museum, has different actors in its digital network. Nevertheless, the government and government agencies, such as the KCISA, have more power than other actors, which might lead to a similar shape of network to that of the MMCA.

Section 6.2 explains the history, the mission statement and the learning goals of the NMK. As a representative history museum, the NMK aims to accurately deliver the official version of Korean history to Korea and the world, which is close to the approach of traditional museology. Sections 6.3 and 6.4 identify how this approach has affected the power relationship between the NMK's actors and the communication and learning approaches of its digital projects. In particular, this case study illustrates why the voices of the public have not been heard enough, despite the museum frequently stating that it has adopted a user-centred approach. Furthermore, the lack of a well-developed museum education policy and museum professional bodies that could cultivate a community of digital museum practitioners is revealed. The issue of the internal IT team remaining marginalised, while digital companies have been extending their network, is further discussed. This unbalanced network and linear working process ultimately results in shaping the NMK's digital projects to resemble school textbooks by excluding diverse actors' voices despite embracing cutting-edge technology.

For this case study, 62 pieces of secondary data (see Appendix 3), interview data generated from 6 museum staff working at the NMK (see Appendix 5 for their profiles), and visual data regarding the digital projects, mainly generated from my field work, were analysed.

6.2 Overview

The oldest archaeology museum[27] in Korea, the NMK, opened in a palace in 1909 (NMK n.d.b). During the Japanese colonial period (1910-1945), it moved to the Joseon Government-General Museum. Upon liberation in 1945, the Korean government took over the museum and renamed it the National Museum and since then, it has moved several times. It reopened in a new building in Yongsan, the geographical heart of Seoul, in 2005, and there are now 12 national museums across the nation under the same director.

There is no museum mission statement within the NMK's annual reports or on their website, although the director's foreword in the 2013 annual report stated that 'in order to communicate the excellence of Korean culture to the globe, to exchange culture, and to promote understanding of other cultures, the museum as a representative cultural organisation of Korea should exhibit and research on various topics, educate the public, and network with international museums and organisations'. This highlights that its target visitors are not only Koreans but also foreign nationals,[28] and it aims to be a 'respectful' museum, recognised internationally, as well being a 'friendly' culture space. From these statements, the NMK can be understood to be seeking to promote the unique and outstanding Korean culture and heritage from a national point of view, and also to position itself on the global stage. Its purpose has two directions, an authorised institute having the capability to regulate a range of values and identities of heritage (Smith 2006), following traditional museology, and a culture space more likely to follow new museology. These purposes can be quite conflicting with each other. I analyse the ways it achieves these purposes (outcome in activity theory) with other actors in the digital age.

In terms of the overall learning approach of the NMK, I could not find any official documents written by the museum on this subject. A mission statement on museum education is lacking (Yang 2011), but according to the director of the education department of the NMK, museum education is supposed to facilitate active 'participants' of the museum (Lee 2015). Through museum education, the NMK aims to engage visitors to communicate with and understand exhibits based on observation, to create their own stories through the process of self-assimilation, and finally to present their opinions of the museum and evaluate them (ibid.). Thus, constructivism learning theory (Hein 1998), seems to be the

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[27] The NMK has a collection of more than 386,236 objects (NMK 2015a, p.20). Almost all are objects that have been excavated in or near the Korean Peninsula or collected because of their cultural and academic values relating to Korean and broadly Asian culture. The range of the collections varies extensively from archaeological objects from the prehistoric age, such as stone axes, to historical and cultural objects, such as official documents, statues of Buddha and metal crafts, created before the early twentieth century.

[28] The NMK was ranked 14th, with 3,052,823 visitors, for Top Art Museum Attendance by the Art Newspaper (The Art Newspaper 2014, p.15), the highest ranking among Korean museums. Although only about 5% of visitors (147,047) were foreigners (NMK 2013a, p. 20), the museum seems to have a strong inclination to attract international visitors.

underpinning approach to museum education. The ways the NMK has applied this learning approach and communication theories to its digital projects will be explained in Section 6.4. In the following section, I present the actors of NMK, who have affected its digital projects and their roles in order to answer the Research Questions 1 and 2-3.

6.3 Identified Actors: Their Network and Roles

In this section, actors of the NMK are uncovered through the analysis of secondary data and interview data. I have traced the key actors, for instance, the government and museum practitioners, to identify other related actors and examine how they together construct/deconstruct a network. Figure 6.1, which I developed, shows the network of the actors regarding digital culture of the NMK. I will discuss each actor in the following subsections and then will come back to this figure in the summary section at the end.
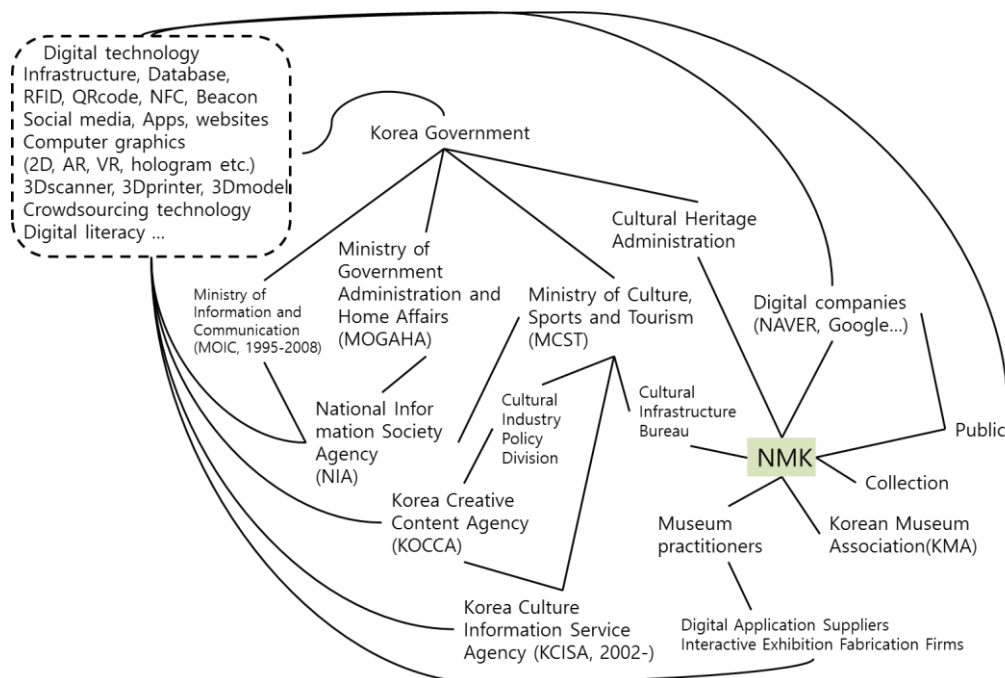
Figure 6.1 Actor-Network map of the NMK

6.3.1 Government and Government Bodies

Unlike the annual reports of MMCA, which include a section on 'informatisation' so that enabled me to easily identify its digital projects developed since 1990, the digital projects of NMK are not strongly represented in its annual reports. However, while collecting data for the MMCA, I juxtaposed the NMK's cases within government documents, thus enabling me to follow its digital projects.

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The way in which the government has extended its network for facilitating digital projects in the NMK is similar to the MMCA, because the NMK is also operated by the MCST. Thus, this has been accomplished by laws, policies and specific funding. In other words, they are explicit rules (Engeström 2015) so that the NMK should follow them. The digital projects of the NMK were initiated by the government 'informatisation' policy in 1995, and the NMK was involved in the same projects (the Public Application Service Development Project in 1995 and the Public Work Programme on Informatisation in 1998) as the MMCA. Thus, the government has affected museum practices through the funding of digital projects, generally digitalising museum collection information. There have been few conflicts when the government has extended its network to the NMK, due to the bureaucratic culture they share.

After the second Basic Plan for Culture Informatisation issued by the MCST in 2002, the NMK's digital projects were considered part of the 'Culture Heritage Informatisation' project, which aimed to create a national image, spreading the features of Korean cultural heritage across the nation and the globe, and supporting the culture industry, which is viewed as a future high value-added industry (MOCT 2002a).

My analysis also showed that different approaches have resulted from the fact that the NMK, together with other historical museums, such as the National Folk Museum of Korea, belongs to the Cultural Infrastructure Bureau, while the MMCA belongs to the Arts Bureau of the MCST. In other words, the MCST is a 'black box' (Latour 1991), which is considered as an actor, although it is actually a heterogeneous network. Even though both the MMCA and the NMK are operated by the MCST, they are controlled by different bureaus, and this difference seems to influence the approaches taken for digital projects. For example, while the digital projects in the MMCA aim to improve the opportunities to enjoy arts and culture, those in the NMK focus on spreading Korean cultural heritage and history from an official point of view.

The types of digital projects funded by the government can be divided into two types; one is concerned with building and enlarging the database on the national cultural heritage, mainly based on collections of archaeology museums, while the other is building online programmes, such as educational programmes, academic programmes, and cyber museums (MOCT 2002a). With the outputs from the previous projects, the NMK participated in a project building an e-cluster of Korean cultural heritage in 2006, as part of an integrated system[29], where users can access diverse digital content (NMK 2006a, pp.128-131; NMK 2015a, pp.118-119). The KCISA, the government body

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[29] http://www.emuseum.go.kr [Accessed 21 August 2017].

dedicated to managing culture informatisation, took charge of managing this project (NMK 2006a, pp.128-131).

The NMK was also required to become involved in a project building a database and website[30], uniting all the services relating to the Korean national heritage of culture and nature, which was initiated by the Cultural Heritage Administration in 2000 (Sin 2005). Although the museum was not one of the organisations which belonged to this government body, it has several national treasures within its collections. Because the NMK comes under a different government body, the KCISA acted as a bridge and had the responsibility for managing the project (MOCT 2002b). By doing so, it can be said that the KCISA has continuously attracted culture organisations, and it has been enabling the organisations move towards a certain direction (e.g. digital culture) by acting like as a representative in the network (Callon 1986).

Since the Framework Act on National Informatisation was introduced in 2009, digital technology has been more widely embraced in museum practices, as evidenced not only by the building of databases, websites, and guide devices, but also by interpreting exhibitions and collections in different ways. This phenomenon does not seem to relate to a strong government mandate, although the government has evaluated all the projects.

According to the evaluation report of the NMK, published by the MCST in 2015, the main performance indicators are the number of on-site visitors and the score for customer satisfaction (MCST 2016). The evaluation indicators include the extent to which policies and plans have been implemented on time, and responding opinions from its field and the achievement of policies, such as the number of events (including exhibitions) organised and attending participants (MCST 2016). This evaluation is based on a quantitative approach, and it requires the NMK to provide detailed information to the government.

The government that came into power in 2013 further aimed to provide a budget for the development of digital projects in order to increase the efficiency of public services. The government presented a stronger political will to accomplish this through 'Government 3.0', which encourages entire government bodies and public organisations to make their resources and data available on the internet with free access. Organisations that truly comply with 'Government 3.0' may receive a higher score in their evaluation (MCST 2016). The KCISA also encourages this policy, holding meetings with national museum directors to provide new insights into digital culture (KCISA_A 2015). An aim of national museums is to increase the amount of open data from their collections available on the

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[30] http://www.heritage.go.kr [Accessed 21 August 2017].

internet from 3.5% to 92% by 2017 (MCST 2014a). As the first step, the NMK has made available ~7,300 selected high-definition digital images of its collections on its website, expecting them to be used in education, the culture industry, and research (NMK 2013a, p.1). The Oegyujanggak Uigwe digital project of the NMK (see Section 6.4.5) was mentioned as a successful project (KCISA_A 2015) and the NMK received extra scores during its evaluation because of it (MCST 2016).

The paradigm of digital projects led by the government has recently changed from resource management to encouraging the practical use of the resources (MCST 2014a). The government anticipates that the extended open data available on Korean culture via the internet and its use for commercial purposes, will be an important foundation in driving the creative economy of Korea (MCST 2014a). According to the analysis of my data, this government's ambition is enough to attract the NMK to become involved in digital culture due to its missions to present Korean culture to audiences beyond the nation (NMK 2013a). In so doing, the development of digital project becomes an OPP (Callon 1986) that the government, the NMK and digital technology need to pass to achieve their final goals.

Recently, another government agency, the Korea Creative Content Agency (KOCCA) has signed a memorandum of understanding with the NMK to produce cultural content and products that are expected to be competitive in the global market (KOCCA 2016). The KOCCA provided funding to digitise cultural archetypes (Joo & Lee 2012) and a range of research projects to develop technologies that can be used with cultural content, for example, 3D models of Korean temples and game technology (KOCCA 2012). With this memorandum of understanding, the KOCCA expects to apply previously developed technology to the collections of the NMK.

In summary, the Korean government and government agencies have constantly encouraged the NMK to implement digital culture. This has mainly been through laws, policies, and specific budgets for digital projects, while evaluations work to keep the NMK within the network. The NMK tends to have few problems with these government policies, and negotiation between the actors does not seem to have been difficult, probably because of the shared bureaucratic culture. However, as I will explain, in the following sections, from the perspectives of the NMK and its museum practitioners, it appears that they do not only act as the government intends them to.

6.3.2 The Museum Itself

As a representative museum of Korea, it is considered that the NMK should take charge of presenting Korean heritage and history to the public from the 'official' point of view in order to build a national identity and image (NMK 2006b). The museum noted that a new gallery had been refurbished to

present Korean history, according to the national curriculum (NMK 2012, p.125). 'History' in a Korean context is a relatively conservative area associated with nationalism, which may be related to continuing historical and territorial issues among the North-East Asian countries of China, Japan, and Korea. Thus, the NMK probably cannot be excluded from this complex context, although it aims to function as a hub for Asian national museums (NMK 2006b, p.142) and to connect with international visitors (NMK 2013a).

The content of digital projects in the NMK can also be understood in this context. It is continuously argued that museum informatisation can make the information held in museum collections accessible to the global public and can 'correctly' improve understanding of Korean traditional culture, heritage, and history (Yang 2001, p.76). The recently launched guide application can also be understood in this context, because it aims to provide knowledge of the exhibits displayed to visitors (NMK 2012, p.3), rather than to provide opportunities to explore the content from various points of view, as in new museology. This analysis can also be understood within the previous criticism of educational programmes, which are only focused on teaching 'accurate' historical knowledge (Yang 2001, p.59). Therefore, based on the analysis of my data, the NMK adopts a traditional museology point of view, and this, as a conceptual tool (Engeström 2015), affects museum practices (e.g. the development of digital projects). I will further discuss this argument with examples in Section 6.4.

Developing digital projects in the NMK also can be understood that the museum reflects society changing into the information age. In order to use museum resources in 'creative ways' in the twenty-first century, the museum planned[31] to develop e-learning programmes for children, adolescents, adults, teachers, and foreigners (NMK 2006b, pp.95-96). Digital experience is considered as being able to provide more learning opportunities, extend the chance to enjoying culture, and to actively communicate with the public (NMK 2015b).

According to the analysis of my data, however, the museum director has more power than museum practitioners in the decision-making process of the development of digital project of the NMK. For example, the embrace of digital technology in exhibitions and education programmes of the NMK is more encouraged by its director to leading visitors to become interested in the museum's tangible objects (Seo 2015). The museum director's ambition and direction to be involved in digital culture seems to be clear, yet the director of the NMK is appointed by the government. This hierarchical organisational culture, however, is a barrier to establish and cultivate internal CoP

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[31] There were plans to develop e-learning programmes. Yet, the output of plans could not be found, except the one presented in Section 6.4.6. This result may be associated with the director changed to another just one year after the plans were announced; therefore, there might be difficulties to keep the plans.

(Wenger 2010). This is because, in order to be a healthy community (Wenger et al. 2002), its members should have equal powers and agency so that they can feel comfortable to discuss and debate with other members, instead of having a strong leader.

Meanwhile, by organising academic seminars relating to digital culture, a device in the process of network making (Callon 1986), the NMK has attempted to provide opportunities for gathering together those with an interest in digital technology and has attracted other actors. For example, at a recent international seminar, entitled 'the future of museums and participation', the director of the Google Cultural Institute and a professor from KAIST, a Korean university whose research area is dedicated to science and technology, were invited to give talks (NMK 2015a). Similarly, one subject of an academic seminar hosted by a children's museum of the NMK in 2016 was also about information technology and children's museums, and a programme manager from the Google Cultural Institute and a manager from NAVER introduced their digital services (NMK 2016a). With these events, the NMK begins to construct its network. Yet, based on my data analysis, this network seems temporary and fragile. In order to make the network stable and durable (Law 1992), there should be the following actions in an institutional level; for instance, organising annual events in the similar topic. The regularly repeated events also can bring potential to establish a CoP (Wenger 1998) between actors of the network by providing social learning opportunities for museum practitioners.

In terms of globalisation and digital culture, the NMK has enthusiastically participated in the Asia-Europe Museum Network, and was the chair museum from 2011 to 2014. During this period, the Virtual Collection of Asian Masterpieces,[32] sponsored by the Korean internet company NHN, was launched, allowing museums to exchange collection information via the internet (NMK 2013a, p.564). The NMK has continuously attempted to be an important member of global cultural organisations and to promote Korean culture. More recently, the NMK attended a meeting for the development of an online platform for the Silk Road project organised by UNESCO (NMK 2015a, p.87).

In sum, although the NMK has attempted to attract other actors within digital culture in several ways, such as organising seminars, participating and embarking on digital projects within exhibitions, and through education programmes, it might be hard to determine whether the NMK has strategically planned this. An interviewee, NMK_F, who has worked at the NMK for more than ten years relating to digital area, mentioned that

> '… the NMK seems to have struggled to follow the fast-changing digital culture. All digital offerings are managed separately, digital multimedia guides by curatorial departments,

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[32] http://masterpieces.asemus.museum [Accessed 21 August 2017].

website by the planning office, and social media by the marketing team. There is no overall control planning and managing the different digital projects from a holistic point of view.'

His opinion again echoes the requirement of a new digital media department (Lee 2015), which would manage all digital offerings with a long-term perspective. The lack of internal representative regarding digital culture of the NMK causes a difficulty to lead its digital culture network. However, it might not be easy to change the organisational structure due to its bureaucratic characteristics, and it appears to be museum practitioners' responsibility to achieve the better performance of digital projects. Now I turn to the museum practitioners' point of view on digital culture in the following section.

6.3.3 Museum Practitioners

In this section, I will present museum practitioners' point of view when they are involved in the development of digital projects. The ways of their professional identity relating to their academic background affects their perspective on digital projects will be discussed and the issue on their professional development will be addressed, especially from CoP (Wenger 1998) perspective. This is important because the subject of human activity is one of components that influence the shape of activity (e.g. developing digital projects), based on activity theory (Engeström 2015).

Over its history, the NMK has undergone several reorganisation processes, pertinent to my research. It is noticeable that the museum established the Education Division in the new Education and Cultural Cooperation Bureau in 2005, when it moved and reopened in a new building. Even though the museum has attempted to employ museum education experts, administrative officers still account for a high percentage of staff, according to the Evaluation Report on the Organisation and Work of the Museum (Jung 2007). The ambiguousness of the identity of the new division and the lack of an education policy and visitor research seem to result in no specialised education programmes and no improvement in the quality of programmes, although their number has increased (Yang 2011).

The lack of a system also results in individual museum practitioners' perspectives on the museum's digital experience being more significant. From the analysis of annual reports of the NMK, it was identified that digital projects, for example, building databases of collections, were managed by practitioners in the Cultural Relations and Publicity Division, and since 2012, the Planning and General Management Division. However, the practitioners of both divisions are mainly administrative officers who have not been educated especially for the projects or in relevant fields. This can negatively influence their projects.

Nonetheless, my interviewees, NMK_B, NMK_C, NMK_ D and NMK_F, agreed that junior curators tend to be more open-minded to embracing digital technology in exhibitions than senior curators. One

of the interviewees, NMK_B, a digital expert who used to work with curators to develop digital projects, noted that:

> '… in general, young curators attempt new methods and approaches for object interpretation when planning new galleries and seemed to be familiar with digital technology and have fewer barriers to including digital devices within galleries.'

Another interviewee, NMK_C, a curator who recently adopted AR technology in a new exhibition also believed that interactive digital media should be further encouraged in the future in order to engage visitors in exhibitions because visitors do not really read the panels. By doing so, they anticipate that digital technology will attract visitors to exhibits.

Yet, based on the analysis of my data, academic background of museum practitioners significantly affects their perspective on digital culture of the museum. Curators tend to perceive digital offerings in exhibitions only as an eye-catching element that potentially supports the exhibits. They also seem to be concerned about the current situation of embracing technology in every new gallery, because this could distract visitors' attention from the actual exhibits (NMK_D 2015; NMK_E 2015). This attitude is different from the digital expert's point of view, who proposes that a digital project that may offer a personalised service to individual visitors for further engagement (NMK_B 2015). He even mentioned that Gallery One at the Cleveland Museum of Art[33] was a good model; although he also understood that this approach might need to be driven by the director and further negotiation with curators would be required. Similarly, the director of the education division of the NMK highlighted that new digital learning programmes are required for school pupils (Lee 2015). Unfortunately, the digital expert was rotated to another government organisation last year and the director of education deployed to another team due to the Decree on the Appointment of Public Officials. Therefore, developing these ideas for digital museum experiences is limited.

In sum, some museum practitioners are interested in digital culture and attempt to employ digital technology in different ways. However, due to job rotations, they are not stable actors (Law 1992); thus, the know-how they have learnt from their digital projects does not seem to be shared and accumulated. In other words, this situation does not help develop a CoP (Wenger 1998) regarding digital museum culture. The necessity of developing museum practitioners' professionalism is a frequently mentioned issue within Korean museum literature (Jung 2007; Yang 2011; KMAC 2011).

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[33] Gallery One in the Cleveland Museum of Art is an interactive art gallery embracing various types of digital technology, for example, motion sensor and face-recognition software for visitor engagement (Alexander et al. 2013).

The current circumstances also mean that digital technology and relevant technology companies have more power than museum practitioners. This power relation will be discussed in the following section.

6.3.4 Digital Technology and Digital Companies

As stated in previous sections of this chapter, digital technology already has interconnected with many actors, including the government and the NMK. By doing so, various types of digital projects can be found at the NMK and are not restricted to collection information databases and websites, and developing an online virtual museum with NHN (NMK 2010, p.241; NMK 2012, pp.54-58). The NMK has also employed digital technology in its collection and exhibition interpretations. Recently, it offered on its website 3D images of selected objects and a digital service using reflectance transformation imaging (RTI) technology that allowed users to change the direction of the virtual light in order to view the surface and shape of objects more clearly. Digital technology seems to be strongly associated with making collections available to use in many ways, mostly for research purposes.

Following renovations of permanent exhibitions or the addition of new exhibits, digital technology has been frequently mentioned as an interpretation medium, for example, video, touch screen, and near-field communication (NFC) technology, to inspire visitors who are familiar with digital culture (NMK 2012, p.132, p.138). Several digital interpretation media are present in permanent galleries, and many exhibits in the children's museum of the NMK have embraced digital technology, such as motion sensors, digital drawing, composite pictures, and so on. The new guide tour programme uses tablet PCs (see Section 6.4.3) and is popular with school pupils. Therefore, from the analysis of my data, digital technology, non-human actor, has successfully constructed its network (Latour 2005) with visitors, especially young visitors.

These new approaches seem to relate to the assumption that Korean children are usually familiar with digital technology, and cutting-edge digital technology is an efficient educational tool (Park 2012a, p.53; NMK_A 2015; NMK_E 2015). The provision of Virtual Reality (VR) technology from the Google Cultural Institute also makes it possible to provide new education programmes of the NMK for child patients in a hospital (NMK 2016b). One interviewee, NMK_A, also said that digital games and online services that Korean children may be interested in are more likely to be considered when planning new exhibitions and programmes for children.

Yet the quality of digital exhibits is likely to depend on the available budget and development time, as a rule in activity theory (Engeström 2015). Additionally, the capability of interactive exhibition fabrication firms and digital application suppliers is mentioned by NMK_A and NMK_C as a crucial element for the success of the digital projects. Obviously, this is why the companies have technology

so that they can actualise the ideas the museum practitioners have. In other words, the companies have a closer relationship with the technology than the museum. However, this point of view sounds like technological determinism. What the museum practitioners overlook here is what kind of ideas they have. Digital technology might shape the projects. Yet, fundamentally, the ideas that the museum practitioners have should lead the projects in a new way by adopting new museology (see Section 3.2). And the technology is there to put the idea into practice rather than the other way round. By doing so, the power among digital technology and digital companies, the museum, and the public can be shared, and the public can be an active actor. In the next section, I will discuss the degree at which the public is recognised as actor in the NMK.

6.3.5 The Public

The public is generally recognised as the NMK's primary consideration, and a visitor-centred approach was highlighted as a strategy of the NMK in the twenty-first century (Yang 2001). The museum has changed its management philosophy from collection-centred to visitor-centred, further highlighting the educational role of the museum, and responding to various groups of visitors (Yang 2001). By emphasising its multiple functions for the public, not only exhibitions but also education programmes, performances, a place for eating out and for relaxing, the NMK considers the public not only as visitors to exhibitions but 'customers' who have different purposes to come to the NMK (NMK 2007b). Thus, they seem to acknowledge that different approaches are required for different customers (NMK 2007b).

However, I am concerned as to whether the concept of the 'customer' sufficiently represents the public who might want to actively participate in the museum as an actor. This is because the new museology perspective on meaning-making process of individual visitors should be understood as dynamic and diverse ways of producing and reconstructing meanings, not simply consuming what is offered. If the public is a visible actor in the network of NMK, their constant negotiation and resistance to other actors should be seen (Law 2009). I will explain whether the public is an actor or not below.

The NMK noticed that they adopted a user-centred approach rather than a provider-orientated one, following the refurbishment of the permanent exhibition halls (NMK 2009, p.125). The annual report stated that 'this refurbishment considers the needs of public and provides exhibitions in the way they expect', although it does not explain how the museum reflected the opinions of the public. The NMK also widely recognises the importance of visitor satisfaction, as this score forms part of its evaluation by the government. However, the evaluation is normally based on visitor survey data collected with

quantitative method. Thus, the detail of the public's thoughts cannot be collected and reflected in the NMK.

Based on the analysis of my data, exhibition planning for the children's museum attempts to reflect its younger visitors; however, the museum seems to have concentrated more on gathering the opinions of teachers, experts in children education, and parents, rather than from the children themselves (Park 2007, p.82; NMK_A 2015). In 2013, the children's museum team recruited a group of parents as an advisory committee, which meets twice yearly (NMK 2013c). Their roles are limited to give feedback on existing exhibitions and educational programmes rather than getting involved into the exhibition planning process (NMK_A 2015). NMK_A said:

> '… planning exhibitions is professional work that should be done by experts like museum curators. The advisory committee might give their opinions about the exhibition after it opens to the public. But, they are not professionals. We only refer to their feedbacks when it is necessary.'

Therefore, it can be said that the public is still hidden and the ways that they can present their thoughts are controlled by the NMK. It is also true that the public is rarely involved in the development process of digital projects studied in this research, as I will further discuss this issue in Section 6.4.

In next section, I will turn to museum professional bodies to examine their roles as actors in the NMK's digital network, especially relating to a CoP perspective (Wenger 1998).

6.3.6 Museum Professional Bodies

In Section 6.3.3, the issue of the professional development of museum practitioners was raised. Museum associations are supposed to provide professional development opportunities for museum practitioners (Teather 1990). In this section, the Korean Museum Association is investigated in terms of how they have responded to digital culture in order to support museum practitioners to become involved. This organisation is considered as an actor because it was uncovered by following the NMK's activity.[34] However, as I explain below, its role and agency seem to not be fully functioning.

The annual reports of the NMK include a chapter on the Korean Museum Association (KMA) as one of the relevant organisations (NMK 2014a, pp.640-654). The KMA was officially founded in 1991 as

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[34] The KMA could be a hidden actor in the MMCA network, although it was not uncovered when I traced the actors of MMCA. Yet, academic background of the members of KMA, normally having in archaeology and history fileds could cause a boundary of the community (Wenger 1998) and this again makes their identity closer to the NMK than the MMCA because of the subject matter.

an incorporated association (KMA 2007), and the relationship between the NMK and the KMA can be understood under the Museum Act. The early stage of the foundation of the KMA began via a few museum professionals in 1976 (KMA 2007). Then the Museum Act in 1984 and again in 1991 included clauses that provide financial support for the foundation and operation of the KMA by the government, and the KMA has its headquarters within the NMK.

The KMA aims to contribute to the preservation of national culture and heritage through museums and encourages Korean museums to collaborate with other museums across the nation and the globe (NMK 2013a, p.549). One of its projects has been to host museum professional development programmes since 2003. These programmes tend to be lecture based and museum professionals describe recent museum projects and museum policies. Recent programmes detailed a database building project (KMA 2014) and museum content embracing VR and AR technology (KMA 2016).

The KMA has organised the annual Korean Museum Conference since 2007, which almost all societies and academic communities which are relevant to museums participate in and hold their own sessions in the same venue at the same time. At the conference held in 2015, 15 groups participated, the most in the event's history. From its programme book (KMA 2015), it can be seen that the subject of more than half of the groups was museum education but there were no groups specialising in digital culture within museums. The speakers at the sessions were typically university professors, lecturers, researchers and graduate students; very few museum practitioners were involved (KMA 2015).

Therefore, it can be said that the KMA is not strongly linked to museum practitioners. Some interviewees, NMK_C and NMK_E, mentioned that the programmes provided by the KMA are normally not relevant to them because of their professional identity (Wenger 1998) as a curator, and they considered the programmes to be more useful for museum educators. Thus, it seems there are not enough opportunities to share the working experiences of museum practitioners with their peer groups like CoP (Wenger 1998) and develop their professionalism regarding digital projects in museums.

6.3.7 Summary

Figure 6.1 is an actor-network map of the NMK and describes the relationships between the actors identified during the analysis of my data and discussed in the sections above. Some actors, for example, the MCST, NHN, the public, and digital technology, are similar to those of the MMCA, while different actors have also emerged, such as digital application suppliers and interactive exhibition production firms.

It is not apparent that the KMA has functioned as a CoP because museum practitioners do not seem to actively participate in it, and sharing opinions and learning together does not seem to be common. The

lack of opportunities to develop their professional knowledge regarding how to embrace digital technology in museums potentially results in the suppliers and firms who have knowledge and skills relating to digital technology becoming stronger actors than museum practitioners when developing digital projects in the NMK.

Although digital technology is identified as an actor, I could not determine the overall digital strategy of the museum, which links all the digital experience in a meaningful way. This might relate to the lack of overall control for digital projects across the NMK. Some staff members are involved in the network described but job rotation prevents them from being stable actors (Law 1992). Additionally, the museum director has more power to establish the network than them have due to the hierarchical organisational culture. The public is also still hidden actor.

I now turn to the next section, which presents the analysis of digital projects of the NMK. I further discuss how the identified actors shape each project and how they affect the communication and learning approaches of the projects.

6.4 Digital Projects

This section describes the digital projects recently developed by the NMK. The projects chosen are analysed in detail in order to understand how they were developed, as this can be associated with the communication and learning approaches adopted in these projects. Through this analysis, it can also be understood what roles digital technology has within the NMK's education philosophy (Lee 2015). Broadly, the NMK seems to aim to adopt cognitive constructivism (Hein 1998), which considers learners as active participants in the learning process; however, several challenges in doing this were uncovered. This section will start with the digital project in the orientation space of the NMK, followed by projects within galleries, programmes and events, the multimedia guide, and online offerings.

6.4.1 Orientation Space

Visitors can find kiosks (Figure 6.2 and Figure 6.3) when they enter the museum's hall and corridors, and there are now more than 30 throughout the NMK (NMK 2012, p.57; NMK 2015a, p.122). The kiosk is a stand-alone device and visitors can use them at any time in order to find museum information. They were developed when the NMK reopened in its current building in 2005, and the hardware was updated in 2011.

Figure 6.2 Orientation space of the NMK

I cannot find any written evidence relating to the purpose and motivation to develop the kiosk, but according to a museum practitioner, NMK_F, who has responsibility for its management, a fundamental motivation was that it would deliver museum information, such as current exhibitions information, visitor facilities, and museum collection information, to visitors 'efficiently'. Because of the huge size of the building, and the fact that the main entrance hall for permanent galleries is separated from the wing for special exhibitions and the children's museum of the NMK, it would be hard to assign staff members at every single point to provide visitors with way-finding information. However, the reason for having the Experience menu, one of services in the kiosks, may be slightly different, because this contains several games and videos about the museum's collections. These are intended 'to encourage visitors to have interests and fun on our culture heritage by activities in the Experience menu' (NMK 2012, p.57).

According to the interviewee NMK_F, the use of kiosks is not intentionally targeted to any specific visitor segments, although children tend to use the Experience menu more. In the other menus, messages concerning the museum collections and exhibitions are much more directly delivered to visitors by adopting a transmission model of communication (Hooper-Greenhill 1999a), while in the Experience menu, visitors have a chance to explore the content via several activities. For example, visitors can virtually decorate a golden crown from the Silla dynasty while learning the names and meaning of each decoration, and can learn about the procedure to produce a piece of pottery from the Josun dynasty, from the design phase to the final object (Figure 6.3); thus, the NMK wants users to learn specific knowledge and facts about its collections through gaming. In other words, knowledge in the games is already fixed by the museum and is believed factual. Again, it is a transmission model of communication (Hooper-Greenhill 1999a). Regarding learning approach of the games, these games

only provide users with feedback about whether they have made a correct choice, and therefore, behaviourism has been adopted (Whitton 2014, pp.25–30). When I highlighted the games during an interview, the interviewee, NMK_F, mentioned that these games had been adapted from existing games which were widely known by software developers. Being easy to design and build, and with the possibility of being reused, are common features of games that adopt behaviourism (Whitton 2014, pp.25–30).

Figure 6.3 A kiosk and its game that is intended to encourage visitors to have interests and fun on Korean culture heritage by activities

When the kiosk project was developed, the IT team mainly handled the project, and the NMK's curatorial teams provided content for the collections. The education department was not involved in the development process (NMK_F 2016), and it appears that the games were not considered 'educational' by the museum at that time (or even now). The kiosks in the orientation space function in engaging and motivating visitors to explore the NMK, but efficiently delivering and updating the museum content via the kiosks may not be sufficient to attract visitors who have different purposes for visiting the museum and bring with them different cultures.

6.4.2 In Galleries

In this section, I will examine two digital projects of the NMK; one is AR Curator that was developed for a permanent gallery, the other is digital exhibits in the children's museum of the NMK. Although the first project is collection-based and the latter digital, the main role of digital technology in both cases is delivering fixed knowledge from the museum to visitors. This shows that the NMK principally adopts a traditional museology. I will discuss this further with the examples below.

6.4.2.1 AR Curator

Adapting digital elements as interpretation media in permanent galleries has been increasingly introduced, especially in recently renovated galleries. The AR Curator is a mobile application which embraces AR technology in a new metal craft gallery (Figure 6.4), was launched in 2014 (NMK 2014a, p.167). In order to use this app, visitors have to download it to their smartphone, then when they encounter small markers next to exhibits selected for the app, they can use their smartphone camera to recognise them. This provide them with an additional experience, for example, looking at the surface of the exhibit in greater detail, listening to the sound of a bell, viewing a candlestick when lit, etc.
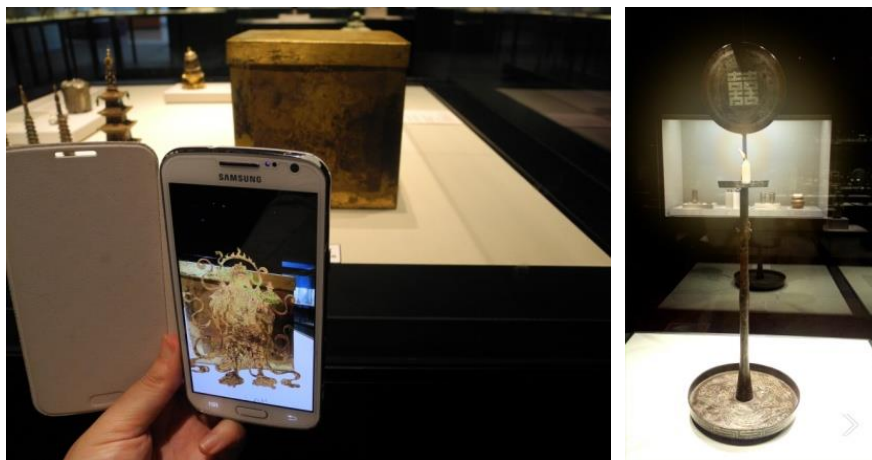
Figure 6.4 The AR Curator application showing the detail of museum objects

This app was designed for on-site visitors to 'discover and know the use of, the structure of, and the engraved design of museum objects in detail' (NMK 2014a, p.167). This project was introduced into Korean main mass media as an innovative and interesting way to make visitors felt welcomed and comfortable in a museum (Noo 2015; Kim 2015). The curator, NMK_C, who planned and managed the gallery renovation, including the development of this app, also said that this app is a fun and interesting factor because it can inform visitors about hidden but interesting things, which generally only curators and experts know and see. He also evaluated this approach by saying that:

> 'This app is a more dynamic and interactive way than reading panels and could be a method that museums use more in the future.'

Yet, based on the analysis of my data, this app adopts a transmission model of communication (Hooper-Greenhill 1999a). Knowledge in this app is considered factual and objective, and it is delivered linearly from the museum to users through the app. Thus, it is more like another form of reactive, moving and hidden panels, which convey predefined content that is produced by the museum.

The highlighted role of this innovative AR technology is also limited to delivering content. In terms of the learning approach of this app, it adopts the discovery learning theory (Hein 1998). This is because the app provides its users with various activities to explore content and to assess their own interpretation against the "correct" one set by the museum. Therefore, it is expected to help visitors extend their understanding of objects and Korean traditional culture "correctly" by increasing the depth of their knowledge about museum objects.

The initial idea which drove this project came from the museum director after she saw digital interpretation media at the Getty Museum in the US (NMK_C 2015). During the development process of the AR Curator, the main decisions were made by the curatorial team regarding content, and an in-house designer worked together to create the exhibit design and contacted relevant software companies to investigate the possibility of developing this project. The museum education team was not involved at all, while the IT team was only involved in ensuring that the app followed the government guidelines for app development, such as avoiding the development of a new app which might have the same functions as existing apps.

Nonetheless, the curator, NMK_C, mentioned that visitors' comments and requirements, which he got from gallery talks, were reflected in the app. According to him, in general, participants of the talks are middle-aged adults, probably regular visitors, have lots of questions on exhibits and culture, and are looking at an exhibit for a long time in order to discover new things. Although the curator is also aware of the importance of encouraging school pupils to visit the museum and the gallery, because of the group which visits most, this app seems to be designed for regular and already motivated adult visitors. The Android version of the app has only been downloaded about 1,000 times (at 23 March 2017) since it was launched in 2014. Although this number does not indicate whether it has been successful, it does reveal that it is not as popular as expected because more than 3,000,000 people visit the NMK annually (NMK 2015a).

6.4.2.2 The Children's Museum

When the NMK reopened in its new building in 2005, a children's museum[35] was opened as part of the educational facilities. According to its website (NMK n.d.c), this space has been established with four aims: as a cultural space for all the family; an educational and learning space where children can see and experience the nation's cultural heritage from a new perspective; a place where children can think about our culture; and a place where children can take pride in our culture. From these, it can be seen that nationalism of Korean history is embedded rather than fostering a global mind. The museum

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[35] Children's museums have increased in Korea since the early 2000s, while the first independent children's museum, the Samsung Children's Museum, was opened in 1995 (Kook 2010).

has not planned to teach history using a one-way approach from teachers to learners, but provides learners with various methods and time to discover learning content for themselves (Cho 2015). Originally, the targeted age range of child visitors was 7-12, elementary school students in Korea, together with their family, but pre-schoolers as a group also make up a high percentage of visitors to this space (Park 2007, p.4).

Since it opened, the museum has been partially renovated several times, but principally, it has not displayed the NMK's real collections and or even replicas. More than 60% of exhibits are hands-on and have interactive elements (Park 2012a, p.30), and the number of digital exhibits has increased following the renovations, which may reflect children's preference for digital elements (NMK_A 2015). NMK_A, who was the main curator of the children's museum, stated:

> 'I think of digital culture a lot when I plan hands-on exhibits for children. The popular exhibits that attract children have digital elements. Thus, it is so obvious to consider digital exhibits regardless of my personal preferences regarding digital.'

In this section, two digital exhibits have been selected following the interviewee's suggestions, and these will be investigated in order to show how digital technology has been adopted to facilitate learning.

People Lost in Nature: This exhibition introduces famous painters from Korea's history and their paintings. The introduction panel of the exhibition says that this exhibition aims 'to facilitate visitors to appreciate and understand the painters' thoughts and feelings', and the exhibition aims to look in detail at the paintings (NMK_A 2015). Based on the analysis of my data, the knowledge in this exhibition is considered fixed and factual, and it is conveyed from the museum to visitors by adopting a transmission model of communication (Hooper-Greenhill 1999a). Although one exhibit provides an opportunity for visitors to paint on a digital screen based on the outline of the original paintings, the activities of the exhibition were not mainly designed to allow visitors to contribute to produce knowledge. The activities are limited to a touch screen to learn about the life of a painter and checking on the knowledge learnt from the exhibition by answering quizzes (Figure 6.5). The overall learning approach is based on behaviourism and discovery learning (Hein 1998). This is because, although there are several digital exhibits learners can explore, most of them only facilitate learners to find out 'right' answers, and digital technology in this exhibition is also only harnessed to react to users' input.

Figure 6.5 Digital exhibits in the exhibition 'People Lost in Nature'

Find a Rabbit of Wisdom - the wisdom of our ancestors: According to the introduction panel of the exhibition, this exhibition aims to facilitate visitors to discover the wisdom of our ancestors and think about what wisdom we need to live together. According to one interviewee, NMK_A, the exhibit 'Land of Hunters' (Figure 6.6) is the most popular, and via this exhibit, it is intended that visitors can learn about how our ancestors hunted animals. As an animated scene opens on a screen, visitors throw toy arrows towards the flying hawk; if the arrow exactly hits the hawk, the rabbit caught by the hawk can be rescued and the mission of the game is completed. This game might encourage children's physical activity, improve their ability to concentrate on something and react quickly, and potentially, users feel a sense of accomplishment (NMK_A 2015). However, this game also seems to be based on behaviourism, as it only focuses on the reactions of users (Whitton 2014).

Figure 6.6 A digital exhibit from 'Land of Hunters' in the exhibition 'Find a Rabbit of Wisdom'

According to a paper written by a senior curator of this children's museum (Cho 2015), activities in this museum are based on John Dewey's learning philosophy. Thus, 'learning by doing' is an important principle of the exhibitions, and children are supposed to gradually learn through play and activities with their companions (Cho 2015). In this context, digitally simulating activities and a

virtual environment are supposed to be playful learning methods, like games. The interviewee also highlighted that digital exhibits are meaningful because visitors' activities can overcome the limitation of traditional one-way communication with museum objects, for example, by observing collections or touching replicas. However, based on the analysis of my data, the digital technology in these exhibitions only reacts to users' input and offers ways to find predefined knowledge, rather than contributing to reconstructing visitors' own meanings. Thus, the museum seems to consider knowledge as objective rather than subjective, as in new museology.

My analysis shows that this approach is influenced by the exhibition development process. The children's museum is run by a children's museum team within the education department (Park 2012a, p.55). In general, exhibitions are planned and managed by the team from the concept phase to the minute detail (NMK_A 2015). If they need advice on historical aspects of the exhibition content and museum collections, the museum's curatorial teams are involved (NMK_A 2015). In addition, an in-house museum designer is involved during the early development phases. An exhibition company is appointed through an open competitive tender process, and the team and the company actively discuss, negotiate, and develop the final exhibits for about three months. While museum professionals are sometimes involved in the process, they are more likely to evaluate and act as consultants. Although the team has run an advisory group with school teachers and parents, this group and children are not involved in the exhibition development process. The planning of exhibitions is considered to be work that should only be undertaken by experts like museum curators (NMK_A 2015). As a result, the exhibition development process is linear, and the voice of the public (e.g. children) is not well reflected and represented.

6.4.3 Programmes and Events

Smart Curator[36] is name of a programme led by a 'well-trained' guide within the NMK permanent galleries. Figure 6.7 shows examples of the programme. The initial programme was launched in 2012 to encourage families to visit the museum following the enforcement of a five-day school week system (NMK 2013b). At weekends and during school holidays, family visitors can participate in the programme, while adult visitors attend on weekdays (NMK_D 2015). The programme has been updated and new topics have been introduced, reflecting subjects that visitors are supposedly interested in (NMK_D 2015, NMK 2014b; NMK 2015c). As of March 2017, 13 topics are currently running in Korean.

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[36] The programme is called the 'smart' guide programme because of the presence of digital technology (NMK 2014b).

Figure 6.7 The Smart Curator programme adopting mini-lecture-type learning by minimising the role of digital technology to deliver fixed content

The programme takes about one hour. The participants of the programme follow a pre-structured path with a guide, who talks about the exhibits. Participants not only listen to the stories told by the guide while observing the exhibits, but also use a table PC by themselves to look at other resources, such as images and videos (NMK 2013b; NMK_D 2015). Occasionally, the guide asks questions, for example, 'Is there anyone who knows about what material was used to make this object?', 'What is the meaning of this pattern?' and so on. Based on the analysis of my data, the intention of these questions is to determine the extent of the pre-existing knowledge of participants, as well as to engage them. Although the guide asks questions and participants can use other resources through the tablet when necessary, the communication approach adopted in this digital project is a transmission model (Hooper-Greenhill 1999a) and the learning approach is didactic (Hein 1998). Because this project is part of the guide programmes, the aim is to deliver pre-structured content. An interviewee, NMK_D, also highlighted that the programmes provide a chance for visitors to obtain more knowledge relating to the exhibits (NMK_D 2015). The digital technology is supposed to support learning by offering an 'easy and fun' option, but only appears to deliver content.

It is interesting that this project is basically considered only as a guide programme which embraces new digital technology, rather than a new education programme. The interviewee highlighted this point of view, noting it had been planned and run by the Visitor Service team, who also run other guide programmes. The main museum practitioner in this project is a curator with expertise in archaeology, who was appointed to this position only a few months before I interviewed her. From her perspective as a curator, this guide programme is a successful model to convey knowledge with accompanying visual resources that can make the participants focus more on the programme due to the tight and intensive time schedule. Discussion and debate are rarely encouraged during the programme, which may be associated with subject matter of history education. In addition, participants of the programme are generally frequent museum visitors (Research & Research 2014).

This means that the content and communication approach of the programme may be designed for a specific visitor segment who can easily decode the content, rather than newcomers and non-visitors (Hall 2006).

6.4.4 Multimedia Guides

A museum multimedia guide system was launched in 2005 via PDA and MP3 audio devices (NMK 2005, pp.124-126).[37] Since that time, it has been partially redesigned in terms of the content and technology. More recently, in January 2016, the NMK launched a new guide app (Figure 6.8) for the permanent galleries, employing Beacon technology that makes the app automatically display and provides information for museum objects near a visitor's current location (NMK 2016c).
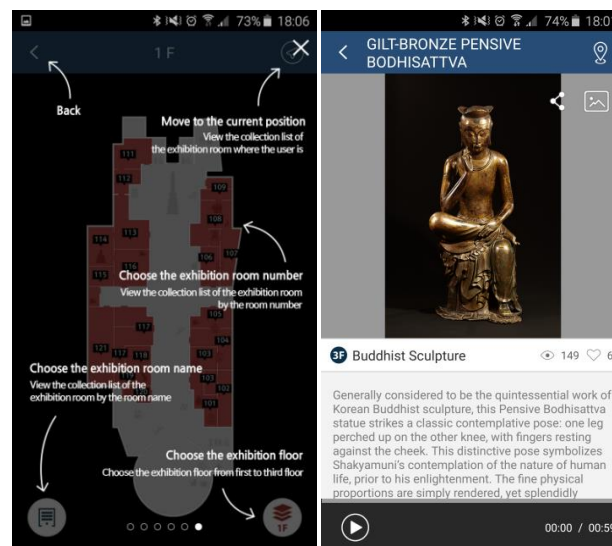
Figure 6.8 The NMK multimedia guide conveying knowledge from the museum to users

The motivation to develop this new app was mainly driven by museum internal issues (NMK_B 2015; NMK_E 2015). The previous multimedia guide system was out-dated and so hard to maintain. Several changes to the displays have also been made so that it was necessary to add, revise, and remove some of the multimedia guide content. In addition, several different styles of narrative had been adopted when the system was partially updated. For example, some explanations were conversation in style between a curator and a visitor, some had a curator explanation style, while others were speech recorded text. Thus, developing a new app was suggested by the IT team who manage this system.

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[37] The first mention of a mobile guide system for the NMK can be found in the annual report for 2005, when the museum reopened in its new building (NMK 2005, pp.124-126). It is unclear whether the museum had a mobile guide system prior to 2005.

The IT team managed the whole development process by communicating with a software company who developed the app, while curatorial departments provided the content (NMK_B 2015; NMK_E 2015). The Research and Planning department acted as a bridge between the IT team and the curatorial departments. An external freelancer, who has experience working in the publishing industry, was involved in this project through proofreading the content written by the curatorial departments and ensuring that the content level was suitable for non-archaeology experts. The app is designed for the general public and is more appropriate for ages 12 and above (NMK_E 2015).

When visitors with the app installed on their mobile phone enter the permanent galleries and pass close to the exhibit showcases, relevant text and images of the exhibits will automatically pop up on their phone because the embedded Beacon technology recognises their location and communicates with the app (NMK 2016d). Visitors can then watch and read the information while observing the real objects in the showcases. They can share the content through social media via the app. They also can push the 'like' button for the exhibits they like, and this feature allows other users to know how many users like the same objects.

Museum multimedia guides are sometimes considered to be a self-controlled and self-directed learning method. Based on the analysis of my data, the 'like' element is an interesting factor which might influence other users to visit the gallery, and isolated and separate users can be linked via this social feature. Another interesting point in this project is that the guide system has always been considered by the museum as an 'easy' and 'fun' way for visitors to understand exhibits (NMK 2005, p.124; NMK_B 2015; NMK_E 2015). However, a study of NMK visitors commissioned by the museum found that visitor satisfaction with the multimedia guide was relatively low compared to other services (PIO 2010). Most of the multimedia guide users are regular visitors of museums (Research & Research 2014). Thus, it can be said that the guide system is designed to suit a particular group of people (Hall 2006).

Digital technology in this project only has the function of automatically presenting additional text, images, and graphics of exhibits to users in an efficient manner although the 'like' element has a potential to link people as mentioned above. Because the aim of the project remains 'understanding' Korean history accurately and in detail, the knowledge in the guide is regarded as factual. The fact that the content of the guide has been created only by internal curators makes it difficult to embrace diverse point of view when interpreting the objects, and the NMK does not seem to recognise or accept different interpretations of their objects. As a result, the knowledge fixed by the curators is conveyed to users through the app by adopting a transmission model of communication (Hooper-Greenhill 1999a).

6.4.5 Online Research

The Oegyujanggak Uigwe[38] website is designed to provide the entire content of the Oegyujanggak Uigwe-royal documents, which were written during the Joseon Dynasty, and returned to Korea from France in 2011 (NMK 2011b). The initial project was part of the national database building projects, funded by the MSIP and NIA, to digitise documents for the preservation (NMK 2011c). The IT team took the main role in running this project in collaboration with the Archaeology and History department of the NMK (NMK_B 2015).

Through providing digitised documents through their website, the NMK aims to allow researchers and the public free access to the digital content because the original documents are too fragile to be frequently handled (NMK 2011c). The NMK anticipates that the content will be used as a resource to support the development of other cultural or educational content (NMK 2011c). Digital preservation was considered a responsive way to maintain the content in a case of a future requirement from France to return them, despite the very low potential of this occurring (NMK_B 2015).

The website can be divided in three sections (Figure 6.9): stories about the Uigwe documents; digitised documents; and a restructured VR about part of the Uigwe content. Online visitors can read the documents in terms of themes, periods, and events. However, it may be difficult for public to understand the original documents because they are written in Chinese characters, the official character set during that period in Korea, and so the website also provides brief explanations of each document in Korean. Another activity available to online visitors is VR content about the funeral of a queen, which is reconstructed based on drawings in the documents. To discover further information, users also can click on each person and object in the VR programme.

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[38] The Uigwe are the records of the state rites of the Joseon Dynasty, and were seized by French troops in 1866, and returned to Korea in 2011 (Lee 2011). The original documents were displayed at the NMK as a special exhibition in 2011 (ibid.).

Figure 6.9 The Oegyujanggak Uigwe website delivering predetermined knowledge

Based on the analysis of my data, the target users for this project are academic researchers rather than the public, although the NMK mentioned that it is for both. The activities users can do on the website are consuming its content with reading and watching. Thus, the knowledge in the website is fixed by adopting a transmission model of communication (Hooper-Greenhill 1999a). Its users can construct knowledge by exploring its content, but the website does not allow alternative interpretation of the historical document by adopting a discovery learning approach (Hein 1998). Interestingly, however, the NMK organised several online events, such as a poetry contest (NMK 2011c). I could not collect additional data for this contest and the poems submitted by participants. But writing poetry is creative work that can contribute to personal meaning-making process. Digital technology should be also harnessed to foster these kinds of activities rather than only delivering fixed content.

6.4.6 Online Learning

I could not find any online learning programmes available via the NMK's main website, although the children's museum website has several online games (Figure 6.10). These games are designed for children 'to learn about Korean history and objects in easy and fun ways' (NMK n.d.d). For example, online visitors can reconstruct the shape of an object using fragments of it, find differences between two drawings, match cards with the same images, and solve simple quizzes. Some of the games have similar approaches to the games of the KIOSK (see Section 6.4.1).

These games are designed for online visitors to observe images of the collections in detail and can contribute to recall of the exhibits. However, based on the analysis of my data, these games adopt behaviourism (Whitton 2014) as the learning approach, as the digital technology only reacts to whether the answers given by users are correct. This approach does not align with the museum's overall education philosophy of cognitive constructivism (Hein 1998), which can foster engagement and critical learning through games (Whitton 2014; Gee 2007). The budget and time allowed for game

development may influence this, however, history education in the NMK is generally dedicated to conveying facts that are believed to be right and objective.
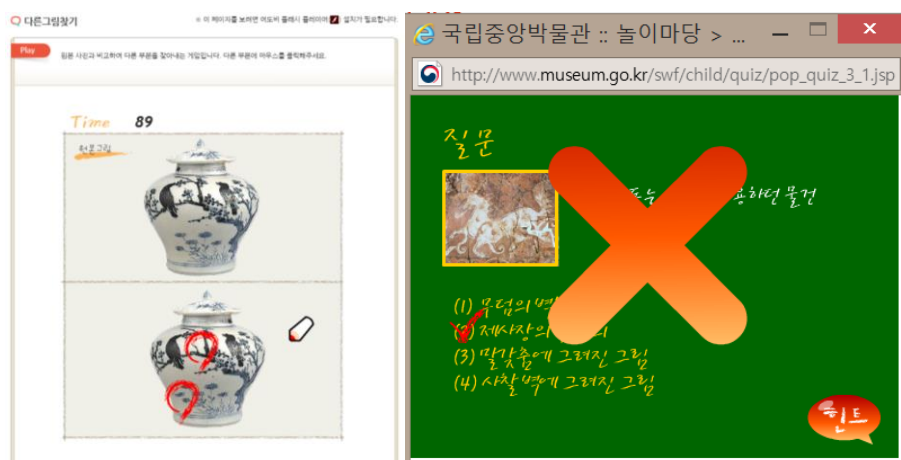
Figure 6.10 Online games of the NMK aiming users to find right answers

6.4.7 Summary

In this section, I discussed the digital projects of the NMK, regarding the development process, underpinning communication and learning approaches and the roles of digital technology. Digital technology has slightly different roles, depending on the space in which it is adopted and the team that developed the projects. However, in general, the technology is used to react to input and deliver content, although its use in interpretation is expected to be easy and fun. Moreover, the link and dialogue between on-site and online cannot be easily identified for either.

Constructivism learning theory (Hein 1998) underpins NMK education. However, historical knowledge about its collections tends to be fixed and factual, and different interpretations are not encouraged within the digital projects. Although the projects have embraced cutting-edge digital technology, they are still concentrated on conveying intellectual knowledge predefined and pre-structured by the NMK. By doing so, the NMK adopts traditional museology. This could be a result of how history education is perceived in a national archaeology/history museum within the Korean context.

6.5 Summary of the National Museum of Korea

I have explained and analysed how the NMK and other actors have interconnected regarding digital projects, and how these have been developed using communication and learning theories. The government has influenced the development of the museum's digital projects since the 1990s, and the

NMK used these projects to illustrate Korean culture and heritage beyond the boundaries of the nation via the internet. The power of the government and government bodies remains influential, as they fund the NMK and evaluate the museum's performance. Although the NMK itself has constantly attempted to extend its network, there are some barriers and challenges, for example, the lack of overall control for all digital projects in the NMK and opportunities to share what museum practitioners have learnt from their projects. The technology itself and companies with knowledge of the technology have more power than museum practitioners during the development of projects.

The isolated and one-way working process means that the communication and learning approach of digital projects is to deliver intellectual content, which has been constructed by the NMK. The historical content of the museum is regarded as factual and neutral, without any conflict. Therefore, it is still believed that only the museum and curators have the authority to decide what content and stories are told and how they are interpreted. Consequently, the NMK adopts traditional museology. The public have been excluded from the development process of digital projects because they are considered non-experts, and the lack of visitor research results in the public voice rarely being heard. Thus, digital technology is only used to support the delivery and official narrative.

Chapter 7 - Gwacheon National Science Museum

7.1 Introduction

The third and the final case for the Korean museums is the Gwacheon National Science Museum (GSM). The GSM is the youngest institution in this study, having opened in 2008. Science museum culture and science communication in Korea are relatively new in both theory and practice; however, these elements have been intentionally encouraged by the Korean government in order to popularise awareness of science. This case study identifies how the government, as a key actor, has influenced the museum, especially regarding introducing digital culture to the public. In Section 7.3, the government-centralised power relationship is revealed once more, and how this has affected the underlying communication and learning approaches of the GSM's digital projects is discussed in Section 7.4.

At the museum practitioners' level, the unbalanced power relationship between the museum director and museum practitioners is identified as another factor that discourages museum practitioners from becoming active actors. Furthermore, this case study reveals how working in silos has negatively affected building common understanding regarding the potential roles of digital technology in the museum context. Although the GSM is a young organisation, and most of its museum practitioners have an academic background in science and engineering, the practitioners are unfamiliar with digital culture and do not have an open mind or an experimental perspective towards it. This attitude might result from a lack of social learning opportunities to exchange their thoughts and practices critically and honestly with other practitioners. Also, there is a lack of brokers (Wenger 1998) who can bring new ideas from other sectors to the museum's existing practices. Therefore, digital projects, which are usually planned and managed by curators, take a transmission communication approach with the consideration of fixed knowledge.

As discussed in Section 7.4, the maker space, in which the public can have additional agency in the development and construction of their knowledge through a making process, has been identified as a potential approach through which the public can be visible actors. Finally, Section 7.5 summarises the findings.

The data I analysed for this chapter were 36 pieces of secondary data, for example, annual reports and policy papers (see Appendix 3), interview data generated from 7 museum staff working at the GSM (see Appendix 5 for their profiles), and visual data regarding the digital projects, mainly generated from my field work.

7.2 Overview

I have generally referred to the annual reports from 2009 to 2014 and the official website of the GSM. The history of the GSM dates back to the Korean President's announcement of a plan to establish a national science museum in 2001. This was a result of the national requirement to introduce more of the public to science and technology and extending the Seoul National Science Museum to the capital area was proposed (Kwon 2000). Following the national science and technology policy and the Science Museum Support Act, the GSM finally opened in 2008. This museum was designated a responsible administrative agency[39] in 2009, like the MMCA, even though its entire annual budget comes from the central government.

The foundation of the GSM was based on the popularisation policy of science and technology (GSM 2009, p.7). There were three fundamental directions to its establishment; it was expected to be future-orientated, to be a scientific theme park, along with nature and the environment, and to be a hands-on museum (GSM 2009, p.7). The science museum aims to be an 'open science museum', in which the public can operate exhibits and experience science through two-way communication so that they can become more familiar with science (GSM 2009, p.7). Recently, the GSM has presented a new vision to be a 'world class science museum that imagines the future and offers happiness' (GSM 2017a). The science museum has attempted to reflect rapidly changing science and technology, and to increase the popular science culture. In general, the overall goals of the GSM have not changed since its foundation. In terms of its education philosophy, the GSM aims to develop and provide experience-centred learning for fostering creativity, rather than employing the lecture-style (Jang 2013; GSM 2014, p.33). How the GSM has embraced digital technology to achieve its overall aim and how the learning approach has employed technology to facilitate visitors' experience at the GSM as well as online will be examined.

It is hard to define the types of collections in the GSM because it was established as an experience-based rather than an object-orientated museum. However, from the subjects of the permanent galleries and facilities, the collections and content of the museum can be broadly described. The GSM covers a diverse range of science and technology topics, including basic science, advanced technology, and natural history. It also has astronomical facilities, including a planetarium and observatory. To enable a comparison of features between Korean and UK museums, however, I will mainly address the

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[39] The responsible administrative agencies are government bodies that have relative independence regarding operational issues, such as human resources and audits. This scheme was legislated in 1999 to increase the efficiency in government administration systems. Some national museums and theatres have been designated to it.

contemporary science and technology sections of the GSM and the SML, although the latter one has a historic collection of science, technology and medicine too.

The GSM is a relatively young organisation, which could be beneficial in terms of flexibility and responsiveness to new trends like digital culture. In the next section, actors associated with the GSM are described in order to investigate how they have encouraged or have created barriers to a digital culture within the GSM.

7.3 Identified Actors: Their Network and Roles

From the analysis of my data, I developed Figure 7.1, which shows the relation among the actors identified. This section explains how each actor has constructed network with others in terms of digital culture and what their roles are in the network. It begins with the government and government bodies as actors, followed by the GSM itself, museum practitioners, digital technology and digital companies, and the public.
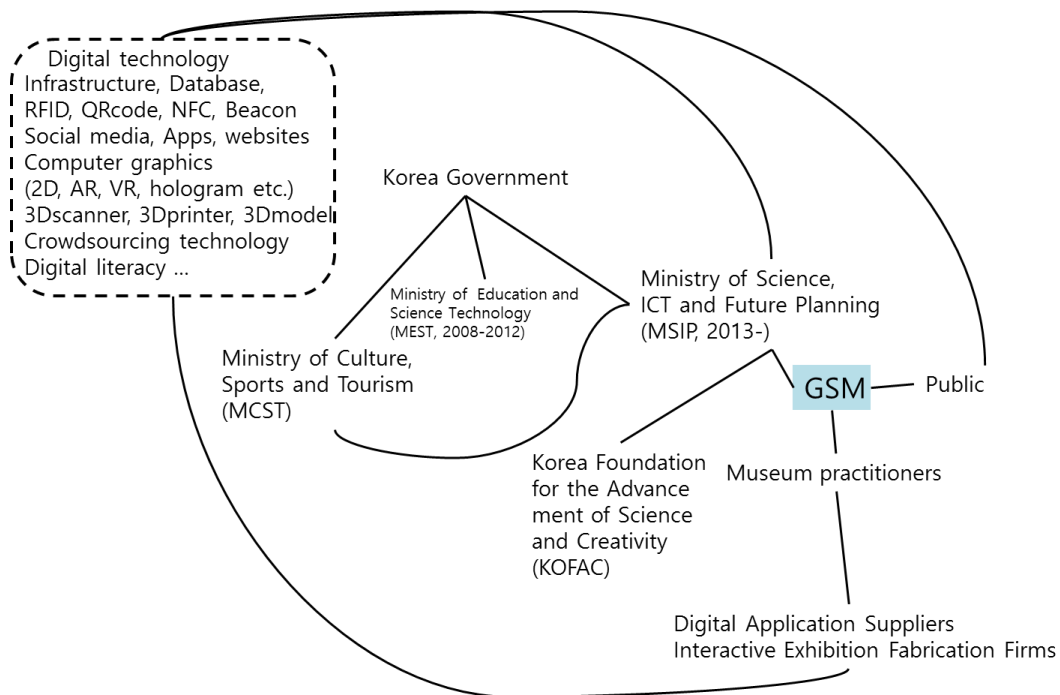
Figure 7.1 Actor-Network map of the GSM

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7.3.1 Government and Government Bodies

The Korean government's political will to promote science and technology culture across the nation has led to strategic plans to establish and support national science museums, including the GSM, based on the Act for the Establishment, Operation and Promotion of Science Museums (MOSF 2003; MOST 2007). Thus, the museum practices of GSM are strongly related to the government policy since it was established by the government. In other words, the policy, as an explicit rule (Engeström 2015), shapes the practices of the GSM, and as a device of ANT (Callon 1986), it enables the government to attract the GSM into its network. Because of the bureaucratic culture of them, the power relation between the government and the GSM does not seem to be balanced.

More recently, the MSIP announced the third basic plan to promote science museums (MSIP 2014a), which included five strategies: extending the establishment of science museums across the nation and managing them efficiently; enlarging science culture to improve the imagination and creativity of the public; the training and employment of professionals; creating an infrastructure for the management of science museums; and improving networking and collaboration among science and culture organisations within and beyond Korea. Thus, the government is not only a financial sponsor but also an active actor, which has displayed its power through deeply engaging in the management of the science museum and developing professional programmes for science museum practitioners.

There are several interesting points in the government's plan relating to my research. The government has initiated research-and-development projects that aim to develop new exhibits for science museums (MSIP 2014a). These are collaborative projects with the MSIP and MCST, and the government expects that interdisciplinary work between science, the arts and culture will further enhance creative thinking. This is an emerging and encouraging aspect within Korea, where academic disciplines are firmly separated from each other. From the ANT point of view (Callon 1986), this can be understood that the MSIP attempts to extend its network to the MCST by posing issues on the development process of science exhibitions. As a result, the network of GSM can be more dynamic, and this also can affect approaches to digital projects.

The motivation for these projects, which merge science and culture, was to improve the quality of science exhibits, as these normally lack content research during their development. The lack of time to conduct the research resulted in the copying of exhibits between exhibitions, although the number of science museums in Korea has increased (MSIP 2014a). The outputs of these projects are expected to be presented in science museums through innovative exhibits adopting new technology. In addition, the funding for these projects is planned to support teams consisting of science museum practitioner(s), exhibition planning and fabrication firm(s) and academics. The combined knowledge

of the different sectors should produce better results, which are expected to reduce the gap between conceptual ideas that museum practitioners have and the technology and skills that exhibition firms have. Additionally, from museum practitioners' point of view, these projects are regarded as a positive opportunity to develop their capability to plan exhibitions, to discuss challenges on planning science exhibitions, and what research can occur within science museums (GSM_A 2015). GSM_A stated:

> 'Many people think that exhibition planning/designing companies have more competence than us [museum practitioners at the GSM]. … Some museum practitioners regard the Science Museum only as an administrative agency. I think, however, with these kinds of projects, museum practitioners can develop their competency to plan exhibitions, and the museum can be a creative and innovative organisation with them in the future.'

However, based on the analysis of my data, all the selected projects (MSIP 2015) only concentrate on developing new technology. There is no audience research considered. Therefore, I can say that although the government has successfully extended its network to science museums, exhibition planning and fabrication firms, digital technology and academics in order to introduce new digital exhibits into science museums, the public as an actor is excluded or remains hidden.

Recently, the government has highlighted its ambitions for ICT education within informal learning environments (MSIP 2014a). The ICT Special Act in 2014 aimed to establish a systemic foundation and ecosystem that encourages the development of the software industry. Computer software education[40] is also considered to be important for the future careers of the younger generation and to enable the constant development of the digital industry (MSIP and MOE 2015). In order for the public to enjoy ICT education, the government plans to provide various approaches to it though science museums and private companies. For example, the Arduino coding learning programmes for school pupils (GSM, n.d.b) and ICT based-inventions and art work fair in the GSM (GSM 2014). With the special Act, as an explicit rule (Engeström 2015), the government further succeeds in making its network stronger and more durable (Law 1992).

The government is aiming for a maker culture, which encourages individuals and groups of people to create what they imagine, which in turn will support the development of the Korean economy (MSIP 2014a). In order to cultivate a maker culture, the government has provided financial support to build facilities, maker spaces[41], such as the 'Idea Factory' in the GSM, where the public can use various

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[40] Computer software education, such as coding, will be mandatory in elementary and middle schools from 2018 (MSIP & MOE 2015).

[41] This project is organised by the Korean Foundation for the Advancement of Science and Creativity, in collaboration with the MCST, MSIP, the Ministry of Education, the Ministry of Trade, Industry and Energy, the

cutting-edge devices (e.g. 3D scanners and 3D printers) to make their own creative objects (see Section 7.4.3). The government aims to provide and extend its science programmes across the nation via science museums, and the GSM is regarded as a central institution in which to conduct these projects. In so doing, the GSM is becoming a powerful player in the network, and it further enables to link to the public. Building physical things, like the maker space, is one of strategies that make the network stable and durable indeed (Law 1992).

Another role of the government is evaluating[42] the performance of the GSM, thereby intensifying its relationship with the GSM further. Most of the assessment criteria can be recorded numerically, such as the number of visitors and the scores for visitor satisfaction for specific programmes (MOI 2016). This means that it is not required to have qualitative audience research that can uncover visitors' real voices in detail. I will come back to the public's point of view in Section 7.3.5.

The last role of the government I found relating to my research is that it intends to create science museum experts. New academic graduate school courses for science museum studies will be set up with financial support from the government and professional retraining courses for science museum practitioners will be offered by the Korean Science Museum Association, also with government support (MSIP 2014a). This indicates that there are not enough science communicators in Korea. By directly funding to establish education programmes, the government, an active actor, is expecting to attract new actors into science museums.

In summary, the process of constructing and extending the network of the government has been achieved through laws, policy and special funding, and there has been little conflict. The government appears to be successfully attracting other actors through highlighting issues relating to digital exhibits in Korean science museums and addressing the need to provide ICT education and maker spaces for the public, and this has become an OPP (Callon 1986) that every actor needs to pass in order to achieve their own goals. However, because of the government's significant role regarding digital projects in the GSM, there are some concerns. For instance, my interviewee, GSM_E, considered the possibility of funding cuts to digital projects when a new president takes over in the future. The continued discussion about the incorporation of the GSM (Lee 2011), which might make the museum an independent agency, may also influence digital projects in the future due to potential funding cuts by the government.

Korean Intellectual Property Office, and the Korean Post. The maker spaces will be extended to over 200 locations across the country by 2017 (KOFAC n.d).

[42] The national museums of Korea are evaluated in two different ways. One is done by the Ministry of the Interior and Safety, if the museums are responsible administrative agencies, like the GSM and the MMCA. Another evaluation is done by the Ministry that the museums belong to. For example, the MSIP evaluates the GSM while the MCST does the MMCA and the NMK.

7.3.2 The Museum Itself

The GSM planned to employ cutting-edge technology for interpreting the concept of science and technology, rather than for displaying the physical objects collected. From the basic principles of permanent exhibitions, cutting-edge exhibition technology, such as 3D images and VR, was suggested for interactive exhibits (Park 2006, pp.94-96). The first annual report in 2009 directly stated that 'the GSM consists of dynamic and interactive exhibitions rather than static and one-way ones. Thus, visitors can interact with and experience science exhibits. The GSM anticipates this could help public feel close with science and technology' (GSM 2009, p.7).

The GSM has continuously demonstrated its interest in developing new exhibition technology. For example, they supported the development of imaging processing technology for the establishment of a 4D animation theatre in the GSM (Kim 2011) and also motion sensing technology to operate interactive science content for the human body (Choi 2012). When renovating existing exhibits or launching new exhibitions, the GSM said that 'we enlarged our exhibits into more interactive forms rather than simple ones by employing innovative IT and video technology' (GSM 2013, p.49). Thus, diverse digital technology is present in the galleries and education programmes on-site at the GSM. However, based on the analysis of my data, these projects only focus on developing technology to create new experiences and how the public experience the GSM is not considered in any depth.

The ambition of the GSM to be involved in digital culture can be seen in the change to the organisational structure. The GSM established a cyber-science museum team in order to further embrace the potential of cyber-space as an informal education environment (GSM 2010). The cyber-science museum broadly refers to online services, including virtual tours of digitised real exhibitions, multimedia educational resources, online games, and an online community platform (Kang 2010). After the creation of the new team, the GSM launched online maths and sciences games, and has hosted annual competitions for these games. In 2012, they also organised a seminar on game-based learning and invited relevant online game associations, companies and a research centre from France to attend (GSM 2012b). Although I could not find any relevant discussion on this, this event shows that the GSM had attempted to construct a network with actors from other countries and industry, and to build a CoP (Wenger 1998) through the exchange of participants' experiences and ideas. However, the team was disbanded because the museum's new director had a different opinion regarding online games, and no further actions could be found to extend their network regarding the games. This situation can be understood that the cyber-science museum team was a representative (Callon 1986) so that it could have mobilised other actors to develop the online games and to organise the seminar. Yet, as the new director disagreed with other actors and resisted the network built by the team, the

network was deconstructed. This case shows how the power of museum director can affect the development of digital projects.

In sum, the GSM has a strong association with digital culture. However, due to its characteristics as a government agency, it is also experiences limitations as an active actor. For example, the frequent change in directorship makes it difficult for the GSM to establish a stable and durable network with others (Law 1992). Thus, in museum practice, the roles of museum practitioners become important for building and extending a network. I will turn to museum practitioners' point of view in next section.

7.3.3 Museum Practitioners

In this section, I will look at how professional identity of museum practitioners affect the development of digital projects, and what causes barriers to how they can be active actors in the network of GSM regarding digital culture.

The lack of suitable professional staff has been frequently mentioned since the planning phase of the GSM (Park 2006, pp.94-96; Boo et al. 2011; MSIP 2014a, p.7). Because of the bureaucratic characteristics and relatively young culture of science museums in Korea, it was hard to employ practitioners with expertise in science communication. During the planning phase, practitioners and executive members of the MSIP were responsible for planning and managing the GSM, and the individuals involved frequently changed (Park 2006, pp.94-96), thus, it was difficult to progress the project coherently. Curatorial staff, most of them having an academic background in science and technology fields, and few having a background in science communication and education discourses, only account for about 30% of all the staff, which is the supposed minimal size to operate the museum (MSIP 2014a, p.7). Consequently, curatorial staff and administrative officers within the same team are undertaking similar curatorial work, such as planning education programmes and science festivals. This situation can have a negative impact on the quality of museum practice. Because of different professional identities (Wenger 1998), administrative officers tend to be more interested in the number of participants than how to improve museum practices. In addition, according to my interviewees, GSM_A and GSM_D, researching science museums, for instance research on the roles of science museums in a society or audience research, has not been widely accepted or understood by museum practitioners themselves. GSM_A stated:

> 'Each museum practitioner might have their own expertise on specific scientific subjects, such as bio-technology, but there is no common understanding in the museum about what makes good science exhibitions. … Sadly, there is a lack of deliberation about exhibitions and science communication.'

Unstable job positions, due to rotations and the ambiguity of the scope of work, could be among other issues that influence museum practitioners from being an active actor. For instance, the GSM employed a computer programme expert in 2012, whose roles included the cyber museum and online game projects, and internet network security (GSM 2012c). His work scope was too wide and subsequently, his role was minimised to only manage the projects, with external firms taking the main roles in the development of projects (GSM_B 2015). After a new director was appointed, this individual was rotated to another position within the GSM, despite his expertise in digital games (GSM_B 2015).

The contract law that the GSM should follow as a government agency regulates the interactions between the GSM and exhibition fabrication firms because it is an explicit rule (Engeström 2015) between them. There would be a negotiation process between museum practitioners and a firm before the firm is given a contract. The exhibition development process, however, generally follows a waterfall approach (Walker 2017) that all work scope and direction are fixed before starting the development. Therefore, after the contract, museum practitioners cannot make significant changes to the content of an exhibition as proposed by the firm; thus, the quality of exhibitions generally depends on the firms (GSM_B 2015; GSM_C 2015; GSM_D 2015; GSM_G 2016). This rule seems to be a barrier which is preventing museum practitioners from being an active actor with the ability to plan exhibitions. Additionally, this potentially prevents the public from getting involved in the process because of a tight schedule.

Moreover, the isolated working process of museum practitioners results in the voice of museum practitioners being less well heard. Because their positions are rotated, almost all of the museum staff in the GSM have a working experience of exhibition planning. According to my interviewees, GSM_A, GSM_C, and GSM_F, however, they are used to working on their own projects and there are no internal processes for discussing and exchanging ideas. GSM_E stated:

> 'Everyone works alone in this museum. This is quite usual. No one asks other museum practitioners their opinion or advice. I personally requested other museum practitioners to attend a workshop that was related to my project. But it was unusual. … I know that collaboration is a key for better performance, but I don't think we have many examples of that approach. This might be associated with the issues of organisational structure, for example, who will have the main responsibility and how the achievement through collaboration will be evaluated.'

There are only a few stakeholders involved in decision-making, and this situation means that museum practitioners have to rely on exhibition firms, who are supposed to be experts in science interpretation.

Consequently, some museum practitioners consider themselves to be project managers, whose role is only to ensure that a project can be delivered on time and in budget (GSM_A 2015).

Based on my data analysis, another issue is that there are not enough opportunities for science museum practitioners to develop their capabilities, although the Korean Science Museum Association (KSMA) was founded in 2006 by the government (KSMA n.d.). The research area of the museum education society/group only partially addresses learning programmes within science museums, and the lack of science museum experts is a widely-recognised issue (MSIP 2014a). There is a tendency that those who have extensive experience of working in science museums are experts, and there are only a few who consider theoretical approaches to learning in science museums (GSM_A 2015). One special case of a professional development programme is the Exhibition Planning Academy, which was hosted by the GSM in 2013 (GSM 2013, p.39). I could not obtain a list of participants in the programme but this was organised 'for improving the ability of staff who take charge of exhibitions and education in science museums, in order to plan and develop the various museum practices in line with visitors' needs' (GSM 2013, p.39).

The lack of social learning process (Wenger 1998) for the discussion of projects with others and training opportunities, seems to lead to difficulties in sharing understanding on the potential role of digital technology in the GSM. Based on the analysis of my data, there are certain types of museum practitioners that tend to be more associated with digital technology than others. In other words, depending on the academic background of museum practitioners, they have different professional identities, which affect their perspective on digital culture. For example, those who have expertise in computing have a positive perspective on it and they believe that embracing digital technology in the GSM can result in increased understanding of visitors by tracking their paths in the GSM, enabling then to offer a personalised service via a self-directed guide (GSM_B 2015; GSM_G 2016). However, those who have an expertise in science subjects have a less positive attitude towards digital culture. They tend to diminish the role of digital technology to visualising science information (GSM_D 2015). GSM_D stated:

> 'I don't think that digital exhibits should be encouraged. … I believe that what digital technology can do best for science education is with the planetarium and SOS (Science On a Sphere), which displays planetary data on a sphere.'

A positive change on social learning for museum practitioners can also be found in the GSM. This change does not originate from the government or directors, but from several museum practitioners. The initial creation of a maker space in the GSM was through the creation of a space which any museum practitioner could use for making prototypes of exhibits when planning new exhibitions

(GSM_E 2015). Usually, only photos of other exhibits in science museums abroad or images found on the internet are referred to when writing a proposal for a new exhibition, and there is a gap between the ideas and products which can be produced. Therefore, a maker space for internal use is expected to be a space where museum practitioners can share their ideas and discuss their projects without encountering any psychological barriers (GSM_E 2015). This activity will help museum practitioners to develop their capability and performance, and could be a CoP (Wenger 1998) where they learn together. By doing so, they can be empowered further and become active actors.

7.3.4 Digital Technology and Digital Companies

As explained above, digital technology is a key actor and feature of interactive exhibits in the GSM. Because older science museums in Korea have been frequently criticised for the static and unengaging nature of their exhibits (Park 2006), this new science museum is expected to encourage visitors to interact with the exhibits, and the use of digital technology in exhibits is strongly recommended. In general, the GSM is more like a science centre than a science museum, where science objects are displayed, and digital exhibits can be found in the technology exhibition halls. For instance, the DNA exhibition, which is described in the Section 7.4.2, only consists of digital exhibits.

This situation of GSM embracing various types of digital exhibits causes digital companies, particularly digital application suppliers and interactive exhibition fabrication firms, to become key actors. As mentioned in previous sections, these companies with digital technology are considered as digital experts by the museum. Although their network might be deconstructed with the end of their contract, the digital exhibits they developed may let the network be durable due to the physical existence of the exhibits (Law 1992).

Furthermore, digital technology as a theme of exhibitions, events and learning programmes has increased following support from the government. For example, the ICT gallery (see Section 7.4.2) addresses how digital technology will influence our daily lives in the future.

According to ANT (Callon 1986), this situation can be understood through how digital technology has posed problems for previous static exhibitions, and attracted other actors, such as the government, the GSM, curators, policy-makers, and exhibition firms. Digital technology, such as 3D/4D visual technology, 3D scanners, and online games, has continuously extended its network, with the final aims of approaching the public in a variety of ways.

7.3.5 The Public

The concepts of 'participatory' exhibitions and visitor engagement have frequently been seen as an aim of the GSM in its annual reports. For example, the 2013 annual report directly stated that 'the GSM seeks to be a participatory place where visitors can have exciting scientific experiences rather than simply pass by like an exhibition in a traditional museum' (GSM 2013, p.3). An example of the participatory approach at the GSM is a temporary exhibition which was planned following a survey of its website visitors (GSM 2013, p.32). The GSM also run a parents advisory group on science exhibitions and learning, and they attempt to listen the public's opinion via its website, social media and a customer centre in the GSM (GSM 2017b). Yet, according to the analysis of my data, comments from the public are mainly concerned with the operational aspect of the GSM, rather than the content; for instance, the accessibility, the appropriateness of opening times, entrance fees, the usefulness of museum signage, and the kindness of museum staff (Kim 2010).

When considering the content of the GSM, museum practitioners do not generally have enough time to conduct audience research, although they sometimes observe visitors within exhibitions to determine how they interact with exhibits (GSM_B 2015; GSM_C 2015; GSM_D 2015; GSM_F 2015; GSM_G 2016). Based on their personal experience, museum practitioners usually only assume what subjects and current issues are of interest to the public. There is no phase which listens to public opinion during the planning and development process of an exhibition, and visitor feedback is only collected after launching a project or opening an exhibition. Thus, it is not easy for the public's voice to be heard in the GSM. However, some museum practitioners acknowledge the importance of listening to the public's opinion. An interviewee, GSM_E, said that the GSM will be a space where people can come to discuss current issues relating to science and technology. In so doing, diverse voices of the public will be able to be heard and then the public will become active actor.

7.3.6 Summary

This section has identified key actors of the GSM and the relationships between those actors. Because the GSM comes under the MSIP and since its establishment has aimed to create interactive exhibits, this has more of an impact on embracing digital technology in this museum than in the MMCA and NMK. The government now has a strong political will to extend ICT across the country, which directly relates to the educational programmes and the provision of cutting-edge technology in order to develop a diverse digital experience in and beyond the museum. The government also seems to be actively extending its network through the provision of academic courses for science museum professionals.

Although the government are leading the construction of the digital network of the GSM, the GSM itself is also attempting to extend its network by embarking on new digital projects. The direction of the digital culture of the GSM has significantly changed according to its director, while museum practitioners and the public relatively appear to be hidden actors, although the importance of their voices is recognised.

Digital application suppliers and interactive exhibition fabrication firms have been highlighted within this network. In deciding and developing the interactive components of exhibitions, the suppliers and firms seem to have a closer relationship with digital technology than the museum practitioners of the GSM, which could have a negative impact on the final output because of the lack of professionals.

I now turn to the next section that presents the analysis of digital projects of the GSM. I further discuss how the identified actors shape each project and how they affect communication and learning approaches of the projects.

7.4 Digital Projects

In this section, the digital projects that visitors encounter on-site and online at the GSM are examined in order to investigate the underpinning communication and learning theories. This section investigates how digital technology is adopted to facilitate the museum experience of visitors and to achieve the learning goal of the GSM; 'experience-centred learning to fostering creativity' (Jang 2013). Based on the visitor journey through the GSM, this section starts with the digital projects in the orientation hall of the museum, followed by digital exhibits within galleries, programmes and events, multimedia guides, and online offerings.

7.4.1 Orientation Space

The main building of the GSM has a huge orientation hall (Figure 7.2), permanent galleries and educational facilities, and other buildings are linked to this hall. The GSM has installed kiosks to provide information about the museum, which consist of six menus: a museum map, exhibitions information, information about the simulators, information about the nearby area, photo mail, and entertainment (puzzles, card-matching game, etc.). Based on the analysis of my data, digital technology allows the GSM to deliver a range of content via a single platform and to update information efficiently for visitors. By conveying knowledge produced by the GSM to users, this kiosk service has adopted a transmission model of communication (Hooper-Greenhill 1999a). The

entertainment menu, however, has an educational function although the types of games included in this menu, for example, matching patterns and puzzles (Figure 7.3), which seem to be based on behaviourism (Whitton 2014). This is because these games only aim to offer answers as a reaction to users' input, rather than reflecting the content of the GSM. Digital technology in these games is only harnessed to repeatedly impress the stimulus on the users. It is also uncertain whether the entertainment menu functions to orientate and motivate visitors to explore the GSM.

Figure 7.2 Orientation space of the GSM

Figure 7.3 A puzzle of the kiosk at the GSM

7.4.2 In Galleries

Since it was established, the GSM has continuously renovated its permanent exhibitions. Recently, in the Advanced Technology Hall, the exhibitions on DNA, ICT (GSM 2014, p.16), and energy (GSM

2015) were remodelled in 2014, 2015 and 2016, respectively.[43] In this section, the DNA and ICT exhibitions are analysed regarding their development process, the underpinning communication and learning approaches, and the roles of digital technology. An interviewee, GSM_F, working in the High-tech exhibition department, mentioned that developing exhibitions about contemporary science and technology is much more difficult than other scientific subjects, because they need to address current issues and emerging subjects and stories. Thus, it could be interesting to look at how museum practitioners in this area have handled this issue in terms of developing their professionalism and the presentation of complicated contemporary science and technology in the form of an exhibition. This will be discussed below.

7.4.2.1 Exhibition 1: DNA - The Key to Unlock the Secret of Life

The renovated DNA exhibition is located at the beginning of the Life Science section, and the new exhibition consists of five parts, entitled: Discovery of DNA Structure; Function of DNA; Biotechnology; Utilisation of DNA; and DNA and Health. The titles directly present the subject of the exhibits in science terms. According to the museum practitioner, GSM_F, who curates this exhibition, digital exhibits, such as videos, a game, and digital touch panels (e-book), have been widely employed due to the limited physical exhibition space and the difficulty in showing real physical objects about DNA. To deliver scientific knowledge on DNA in detail, digital technology is considered to be an effective method that can include lots of contents, allowing visitors to 'interact' with exhibits in order to explore deeper content, rather than simply passive observation (GSM_F 2015). However, based on the analysis of my data, almost all the digital 'interactive' elements in this exhibition are employed to play a video, or to turn to the next page, with the aim of delivering content in a structured order. In order words, they are embraced for didactic delivery of content (Hein 1998), which was determined by the GSM.

Another role of digital technology in this exhibition is in testing visitors to see if they have understood the scientific knowledge on DNA. For instance, a digital game developed for the exhibition directly considers protein synthesis, and in order to complete the game, visitors need to know the base pairing rules for DNA. This is the exactly the same science content that pupils learn in schools, and according to the interviewee, GSM_F, the age of the targeted visitors is 13 and above, middle school pupils in Korea, because the curriculum of elementary schools does not include DNA. This may result in some content of the exhibits being similar to school science textbooks, for example, Mendel's law of inheritance. The interviewee asserted that he intended to exclude 'entertainment' elements within this

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[43] When I visited the GSM to conduct interviews in 2015, the renovation of the energy section had not been completed, and consequently, it is excluded from my analysis.

exhibition, which he thought should present science knowledge. He does not even call the game a 'game', because this could be misleading, as it is a knowledge-based interactive exhibit.

The last part of the exhibition has an immersive space with videos projected onto three walls. While the exhibition attempts to link the science to society and how DNA research can affect human health treatments, this approach remains one-way transmission communication (Hooper-Greenhill 1999a). As Figure 7.4 shows, the only activities visitors can undertake are to choose a video and watch it. The museum practitioner is concerned with how to respond to rapidly changing contemporary science and technology research. Nonetheless, visitors are not allowed to present their ideas and experience of DNA and biotechnology research is a controversial topic. Scientific knowledge in this exhibition is supposed to be objective and fixed, and digital technology only has a role in delivering the fixed content.
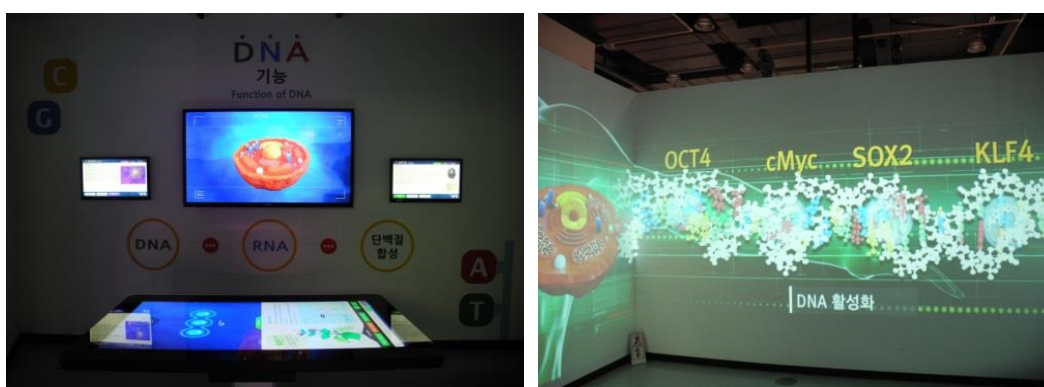
Figure 7.4 Digital exhibits in the DNA exhibition that convey knowledge as factual

The exhibition development project took about seven to eight months from planning to installation and opening (GSM_F 2015). A curator, who had responsibility for handling the whole process and was an expert in biotechnology, worked with an external exhibition development company, from exhibition design, fabrication, installation, and during the Audio and Video (AV) design-development. Some academics were involved in advising and confirming the science knowledge presented. The exhibition company had the main role in designing the exhibit's interpretation approach, and is considered to have expertise on which interpretation media is appropriate for different content due to their previous experience (GSM_F 2015). Feedback from visitors was employed after the opening because the exhibition company has a duty to maintain the exhibits for a certain period of time, depending on the contract (GSM_F 2015). Yet, changing the fundamental approach is impossible to implement after the completion of delivery of the project. Thus, voices of the public are barely reflected.

7.4.2.2 Exhibition 2: ICT Experience Hall

The ICT experience exhibition opened in 2014 (GSM 2014, p.16), at a time when the Korean government was highlighting the importance of ICT as an essential skill for the future generation, as well as a source of new economic growth. According to one interviewee, this exhibition was launched as part of the 'Smart Science Museum' project (GSM_F 2015; GSM_G 2016), and the aim was to develop exhibits that embrace state-of-the-art ICT technology. Some exhibits directly present new technology, such as holograms (Figure 7.5), as exhibits, while others explain how our future life may be changed by adopting ICT, for example the health care system (Figure 7.6).
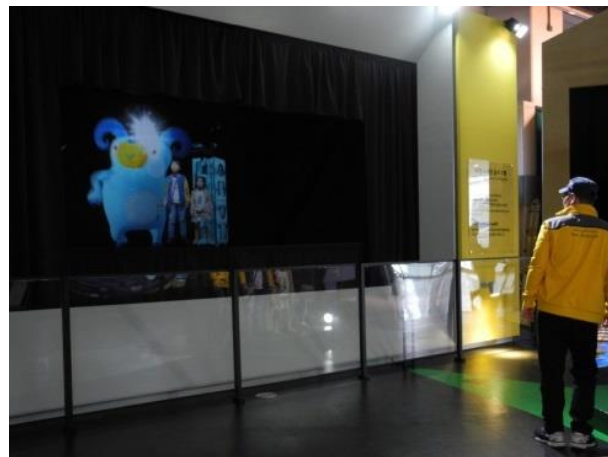
Figure 7.5 Digital exhibit where visitors consume hologram technology
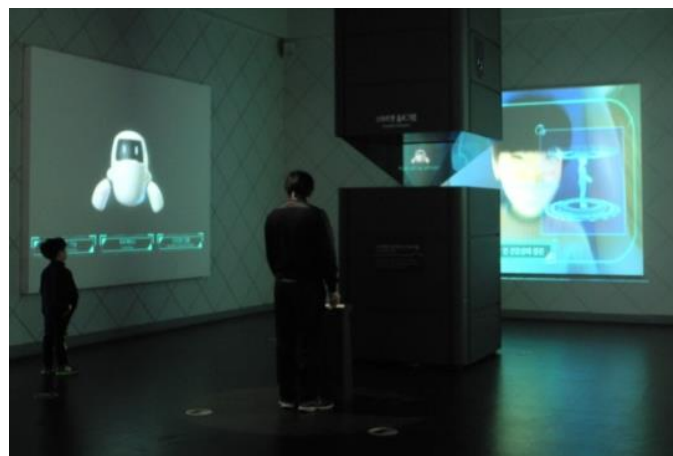
Figure 7.6 Digital exhibit introducing a life in future; visitors can only watch it

As can be noted on the title of this exhibition, ICT experience hall, this exhibition does not plan to deliver science and technology knowledge, rather, it aims to provide 'new experiences' of ICT. Thus, the digital technology in this exhibition plays a key role in offering a new immersive experience and the presentation of ideas. However, based on the analysis of my data, this exhibition seems to be planned in such a way that visitors only consume the technology offered, thus questioning what is

meant by 'experience' in the GSM context, because the overall goal is to provide experience-centred learning. When John Dewey highlighted the importance of experience in learning, this does not only refer to actual 'doing' (Ansbacher 1998), and the experience of learning should be understood within a personal continuum of experience from the past to the future. The experience designed in this exhibition, however, seems to fail to link it to visitors' personal or societal contexts. According to the GSM's internal informal evaluation, this exhibition is not deemed to be a success. One reason is the lack of scientific content (GSM_F 2015), for example, the storyline of the exhibits should have conveyed scientific knowledge. The developed exhibits are considered to have 'entertainment' elements rather than educational content (GSM_F 2015), and this again may be associated with the vague definition of 'experience' in the GSM context.

Another issue mentioned by my interviewees, GSM_B and GSM_F, is the possibilities for advanced technology being adopted for exhibits and the ability of an exhibition development company contracted to undertake a project. When an exhibition was proposed by a company, they referred to relevant resources and images of advanced technology that had just been developed in outstanding research institutes like the MIT media lab (GSM_B 2015; GSM_F 2015). Yet, it was difficult to employ new technology in the exhibition within the short development time, thus some of the proposed exhibits could not be developed. GSM_B stated:

> 'In terms of VR technology, there are many outstanding Korean university research institutions that might have the technology and skills to develop high-quality interactive exhibits, but they normally don't want to be involved in our museum projects owing to lower budgets than their research grant…. And exhibition development companies are usually small businesses, and don't have the competency to present cutting-edge technology. There is difficulty developing digital exhibits.'

This issue can be understood in terms of how digital technology acts as an actor within science exhibitions of the GSM by shaping the exhibitions and negotiating with human actors.

7.4.3 Programmes and Events

The Idea Factory at the GSM opened in August 2013 (GSM 2013, pp.8-9), and is a space that supports making products using digital equipment, such as 3D printers, 3D scanners, laser cutters, etc. (GSM n.d.c). This facility is open to the public, is free of charge, and aims to support them to discover and extend their creativity, imagination and ideas, and to create experimental products and user-created content (GSM n.d.c). This facility is separated into several specialised rooms for equipment and

programmes, and an open space to exhibit the outputs of programmes and for free markets and public events (Figure 7.7).

Figure 7.7 The Idea Factory at the GSM being separated into several specialised rooms

Its programmes can be divided in terms of the target audiences: entrepreneurs, who visit the facility and use the tools to create products for sale; hobbyists, who are interested in fabrication for personal reasons; and children, school pupils and young children. For all newcomers, the GSM runs several workshops where they can learn how to use the equipment and develop their skills (GSM n.d.b). Only those who attend these workshops receive a membership card which allows them to use the equipment, and only 16 year olds and over are able to attend the workshops. The Idea Factory seems to be an adult-orientated maker space (Byun & Cho 2016). The workshops adopt a demonstration-lecture-type learning approach where skilled staff show how to use equipment then participants follow the instructions (Sheridan et al. 2014). After becoming a member of the Idea Factory, time slots can be booked to use the equipment, when they can ask other members and staff in order to develop ideas and further get to know how to the use the equipment.

Based on the analysis of my data, the sharing of ideas and linking people are important roles of this facility. The GSM encourages members of the Idea Factory to participate actively in sharing what they have learnt from their projects via a website,[44] which utilises a wiki document that members can create and edit. The participants of this website are also normally adults, and further questions on the process of making and possible solutions can be found on the website. The GSM has organised exhibitions, fairs and events where makers can present their products and talk about their projects. For instance, a series of events, *Pechakucha,* aimed for building a network with people with similar interests but diverse backgrounds, such as architects, artists and engineers (GSM n.d.d). These social gathering events can be understood as an attempt by the GSM to cultivate a maker culture community. The adult-orientated maker space could be recognised as functioning as a CoP (Wenger 1998), and

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[44] http://sangsangmaker.kr [Accessed 21 August 2017].

situated learning (Lave & Wenger 1991) occurs as advanced makers and beginners help and learn together as peers within this maker space (Brahms & Crowley 2016b; Sheridan et al. 2014). Having regular meetings in person or via the internet with those who have similar interests further encourages learning.

Yet the programmes for children are more structured, based on the analysis of my data. For example, courses that run at weekend for ten school pupils aged from 10 to 15 are designed to be completed in four weeks. These courses are making digital media art, Arduino programming, and making electronic cars. For children under 10, a separate space, the Kids Maker Studio, has several learning programmes, including making a balloon car, making paper automata, making a flying object, making vibrating robots, and so on. These programmes also limit the number of participants to ten per session, and the participants are supposed to complete an activity in one hour. According to its brochure, the programmes in this space have a more open approach to learning, stating that 'participants would be encouraged to create their own products, reflecting their ideas and possibilities of various materials provided, rather than to follow a fixed process to make same outputs' (GSM n.d.e). Based on the analysis of my data, a cultural theory of communication underpins these programmes (Hooper-Greenhill 1999b). This is because knowledge in the programmes is not predetermined by the museum. Instead, the participants are highly encouraged to produce their own knowledge as reflecting their culture they bring with them. Moreover, the learning approach, which adopts cognitive constructivism (Hein 1998), allows learners to explore their ideas by reflecting on their previous knowledge, although the limited time of programmes can be a barrier to be fully engaged.

I could not obtain details of the children programmes, and interviews with participants were not conducted as part of this study. However, these learning programmes tend to be designed for those who are already interested in and are motivated to learn about new technology and equipment (Byun & Cho 2016). There is also an assumption that talented pupils who are already involved and who participate in invention classes in their schools or other educational institutes would be the main participants of the Idea Factory learning programmes (Byun & Cho 2016). Drop-in sessions targeting novices are not commonly offered, and the closed space design of this facility seems to be another barrier to welcoming newcomers. Thus, it can be argued that the children's programmes are more likely to be run in a pre-structured way within an education room, rather than learning occurring in an authentic situation with experts, based on situated learning (Lave & Wenger 1991). In general, children are supposed to be individual learners rather than a member of a family in a learning unit, based on the social constructivism learning approach (Vygotsky 1978). This maker space was recently established in Korea, and there are a lack of well-trained staff who can guide young makers' projects,

not only in terms of helping them to use the equipment but also by being a mentor with whom they can discuss and learn together to solve problems they encounter (Byun & Cho 2016).

According to a panel in the Kids Maker Space, these programmes are adopted from learning programmes at the Exploratorium, USA. Recently, the GSM invited a museum practitioner from the Smithsonian Institution to run a workshop for children (GSM 2016), and the GSM has a strong relationship with US museums for developing learning programmes. This may result from the maker culture beginning in the USA (Halverson & Sheridan 2014), and GSM museum practitioners sometimes visit US museums for benchmarking purposes. Maintaining this relationship in the future could be another way to cultivate and extend the maker culture community beyond Korea.

The Idea Factory at the GSM is considered to be a success through both quantitative and qualitative evaluations, and is extending the maker culture (MSIP & KOFAC 2014, pp.45-88). Its programmes are usually fully booked, and users are requesting more equipment (GSM_E 2015), with some inventions developed in this facility now having been patented.

In this project, digital technology has several important roles, and it is considered a fundamental factor to extending the maker culture. Thus, digital literacy, knowing how to use the digital fabrication techniques, is encouraged. Some programmes offer new approaches for adopting digital technology that can affect participants' ideas and outputs. While some programmes tend to focus on learning about the 'technology' itself, in general, the programmes seem to provide open approaches to learning. However, more programmes for novices are required.

7.4.4 Multimedia Guides

Currently, there is no multimedia guide available in the GSM. When it opened in 2008, a quick response code (QR code) system was introduced to deliver additional explanations for selected exhibits (GSM 2009, pp.123-129). Yet the service has not been updated since then. A Smart Exhibition Guide System is under development (Jeon 2011;MSIP 2014a; GSM_G 2016), and this system is expected to guide visitors based on their location in the GSM, and to provide additional learning content, which may be useful after visiting the GSM .

7.4.5 Online Research

There is no online research available via the GSM website, which only conveys the services offered on-site at the GSM. According to a visitor survey, the public would like to know about ongoing scientific research through the GSM (Kim 2010), and the website could be a platform where the public's opinion on scientific research could be heard.

7.4.6 Online Learning

The GSM's official website includes a menu for the Cyber Science Museum. The Cyber Science Museum is expected to support self-directed learning, based on constructivism learning theory (Kang 2010; Kim 2011). Currently, it consists of three submenus: Cyber Exhibitions, Digital Learning Centre, and Science Playground. My analysis here only includes the Digital Learning Centre because its target users are children.

The Digital Learning Centre has a series of online science and maths educational games, namely Milc and Seereal (Figure 7.8). These games are targeted at Korean elementary school pupils aged 7 to 12 years old (GSM n.d.f), and are based on a story where two child characters, together with a scientist, have to rescue an island invaded by a group of villains (GSM n.d.f). Each game has been designed to be linked to the school curriculum and is intended to achieve specific educational goals, for example, understanding the weight and balance of objects, and learning about arithmetic operators (Lee 2012).

Figure 7.8 The online games of the GSM, designed to link to the school curriculum

This project was developed under the GSM's vision for popularising science and technology, and online digital gaming was considered a new learning approach for the future (Lee 2012). Together with developing the games, a multi-platform for the games, a management system, and building a network and infrastructure were presented as the four main strategies (Lee 2012). Through this project, the GSM aims to encourage elementary school children to learn about concepts and theories of maths and science via the games as a self-directed learning method; to support the foundation of an educational game industry through developing a platform; and to extend public awareness of educational games; and to build mid- and long-term strategic plans for the application of these games within school classrooms (Lee 2012). In addition, the GSM has hosted annual competitions for the science and maths online games (Lee 2012, p.6; GSM 2010, p.109), and launched an app for the games. Visitors can also play the games within the GSM's orientation hall.

However, these digital games are developed based on the behaviourism approach, which responds to learners selecting the correct answers (Whitton 2014). The aim of the games is simply to test if learners possess maths and science knowledge, and the games are digital versions of exercise books for maths and science. Although the storyline, levels and point system as extrinsic motivators which constantly encourage learners to play the games step by step, the story is only told as the background to the games, and is not properly linked within the games.

7.4.7 Summary

In summary, digital technology is employed in the GSM within many different museum practices, possibly due to the fundamental principles of its establishment to be an interactive and hands-on science museum. The digital projects tend to be further developed as an on-site static service, for example, the exhibitions and Idea Factory. Digital exhibits are perceived from the beginning of an exhibition and are the main exhibits, even shaping the space of an exhibition, which Parry and Sawyer (2005) term the integrated or innate phase of museums. However, the on-site and online content do not seem to be integrated, and instead exist separately.

When considering the overall communication and learning approach of the digital projects, transmission and didactic and behaviourist models of scientific intellectual content is conveyed from the GSM to the visitors. This means the GSM adopts traditional museology. Although the GSM aims to foster creativity, and two-way communication is expected from its education philosophy (Jang 2013; GSM 2014, p.33), there is a fundamental assumption of predefined right/wrong science knowledge answers. The exception is the Idea Factory, which pursues a constructivist and partly situated learning approach, particularly for adult makers. However, the GSM's digital projects normally target motivated learners who want to advance their knowledge.

7.5 Summary of the Gwacheon National Science Museum

The GSM is a relatively young science museum, which was founded by the government in its bid to make science culture popular. Strategically, the GSM is planned to be a hub for the expansion of science and technology culture, and ever since its inception, the government has been an active actor. The development of digital technology is expected to boost the Korean economy in future, and the government and technology have extended their network to the GSM and the public. However, museum practitioners, who should be actors, are not well presented due to the hierarchical organisational culture, a lack of professional development opportunities, and most importantly, the

isolated work process. Their professional identity is uncertain and the gap between curators who have a scientific background and government officers, seems to influence the learning and communication approaches of digital projects. Because there is no shared framework or opportunities to discuss and ensure that the overall learning approach is constructivist and fostering creativity, the GSM appears to be producing digital projects which only focus on the science content. Therefore, digital technology mainly functions to convey science intellectual content and the GSM has concentrated on educating the public by using digital technology.

Chapter 8 - Tate Modern

8.1 Introduction

In the previous three chapters, the findings of three Korean national museums were presented. The digital networks of the Korean museums are all government-centred models, and the power of actors is not well distributed. This situation has resulted in underpinning the communication and learning approaches of the digital projects of the museums by mainly adopting a transmission communication model and didactic and behaviourism learning approaches that consider learners (the public) as lacking the agency to produce knowledge. Additionally, the case studies identified that museum practitioners, especially internal digital experts, have not been empowered. The lack of CoP regarding digital museum practices is a significant issue; and cultivating a digital museum culture that can empower digital experts and lead to better performance is required.

I now turn to three case museums of the UK, beginning with Tate Modern. The structure of the following three chapters is similar to those of the Korean museums. However, the UK case study illustrates how the different shapes of the UK museums' digital networks (compared with the Korean museums) has affected their digital projects by further involving museum practitioners and the public as actors. In the case of the Tate, this has been done via the learning department continuously conducting audience studies and through collaborative working processes with diverse internal and external actors, such as digital artists. This case study discusses how the learning department represents the voices of the public by adopting social constructivism learning theory, critical pedagogy and the cultural theory of communication.

Moreover, the relationship between the UK government and its national museums is comparatively balanced, and the museums display strong will, agency and leadership regarding digital culture by forming digital departments. Giant global companies such as Google have actively extended their networks into the museums as funders and partners, although their networks might not be stable. Unlike the Korean case, informal groups, for example Digital Learning Group at the Tate, have emerged as one of the crucial factors that encourage digital museum practices and empower digital museum practitioners. Through these CoP (Wenger 1998), museum practitioners further develop their competency as well as their professional identity.

The data I analyse in this Chapter are 45 pieces of secondary data (see Appendix 3), interview data with 7 museum staff working/who used to work at the Tate (see Appendix 5 for their profiles), and visual data regarding the digital projects, mainly generated from my field work.

Before discussing the Tate case, the section below provides the broader context of national museums in the UK.

8.1.1 National Museums in the UK

The history of national museums in the UK is longer than in Korea, and the museum culture is known to be relatively well-established. In terms of the relationship of the government with the museums, it is based on the government's arms-length principle for cultural organisations. The museums are non-government operating bodies and are supposed to perform more efficiently when spending public money since the 1980s (Kawashima 1997). During the Coalition Government (2010–2015), market-based approaches to cultural organisations further stated the consideration of culture as an economic commodity (Gordon et al. 2015). Cultural organisations, including museums, have been greatly required to find alternative sponsors, such as the commercial sector (Bagwell et al. 2015). This situation might result in a flexible working environment that can actively reflect digital culture.

Although the UK government keeps a distance from museums, the government bodies, as actors, provide guidelines and overall policy that the museums are supposed to follow. Regarding my research, first, the New Labour Government's (1997-2010) emphasis on the role of museums as an educational institution seems to have resulted in learning departments in museums having a louder voice in representing the public through audience research (Hooper-Greenhill 2007). The work scope of the learning departments also tended to be extended, not only to learning programmes but also to exhibition developments and museum object interpretation. I assume this could have influenced the communication and learning approaches adopted in digital museum projects (Research Question 2-2). Second, the government seems to persuade the museums to employ digital technology by setting one of the performance indicators in their funding agreements to the number of unique website visits (Tate 2011b; BM 2008b; NMSI 2006b), and by publishing policy documents, for example *Becoming digital by default* (DCMS 2012).[45] Therefore, the way that the government, as an actor, relates to the digital museum projects can be addressed (Research Question 1).

Additionally, museum professional communities in the UK have been developed to reflect changes in museum practices and society. For example, the Museum Computer Group was established to exchange work experiences and to discuss the issues regarding new museum digital practice. That is, museum professional communities as well as academic discourse and museum studies have important

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[45] The digital strategy document (DCMS 2012) argues that their arm's length bodies "engage with the public in new and exciting ways - offering innovative digital experiences and services that people really want to use."

functions to re-educate museum practitioners and to share experience, and to provide common ground, for preparing future museums (Research Question 1-2).

In sum, the national museums of the UK have developed by reflecting the opinion of various actors. Thus, understanding the museums and their network and relationship with actors could be beneficial for answering how the various actors play their roles and how they have impacted museum communication and learning approaches in digital projects. The first case study of the UK national museums, the Tate, is now discussed below.

8.2 Overview

The Tate is a national art museum, which has four sites across the UK: Tate Britain, Tate Modern, Tate Liverpool and Tate St Ives. The Tate first opened its doors to the public in 1897, displaying mainly Henry Tate's collection of British art, which he had given to the nation, while Tate Modern opened in 2000 in London and was planned to be dedicated to introducing modern and contemporary art (Tate n.d.b). The Tate now has the national collection of British art from 1500 to the present day, together with international modern and contemporary art, totalling nearly 70,000 artworks.

In my study, Tate Modern is studied to enable a comparison with the MMCA. Yet, it is hard to divide Tate Modern from Tate Britain due to its organisational structure and staffing. Some departments, such as Learning and Digital, work across both sites, and although I focus on Tate Modern, it may be necessary to consider the Tate as a single institution. The way that departments and staff members have worked together in terms of digital projects will be examined in Section 8.3, with the museum and museum practitioners as actors.

The Tate's mission is to 'promote public understanding and enjoyment of British, modern and contemporary art' (Tate n.d.d). The Tate considers the public (novices), as its main audience, rather than researchers (experts). This may result from its responsibility as a public institution, where it is expected to make its content available for broad and diverse audiences. Thus, the approach of its mission that the Tate takes can be understood as new museology, which places people at the centre rather than museum objects. In addition, research at the Tate refers not only to studying works of art, but also to studying the field of learning within galleries. This aspect was highlighted through the establishment of the Tate Research Centre: Learning in 2014.

The vision of Tate Learning is to 'inspire new ways of learning with art, and specifically with Tate's collection, that reach a wider audience and promote positive change, dialogue and engagement in

contemporary cultural and artistic life' (Cutler 2014). The Tate notes 'art is a powerful catalyst for creativity, critical thinking, emotional reflection, and social connectivity' (Tate n.d.c). Here, it can be seen how the Tate links art to society; learning at the Tate seems to not only mean the acquisition of knowledge on artworks via individual learners' cognitive processes, but also the recognition of society, previous knowledge and changing how to think (Pringle & DeWitt 2014). Thus, the overall underpinning learning approach is social constructivism learning theory, with some critical pedagogy. In Section 8.4, I investigate how digital projects at the Tate have been implemented to achieve this overall approach. The analysis of the digital culture at the Tate will start by analysing the actors who have influence.

8.3 Identified Actors: Their Network and Roles

During the data collection and analysis of the Tate, its strong focus on digital culture has been noted. Figure 8.1, which was developed by the analysis of my data, shows the network of the Tate with various actors regarding digital culture. The following subsections will explain the actors described in the Figure, including the government and government bodies, the museum itself, museum practitioners, digital technology and digital companies, the public and others. With the analysis and findings, how and why the different actors have constructed/deconstructed their network can be understood.

My research case is Tate Modern, but Tate Modern is under the Tate. Thus, in some sense, it is difficult to address Tate Modern separately because it shares its vision with the Tate, and the learning and digital departments work across Tate Britain and Tate Modern. Thus, I will refer to the Tate broadly while I mention Tate Modern, if necessary.
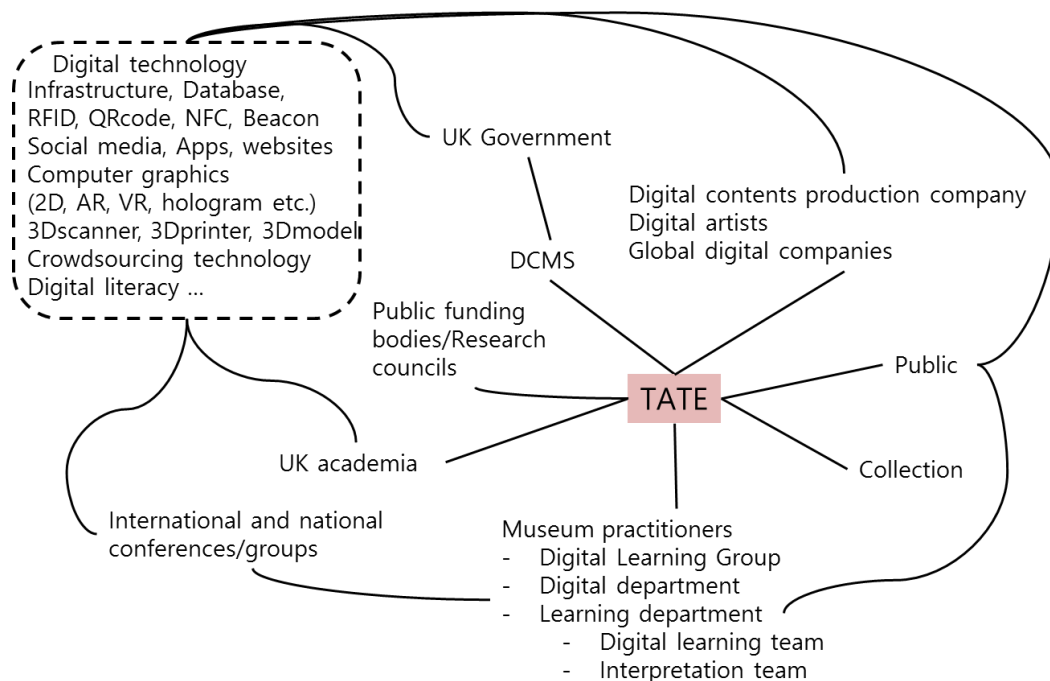
Figure 8.1 Actor-Network map of the Tate

8.3.1 Government and Government Bodies

The Tate is a national museum and a non-departmental public body under the auspices of the Department for Culture, Media and Sport (DCMS). The Tate used to be primarily funded by a grant-in-aid from Parliament (Tate 1994, p.77), but since 1992, when the Museums and the Gallery Act came into force, the Tate's income from this source has been reduced based on the privatisation policy. For example, the grant-in-aid as a percentage of the total income of the Tate was 82% in 1992/93 (Tate 1994, p.77) but had decreased to around 32% in 2014/15 based on the funding agreement between the DCMS and the Tate (Tate 2015a, p.89). This means that the Tate needs to generate most of its income from other sources, and this has resulted in the Tate becoming a more independent organisation away from government political interventions. The interviewees from the Tate were less likely to recognise the government as an actor influencing their digital projects (TA_A 2016; SML_E 2016). The interviewee, SML_E, who was the former Head of Digital at the Tate and the current Digital Director at the Science Museum, London, stated:

> 'What we don't see is ourselves sort of pointing back to those strategic documents from central government saying oh well this is what they want to do so this is what we'll do. … In a sense they [the government] are not really saying to us, 'You've got to go digital now', because they kind of see that we're doing it already.'

Nonetheless, the government seems to be an invisible actor, as it not only provides financial support, but also evaluates and monitors the Tate's activities, addresses significant issues, and informs the Tate about relevant government policy (Lang et al. 2006; Pamies 2009). In terms of the digital culture, the government's strategic reports, such as 'Digital Britain' (DCMS & BIS 2009) and 'Becoming digital by default' (DCMS 2012) act as devices within ANT (Callon 1986). In so doing, the government encourages cultural institutions, including the Tate, to consider digital practices, although direct pressure from the government was not found. Through posing the issue that public organisations should engage with the public, the government and digital technology have attracted the Tate to their network.

As an educational institution, the Tate has also had to consider its learning programmes and resources to help school teachers by enhancing and extending the national curriculum. These have not only included art and design, but also created links with other areas, such as language, history and citizenship (Tate 2009, p.48). More recently, digital skills, such as computer programming, have been recognised as a key skill for the future generation and have been adopted as a subject within the UK national curriculum since 2014 (DfE 2013). Based on the analysis of my data, the digital making programmes at the Tate provide innovative digital experiences to school pupils, which can be understood within this context (see Section 8.4.3).

As mentioned above, it has been necessary for the Tate to find funders to support its digital projects. Public funding bodies, such as the Heritage Lottery Fund (HLF), the ACE, and British research councils, have provided significant funds to the Tate. For example, the HLF has attempted to embrace digital technology within cultural sectors by promoting its general benefits for sustainable management, widely accessible digital collections/resources, and potentially innovative interpretations (HLF 2012). The HLF has mainly funded digitisation projects of the Tate through the New Opportunities Fund (Tate 2004, p.240), and recently has supported the Archives & Access project (Tate 2012a, p.13; Tate 2014a, pp.48-50; Tate 2015a, p.32), which will be further introduced in Section 8.4.5. UK research councils[46] have also provided funding for digital culture from an art museum's point of view and to support collaborative research with other potential actors, such as universities. However, it is not certain that these types of networks are stable and durable (Law 1992) after projects have been completed.

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[46] For example, The Digital Research & Development Fund for the Arts ran from 2012 to 2015 and was a strategic partnership between the ACE, the Arts & Humanities Research Council (AHRC) and the National Endowment for Science Technology and the Arts (NESTA), to support collaborations between organisations with arts projects, technology providers, and researchers.

In summary, the government has generally encouraged the digital culture of the Tate and public bodies have provided funds for digital projects. However, the Tate cannot guarantee obtaining these funds and has to submit applications and go through the competitive process. This circumstance makes the Tate an active and responsible actor who is constantly negotiating with other actors. In the following section, I will discuss the Tate's point of view and address the ways of it has constructed its digital network.

8.3.2 The Museum Itself

Based on the analysis of my data, there is ample evidence that the Tate has actively extended its network into digital culture. This section will explain why the Tate has built and extended the network, and how it has done. The process of network building of the Tate can be understood with ANT (Callon 1986), and I will investigate what issues were posed by the Tate when it attempted to construct a network to other actors, such as the public. The ways of which the Tate has constantly attracted internal and external actors of it also will be uncovered.

It is clear that the Tate has a specific digital vision, and this is described on its website, in a section entitled 'Our work', which contains eight categories: Our priorities; Collections; Conservation; Research; Learning; National; International; and Digital (Tate n.d.a). The 'Digital' section explains how the Tate runs its website, podcasts and social media, the way it evaluates its digital offerings, and how its digitising collection projects, etc. are managed (Tate n.d.e). More obviously, Tate Modern emphasised its digital presence in the annual report of the Tate 2014/15 in a section entitled 'Promoting digital growth and engagement' (Tate 2015a, pp.32-34). This document explains how Tate Modern's digital projects, for example, the Bloomberg Connects project and Tate films, have provided existing and new audiences with rich content and have promoted a wide range of exhibitions and events both within galleries and on the internet. The Tate Modern's new extension project was completed in 2016, and Tate Exchange in the new building is a dedicated learning and research space, where visitors, groups, visual arts professionals and Tate staff can explore digital resource, create and share their digital works (Tate n.d.f).

Based on the analysis of my data, Tate Modern has actively attempted to develop a digital culture for several reasons. Tate Modern fundamentally aims to show what the next generation of art museum can be (Tate 2000, p.5), and thus, since the planning phase, the first modern and contemporary art museum of Britain was expected to provide 'innovative' and 'global' approaches within all its works (Tate 1996, pp.24-25; Tate 1998, pp.32-33). Embracing digital technology in Tate Modern seems to be encouraged as one way to reach international audiences in a new manner.

Additionally, following the election of the New Labour government in Britain in 1997, culture and museum policy guided museums to reach wider audiences in order to increase social inclusion, and highlighted the educational role of museums (Hooper-Greenhill 2007). Through visitor studies, the Tate has acknowledged not only the demographic features of their audience, but also its various demands and motivations, together with their different learning styles, as well as non-visitors' perspectives on the Tate (TA_B 2016; TA_C 2016; TA_E 2016). Thus, digital projects that implement different approaches to art interpretation, for example, digital games, are expected to meet the public's diverse needs.

In addition, modern and contemporary art is supposed to be more difficult to understand and appreciate compared to traditional art (TA_C 2016). Therefore, visitors tend to require further resources to help understand the works of art displayed (TA_C 2016). Digital interpretation, such as mobile guides and games, could facilitate them. Therefore, this is an OPP in the ANT (Callon 1986) for Tate Modern to get involved in a digital culture that can provide new opportunities to network with other actors and to reach a wider public.

In order to be strategically networked within the digital culture, the Tate had to establish and then continuously update its internal digital strategies. The first ICT strategy for the period 2002 to 2005 was focused on developing the IT infrastructure and managing digital resources (Tate 2002, p.29). In doing so, digital resources were recognised as 'assets to be developed as new products and services in a rapidly developing marketplace, as resources to provide a growing public with free access to the collection, and as tools to help it (Tate) plan and deliver a full and diverse programme with greater efficiency and effect' (Tate 2002, p.29). This was followed by the Tate Online Strategy 2010–12 (Stack 2010), Tate Social Media Communication Strategy 2011–12 (Ringham 2011), Tate Digital Strategy 2013–15 (Stack 2013), and recently, the updated Tate Digital Strategy 2016-2017 (Tate n.d.e). Through presenting its digital strategies on the internet, the Tate is demonstrating some leadership in terms of digital culture within the museum field. From an ANT perspective, these activities, writing documents and sharing them with others are typical strategies to make a network stable and durable across time and space (Law 1992). In so doing, the Tate can be a constant actor.

The Digital Transformation Project, which took place between 2013 and 2015, aimed 'to embed digital skills, processes and a digital culture across the organisation to make digital a dimension of everything that Tate does' (Tate 2013b), and has further encouraged the Tate's internal actors to network digitally. With this project, the Tate has intentionally attempted to attract every staff member in all its departments, from research and conservation to fundraising and public programmes, to participate in digital activities, such as writing blogs that share their work. Thus, the digital strategy is

not only concerned with digital technology, but also with how to improve museum practice and visitors' experience both on-site and online.

Based on my data analysis, it can be said that organisational changes and new staff employment have supported these strategies. For example, a new department of Information Systems was created during the 1990s (Tate 1996, pp.21-22) due to the increased value of a computerised system. To reflect new media developments, for example, film production, Tate Media was formed in 2006 (Tate 2008a, p.67), and a Digital Learning Team was established in 2011 as a bridge between the learning department and the digital team (TA_A 2016). More recently, the digital department was restructured in 2015, and the formation of this new digital department can be seen as a strategic approach to digital culture, and as a result of the increased voice of staff working on digital projects. By integrating all digital work within one department, this has responsibility for producing and analysing digital content, for example, Tate Kids and Tate Shots; the development of Tate websites; and the management of e-commerce via Tate online shops. The creation of this department is expected to lead to a holistic understanding of digital culture in the Tate, as well as effective digital resource/asset management, and to highlight visitor perspectives rather than the Tate's (TA_E 2016).

Furthermore, the Tate has organised and hosted conferences and seminars, and has participated in research projects on digital culture in order to understand digital technology and its potential. These events and practices can be understood as devices in ANT (Callon 1986) that potentially attract other actors into the Tate's network, and might be ways they can pose issues on digital culture. For example, the conference 'From Audio tours to iPhones' in 2008 focused on advances in mobile technology that could change museum tours (Tate 2008b), while in 2010, the symposium 'Museums and mobiles in the age of social media' looked at the wider contexts of mobile experiences that can engage audiences both on-site and beyond the museum's walls (Tate 2010b). Research projects, such as 'Resolutely Analogue? Art Museums in Digital Culture', a week-long programme of panel discussions as part of the Tate Encounter project and the 'Modelling cultural value with new media cultures and networked participation' project (Walsh et al. 2014) could also have been important influential factors, as the Tate considers digital culture as a subject to be discussed and researched, and in so doing, seems to potentially be attracting academics, policy-makers, and even the public.

Moreover, the creation of the IK Prize[47] in 2014 indicates the Tate's strong ambition to extend its territory into digital culture and to encourage digital creativity and innovation (Tate 2014a, p.48; Tate 2015a, p.34). By awarding and celebrating a talented idea that proposes the innovative application of

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[47] The IK Prize is awarded by the Tate for 'an idea that uses digital technology to innovate the way we discover, explore and enjoy British art in the Tate collection' (Tate 2014b).

digital technology, for instance, robots, virtual worlds and artificial intelligence as a digital interpretation of the Tate's collection, the museum can expose new issues within digital culture, and can focus on them with others.

Overall, the Tate as an actor has actively extended its network into digital culture by establishing its own digital strategies, employing digital specialists, being a platform for discussing digital culture with others, and even encouraging the production of digital interpretations. Although those activities have been planned and managed by the Tate as an institution, individual museum practitioners also can be significant actors who shape the digital network of the Tate. The next section will address their point of view as actors.

8.3.3 Museum Practitioners

The Tate has already recognised its members of staff as important actors at the foundation of its work. The museum has also attempted to improve and encourage its staff's professionalism and expertise in many ways (Tate 2009, p.60; Tate 2010a, p.50; Tate 2011a, p.54; Tate 2012a, pp.62-63). In this section, individual museum practitioners will be dealt with as actors, and the ways they have extended their networks into digital culture are investigated.

While digital projects at the Tate have been enlarged in recent decades, the Tate has a relatively short history of digital museum areas and digital staff, and for senior staff, a digital culture is less likely to be a familiar subject. Museum practitioners of the Tate predominantly have an academic background in art/art history and their perceptions of digital technology have impacted upon the museum's digital projects (Walsh et al. 2014).

Since the 1990s, internal members of staff having an academic background in digital-related fields have been employed to take charge of digital technology and digital projects. With the creation of a new Information Systems department in the 1990s, the first staff group involved in digital culture was most likely to be technicians (Tate 1996, pp.21-22). This period was when the Tate invested in the establishment of a digital infrastructure as part of a modernisation project. Since 2000, new members of staff that plan and manage digital content have been employed; for example, the Head of Digital Programmes, the Senior Digital Content Manager (Tate 2002, p.29), and an E-learning curator for Tate Kids (Tate 2004, p.240). With the need to extend the Tate's video production in 2006, the division Tate Media was formed (Tate 2008a, p.67). By employing various types of digital experts as internal staff, museum practices of the Tate can be more specialised than ever before, and their voices that differ from curatorial staff can be reflected in digital projects.

Furthermore, a significant improvement in the Tate's digital presence resulted from the formation of the Digital Learning Team. The team was formed in 2011, and links art learning to digital technology and the digital department of the Tate (TA_A 2016; Tate n.d.c). Through working with colleagues across the organisation and with external partners, the team has provided various innovative learning programmes and events for a range of visitors, from young children to the over-60s, and from beginners to technology experts (Tate n.d.c, p.9). The digital projects run by and in collaboration with this team will be further explained in Sections 8.4.3 and 8.4.5.

In addition to offering new digital experiences for visitors, the team has organised an informal Tate internal group, the Digital Learning Group. Members of this group come from various departments, for instance, learning, collections and digital departments, and are interested in how to employ digital technology in their practice and how to better undertake digital projects; every member seems to get involved in digital projects in some way.[48] In their regular meetings, they introduce their digital projects and present ideas to the members, and critical comments and feedback are exchanged for a better performance. TA_A said that:

> 'The main reason they come to the group meetings is because they are interested in or in some way deploying digital technologies in the learning that they offer to the audiences they work with. … Sometimes, we do get the people who are working on the developing side of things and doing more of the technical stuff, … because we want them to talk about what they're doing, so we have again, a greater understanding, and similarly, we might invite someone from marketing or someone from the archive to come and give a bit more in-depth on what they're doing, particularly where it involves digital…'

Based on my data analysis, the group is a good example of a CoP, which provides opportunities for its members to learn from each other by sharing their recent work and issues (Wenger 1998). Particularly, the diversity of the members' backgrounds can make the group very dynamic, innovative and creative. Because the group sits in a boundary of different domains, for example, learning, computing and archiving that relate to digital, diverse points of views on digital projects can be discussed with the members. Additionally, this social learning process can help reduce the gap between different perspectives on digital culture of those who have different academic backgrounds. The group also attempts to be horizontal by encouraging every member to feel free to discuss and debate with others, regardless the hierarchy of their job positions. Instead of relying on one leader, the group seems to

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[48] Some are regular members and others are not. They also sometimes invite someone outside of Tate to the meeting if a specific issue is raised (TA_A 2016).

encourage all the members to contribute it in some ways. This is also one of elements that make a CoP healthy (Wenger et al. 2002).

Meanwhile, museum practitioners, as major actors of the Tate, actively present themselves as participating in relevant conferences and delivering talks and lectures to extend their network with external actors. It is not difficult to find publications on digital programmes from the early 2000s (Tate 2004, pp.336-337). Digital museum practitioners have participated in conferences directly related to museums and digital technology, such as the 'Museums on the Web' conference, organised by the UK Museum Computer Group and the international conference 'Museums and the Web', and also in conferences that cover the wider contexts of digital media and e-commerce. By doing this, the museum practitioners can show their interest in digital culture, exchange ideas, and learn from other sectors. It can be said that the museum practitioners have recognised the importance of continuous professional development, and conferences are acknowledged to be a place where they can learn with peer groups as a CoP (Wenger 1998).

Nonetheless, there are still barriers for some museum practitioners who are hesitant about becoming involved in digital culture. Historically, art museums have been considered as a white cube, isolated from society and pure (Wright 1989). As mentioned by my interviewee, TA_C, curatorial staffs who usually have an academic background in art history have a tendency to believe that art museums should be collection-based. Thus, depending on occupations, their attitude towards digital culture differs. Moreover, in general, most digital projects at the Tate have been funded by external sponsors, and the involvement of internal and external actors can be significantly different, depending on the digital project, and this issue leads to the funding of the Tate.

8.3.4 Digital Technology and Digital Companies

Digital technology has gradually extended its connections to other actors, such as members of staff and sponsors, not only online but also on-site at the museum. The Head of Content and the Creative Director of the Tate anticipates that digital technology can provide new opportunities for the Tate to engage with the public by saying, 'Now more than ever, new web technologies allow the museum to be a place where ideas, experiences and opinions about art and culture are exchanged' (Tate 2013a, p.35).

In the Tate's annual reports in the 1990s, digital technology was referred to only as ICT, the technological aspect. Since the successful launch of the Tate website and branding it as Tate Online, the fifth gallery, digital technology has been further recognised as a crucial actor to connect potential and actual audiences of the Tate. Because the public has already widely embraced digital media for

their personal needs, digital technology and media are supposed to be a bridge to link the Tate to the public. In doing so, digital technology is increasingly recognised as a tool to interact with audiences (Tate 2010a, p.5), and the digital future needs to be prepared to provide opportunities to reach new audiences (Tate 2011a, p.59; Tate 2012a, p.64).

Digital companies related to Tate Modern can be grouped into three: those that actually develop digital content; those that provide their digital platforms; and those that provide financial support. The first group who produce digital content, such as websites and mobile applications, has expanded. The Tate has introduced a multimedia guide system in the early 2000s, and today, companies who can produce similar systems have various approaches and are specialists in different techniques. Antenna International, who was contracted by the Tate to create multimedia guides, is a pioneer in this area and has museum clients from around the world.[49] With diverse working experience, this company has gradually extended its network, sometimes participating in digital conferences and sponsoring them, which has attracted potential actors. In terms of small projects, digital artists developed innovative and experimental projects with the Tate. For example, as a leading digital workshop, artists can take advantage and explore the digital potential, as well as developing connections with the Tate and its audience.

According to the analysis of my data, collaboration and partnership with giant global companies, for example, Google, Instagram, YouTube, and Minecraft, have also been recently extended. While the Tate originally adopted their services as part of museum practice, today, they are attempting to enlarge their service territory to within galleries as well as beyond the museum. By offering their outstanding technology to the Tate, one of the world's leading art museums, these companies can expand their presence to potential and loyal users, while the Tate can utilise the advantages of their platforms, and implement a new innovative visitor experience (TA_C 2016; TA_E 2016).

Corporate funders seem to have a different purpose in funding digital projects at the Tate. The role of private sector sponsorship has been considered increasingly important since the early 1990s (Tate 1992, p.31; Tate 1996, p.37). As a marketing method, those corporations have a well-established relationship with the Tate. For instance, Bloomberg has funded innovative digital projects such as interpretation zones, the Drawing bar and smartphone apps (Tate 2015c).

The network of the Tate with its sponsors has become more complicated and seems to be growing. Events such as REMIX SUMMIT[50], where content providers like the Tate, media companies, and

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[49] https://antennainternational.com/clients/ [Accessed 21 August 2017].

[50] REMIX aims to 'explore the intersection between Culture, Technology and Entrepreneurship' (REMIX n.d.).

funders have the chance to explore others potential projects, and to discuss future collaboration plans, seem to be important in extending the social network. This type of event can be a significant hidden factor, which can facilitate the dynamic digital network of the Tate.

In the following section, I will discuss the extent of which the public is recognised as an actor in the Tate. This is associated with museology that the Tate adopts because new museology puts the public at the centre of museums, while old, traditional museology considers museum objects first (see Section 3.2). I will explain how the public's voices are heard and reflected in the Tate. By doing so, I will discuss the power relationship between the public and the Tate.

8.3.5 The Public

As the Tate's 2016/17 digital strategy states: '… the Digital team will promote digital growth and engagement with an emphasis on reaching new audiences, while continuing to develop high quality digital experiences for Tate's loyal fans.' Embracing digital technology in museum practice and working with digital companies are basically associated with audience development. Reaching new audiences and identifying those not targeted has become an important aim for the Tate.

The Tate has conducted visitor research in order to find ways to reach a more diverse audience. Early visitor studies at the Tate in the 1990s generally focused on marketing, and quantitative research methodologies were employed to identify the demographic features of visitors (Tate 1996, p.17; Tate 1998, pp.22-25). Later studies have concentrated more on qualitative research on visitors' demands, purposes, motivation and expectations when visiting on-site and online (Villaespesa 2014; Villaespesa et al. 2014; Ohlson & Villaespesa 2015; Box & Villaespesa 2015; TA_B 2016; TA_C 2016; TA_E 2016). Through these studies, the public's various voices on museum practices can be heard.

Moreover, the public is frequently invited to participate in the production process of digital projects. The public have critically addressed issues relating to museum content, have given advice on the interpretation of arts, and been consulted about their user experience. When digital projects have been developed, audience research has been considered as an essential process that must be undertaken (TA_B 2016; TA_F 2016). As an example, the Tate changed the name of a menu on its website from Collections to Art & Artists, reflecting audience feedback and their understanding of the meaning (SML_E 2016). Particularly, crowdsourcing projects, such as AnnoTate, which is briefly described in Section 8.4.5, could not have been completed without public participation.

The global public are already interconnected with digital culture in their daily life, therefore, in order to reach them, it is necessary for the Tate to be involved in digital culture. For instance, the Tate has invited leading Instagrammers to its special events, recognising their powerful influences on the

digital world (Tate 2015a, p.33). Therefore, the public at the Tate are widely recognised as actors in many ways. The way the Tate considers the public as actors and how this has influenced their digital projects will be further analysed in Section 8.4.

8.3.6 Academia

The last identified actor of the Tate is academia. The Tate has collaboratively worked with academia in many different ways. Through participating in conferences and seminars, museum studies scholars have addressed theoretical issues relating to digital culture in art museums. Doctoral researchers at the Tate have also impacted on developing and analysing the digital audience experience. Academia's experimental approaches and new insights into digital technology could result in new digital projects. For instance, the Art Maps project was the result of interdisciplinary research by staff at University of Nottingham, the University of Exeter, and the Tate (Tate 2012b). Additionally, because of its contemporary art subject matter, the Tate has a strong relationship with art and design schools, including Chelsea School of Art (TA_A 2016). Consequently, theories proposed by academics can be employed in museum practice, and this in turn contributes to theory building, as well as through joint research like the cultural values and digital project. However, the relation between academia and the Tate is generally project-based. Thus, it is not sure if their network can be stable (Law 1992) after the projects.

8.3.7 Summary

This section has identified the actors of the Tate. Through strategies and the foundation of a new digital department, the Tate has actively negotiated with internal and external actors, for example, the government, digital companies etc. A cross-departmental approach has been adopted when working on digital projects, which means that not only are staff from the digital department involved, but also those in other departments. This distributed power network within the Tate seems to influence the communication and learning approaches of its projects, which will be explained in the following section. The museum practitioners are active actors, presenting and sharing their experiences in the field. The Digital Learning Group and participation within conferences have been recognised as a CoP model (Wenger 1998) where museum practitioners learn within peer groups, thereby increasing their power.

The Tate and digital technology are interconnected, and the strong connections between digital companies and the public have attracted the Tate to embrace digital culture in order to create new and innovative visitor experiences. The Tate has also anticipated approaching the wider public via digital

technology and through providing diverse opportunities to enjoy works of art. The way the public is recognised as an active actor through participating in digital projects is investigated in the next section.

8.4 Digital Projects

The previous section examined actors of the Tate who have affected its digital projects, and how they have extended their network to other actors. In this section, I move on to the analysis on digital projects at the Tate, which were chosen according to criteria explained in Chapter 4. The aims and motivations of the projects, the development process, and the actors involved will be described. In particular, the ways in which digital technology is embraced in order to reach the Tate's intended learning approach (Tate n.d.c), social constructivism and critical pedagogy, and cultural communication approach, will be further illustrated. Based on the anticipated journey of visitors at the Tate, this section will start with the digital projects presented in the orientation space, followed by those in galleries, employed in programmes, the multimedia guide and online projects.

8.4.1 Orientation Space

8.4.1.1 Digital Drawing Bar

The Digital Drawing Bar (Figure 8.2) is part of Bloomberg Connects, and was launched in 2013 (Tate 2014a). On a digital drawing tablet, visitors can make a visual response to their visit to the gallery or express themselves. Together with an external design company, the interpretation team in the learning department and the digital team worked closely to design this project (Scott 2013; TA_C 2016).

Figure 8.2 Digital Drawing Bar, in which visitors can draw what they want and can share it with others

The general learning aim of this project is to empower visitors to have their own thoughts, create something, share it, and respond to others (Scott 2013; TA_C 2016). The creative activities and social element of sharing are considered to be as important as the gallery providing information from the curators' point of view. In other words, by considering knowledge subjective, visitors are invited to produce their own knowledge through drawing that reflects their culture. In so doing, cultural theory of communication (Hooper-Greenhill 1999b) underpins in this project.

In terms of learning approach, this project has been adopted social constructivism (Vygotsky 1978). Drawings created by visitors are displayed on a huge projection on the Tate's digital wall, alongside a selection of artists' thoughts about art-making. This scaffolding element was intended to inspire people and encourage them to participate in drawing (Walter & Scott n.d.). The open space design and the digital projection also enable visitors easily share their works with others.

This approach is due to the targeted visitors for this project. According to an interviewee, TA_C, this project was developed to target specific visitors whose motivation to visit Tate is for a social experience. The Tate tends to think much more about this type of visitor, particularly for projects that are more interactive, and this is one of the reasons why the digital drawing bar has been moved from a concourse on Level 1 to next a café at Level 0, which was planned as a space for family visitors (TA_C 2016).

Digital technology has been embraced to take the main role and encourage visitors to create their drawings easily and widely share them with others. This is not only limited to the physical space, as they can be shared globally via the internet. In addition, the huge projection wall seems to make the space immersive and results in further engagement.

8.4.1.2 Timeline of Modern Art

The Timeline of Modern Art (Figure 8.3) was launched in 2015, and is the Clore Welcome Room, Level 0 at Tate Modern (Tate 2016a). This 6.5-metre-long digital touch screen consists of a series of touch-sensitive micro-tiles, and visitors simply touch the moving words and images that they are interested in. They can then read more about key art movements and see the connections between artists across times. From the planning phase of this project's development, it has aimed to target visitors who want to find out more about works of art (TA_C 2016). Thus, this project aims to provide further knowledge on museum collections, provide people with a taste of what they can see in the galleries, highlight global aspects of the collection, and present the collections visually (TA_C 2016).
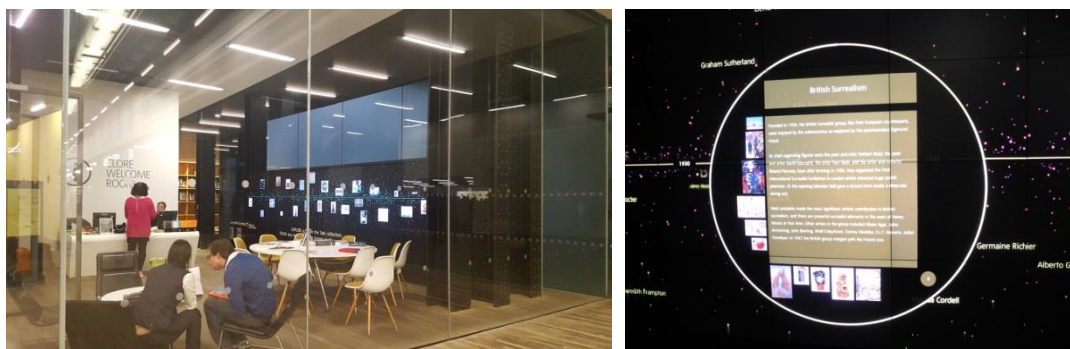
Figure 8.3 Timeline of Modern Art providing in-depth explanations on artworks that visitors might encounter at Tate Modern

According to one interviewee, TA_C, this digital project was motivated by several factors. A previous project, a timeline of modern art written on the wall of a concourse space in graphics, predated this project, but was difficult to alter due to the nature of the material. This was only based on text, with no images, and feedback from visitors indicated that they wanted to also see images. The reproduction of the graphic timeline in a little booklet has sold well to the public in the museum shop, and visitors seem to want to know about artworks according to their chronological order, although Tate Modern's permanent exhibitions are famous for their thematic approaches (TA_C 2016).

Digital technology has worked well to support the motivations of both the institutional aspect and that of visitors and achieves multiple goals (TA_C 2016). The flexibility of the digital platform allows the museum to easily change and update the content, and it has been designed to be updated efficiently by internal staff. This enables the museum to present different stories, such as a point of view from less represented communities. As the interpretation team has embraced the diverse voices of visitors and reflects the various interests of visitors, this digital platform is expected to provide a variety of approaches in the future. By doing so, digital technology fosters the museum to adopt cultural theory of communication (Hooper-Greenhill 1999b) that sees knowledge plural.

Additionally, digital technology which provides a variety of resources, such as text, images and videos, has been combined together in one platform, which is not only visually attractive, but also can offer in-depth content. In so doing, this project has adopted discovery learning theory, allowing visitors to learn through exploring resources and gradually finding out knowledge structured by the museum (Hein 1998). In contrast, the large visual wall, which enables visitors' social interaction as they can see others' choices and interests, facilitates social constructivism learning (Vygotsky 1978). Potentially, this approach can facilitate a way for visitors to look around the galleries.

Similar to the drawing bar project, this project has also been undertaken collaboratively by the interpretation team, digital team, and curatorial department (TA_C 2016). The curatorial department

generally has a role in selecting which artists and artworks should be involved in the timeline, while the interpretation and digital teams are responsible for managing the project and creating the content, including the visitor interactive elements. Based on my data analysis, this cross-department approach makes the project more user-focused than curator-centred.

8.4.2 In Galleries

It is not easy to find digital offerings in the galleries of Tate Modern except for mobile guides. As an interviewee, TA_C, said, this may result from the principal idea that the artworks displayed should not be interrupted by other devices.[51] She added that:

> 'I think one of the great things about doing multimedia guides and apps nowadays is when you're working in a kind of white cube museum, curators often want to keep the gallery very aesthetically pared down, very minimal, and not have lots of text on the wall or lots of extra context, but you know, we often want to present extra context and the visitor wants that. So, to provide it on a mobile can be a really good solution because you can have it with you as you're walking round the gallery, but it doesn't need to clutter up the wall. So, I think that's still really the reason why we do that.'

Consequently, mobile guides, which are discussed in Section 8.4.4, have been developed that do not need to be attached near to artworks.

8.4.3 Educational Programmes and Events

Digital Makers, as part of Tate Kids on-site museum learning programmes, is a series of digital art-making workshops for children aged 8 to 14 years old (Tate 2016b). A range of programmes has been developed, for example, designing 3D objects and drawing robots.[52] In general, these workshops are led by digital artists who utilise similar digital tools (TA_B 2016). This affects the learning approach of the workshops, as I will discuss below.

These digital learning workshops are a result of the collaboration between Tate Kids digital department, the digital learning team in the Tate learning department and digital artists. This came about due to museum practitioners' personal interests and ambitions concerning digital learning in art

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[51] When planning the Tate Modern's new building, the Switch house, which opened in June 2016, creating several digital spaces for art interpretation was considered (Tate 2015c; TA_C 2016; TA_E 2016; TA_F 2016). Basically, these spaces aim to offer new opportunities for visitors to explore various resources, discuss and debate ideas raised by the art on the display, and express their voices (TA_C 2016; TA_E 2016). However, these projects could not be included in this study because they opened after I completed data collection at the Tate.

[52] Since the Tate Kids website was redesigned, the 'Art and Technology' section is separate in the Make menu (Tate n.d.g).

museums (TA_B 2016). It has then gradually been extended to formal workshops for kids. The original digital learning programme, Digital Kit,[53] was motivated by a digital artist who was part of the Tate artist in residence programme (TA_B 2016). Thus, it can be seen how actual practice of a digital artist is associated with the learning process in the workshop programme.

The digital learning programmes developed have been tested with children to obtain feedback, before being delivered (TA_B 2016). Testing the programmes with children is essential, as digital elements can cause unexpected technical issues, and testing is also a way to understand children's interests, expectations, pre-knowledge and skills (TA_B 2016). Consequently, learners' perspectives can be reflected in the programme through a feedback loop (Hooper-Greenhill 1999a).

The artist-led digital learning workshops have adopted several learning approaches to explore digital elements as well as the Tate's collections. The Tate's collections are the backbone of the programmes and link the activities to the Tate; however, the programmes are generally intended to encourage learners to present their own ideas creatively, rather than to teach about art movements or artworks. Here, the digital artists as experts have an important role in facilitating learners who might have no experience of the tools. Therefore, the situated learning approach is being adopted to encourage learners to learn through participation in the actual art practice (Lave & Wenger 1991). Knowledge that experts have is shared with learners through the participation and learners contribute to produce new knowledge with the experts. An interviewee, TA_B, also highlighted, the importance of peer interactions for exchanging skills, and participants are encouraged to share and talk about their outputs. This can be scaffolding and mediation elements. Overall, by considering social interaction as a factor that can impact on learning, these programmes adopt a social constructivism approach (Vygotsky 1978).

Digital technology functions as a tool for facilitating learners to present their ideas in different ways and as new media that can make it possible to create new types of art, such as digital art. Digital technology is considered an important skill that the younger generation needs to know for the future, and the new national curriculum, which includes coding, has influenced the programme development. A research report entitled 'Young digital maker', by Nesta, was named by the interviewee as a background for the programmes planned.

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[53] 'Re-imaging landscapes' and 'Digital to chemical' are examples of the programme (Tate n.d.g).

8.4.4 Multimedia Guides

The Tate has three different types of multimedia guide systems. The first type is a guide for some special exhibitions, which has been developed by an external company, and visitors pay to rent a guide device. The next type is a free audio guide for the other exhibitions, developed by in-house technicians from the Tate digital department (TA_E 2016). Because selling a service and making a profit are important to the company, the Tate and the company decide which special exhibitions will have a multimedia guide, depending on the anticipated number of visitors (TA_E 2016). When the new Tate Modern building was opened to the public in 2016, the museum launched a new app for the permanent galleries of Tate Britain and Tate Modern.[54]

Although the three types of mobile guides have been developed in slightly different contexts, the Tate has tried to keep a similar approach by providing a similar experience (TA_E 2016). Visitors with the multimedia guide generally listen to audio descriptions, watch videos, and read additional text relevant to the artworks displayed. The content has been selected so that non-art specialists can understand it, although depending on the target audience, which is determined by curators, the content can be more academic (TA_E 2016).

In terms of communication theory, it adopts the cultural theory of communication (Hooper-Greenhill 1999b). This is because the mobile guides are intended to embrace multiple voices and present different views about art works in order to assist visitors with different cultural and social backgrounds to reconstruct knowledge by themselves (TA_C 2016). Digital technology makes it possible to present a multiplicity of interpretations for artworks rather than a short explanation on a panel written by curators (TA_C 2016). Therefore, the social constructivism approach (Vygotsky 1978) which acknowledges the impact of different cultures and social backgrounds of learners, underpins the multimedia guides.

Based on the analysis of my data, these approaches result from the collaborative work process involving various voices. The Interpretation team takes charge of creating and editing the content (TA_E 2016), and as the representative of the Tate it works closely with the company developing the guide, while also providing a useful internal resource. In addition, they undertake image research when necessary. The work scope of the internal team and external company can vary depending on a project, as a result of the content and resources available (TA_E 2016). The collaborative and complicated work process among the interpretation team, curatorial teams, digital team and a development company continues until an exhibition opens, because some artworks may be included

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[54] http://www.tate.org.uk/context-comment/apps/tate-app [Accessed 21 August 2017].

or excluded, and the mobile guide needs to be responsive. Audience research on the guide system has been conducted continuously to determine which factors cause visitors to engage in the museum (TA_E 2016).

8.4.5 Online Research

The Archive and Access project is a collection digitisation project funded by the HLF (Tate 2015b), although it involves more than simply digitising collections and uploading them to the internet. This is a collaborative project and almost every department within the Tate has been involved since the beginning, resulting in the consideration of a range of issues, which have been discussed from each department's point of view (TA_A 2016; Tate 2015b; Tate 2013c). In addition, participants have shared what they have learnt from the project with those who are interested via a blog written by museum practitioners and a conference hosted by the Tate. I consider the sharing activities are crucial because it can contribute to reduce a gap of the understanding of the project between different departments.

Ever since the beginning of the project the museum has considered diverse ways to present the digital resources created. These include video resources, for example 'Animating the Archive', which brings to life some of the processes and practices of the project, and the stories behind artists' lives are introduced as another angle from which to understand works of art. Visitors also have a chance to look in detail at the digitised collections via screens which are positioned in corridors at the Tate. In addition, the digital learning team has run outreach programmes with other organisations across the UK that aim to make these digital resources accessible to the wider public (TA_D 2016). Furthermore, an online crowdsourcing transcription tool, AnnoTate was developed as part of the project. This is another way that the public, as volunteers, can participate in the project by helping the museum to transcribe archive materials.

It seems that the departments involved have different perspectives on the project, resulting in diverse approaches to exploring the collections and archives. What visitors can do and the communication theories adopted vary from simply consuming content, probably via one-way communication, to actively participating to create content, by adopting a cultural model of communication (Hooper-Greenhill 1999b) and serious leisure (Stebbins 2001), especially in the case of AnnoTate. However, the role of the public in this crowdsourcing tool is limited to data generation, instead of data analysis, so there is still an unequal power relationship between the public and the Tate in terms of knowledge production.

Overall, by embracing digital technology in this project, the Tate attempts to reflect the various motivations and requirements of visitors, and to provide various points of view on art interpretation and even the possibility of a different interpretation.

8.4.6 Online Learning

Tate Kids[55] is a website (Figure 8.4) for under 13-year-olds and their gatekeepers, parents and teachers (Tate n.d.h). It is intended both to entertain and educate children through colourful, interactive elements with engaging content (Jackson 2009). It was collaboratively developed by the Tate Kids Editor, a developer and an internal web designer, and is now run by the digital team from the Tate. Since the beginning of its development, it has been crucial that this website should appeal to its diverse primary audience (Jackson 2009). In order to suit and appeal to children, the museum has continuously conducted audience research with them since the very start of the website development, receiving feedback on naming, design and content, and in order to understand the current topics that children are interested, together with their pattern of internet usage and so on (TA_B 2016; Jackson 2009). TA_B, who took charge of developing the content of Tate Kids, stated:

> 'So, that's what I'm doing this afternoon. So, yes, if it's a new game, we might pitch some ideas to them [pupils] and see what they think. … or we're just making sure that the changes that we've made work and that they get their user journey and that it makes sense, where they click on something, something happens, their expectations of the technology. So, yeah, going to schools and test it out on different devices in primary schools.'

However, as the interviewee indicated, it is also true that the audience research at the Tate is mainly to test users to see if the decisions made by the museum are working properly with the visitors, rather than embracing the voices of the public from the beginning of the museum practices.

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[55] Prior to the re-launch of Tate Kids in 2008, it was housed within the Tate Learning webpage, and consisted of several collections of online games (Jackson 2009).

Figure 8.4 Tate Kids provides diverse activities that children can do, such as games
(Park 2016f)

The website had seven menus,[56] including: My Gallery; Games; Videos; Tate Create; What's on; News & Other things; and Adult Zone. According to recent audience research, Games is the most popular page, followed by Tate Create[57] and My Gallery (Box & Villaespesa 2015). The Games section has been further extended during the evolution of the website, and the Street Art game[58] is the most popular (Box & Villaespesa 2015). This success is a result of the Tate Kids ethos of 'being humorous, irreverent, anarchic, educational and non-patronising' (Jackson 2009). The content is not only authentic but also entertaining, while looking at art from different points of views. Gaming is regarded as an interesting learning approach because of its familiarity for children (TA_B 2016), and consequently, it can be relatively easy to introduce difficult topics, such as arts, through games. Games can have creative elements, be open-ended, have competitive elements, encourage intergenerational learning and team learning, and provide fun and emotional elements (TA_B 2016; Whitton 2014; Gee 2007; Kidd 2014). Thus, this approach can cover various learning aspects, not only the acquisition of intellectual knowledge, but also emotional and sociocultural elements.

Overall, the Tate Kids website underpins a social constructivism learning approach (Vygotsky 1978). Although children use this website individually in an isolated context, the website content attempts to link users by networking (Jackson 2009), and the programmes and games developed tend to consider peer users. For example, in My Gallery, users are able to create their own online gallery, can add information about their favourite artists, add their own works and those of other users, apply star ratings to works, and share works by email. According to an interviewee, TA_B, this website has also

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[56] The Tate Kids website (http://www.tate.org.uk/kids) has been redesigned after I completed data collection in early 2016. Now the website has three menus: Make; Games & Quizzes; and Explore. [Accessed 21 August 2017].

[57] Tate Create introduces various art activities that are developed by the Tate for children to undertake off-line.

[58] Users can create street art on a digital wall using rollers, sprays, stamps and stickers.

attempted to introduce various social issues, such as feminism, by linking it to artworks. This can make children think more about society and can provide new insight, based on critical pedagogy (Lindauer 2007). By so doing, this website encourages children to think about how artworks are constructed by reflecting society and social change, rather than only conveying knowledge determined by experts.

8.4.7 Summary

In this section, several digital projects at the Tate have been investigated in order to understand how digital technology has been embraced to achieve the learning goals set by the Tate. Although the overall learning approach of the Tate is social constructivism and critical pedagogy, the approaches adopted in the projects differ depending on the target audience. Projects dedicated to an audience who wants in-depth knowledge, for instance, the Timeline of Modern Art, adopt a discovery learning approach, and digital technology is only used to interact with users to provide various resources. In contrast, projects for non-art experts and children tend to adopt more social elements of learning, and digital art practice is also designed with artists.

It is interesting that the Tate considers learners (the public) to be co-producers who are willing to actively participate in projects, by adopting a cultural approach on communication. Through constant visitor research, diverse voices of the public have also been reflected. Therefore, it can be said that new museology has underpinned at the Tate's digital projects. This results from the collaborative work process between the Tate's learning, digital and curatorial departments. The Tate learning department becomes a bridge which links audiences to curatorial teams and the art expert's point of view.

8.5 Summary of Tate Modern

In this chapter, actors at Tate Modern have been identified and how they have influenced its digital projects have been investigated in terms of the communication and learning approaches adopted. The Tate itself as an actor has had to continuously negotiate with other actors in order to become involved in digital culture. The formation of a digital department and an informal internal group means that the Tate and its museum practitioners have further extended their power. By involving the Tate's learning department in every digital project in some way, this department can act as a representative of the public, who are perceived as active participants with their own voices. These digital projects have also encouraged the public to express and share their ideas with others, although these could be different from the Tate's official interpretation. Social elements, open dialogue and the exchanging of ideas are encouraged.

Chapter 9 - The British Museum

9.1 Introduction

For the second case study of UK museums, this chapter presents the findings from the British Museum (BM). The digital network of this museum is similar to the Tate in terms of its relationship with the government and the recent formation of its digital department. With this network, the museum has become an active actor, fostering its museum practitioners (e.g. digital experts) to become more empowered. Through the analysis of data collected in this study, however, this chapter argues that the BM has been mainly actualising traditional museology by limiting the potential of digital technology to deconstruct existing meanings and create new ones. The archaeological and historical collections of the BM, as actors, have affected the communication and learning approaches of the digital practices in the museum by considering knowledge as fixed and factual. Working in silos might also cause this, although the digital practices planned and designed by the learning department, especially for family visitors, tend to adopt cognitive constructivism, discovery learning approaches, and the cultural model of communication that is aware of the public's agency.

Another interesting point is that museum practitioners in the digital department and in the Samsung Digital Discovery Centre are acknowledged as active actors and brokers (Wenger 1998), who connect different sectors (e.g. digital and museum learning) and bring new approaches to the museum. With their proactive approach to digital culture, the museum's culture, which used to have barriers against embracing digital technology in practice, is beginning to change. The museum's digital practices have become increasingly diverse; for example, a crowdsourcing project (see Section 9.4.5). Nonetheless, the on-site and online digital offerings of the BM are still disconnected, and a holistic approach to the visitors' digital museum experience was not found.

In this chapter, 55 pieces of secondary data (see Appendix 3), interview data from 3 museum staff working at the BM (see Appendix 5 for their profiles), and visual data regarding the digital projects, mainly generated from my field work, were analysed.

9.2 Overview

The foundation of the BM is based on the private collections of Sir Hans Sloane, which were bequeathed to King George II for the nation (BM n.d.b). The range of these original collections was already diverse when the BM opened in 1759, from art objects to natural history collections. In the

nineteenth century, the collections were further expanded to 'not only British and medieval antiquities but also prehistoric, ethnographic and archaeological material from Europe and beyond as well as oriental art and objects' (BM n.d.b). Visitors to the BM today encounter objects from various periods collected from diverse countries. This is a different context to that of the NMK, although both are the main national museums for archaeology and history in each country. I will come back to this issue in Section 9.3.2, which explains the BM's digital network from the museum's point of view, to investigate how the objects that were collected beyond British mainland affect the BM's digital approach.

I could not find clear mission statements or a learning philosophy for the BM, although it is stated that the BM 'exists to illuminate for present and future generations throughout the world the histories of cultures by preserving, presenting, researching and enhancing the unique collections in its care' (BM 2002), and is 'to be a place of scholarly inquiry' (BM 2012b). In general, it seems to adopt a traditional museology where the research function of museums is highlighted. Yet, approximately 40% of visitors to the BM come from abroad, and the BM could endeavour to interpret objects through reflecting diverse voices, understanding the world from a global perspective, and extending the discussion and debate on controversial issues with the public (BM 2012b). The BM has acknowledged the opportunities that digital technology and media can bring, and the next section looks at the actors involved and their interconnections.

Although the BM was established during the Age of Enlightenment to educate the public, the meanings of 'public' and 'education' could be different today. According to my interviewees, BM_A and BM_B, who are education managers at the BM, generic learning outcomes (GLOs)[59], which consider learning as not only knowledge acquirement but also emotional and social aspects, have been adopted to evaluate the learning outcomes of BM learning programmes. Thus, cognitive constructivism learning theory and the cultural model of communication are expected to be adopted within digital projects. The ways that digital technology facilitates these approaches in BM projects will be investigated in Section 9.4, while the next section will explain who actors of the BM are that affect the BM's digital projects.

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[59] GLOs were developed through a study commissioned by the Museums, Libraries & Archives Council (Hooper-Greenhill 2007). Many museums, including the BM and SML, adopt these in their learning framework. Indicated outcomes of GLOs involve Knowledge and Understanding; Skills; Enjoyment, Inspiration and Creativity; Attitudes and Values; and Action, Behaviour and Progression.

9.3 Identified Actors: Their Network and Roles

The BM has a long history of connecting with the world and is a large organisation with many staff members. This could lead to both positive and negative factors when the BM has attempted to network with digital culture. In this section, actors in the BM in terms of digital projects and their network are uncovered, and I investigate the way that networks have constructed. Figure 9.1 shows the summary of the analysis of my data, which describes the BM's network with actors. In the following subsections, I will discuss each actor, including the governments and government bodies, the museum itself, museum practitioners, digital technology and digital companies, and the public.
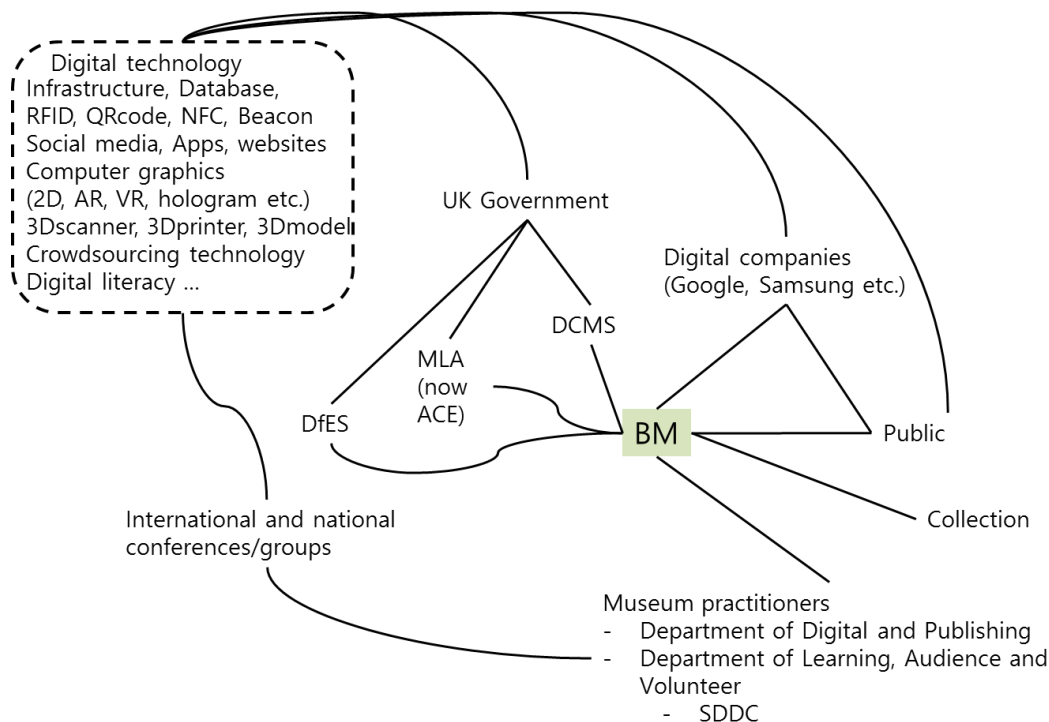
Figure 9.1 Actor-Network map of the BM

9.3.1 Government and Government Bodies

The BM is a national museum that is partially funded by the DCMS. In this section, the UK government and government bodies are traced as actors, although it does not seem that they have 'directly' influenced the digital projects of the BM.

Firstly, based on the analysis of my data, the government has extended its network into digital culture by posing issues in terms of British collections management and their accessibility. A 1996 report entitled 'Treasures in Trust', published by Department of National Heritage (now called the DCMS), called for a way to be found of recognising the richness and diversity of collections. With the report,

as a device (Callon 1986) that is used to consolidate the network of other actors, the government succeeded in involving the BM and digital technology into its network.

Digital technology, especially databases and web technology, was attractive to the government, and led to the funding of digital projects. The Portable Antiquities Scheme (PAS)[60] and Cornucopia (Turner 2004) projects that the BM participated in, exemplify the way the government has extended its network, and the World Timeline website of the BM was also made possible by the Capital Modernisation Fund (BM 2004, p.57). These projects were overseen by the government, and administered by a government body, the Museums and Galleries Commission[61] (Dunmore 2006). As a result, the DCMS and MLA[62] seem to have had a crucial role as a representative (Callon 1986), in supporting these projects. Moreover, as part of the PAS project, an ICT adviser was appointed at the BM, thereby involving a human actor with specialist digital skills in the network. Other human actors, museum practitioners, will be further investigated in Section 9.3.3.

The Department for Education and Skills (DfES, now Department for Education) is also an actor when considering the digital learning resources developed by museums. The department has a role to consider digital learning resources in lifelong learning and has attempted to work together with museums when museums develop e-learning resources (DfES 2005, p.148). The BM's learning resource, Teaching History 100 project, can be understood in this context.

Furthermore, UK research councils have recognised digital technology as a new research tool, and digital culture as a new research subject has been the reason for the funding of several digital projects of the BM and has encouraged innovative research ideas. The MicroPasts project (see Section 9.4.5) was also funded by the AHRC, and this has further allowed the BM to take advantage of digital technology in their research, and to foster new approaches.

In summary, the early digital projects of the BM were generally funded by the government and the government continues to encourage its digital culture. Although funding from the DCMS is not stable and guaranteed, there are still funding opportunities from other government bodies, which attract the BM to get involved into digital culture. However, the evolution of digital projects is dependent upon the capability of the BM as an independent organisation. Thus, it is necessary for the BM to be an active actor in order to attract other actors, such as sponsors, who can support their digital projects

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[60] https://finds.org.uk/ [Accessed 21 August 2017].

[61] In 2000, the Museums and Galleries Commission and the Library and Information Commission were combined into Re:source, which was later renamed the Museums, Libraries & Archives Council (MLA).

[62] The MLA was a national agency working on behalf of museums, libraries and archives, and advised the government on policy and priorities for the sector. It was abolished in 2012 and its functions were transferred to the ACE and the National Archives.

further in terms of both budget and technological aspects. In the next section, the ways the BM has extended its network will be described.

9.3.2 The Museum Itself

The BM is a very big museum in terms of its diverse collections. Its collections make the BM unique and become a point connecting the museum to the public. Regarding this, I will explain why and how the BM has extended its network into digital culture, and discuss how its digital strategy, as a device in ANT (Callon 1986), supports its mission. Moreover, I will see how this old museum changes its organisational structure to reflect the digital age.

The BM is a popular tourist attraction in London. Although the physical space of the BM still has a significant meaning, it has been extending its boundary into digital world. The Head of Digital at the BM even stated, 'The British Museum is undergoing a historic once in a lifetime transformation, from being a physical place to a digitally connected place' (BM n.d.c).

Additionally, the embrace of new media is perceived to 'have revolutionised access to the collection, and helped the British Museum truly become a "museum of the world"' (BM 2006, p.37). This is because, while the physical space of the museum can present a barrier to potential visitors, digital technology and new media can provide opportunities for the museum to welcome visitors in a variety of ways (BM 2006, p.37). The underpinning idea of making the museum's collection information accessible on the internet for the public and of encouraging the public to look at and enjoy it comes from the fundamental philosophy of the museum, namely Enlightenment (BM 2006, p.4). By doing so, the museum is further attempting to network with digital culture.

However, based on the analysis of my data, this approach of the BM on digital can be understood just as another form of its encyclopaedic/imperialist approach (Barringer & Flynn 1998; Simpson 2001; Duthie 2011), rather than a way of democratising the museum for the public, especially for those who cannot physically come and see their national objects that the BM has hold from the history of colonialism. This is a result of the BM principally maintaining the idea that people can see the entire world in the BM, and that the museum is regarded as a centre of world cultural heritage (O'Neill 2004; Duthie 2011). If the BM develops its digital projects as aiming to be democratised, the contents of projects would allow diverse interpretations of the BM collections as reflecting diverse cultures of the public, based on cultural theory of communication (Hooper-Greenhill 1999b), and would provide alternative approaches that might enable the source communities of non-British collections to be empowered with innovative digital technology. Alternatively, at least, an approach could be adopted that addresses current controversial issues surrounding the BM's collections, for example, through a

language of hope and critique based on critical pedagogy (see Section 3.4.4). Yet, the BM harnesses digital technology to enhance its world reputation as a storage of knowledge and objects of the world by adopting a transmission model of communication (Hooper-Greenhill 1999a) that considers knowledge objective, factual and fixed. Some examples of this will be explained below, although I will come back to the investigation of communication approaches of the BM's digital projects in Section 9.4.

One of digital projects which was accessible to the public is the COMPASS. The COMPASS database was installed in the Information Centre within the Reading Room to allow on-site visitors to explore the BM's collections (BM 1996, p.65), while online visitors could view them via the museum's official website (BM 1996, p.6). A children's version of COMPASS was also launched in 2001 (BM 2002, p.20), and more recently, the museum launched Collection online, a web version of its collection database (Szrajber 2008). This decision to make the BM's internal collection database publicly available on the web, rather than rewriting it for this particular audience, seems to result from the challenges the institution faces. It is difficult to handle collection information and to determine a particular audience for it due to the range of anticipated users, from academics to the general public (Szrajber 2008). However, this project also takes encyclopaedic approach by adopting a transmission model of communication (Hooper-Greenhill 1999a). Employing academic terms for the categories and descriptions in the service even can make the general public feel unwelcomed. Moreover, generally, non-experts tend to prefer browsing to specific searching (Frost 2010). Although I will further look at the BM's digital projects in Section 9.4, the BM's approach to digital seems to be based on a pursuit of being an authorised museum.

In terms of organisational structure, fundamentally, the BM is not a digital-friendly organisation. The ways to extend the presence of the museum into the digital culture began by the museum imposing conditions on its collection management and documentation systems. This can be understood as the first step of translation, problematisation (Callon 1986). Since the late 1970s, embedding computers and electronic technology has been encouraged for the efficient management of the massive collections (Szrajber 2007). Although in the early days of digitising collection projects, this was undertaken by each curatorial department separately, for instance, in Egyptian Antiquities in 1976 and in Ethnography in 1979, and a team of collection documentation staff was only formed later, with collection management systems introduced and evolving (Szrajber 2007), while a web team and the Samsung Digital Discovery Centre (SDDC) team, who mainly handle the digital technology that interfaces with the public, sit within the Department of Learning, Volunteers and Audiences. Although the SDDC is an outstanding and pioneering example in terms of digital learning in museums and its physical space makes it a stronger actor (Law 1992), its boundaries seem to be limited to its facility,

and not the whole museum experience point of view. Thus, according to my interviewee, BM_C, it has not been easy to embrace digital technology as a strategic approach across the BM, and the museum lacks staff members with digital skills such as programming.

Recently, significant changes have occurred following the formation of the Department of Digital Media and Publishing in 2014. Digital projects that were distributed across the BM are now run by this department, which has grown and recruited several digital specialists like a digital data analyst. BM_C stated:

> 'We have a very new department. It's about 18 months old. Until recently, we had a department that just dealt with the website, so it was called the Web Team. It was pretty narrow-focused, where it was just doing a web offering and a couple of apps. People [visitors] are now starting to expect more digital opportunities within museums. … And so we needed a much bigger department to deal with that…. We now have a department of around 26 people.… And it's planning to grow by about 30% over the next year.'

The department has taken on several roles,[63] including management of the BM website, the Google Cultural Institute project, an audio-guide project, digital data analysis, and web and video production and broadcasting (BM_C 2016). The formation of this new department can enable the BM to extend a more stable and durable network (Law 1992) into digital culture.

By delivering the BM's new digital strategy, a device of ANT (Callon 1986), the new digital department can further encourage other actors into digital and becomes a representative who can mobilise other actors in a certain direction (Callon 1986). The BM's new digital strategy aims to 'widen digital audience via its digital platforms and services, as well as to plan for its implications from how online users understand the BM to the commercial implications of digital platforms' (BM 2015a, p.27). As the strategy notes, the BM aims not only to reach the global audience and engage them with the museum, but it also attempts to generate money from digital offerings (Blooloop 2015). For this, the BM is now considering the advantages that digital technology that can provide in terms of audience data. For example, the BM expects to improve its online ticketing service by analysing data on how the public uses the museum's website and behaves when they buy tickets.

As another way to extend the BM's digital network, the museum organised several public debates, which are acting as devices of ANT (Callon 1986). Through the public events, the BM has addressed issues on digital culture in the museum contexts and has raised awareness on this together with other

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[63] The BM's social media is run by the marketing department (BM_C 2016).

actors, such as museum experts and the public. The Museum of the Future programme in 2014 exemplifies this (BM n.d.d; BM 2015a, p.24) as the role of physical collections in the digital age, and how people use museums with technologies was discussed. Afterwards, placing digital reform at the heart of the museum's future programmes and undertaking a user-centric review of all digital offerings was recommended (BM 2015b). In addition, engagement through social media was suggested.

In summary, the BM has embraced digital technology for its own purposes and attracted other actors in order to include them into the digital network. The BM has reorganised its structure to fit into the digital culture and recruited digital experts who are expected to lead the museum further into digital culture. By participating in collaborative digital projects and organising public programmes, the museum can network with other actors, for example, external experts, relevant cultural institutions, and the public. However, the reasons of the BM getting involved in digital culture are understood as one of its imperialist approaches rather than democratic one. By harnessing digital technology, the BM can further deliver its knowledge across the world. Regarding this, I will come back to underpinning communication approach of its digital projects in Section 9.4. In the next section, I turn to museum practitioners' points of view on the BM's digital culture.

9.3.3 Museum Practitioners

The BM can be understood not only as a concrete organisation but also a connected network with staff members who have diverse academic backgrounds and interests. Although the majority of staff have experience of archaeological subject matters, their work and services provided are now more focused towards the public, as the educational and social roles of museums has been emphasised. In the BM, an education service (now called the Department of Learning, Volunteers and Audiences) was established by the 1970s (BM n.d.b), and the department is now responsible for public engagement and services. In terms of the digital offerings in the BM, the web team used to belong to this department, and its structure could impact on the approach taken by the BM towards web development, which has been based on audience research.

It has been deemed necessary to employ specialised staff as the BM's digital projects have expanded. For example, ICT adviser(s) for digital projects such as PAS have been employed in new capacities at the BM, although these posts were more likely to be associated with MLA projects (BM n.d.e). Recently, internal human actors who mainly provide digital offerings have been increased, and their voices can be heard more following the foundation of the new Digital Department. This seems to enable the BM to further connect to the digital world and understand it in the context of the museum. BM_C stated:

'I want people to start teaching curators how to use these digital tools, and teach them that they can manipulate data quickly, that they can build their own website, blog or whatever with a portfolio of what they're doing themselves. So, they'll learn a bit more and then they can ask for things that they want; they speak the same language as the people who work with digital.'

Embracing digital features within the museums and culture sectors is still an evolving area, and normally, a significant budget is needed to launch a digital project. As a pioneering museum that has undertaken experimental and innovative digital projects, the museum practitioners of the BM have continuously shared what they have done with digital technology and what they learnt with other museums through informal networks, such as conferences.[64] Blogs and conference papers written by BM museum practitioners and talks/lectures/seminars in universities delivered by them are easily found. Talking about their digital projects with others can inspire future projects, as well as allow learning about more practical aspects of projects. This is a benefit of a CoP (Wenger 1998), which practitioners working in an emerging area might be encouraged to participate in it (BM_AB 2015). Through actively participating in a CoP, museum practitioners are better recognised and potentially can expand their own network.

The museum practitioners who deal with digital technology have to continuously develop their knowledge and keep up-to-date with trends in the digital world. Because of the rapid evolution of technology, it is necessary for museum practitioners to be aware of new possibilities provided by new technology, and to teach themselves to understand this technology. Staff members of the SDDC have undertaken courses in computer coding and sometimes attend technology-related conferences (BM_AB 2015). The museum digital learning area is situated within the boundaries of both digital and museum sectors. Thus, by participating in conferences in both these sectors, which are CoP, the museum practitioners become brokers (Wenger 1998) who can bring new ideas from one side to the other and provide opportunities to network with other actors who are likely to be closer to the technology area.

Sharing stories about digital projects with other practitioners of the BM through informal meetings also enables museum practitioners to overcome the gap between different perspectives on digital culture, and enhance the understanding of other departments' points of view while preventing it being in silo. Thus, sharing what they are doing and what they learnt from previous projects seems crucial for a big organisation like the BM to harmonise internally. An interviewee (BM_A) also noted that:

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[64] UK Museums on the Web, Museum Next and the international conference Museums and the Web, etc.

'We sit within Schools and Young Audiences department but as a digital programme, we naturally have lots of links to the wider digital strategy in the museum… and the encouragement of people not working in silo, so obviously, we may be in different departments but we try and make sure that we're communicating our aims, our objectives, what we're hoping to do, and sit well within the museum as a whole.'

Overall, museum practitioners who have specialist skills and interests in digital technology have been involved as internal actors in the BM, and potentially attract external actors through social networking, such a via a CoP. The integrated museum digital experience should be managed by interconnecting internal human actors across departments.

9.3.4 Digital Technology and Digital Companies

Digital technology as an actor has influenced several issues within museum practices, including sharing collection management and information, to researching in a new way by employing digital technology to uncover new knowledge about the collections. In doing so, the technology has finally attracted some museum curators who did not get involved into digital culture. Although it is not easy to find digital exhibits within BM galleries, there are some examples; the 'Virtual Autopsy of an Egyptian Mummy' (BM 2001, p.28) and 'Ancient Lives, New Discoveries' exhibitions[65] (BM 2013, p.11), which have harnessed 3D scanning technology and image visualisation technology to reveal new stories about objects, such as what ancient people ate and how they died. It is also possible to present the new knowledge in different ways through the use of digital tables in the exhibition.

Digital technology and media are also perceived to provide new approaches to museum learning. Based on the analysis of my data, the technology has particularly extended its network to young visitors than to adults. Many examples of education programmes and events for school pupils and family visitors can be found, which harness digital elements. The interviewees, BM_A and BM_B, also highlighted that school teachers are interested in digital learning programmes due to their unique features. Moreover, computing skills are increasingly recognised as important for younger generation as contemporary society continues to widely embrace digital technology. Since digital literacy has been emphasised in the UK national curriculum, the SDDC has launched a new innovation lab programme for teens. This not only teaches how to edit images using software, but also links future careers in the digital area (Rae 2015).

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[65] 'Ancient Lives, New Discoveries' was sponsored by Julius Bär with Samsung as the technology partner (BM 2013, p.11).

Furthermore, digital technology has grown rapidly and the BM has to manage and update its technology infrastructure in order to satisfy not only an internal need but also the visitors' need to connect to free WiFi in a public space (BM_C 2016). Therefore, it is necessary for the BM to constantly invest in the technology. From the technology's point of view, this is one of ways that it keeps and extends the network.

In order to continue exploring and extending its digital projects, the BM also needs to find interested sponsors. Public funds have enabled the digitisation of museum collections (BM 2012a, p.63), but most of the digital projects at the BM have only been possible through multiple partnerships with media or technology corporate sponsors.

Giant digital companies developing cutting-edge technology devices are more likely to be attracted to the BM due to the richness of its collections and it being a popular tourist attraction. For example, Samsung supported the SDDC, where children and young people can learn about and interact with the BM collections via Samsung digital devices (BM 2009, p.76). This partnership can be understood as an investment in future education and marketing for Samsung. Google has also had a close partnership with the BM by providing outstanding web technology to develop a new tool to present the BM's collection on the internet (BM_C 2016). These digital companies, who have developed digital devices and services, have extended their networks into a museum which is already connected to the public. This approach of sustaining partnerships with technology companies and digital publishers is also a strategy of the BM (BM 2012b).

The partnerships that have made the large digital projects possible seem to be encouraged by the formation of an informal human network. For instance, events like the REMIX SUMMIT, where leaders of the creative and cultural industry and innovative digital industry meet together to share their visions, potentially provide opportunities to connect with others, and participants can informally discuss their potential future projects. The head of Digital at the BM participated in this event and gave a talk. Especially in the UK context, IT, software and computer services are broadly involved in the creative industries and were the second fastest growing area by employment between 2011 and 2015 (DCMS 2016a). Through this type of event, a device of ANT (Callon 1986), digital companies can meet members of the culture sector, like the BM, and there is the possibility to develop a relationship as partners and co-workers. Each has expertise in their area, and partnership rather than sponsorship can give each side agency and make their projects more integrated rather than one-way financial support.

As noted above, the intention of digital technology and digital companies to extend their network to the BM is associated with connecting to the public. In the following section, I will turn to the public's perspective as an actor in the BM's digital network.

9.3.5 The Public

Nearly 7 million people visited the BM on-site in 2014 and around 34 million visits are made to the website every year (BM 2015a, p.4). In order to investigate if the public is an actor of the BM, I look at the extent of which the BM has interconnected with the public, and whether the public is negotiating with the BM to achieve their goal.

Issues on understanding visitors' various motivations and expectations, and communicating with them, have been raised relating to increasing their satisfactions in terms of their experience of the BM (Mannion et al. 2015). Thus, collecting the voices of the public, both visitors and non-visitors, has been approached in various ways by the BM. The Department of Learning, Volunteers and Audiences has continued to undertake visitor research (BM n.d.f) and public participation programmes, such as 'Old Object and New Voice' and 'People & Place', which have reflected the diverse perspectives of the public on museum collections. This approach can be more active through the use of digital technology, which can enable the public to coproduce content. For example, an online campaign associated with an exhibition has been run to collect personal stories about the Hajj via its website (BM 2011, p.35), and objects suggested by public for the History 100 project have been considered and shared with other participants (BM 2011, p.38; Cock et al. 2011) The new audio guide that was launched in 2016 was designed based on the Visitor Attributes Scale, which was developed by the BM through visitor research (Mannion et al. 2015).

Embracing digital technology, especially the website and social media, has been an attempt by the BM to reach the wider public, where digital technology is already embedded in their daily life. Social media has been recognised as a platform to directly communicate with the public (Pett 2012). Thus, internet third-party services like YouTube, Facebook, and Mindcraft, where the public is already present, have been utilised, rather than the BM's own media or blogs (BM_C 2016).

Overall, the public is recognised as an actor in the BM. The power relation between the public and the BM, however, will be further examined in Section 9.4 by investigating communication and learning approaches adopted in the BM's digital projects.

9.3.6 Summary

This section has identified the actors in the BM's digital culture and their relationships. The BM, which is a national museum with many rich collections and a popular tourist attraction in London, is also a place of scholarly inquiry (BM 2012b). The BM stated that digital technology has been embraced to actualise 'a museum of the world' for the world by making it accessible (BM 2015a). Based on my data analysis, this BM's approach on digital is uncovered as another form of its encyclopaedic/imperialist approach, rather than a way of democratising the museum for the public.

It is interesting that digital companies with skills and technology have further extended their networks to the BM through partnerships, while the government has continued to encourage the BM to develop digital projects and learning programmes that can improve the digital literacy of the younger generation. The formation of the new digital department has further empowered digital technology and digital experts in the BM, and enables the BM take strategic and holistic approaches to digital. The dynamic network seems to be flourishing more through museum practitioners' active participation in social events and CoP-like groups.

9.4 Digital Projects

The actors identified in the previous section have influenced the digital projects of the BM in different ways. In this section, how the actors work and what communication and learning theories underpin the projects will be investigated. It will be seen that digital technology has different roles, depending on what theories are adopted. Thus, I explain the extent of the overall learning philosophy of the BM, which is based on discovery learning and the cognitive constructivism approach. Furthermore, I discuss how this is linked to museology. The data I analysed in this section is secondary, interview and image data. Where I was unable to conduct interviews with museum practitioners who took charge of the development of a digital project, for example, the multimedia guide, I attempted to collect and analyse secondary data from publications on the projects by the practitioners. This section starts with the digital signage in the orientation hall followed by a digital exhibit in a permanent gallery, educational programmes, mobile guides, and online offerings.

9.4.1 Orientation Space

The BM has a number of entrances, although the south gate is the most widely used by visitors. The Great Court is a huge space, which most visitors encounter after passing through the gate. As an

orientation space, the Great Court offers several services for visitors, including information desks, ticket office, museum maps, audio-guide rental, guide books sales, etc.

'What's on' (Figure 9.2) is a digital signage system that presents the activities currently taking places or will soon be occurring. This screen is non-touchable and so visitors are unable to explore and interact with the content. Here, digital technology is only adopted for information display and for updating information efficiently (Booth 1998), and messages are supposed to be transferred from the museum to its visitors by adopting a transmission model of communication (Hooper-Greenhill 1999a).

Figure 9.2 Digital signage - 'What's on'

9.4.2 In Galleries

On-site visitors of the BM encounter a range of exhibit interpretation methods within galleries, from analogue styles such as labels, panels, leaflets and worksheets, to new digital approaches with embedded digital elements, such as an interactive touch screen table. Although digital interpretation seems to be rare within the permanent galleries of the BM[66], a virtual autopsy table (Figure 9.3) in the new Raymond and Beverly Sackler Gallery of Early Egypt (Room 64, Upper level) is an example (BM 2014, p.15).

In this project, digital technology has several roles: leading to new research findings, presenting the results in a new way within the gallery, and encouraging visitors to know more about the museum collection. Based on medical visualisation technology, the new state-of-the-art interactive exhibit

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[66] 3D scanning of mummies has been continuously undertaken at the BM. The first project I can find in the annual reports of the BM is a 3D scan of a mummy in 2001 (BM 2001, p.28). More recently, scanning data and 3D images have been displayed in temporary exhibitions such as 'Ancient Lives, New Discoveries' and 'Scanning Sobek: mummy of the crocodile god' (BM 2014, p.18; BM 2015c).

virtual autopsy table offers the chance for gallery visitors to operate an interactive touch screen and explore CT scans of a 5,500-year-old mummy (Antoine 2012).

While they are zooming, rotating, and sliding the CT images on the screen, visitors can observe the detail of the images and uncover new findings that the museum curator only recently discovered using this technology. 'Information points' on the images guide users to the more detailed content, and through this activity, users can discover and understand the findings that the BM has produced. Based on my data analysis, the knowledge produced by the museum in this project is considered factual and it is simply conveyed from the museum to visitors. Therefore a transmission model of communication (Hooper-Greenhill 1999a) underpins this project. In terms of learning approach, this system fosters the user to find out 'correct' knowledge and interpretations based on discovery learning theory (Hein 1998). This is because users are perceived as active learners who are willing to explore the system themselves. This digital exhibit also has no intended paths that users should follow. They can go back and forth while exploring the images and texts of the exhibit. However, the 'Information points' act as means that users can assess their own interpretation against the 'correct' one determined by the museum. On the near wall, a non-touchable screen is installed, which shows the same scene as present on the interactive table. This screen allows more than one visitor to view the digital exhibit and potentially stimulates social interaction.

This digital interpretation media seems to be primarily designed for the scientific research conducted by the BM, together with a hospital that supported the CT technology in order to understand and uncover the mummy in different ways (Antoine 2012). With the Interactive Institute, the interactive table was finally developed for the public and it is not certain if the education department was involved in the development process. The project was mainly driven by a curatorial department as the technology attracted subject matter experts. The digital exhibit also seems to be an add-on element in the gallery rather than integrating with other displays. This may result from the project only receiving funding for research on the mummy rather than for the whole exhibition. In addition, it does not seem to be clear how the digital exhibit makes a conceptual link between the real object and the digital element, and how the expert knowledge from the research findings encourages museum visitors to make a personal meaning.
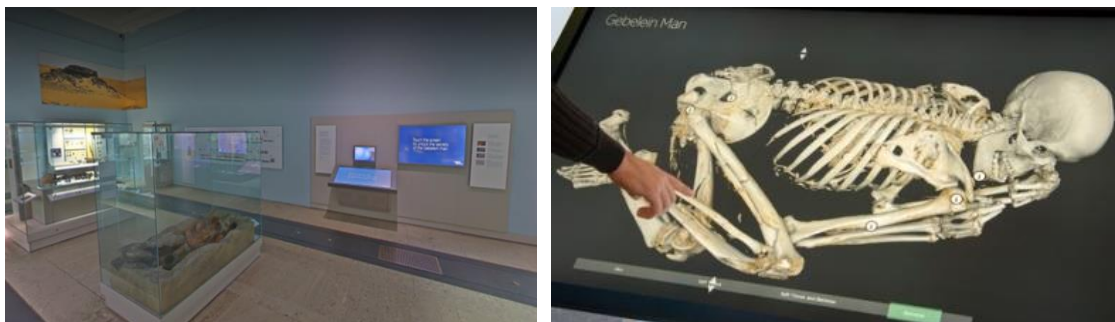
Figure 9.3 A virtual autopsy exhibit where visitors can find out details on CT images of a mummy

9.4.3 Educational Programmes and Events

Digital learning programmes and events on-site at the BM, in general, have been enlarged since the SDDC was opened in 2009. The SDDC, with support from Samsung, a world leading company producing digital devices, has been well equipped with a range of digital devices[67] for its public programmes, which specifically target schoolchildren, teens and family visitors (BM 2009, p.62). This may be aligned to the company's wider digital classroom initiative (Samsung n.d.), which aims to encourage the next generation to become more engaged and collaborative through digital technology. In addition, this approach meets the BM's ambition to provide innovative programmes for young visitors in order to capture their interest (BM 2009, p.62).

The SDDC comes under the Schools and Young Audiences team within the Department of Learning, Volunteers and Audiences. The strategic vision of the Learning Department has two key principles, which are embraced by the programmes of the SDDC: focusing on collections of the BM and providing meaningful ways of accessing and engaging with them; and visitor-centredness, meaning that the access and engagement strategies need to be responsive to audience profiles, needs and interests (Sabiescu & Charatzopoulou 2015). In the SDDC, digital technology has a crucial role in employing this vision.

Based on my data analysis, a cultural theory of communication (Hooper-Greenhill 1999b) underpins the SDDC programmes. For instance, in one school programme, the Symbols and Statues in Buddhist Beliefs, school pupils used tablet computers in small groups to capture museum objects, such as Buddha statues in the galleries, and created multimedia presentations to interpret them from their own perspectives (Doll 2012). In other words, the learners are allowed to produce new knowledge that

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[67] The range of digital devices that have been facilitated in the learning programmes include laptops, Android smartphones, a smartboard, cameras, video cameras, audio recording equipment, a 3D television, a green screen, and Galaxy tablet devices (Sabiescu & Charatzopoulou 2015, p.8).

might be different, depending on an interpretive community they belong to. The new knowledge can even differ from the museum's official interpretation. However, programmes for school groups tend to have more links to the school curriculum and include more knowledge-based activities than family sessions because teachers are more likely to value increased knowledge and understanding (Doll 2012; BM_AB 2016).

According to the managers of the SDDC, BM_A and BM_B, its programmes have two main approaches: one is historical enquiry related to objects and the collection, and the other is a creative response. They also mentioned that these two approaches are complementary and there is no clear boundary between the two. This is associated with the cognitive constructivism learning theory (Hein 1998) that the SDDC programmes have mainly adopted. This is because, in the programmes, visitors are encouraged to actively participate (take pictures of objects, create a presentation, and physically engage with museum objects, etc.) in order to learn and create something. Moreover, the goals of the programmes are not finding right answers but constructing content and developing knowledge through continuous interactions between an individual and their environment.

For example, in a family session, an Egyptian photo booth (Figure 9.4) allows family visitors to take a picture of them in an Egyptian painting, using green screen technology, while discovering what the poses of Egyptian pharaohs, gods and dancers mean (BM 2016a). The meanings in the painting are considered subjective in the programme by the participants to produce outputs to creatively present their thoughts and experiences of the painting. The programmes, especially those employing mobile devices, are more likely designed to support various types of learning styles, such as kinaesthetic and mechanical learners (BM_AB 2015; Mannion 2011). By exploring galleries with these devices, learners are supposed to be engaged physically, and this is perceived to support their learning. BM_B, the Education Manager, stated:

> 'I think there is no one best way of learning, there's no one way that everyone learns. So, some people might learn best by themselves. Some people might learn best in groups. … And we can't define that. However, in our sessions, we provide opportunities for all those different methods of learning.'

On the other hand, the SDDC adopts GLOs when evaluating learning outcomes of their programmes (BM_AB 2015), which support that learning in the centre not only refers to the acquirement of knowledge but also social and emotional aspects. Especially during the family drop-in sessions, attempts are made to engage all the family members as a learning unit, rather than only providing programmes for children (BM_AB 2015). The family group experience is recognised as an important learning outcome based on the social constructivism learning theory (Vygotsky 1978).

Figure 9.4 Egyptian photo booth programme where participants creatively present their experience
(BM 2016b)

More recently, and to reflect the new inclusion of computing within the national curriculum, digital literacy, such as coding skills, has been further integrated into the SDDC programmes. The stories of Krishna,[68] Innovation lab: future makers,[69] and Teens game design workshops[70] exemplify this by providing opportunities for participants to explore various types of digital technology in order to create new things, rather than simply consuming the technology.

In terms of the working process for SDDC programme development, the centre is run by a small team, including two education managers and several session facilitators. The team is in charge of designing, managing and evaluating learning sessions, and mostly works independently (Sabiescu & Charatzopoulou 2015). When designing programmes, members of staff who participate in meetings and events at the museum are encouraged to join ongoing museum projects (BM_AB 2015). Advice is received on their digital workshops from school teachers and is reflected in their comments (BM_AB 2015). Several visitor studies have been conducted and so a circular model of communication with feedback (Hooper-Greenhill 1999a) for the development process of the programmes has been adopted.

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[68] The stories of Krishna are designed for learners aged over 5 years and their family to discover the many avatars of the Hindu god Krishna, and to develop computer coding skills to make characters move and play (BM n.d.h).

[69] The Innovation lab is designed for learners aged over 7 years and their family through experimenting with the latest maker technology and creating their own masterpieces, inspired by metal objects of the BM (BM n.d.h).

[70] This workshop, which is suitable for teenagers aged 13–15, allows participants to draw characters and settings inspired by Mayan objects from Mexico to feature in their own computer game, and then learn programming skills on tablets to create games (BM n.d.h).

A recent VR programme[71] has demonstrated the potential of the SDDC to work together with other departments of the BM, such as the Digital and Publishing Department. Through a collaborative work process, 3D models created by the Micro Pasts project were used to develop a VR scene within a short development time schedule (BM_AB 2015). This could occur because the BM has a consistent approach to digital culture.

In summary, throughout the SDDC programmes, digital technology as a learning tool has been adopted for content construction and collaboration rather than content delivery. Recently, digital technology itself as a learning subject has been further addressed, and the collections of the museum act as the backbone for associating learners with technology.

9.4.4 Multimedia Guide

An audio-guide system was introduced into the BM in the mid-1980s (Mannion et al. 2015), although the hardware and software technology has evolved, and the design and content approach has been redeveloped several times (BM 2002, p.20; BM 2010, p.10). In 2015, the museum launched a new audio guide for the permanent galleries, with support from its sponsor, Korean Air (BM 2015d).

The development of the new 'audio' guide[72] seems to have involved a long and complex collaborative process by adopting a user-centred approach (Mannion et al. 2015). A team led by a project manager, with a technologist, ethnographic researcher, and digital learning specialist, conducted visitor surveys and interviews, and observed audio-guide users (Mannion et al. 2015). A prototype was also tested with visitors, and the team worked together with the Visitor Service staff and the Museum's retail team from the beginning of the project (Mannion et al. 2015). This long development process seems to have provided the team with various opinions from different stakeholders, and also a chance to negotiate with them. Through this interactive process, diverse feedback, especially visitors' voices, is reflected in the final output.

Through the visitor research, the team recognised that visitor identity is not fixed and can change during the museum visit, and identified factors[73] that might impact visitor decisions to utilise the audio guides. These results seem to have made the team to further consider the content approach of the guide depending on target audience: adult users and family users with children. The guide for adults is more likely to deliver concrete knowledge from experts' point of views with mixed materials,

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[71] A Bronze Age roundhouse has been created in a virtual environment to explore how VR technologies could be used to engage a new generation with BM objects (Rae & Edwards 2016).

[72] It is called an 'audio' guide, although it provides not only audio description but also images and videos. The BM decided on this term, based on visitor feedback (Museums and the Web 2016).

[73] These include time, confidence, authority, tools, movement, and aim (Mannion et al. 2015).

for instance, music, images, video and text. In contrast, the family guide (Figure 9.5) adopts a game-like framework and tends to adopt cognitive constructivism (Hein 1998) and a social constructivism learning approach (Vygotsky 1978), as it encourages a family as a learning unit to express their own thoughts on an object. The family guide presents questions about objects so that each user can ask, answer and receive a score, depending on their perspective, rather than right/wrong answers which are defined by the BM. Although some content of the guide presents historical facts relating to the objects, most questions, such as 'What would you name the statue?', are designed to engage young users to actively participate in the meaning-making process with other players, rather than absorbing knowledge on objects delivered by the BM.

Figure 9.5 The family guide of the BM asking users' thoughts

In this project, digital technology has been embraced to convey content efficiently and directly interacts with users to provide information on what they want to know. In addition, in the family guide, the technology seems to lead and engage visitors to discuss their thoughts and to enjoy the museum by socially collaborating with others as a group.

9.4.5 Online Research

The recent online digital project MicroPasts,[74] jointly managed by the UCL Institute of Archaeology and the BM, is a web-based crowdsourcing platform that has been run since 2014.[75] The fundamental

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[74] http://micropasts.org [Accessed 21 August 2017].

[75] 2,014 participants have contributed, 123 projects have been completed, and in total, 133 projects have been conducted via the web platform (Pett 2016, p.15).

aim of this project is driven by the idea of 'public archaeology', which tries to make more connections between archaeology and society, and to enrich the social values of archaeological objects and research (Bonacchi et al. 2014). By so doing, this project intends 'to promote the archaeological collection and use of high quality of research data via institutional and community collaboration, both on- and off-line' (Bonacchi et al. 2014). In order to actualise this, a web platform has been developed that can connect academic researchers, communities, and members of the public with research interests in archaeology, history and heritage. Therefore, connecting groups of professionals and of non-professionals is crucial in this project, and I look at how non-professionals, the public, are recognised and their knowledge is accepted by investigating communication and learning theory underpinning this project.

It is necessary for the success of crowdsourcing projects that the public actively participates on the projects. MicroPasts contributors can participate in various activities; for example, by helping to transcribe and digitise the BM's object cards or by making 3D models by using photo-making technology available on the website (Bevan et al. 2014; Bonacchi et al. 2014). Moreover, for the quality control of the produced data, the project team not only relied on expert reviews but also asked regular contributors to help with this task. This seems to empower the contributors by providing them with the authority to decide which content is correctly presented. In other words, however, there is 'correct' knowledge that is intended and knowledge produced by contributors is controlled. On the other hand, it is also anticipated that new research initiatives will be developed collectively through the crowdsourcing platform (Bevan et al. 2014). By so doing, although there is still an unequal power relationship between experts and contributors, the overall communication approach of this project is intended to be a two-way participatory process (Bevan et al. 2014) rather than a one-way approach, which is typically adopted in crowdsourcing projects, such as for collecting data (Simon 2010, p.187; Rotman et al. 2012). In terms of learning approach, discovery learning approach (Hein 1998) underpins this digital project. This is because, although contributors gradually develop their knowledge through the participation of various volunteering activities, there is 'correct' knowledge intended.

Based on the analysis of my data, the motivation of MicroPasts contributors can be understood by serious leisure theory (Stebbins 2001) because this volunteering is not easy but complex and challenging. According to an initial finding from the project team, the majority of the contributors do not work with history or archaeology in a professional way (Bevan et al. 2014). The amateurs, hobbies, or career volunteers (Stebbins 2001) might make an initial decision to participate in the project due to their intrinsic motivation for developing their interests and knowledge. The project team also initially advertised the project to targeted communities that already existed on offline and

had a particular interest in archaeology (Pett 2016). However, the offline societies and archaeology and history research groups in the UK are not represented in the online contributors, although they were the groups expected by the project team (Bevan et al. 2014). The digital elements of a crowdsourcing project can be a barrier to attracting those who have an interest in archaeology and history but not are familiar with digital culture. Moreover, as mentioned above, by adopting a discovery learning approach in this project, there is the lack of social elements (Stebbins 2001) that can motivate volunteers. This can attract potential volunteers less and can affect volunteers who do not participate constantly.

MicroPasts has been funded by the AHRC Digital Transformations in Community Research Co-Production in the Arts and Humanities, which aims 'to harness the transformative power of digital technologies to stimulate innovative engagements and research co-production between communities and researchers' (AHRC n.d.). Here, digital technology is not only used as a tool to assist research and data generation, but also as media to connect to those who have common interests but used to be not linked. Moreover, in keeping with the open source and open data principle, it is also possible to reuse and recreate the results of projects for additional purposes, for instance, a VR project in the SDDC (BM_C 2016).

9.4.6 Online Learning

Online websites could be an efficient platform for the distribution of learning resources and to offer an online learning environment. The BM has launched several micro websites since the early 2000s, for example, Children's COMPASS (BM 2001 p.20; Howitt 2002). A recent example dedicated to child users is 'Young Explorers'[76], which was launched in 2010 (BM 2010, p.35). These micro websites provide museum collection features, making and doing activities, and games. These spaces were intended to 'create a positive feeling towards the museum and its collection; spark an interest that would inspire the seeking out of further information; offer opportunities for participation; and ultimately to establish the museum as a place young visitors want to be involved with now and if they ever grow out of Young Explorers' (Prudames 2011).

The game 'Time Explorer' (Figure 9.6), one of games on the website Young Explorers, is a simulation type of game, designed for children aged 6 to 12 years (Prudames 2011). Game players have a role as young curators who need to rescue objects from four ancient cultures from natural disasters, and to deliver them safely to a representative of the local culture. Players are encouraged to 'informally pick

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[76] Unfortunately, due to the on-going redesign process of the main website of the BM, this micro website was not accessible when this thesis was being written, although it was available during the initial phase of the research.

up information about objects and cultures along the way, or be given the opportunities to find it' rather than directly absorb and be taught information (Prudames 2011). This is a fundamental advantage of the game approach in the museum context, where players learn things unconsciously while having fun. Players are further motivated by scores and level-up elements as external motivation factors. Digital technology is adopted to create and reconstruct the context of the game, which can help learners (players) be immersed in the historical context, and visually support them to construct knowledge. This approach adopts the discovery learning theory (Hein 1998), as learners are encouraged to find correct knowledge using cognitive skills, such as observation, comparison, memorisation, analysis, and inference. However, this approach, as Schaller (2014) noted, is more like 'a museum exhibit wrapped inside a game' to attract young learners. The museum collections presented in the game are perceived as static elements, where their meanings cannot be misunderstood or interpreted differently. Therefore, the behaviourism point of view is also adopted as digital technology only functions to match right/wrong answers relating to content (Whitton 2014).
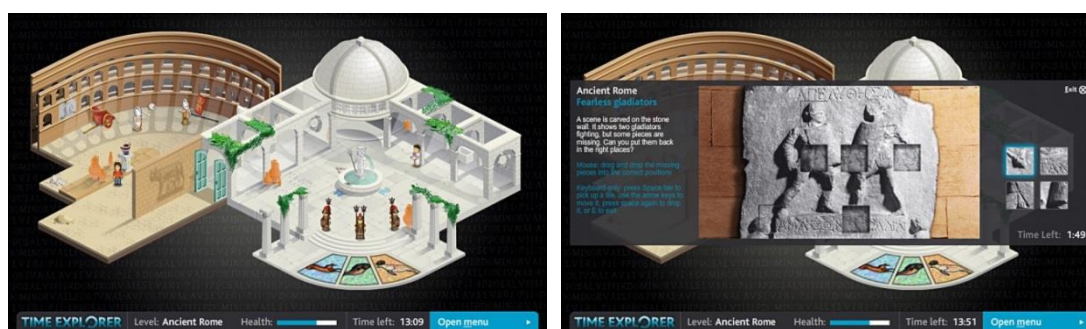
Figure 9.6 Time Explorer, a simulation type of game for children
(Smith n.d.)

Collaborative work flows may be necessary for game development, and this game project was led by a web team in the learning department, while curatorial consultants advised on the ancient culture context, and an external agency designed and developed the game (Prudames 2011). The team also carried out consultations with children during the initial design process, enabling the team to reflect the opinions of real users, and thereby employing a circular communication model (Hooper-Greenhill 1999a).

9.4.7 Summary

In this section, the BM's digital projects have been investigated in terms of the communication and learning theories adopted and the development processes employed. From the findings, it can be seen that the BM has investigated online offerings rather than on-site digital projects, such as digital interpretation within galleries. Furthermore, the physical space and digital have been developed

almost separately, rather than being integrated (Parry & Sawyer 2005). There might be several reasons for this, for instance, the lack of exhibition space to display the collections and busy exhibition areas. Mobile guides and the learning programmes of the SDDC are supposed to provide additional links to objects for the visitors.

The BM's digital projects have mainly adopted the discovery learning theory, although constructivism and cultural theory of communication are partially adopted in the projects for children. Knowledge is considered factual and objective in most of the projects. Therefore, the roles of digital technology are minimised to convey the fixed knowledge and traditional museology generally underpins in the BM's practice.

9.5 Summary of the British Museum

The BM has various rich collections from across the world and visitors come from the UK and also in significant numbers from aboard, and it has endeavoured to embrace digital technology in a number of ways. The museum has interconnected with a diverse range of actors, but its digital projects do not appear to have a cross-departmental perspective. The projects that the learning department manage tend to reflect visitors' points of view, while those managed by curatorial departments mainly adopt experts' points of view and conveying knowledge is their main purpose. The recent establishment of a new digital department is expected to act as a bridge between visitors and experts and may result in the BM more actively responding to digital.

Chapter 10 - The Science Museum, London

10.1 Introduction

This chapter discusses the final case-study museum, the Science Museum, London (SML). Although its collections include historically significant scientific objects, such as an 18th-century telescope, in this study, the exhibitions in the Wellcome Wing, which mainly involve contemporary science and technology, were chosen and analysed to compare with the GSM.

The SML has a relatively stable and strong digital network because of its subject matter. The network has been gradually constructed by internal staff members as actors with digital skills. A recently-formed digital department has further fostered the embracing of digital culture and supported internal digital experts to become more empowered by creating human networks with the commercial sector and higher education. Moreover, this study illustrates how the museum has critically employed digital media in its practices through the audience research process. This approach results from the underlying communication and learning approaches of their digital practices and from intensive collaborative workflows with internal and external actors, especially by involving the learning department as a representative of the public in the development process of digital museum practices. Thus, various approaches reflecting the voices of the public, based on discovery learning and cognitive constructivism, were found during this study; for example, citizen science projects and online polls concerning controversial contemporary science topics.

The data I analyse in this section are 49 pieces of secondary data (see Appendix 3), interview data from 5 museum staff who work/worked at the SML (see Appendix 5 for their profiles), and visual data regarding the digital projects (see Table 2), mainly generated from my field work.

10.2 Overview

The SML has its origins in the Great Exhibition of 1851, which was held in Hyde Park, London (SML n.d.b). The scientific objects displayed at that exhibition became part of the foundation of the collections of the South Kensington Museum. Later, the museum became more focused on art collections, and new buildings were opened, namely the Victoria and Albert Museum in 1909, and the scientific collection was separated. The SML opened in a new building in 1928 and the museum has expanded several times since. However, my research focuses on the Wellcome Wing, which hosts exhibitions of present and future science and technology and was opened in 2000.

The SML is one of the museums within the Science Museum Group (SMG) that has a mission 'to engage people in a dialogue about the history, present and future of human ingenuity in the fields of science, technology, medicine, transport and media'(SMG 2016a). A 'dialogue' can be understood as two-way communication, with the public having agency as well as the SML, which appears to be underpinned by new museology. In the following sections, the way digital projects at the SML have been developed to achieve this mission is investigated.

In terms of learning, the SML appears to have a clear learning philosophy and definition of learning, which is 'to encourage and promote curiosity and questioning; to assist discovery' (SMG 2016b). The learning theories that guide the museum are discovery learning and cognitive constructivism (SMG 2016b). By defining learning as 'the process of active engagement with experience', learning at the SML aims to contribute to the development or deepening of skills, knowledge, understanding, values, ideas and feelings, or to increase the capacity to reflect. The SML also adopts GLOs as museum learning outcomes (SMG 2016b). This means the SML sees the outcome of museum learning as not only the acquisition of knowledge but also includes other emotional and social aspects. Recently, the SML has studied 'science capital', which is concerned with the social influential factors regarding how and why young people do or do not engage with science. This can be associated with critical pedagogy. I will look at how these learning approaches have been integrated in their digital projects in Section 10.4. The following section presents and discusses the relevant actors of the SML identified within its digital projects.

10.3 Identified Actors: Their Network and Roles

In this section, the actors who have impacted on the SML's practices that embrace digital technology are presented. Based on the analysis of my data, I developed Figure 10.1, which describes the relations of the identified actors. Some actors, such as the UK government, have extended their boundary in past through the funding of digital projects, while museum practitioners who have digital knowledge tend to have the main role in designing and developing the current digital culture of the SML. How to extend a network and attract other actors varies depending on the actor. In the following sections, I will discuss how their digital culture networks have been evolved.
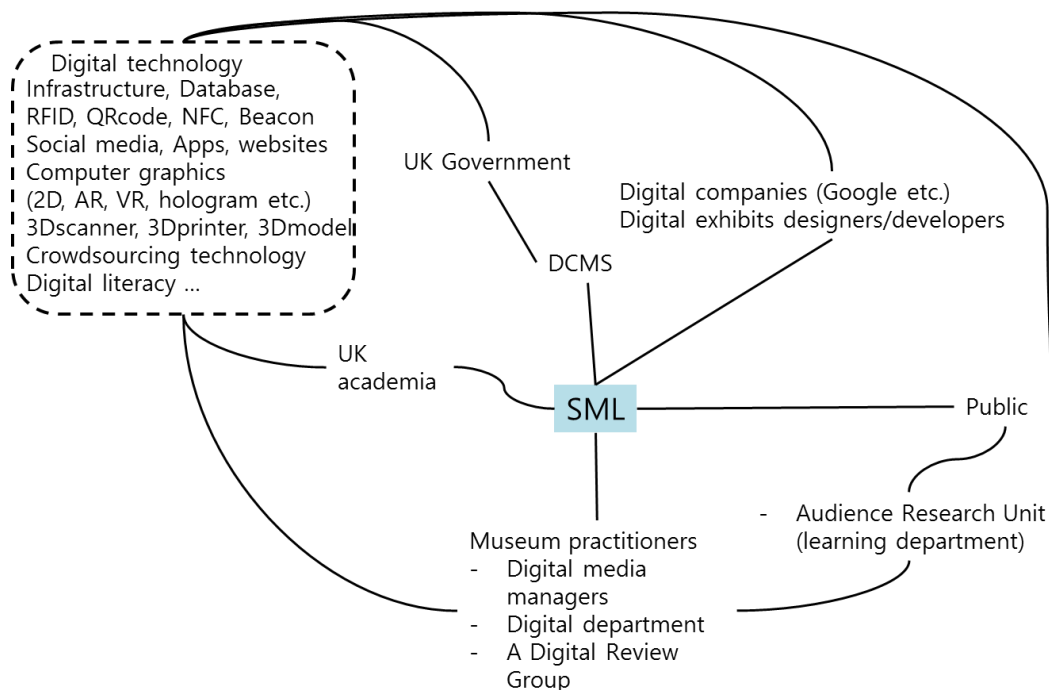
Figure 10.1 Actor-Network map of the SML

10.3.1 Government and Government Bodies

The SML is a national museum that was originally founded and funded by the UK government. Following the Museums Act of 1983, the museum was devolved from direct Civil Service control to administration by a board of trustees (SML n.d.b). Now it is partially funded by DCMS and the grant-in-aid only accounts for around 30% of its income. There is the possibility that this will be further reduced in the future. Thus, the influential power of the government as a funder seems to be reduced, although it still indirectly impacts upon museum practices in many ways.

The government has noted the potential of digital technology when it is embraced within museum practices, especially in terms of information and knowledge distribution. Through funding schemes, for instance, the New Opportunities Fund for Digitisation, the government has supported the SML to digitise its collections and make digital material available to the public (Dunmore 2006). The websites developed, such as Ingenious,[77] and Science, Invention, and Nature, generally aim to offer accurate and integrated scientific knowledge (NMSI 2003, p.22; Bowen et al. 2005, pp.384–386). However, these projects were developed from the provider point of view by considering what could be digitised first, rather than what the public wanted (Dunmore 2006). This is understood in the public understanding of science literacy context through considering the public deficit in scientific

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[77] http://www.ingenious.org.uk/ [Accessed 24 April 2017].

knowledge and the SML providing resources (Bauer et al. 2007). Based on the analysis of my data, the digitisation collection project becomes an OPP (Callon 1986) that every actor, including the government, SML, public, and digital technology, has to pass in order to achieve their goals. Although the special funding projects have been completed, the government still attempts to maintain its power as the number of users accessing the SML website is considered to be a performance indicator and outcome (NMSI 2006b).

As a policy-maker, the government seems to have close networks with public organisations that research, analyse and even encourage science and digital culture. Reports written by public organisations, such as the Royal Society, Royal Academy of Engineering, and Nesta, have been a significant resource for policy-making, and museum practitioners also frequently mentioned their research reports relating to museum practice. These reports become devices that are used to negotiate between actors (Callon 1986). For example, interviewee SML_A said that a Nesta report helped her understand potential visitors' preferences for digital media and how to use it.

Moreover, the recent ambition of the government in terms of science, technology, engineering and maths (STEM) education and digital literacy has been likely to impact on museum practices. Relating to this, my interviewee, SML_D, also mentioned that the 'Engineer Your Future' gallery was fundamentally driven by the UK's STEM education policy and aims to engage school pupils with STEM subject relevant careers. According to a SML learning document, learning in a museum is 'informed by, not led by, the school curriculum' (SMG 2016b). Although the SML's exhibition subjects seem to be associated with the national curriculum, the way they are implemented depends on the SML. The following section will explain the SML's point of view.

10.3.2 The Museum Itself

The SML has evolved and shaped its museum practices over time to reflect societal and technological changes. The SML notes that 'the exhibition galleries are never static for long, as they have to reflect and comment on the increasing pace of change in science, technology, industry and medicine' (SML n.d.b). It seems that the SML reflects the evolution of cutting-edge science and technology in their practice.

Further relating to digital culture, the museum has introduced digital culture as a subject within its museum practices more widely since the Wellcome Wing opened in 2000. While traditional subjects of the museum's exhibitions tended to deal with the history of and stories about scientific collections, exhibitions in the Wellcome Wing have addressed contemporary science and technology as

'unfinished science'[78] topics, thus, presenting subjects related to digital culture is encouraged. For example, 'Digitopolis', one of the first exhibitions in the Wellcome Wing, presented 'the nature and origins of digital technology, demonstrates what this technology can do today, and discloses options for tomorrow' (SML 2001, pp.32-37). Recent subjects of public events and programmes, for instance, the 'Big data' exhibition in 2016, have also exemplified this. By doing so, the SML seems to be continuing the discussion on the relationship between digital culture, society and the museum itself.

It is not a surprise that new digital interpretation media for the new types of exhibitions has evolved. Although AV sources have been used for exhibit interpretation prior to 2000, the SML has actively embraced digital media, such as computer interactions, within the exhibitions in the Wellcome Wing. As one interviewee, SML_B, stated, this could be a result of a lack of physical objects with which to display contemporary science and technology. But, based on the analysis of my data, this also reflects the changing notion of science museums, from where scientific collections were the focus, to science centre, where hands-on style interpretation is embraced to introduce the concepts of science principles (Durant 2004). In so doing, the SML becomes an enthusiastic actor in the development of new types of digital exhibits.

The need to develop new digital exhibits led to attracting new staff members; human actors who have computing skills and are familiar with digital technology and digital systems. An AV team was established in the 1980s (Boon 2010, pp.122–123), and new media managers were employed when planning the Wellcome Wing exhibitions, who act as a bridge between digital technology and the museum (SML_A 2015; SML_B 2015; SML_D 2015). The context of these new staff members will be further analysed in Section 10.3.3.

More recently, the notion of digital culture in the SML has been widening, from handling information technology via the IT infrastructure, data management, web accessibility and security, and computer interaction (NMSI 2002, p.27; NMSI 2007, p.16) to something that should be embedded into 'the culture of the organisation' (SMG 2014b, p.29). A Digital Review Group has been established and staff members are encouraged to learn and explore digital topics, such as 'Writing for the Web' and 'Twitter for Beginners' during the annual 'Learning at Work' week (SMG 2014b, p.29). A recent annual senior management meeting was themed around the transformative potential of digital technology for the museum (SMG 2014b, p.29), whereby digital skills are not only for dedicated digital technology staff members but all staff across the organisation.

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[78] The phrase 'Unfinished Science' was used by Durant (2004) and means scientific claims and conclusions that are unsettled within the scientific community. Thus, it could be necessary for society to consider various actors, like the public, when discussing science issues.

Based on the analysis of my data, the SML's ambition in terms of digital culture increases through employing an expert in digital museums and the formation of a new digital department in 2015 (SMG 2015b, pp.30-31, p.48). Digital media managers who used to belong to exhibition teams now belong to the digital department, which means that their voices can be better heard, and their expertise is well recognised. A holistic approach that integrates all the digital activities occurring in and out of the museum now can be undertaken strategically.

With the arrival of the first digital director, a new SML Digital Strategy, a device for attracting other actors (Callon 1986), has been published, which encompasses six digital principles: audience centred; sustainable and scalable; entrepreneurial and innovative with partnership; open, reusable and sharable; and embedded across the organisation (SMG 2015a). This highlights the importance of visitors' points of views and encourages a museum visiting experience via its website, not only through a physical museum visit. It is interesting that the SML has attempted to establish a pan-museum digital department and to create a digital mindset throughout the organisation through knowledge sharing. This can cultivate an internal CoP by fostering practical knowledge exchange (Wenger et al. 2002). Moreover, the SML has planned to be a digital innovator by establishing a 'Digital Lab' to 'build capability, explore the full potential of digital, and establish the digital reputation of the Group' (SMG 2015a). This will be accomplished through collaborations with the commercial sector and higher education; findings and outputs from research will be published (SMG 2015a). This is understood as the SML itself attempting to become an OPP (Callon 1986) within digital culture by attracting other actors, and the Digital Lab also potentially can lead to a CoP through sharing its findings and constantly interacting with relevant actors. Another result from this strategy is the appointment of a Digital Learning Producer (SMG 2015a; SMG 2016a). With this new human actor, the SML is further extending its digital boundaries.

In summary, the SML as an institution has endeavoured to extend its network via strategic approaches, although museum practitioners as actors have made important changes. For example, the SML's new Digital Director is a former head of digital at the Tate, and his approach to digital museums can be found in both museums. The Digital Director, SML_E, particularly highlighted embedding digital practice throughout museums:

> 'I'm writing a sort of paper for them [the SML's Trustees] to try and provoke questions. ….
> What I am saying is we need to kind of embed digital throughout the organisation. … It's not
> just something that happens in a digital department, it's something that happens everywhere.
> … The real and the digital are not like two separate things. They're part of a continuum. …
> Suddenly, trying to have a holistic vision of what that is like feels like a kind of really

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tricky… that feels like a really important piece of work to do, which makes it more difficult than thinking.'

His intention to develop digital culture in museums based on audience research is founded in the digital strategies of both museums (Stack 2013; SMG 2015a). Thus, the impact of individuals cannot be minimised. I will further discuss museum practitioners' points of view in the following section.

10.3.3 Museum Practitioners

Since the 1980s, the SML has been required to increase its performance through efficient and professional routes. Museum practitioners, internal human actors, have been expected to develop their professionalism and be experts in their field. In this section, I will particularly address the perspective of the SML's in-house digital specialists, based on my interview data. I will present how they become new actors and how they extend their network.

In terms of exhibition development projects, it has been essential to involve human actors in the new types of exhibits, which have widely embraced digital elements, such as interactive media. The new job position of new media manager (now called digital media manager) was created around 2000 when the Wellcome Wing opened. Since that time, the internal staff members have been able to develop their knowledge of how to design and develop digital exhibits through work experience and via visitor studies. A guideline for digital exhibit development has been produced, and this has been provided to external exhibition fabrication companies when procuring a new exhibition (SML_A 2015). In so doing, digital media managers[79] have acted as bridges between SML internal content developers, external digital exhibit designers/developers and the audience (SML_A 2015). Although each digital manager has a slightly different academic background, including engineering and interactive media production, their specialist areas are not the content of the exhibits but rather the interactive elements of exhibits (SML_A 2015; SML_B 2015; SML_C 2015; SML_D 2015). Thus, it can be comparatively easier for them to consider the audience's point of view of a digital exhibit, rather than the content experts' perspective on it.

Staff members who are digital specialists have extended their network by actively working with external companies who develop digital exhibits. Acting as a bridge, they have a role in contacting, contracting and communicating with companies (SML_A 2015; SML_D 2015). By undertaking similar work within the museum, they can also collect general information on external companies, and maintain a reliable and sustainable network with them for future projects.

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[79] They now belong to the new digital department (SML_A 2015).

Furthermore, the digital staff members are aware of the importance of updating their specialist knowledge on digital technology and museum digital offerings. One of ways to do this is participating in regional, national and international conferences, seminars, and cultural events that address topics/issues relating to digital (SML_A 2015). However, it is not easy to find any research publications presented by them, so I am unable to say whether they are active members of any CoP. My interviewees, SML_B and SML_D, mentioned that they hesitate to present their projects in social events for museum professionals because what they learnt from the projects is driven by practice rather than via a theoretical approach. The professional identity of museum practitioners also affects this peripheral participation. SML_B said:

> '… I see myself as technical, and I don't see myself as an expert in any of the interpretation side of things… My old boss used to say, "Go on, go and speak at conferences." I'm like, "What am I going to talk about?"'

Although they are not active central members of the communities, they might learn from peripheral participation based on situated learning (Lave & Wenger 1991) by attending social events such as conferences that are relevant to their works .

In sum, having in-house digital experts enables the SML to reflect digital culture in flexible and diverse ways because they have a relatively close relationship with digital technology and digital companies than any other members of staff have. Therefore, their network to digital even makes the SML's network to digital culture strong and dynamic. The following section will present my analysis on digital technology and digital companies as actors in the SML network.

10.3.4 Digital Technology and Digital Companies

Digital technology has been an actor within the SML and has continuously extended its boundaries since the 1960s. [80] With the expectation that digital technology offers fast and efficient communication and will be a vital factor in the future, technology seems to present opportunities for scientific knowledge distribution, exhibition interpretation media, education materials, and skills for the next generation.

Digital technology has supported the SML in its aim to reach a wider public audience. Websites have been considered to foster the different needs, interests and expectations of SML users and also to support post-museum visiting activities (Bowen et al. 2005). A personalised service using users'

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[80] The location of the SML next to Imperial College, London has brought benefits for the museum due to its early connection to worldwide network services (Bowen et al. 2005).

profile data has been explored on the websites (Fantoni et al. 2005), while digital games on science topics have been considered to be more likely to attract to school pupils and teens because of their familiarity and preferences (SML_D 2015). SML_D commented:

> 'The museum, over many years of experience, knows that, for teenagers in particular, you just need to engage them through games. If you want to really hook them in, it's through games. Obviously not all games create learning, hence why so many rounds of user testing to make sure that these games did.'

Digital media which can interact with users in a joyful way can contain multiple sources and be flexible to edit, and has been more attractive in galleries in the Wellcome Wing. Historically, the SML has focused on displays of scientific objects, but today, it aims to develop new approaches for exhibitions on contemporary science and technology that have few objects available (SML_A 2015). Digital media has been utilised to solve this issue by presenting interactive features and eye-catching exhibits, and to support building spaces which are emotionally engaging (Casini 2010).

Digital literacy for the next generation has also been a focus of UK policy-makers. This means that the younger generation should be taught not only how to consume digital products but also how to create digital features by themselves (Royal Society 2012; Livingstone & Hope 2011). This has resulted in the SML running computer coding workshop programmes for young children in the museum (SML 2014).

Meanwhile, the roles of digital companies are important, as digital technology has extended its boundaries into the SML, not only as funders but also collaborators. As funders, the SML has tended to have stronger relationships with digital companies that produce digital products, such as computer hardware or digital games, compared to other museums, probably due to its subject matter. Based on the analysis of my data, the SML has successfully approached targeted sponsors who might be interested in supporting a digital project due to the relevance to their business area. The initial website of the Wellcome Wing was enabled by a sponsor, Intel (NMSI 1999, p.9), and Toshiba was a sponsor in the development of an online educational resource (NMSI 1998, p.7). In the competitive digital industry area, this kind of company might also need to reveal their presence to the public, and working with cultural institutions like the SML becomes a strategic marketing tool.

Recently, the relationship of the museum with digital companies has become stronger than ever before. Companies have outstanding technology and skilful human resources, while the SML has content and a physical (and virtual) space where it is already well known to the public. Through working together as partners, each can achieve what they need. For instance, the Web Lab project, a special exhibition

that took place in 2013 within the SML, was produced using technologies provided by Google, and advice on exhibits was provided by the museum (Patten 2013). Through such collaborations, a new form of exhibition is possible. Additionally, by involving digital experts from companies funding an event at the SML, for example, the 'Computer Stay Lates', held in October 2015, this can reflect real stories from the industry. This active partnership might potentially lead to further collaborations, as well as informal learning opportunities for museum practitioners to update their knowledge on digital culture.

10.3.5 The Public

The audience has been widely recognised as an actor in the SML, and the first step in listening to audience voices was the establishment of the Interpretation Unit and the Visitor Studies Unit within the Public Services division[81] in 1989 (Bicknell & Farmelo 1993; Macdonald 2002, pp.43–47; Boon 2010, pp.122–123). The Visitor Studies Unit (now called Audience Research Unit) took a role in conducting visitor research, was involved in designing interactive exhibits together with the museum's audio, visual, electronic and computing exhibit team (AVEC), and designed public programmes, and, through work, audience voices were reflected in museum practices.

Generally, there are three steps in audience research, front-end, formative and summative, which are systematically required during the exhibition development process (SML_A 2015). While front-end research helps to determine what visitors want, know, think or expect, and what their ideas are about something before the museum commences on a project, formative research, for instance, testing mock-ups of interactive exhibits, provides the chance to see if they work properly and the learning objectives are achieved. After launching a new project, summative research generally looks to see if it has met its original objectives and how visitors interact with the project.

The SML has also studied how visitors use computer exhibits. Gammon (2010) summarised his findings and made suggestions for improved computer exhibits, for example, including layers of diverse knowledge levels for visitors and making the exhibits accessible to group visitors. In addition, an interviewee, SML_B, recalled that when the 'Who am I' gallery underwent renovation, various audience research methods (e.g. visitor observation, interviews and estimated time spent on each exhibits, etc.) were adopted to investigate whether learning had been achieved through the exhibits, how visitors experience and behave in the gallery, and what were their thoughts, etc. The results of audience research previously undertaken at the SML can provide a better understanding of its visitors'

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[81] The work scope of this division ranges 'from educational services and mounting exhibitions to managing the restaurants and toilets' (Macdonald 2002, p.4).

preferences for museum activities and approaches. For instance, the preference for computer games by teens was a significant factor when the museum designed the exhibition 'Engineering Your Future' (SML_D 2015). Continually conducting visitor research is a way to reduce the gap between content experts and the ordinary public by finding appropriate ways to interpret content. Through this feedback loop of communication (Hooper-Greenhill 1999a), the public's voice can be heard, although most of the audience research was more likely to test whether what the museum thinks works will actually work for the users.

In addition, visitor studies at the SML have evolved towards understanding visitors' different cultural, conventionalised and historical contexts that they bring with them from an interpretative sociologies point of view, rather than behaviourism and cognitive psychologies that in general seek to understand the relationship between individuals' attitudes and behaviours (Lawrence 1993). This approach can be linked to 'science capital', when the SML recently looked at how and why young people do or do not engage with science. This overall approach can be understood via the paradigm shift in public understanding of science (PUS) research – from a deficit concept that regards the public as lacking scientific knowledge and believes that science museums (and experts) should provide accurate knowledge, to a cultural approach that highlights the different cultures that the public brings and that considers it significant when museums communicate with their audience and even invite them into the knowledge-producing process (Macdonald 2002, pp.48-52; SML 1991, pp.36-37; Bauer et al. 2007). According to the SML's recent digital strategies, it considers audiences to be co-producers who can contribute to the museum's work by adding value. An online crowdsourcing project is an initiative which adopts a tagging system whereby the public can add tags to photography collections to facilitate better searching (SMG 2015a). Consequently, the actual demands of the public, visitors and non-visitors, and their points of views can be echoed in museum practices. This discussion on agency of the public will be continued and extended with the explanation of the SML's digital projects in Section 10.4. The next section will look at the last identified actor, academia.

10.3.6 Academia

It is easy to find digital projects in the SML that have collaborated with academia. Probably because of the museum's subject matter, academics who have conducted research into new digital technologies and have been enthusiastic about experimental projects in digital culture have been actors attracted by the museum. For instance, when the SML decided to decommission the Shipping galleries, one university lab proposed a new approach to preserve the galleries through conducting a 3D scan (SMG 2014a, p.48). Via cutting-edge digital technology, this lab can construct a network to the museum.

The SML is also a place for academia to encounter the public and to introduce their current research to an audience. By participating in a museum event to present their research, academics can extend their network to the public. For instance, at a 'Lates' events in October 2015, a university research team invited the audience to experience a computer programme entitled the Painting Fool, which could read participants' emotions and create images reflecting it (SML 2015). Through the network of academia and the museum, museum practices concerning digital technology can be further diversified. The Digital Lab explores digital technology through collaborations with higher education (SMG 2016a) and potentially also can create stable and durable relationships (Law 1992).

10.3.7 Summary

Figure 10.1 shows the actors identified in this section and their networks with others. Digital technology had a narrowed meaning in the SML, but now it refers to many different meanings, from exhibition interpretation media to the subject of exhibitions and programmes. This is a result of digital technology has extended its network. Yet, the government seems to only provide a general context for encouraging the SML's digital culture. The SML itself has profoundly expressed its interest in digital technology by employing digital experts and forming a digital department. Moreover, its digital strategic approach, which plans to establish the Digital Lab with external actors is understood that the SML attempts to build and cultivate a CoP. By so doing, the SML can extend its network and show its leadership in the digital area, while museum practitioners who participate in the community also can be further empowered. Moreover, continuous audience research enables the museum to design digital activities and the audience voice can be reflected in museum digital projects.

The following section will look at how the actors work to develop digital projects and how they have influenced the communication and learning theories adopted in these projects.

10.4 Digital Projects

In this section, I look at how the actors identified in the previous section are interconnected in the project development processes and how this relationship has influenced the communication and learning approaches of the projects. Finally, I investigate how digital technology has been employed within projects to align with the overall learning philosophy of the SML, which is based on discovery learning and cognitive constructivism approach (SMG 2016b). This section begins by describing the digital offerings in the orientation space of the SML, followed by those within the galleries of the Wellcome Wing, the educational programmes and events, mobile guides, and online offerings. The

Wellcome Wing's exhibitions have been chosen to present contemporary science and technology (NMSI 1997, p.10) and facilitate the comparative element of my research.

10.4.1 Orientation Space

The main entrance of the SML that every individual visitor enters and exits through is located on the east side of the museum building. Visitors are welcomed by staff members at an information desk, and digital signage; 'What's on' (Figure 10.2) also helps them locate activities and events available on that day. The same digital signage is installed across the museum and is a non-touchable screen so that visitors cannot select or search the content. This signage seems to be designed to convey the information mostly required by visitors, and to be updated efficiently by employing digital technology. This system may be a more recent version of 'Information', which the SML developed in the late 1990s to foster museum visitor navigation (NMSI 1998, p.3; NMSI 2000, p.3). 'What's on' has been designed in response to visitor research, thus adopting a circular communication model (Hooper-Greenhill 1999a; Hooper-Greenhill 1999b), with feedback from the audience research utilised during the development process to optimise the message and the way that messages are presented. This service clearly presents when and where events are taking place and for how long, together with suitable visitor ages, and if tickets are required.
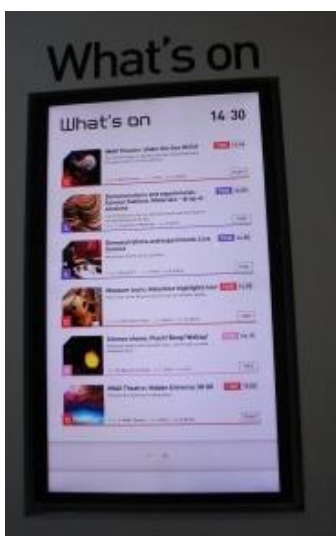
Figure 10.2 Digital signage, 'What's on', which conveys information on activities at the SML

One of significant functions of an orientation hall is to make visitors feel welcomed and emotionally comfortable so that they enjoy the museum (Wolf 1986; Davies 2001). The overall blue lighting atmosphere of the Wellcome Wing on the ground floor is designed to make the space more engaging (SML 2001, pp.6-9) and to look like a theatre, because the idea for the wing was to be a theatre of science. Visitors were consulted in choosing the blue colour, and it transpired that blue is associated

with science and technology. In addition, 'the Worm Wall' (Figure 10.3) shows a selection of visitors' comments moving around a maze of LED tracks on the blue wall of the wing (NMSI 2001, p.4). Overall, this space adopts a holistic communication approach (Hooper-Greenhill 1999a) through considering not only the content of exhibitions but also the whole museum experience. This is a new way that digital technology can contribute to make the space more visually immersive and to present visitors' comments; however, it appears to have a low readability.
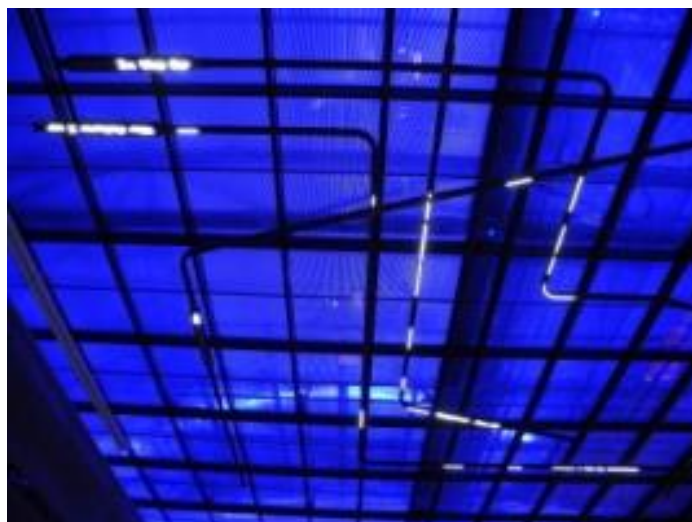
Figure 10.3 The Worm Wall, which shows a selection of visitors' comments

10.4.2 In Galleries

The Wellcome Wing, which was opened in 2000, aims 'to create a unique environment for exhibitions on key topics in contemporary science and technology', and was planned 'to enable you (visitors or public) to have your say on some of the hottest science issues of the day' (SML 2001, p.4). The SML used to be an object-based science 'museum', where scientific knowledge presented in the museum was supposed to be objective and non-controversial. Since the mid-1990s, there have been discussions on the role of science museums (and science centres) within contemporary society, where science and technology encounter both political and social issues (Durant 2004). Therefore, the interpretation of scientific exhibitions has been more complicated, and it is interesting to consider how digital interpretation has been adopted to address this by providing agency to visitors. This is also associated with underpinning communication and learning theories.

The exhibitions that took places in 2015 and early 2016, when I was collecting data, were the Antenna gallery, 'Who am I?', 'Atmosphere', and 'Engineer Your Future'. The Antenna gallery was redesigned in 2010 and has continuously updated its content to introduce current scientific issues and news. The 'Who am I?' gallery was also redesigned in 2010 (NMSI 2010, pp.9, 19) and presents biomedicine through various types of digital exhibits, as well as via collection displays. The 'Atmosphere'

exhibition opened in 2010 (NMSI 2010, pp.9, 19) and is a gallery about climate science, while 'Engineer Your Future' introduces relevant skills and careers in STEM subjects and targets teens (SML_D 2015). All the galleries have embraced digital technology in their exhibits. In this section, the general findings of the analysis of the exhibitions in terms of communication and learning theory will be explained, rather than introducing every single exhibit in detail.

Based on the analysis of my data, game-like approaches based on stories have been widely adopted in the galleries. For example, in 'DNA profiling with the three bears' (Figure 10.4) in the 'Who am I?' gallery, visitors investigate a suspect's DNA profile to determine who has eaten the bears' porridge. By choosing the right evidence and suspect on the screen, visitors can solve the crime. The storyline that links visitors to a situation with characters, the three bears, seems to help novices who are not familiar with DNA-related scientific knowledge to understand how DNA can be used in real life. In addition, the games attempt to link scientific content to an individual person's features. For example, instead of directly explaining the influential factors on life expectancy, a digital exhibit allows visitors to make a decision for given situations and presents his/her life expectancy based on their choices. By doing so, a personal link to scientific knowledge can be built. One interviewee, SML_B, particularly mentioned that:

> '… like those magazine quizzes where you tick the boxes and then at the end, it says you are this, so we wanted to sort of harness a bit of that, that I'm interested in myself, and through that, I'm learning about how my brain works and how my body works and how other people are.'

By so doing, digital technology has been employed to provide various entry points depending on individual visitors, and they unconsciously learn scientific knowledge through these games. This is an advantage of game-like approaches, whereby learners gradually construct knowledge while playing games (Whitton 2014).

Figure 10.4 A digital exhibit, DNA profiling with the three bears, as an example of game-like approaches based on a story

The preference of the target audience, normally school pupils, towards games could be a reason for exhibitions adopting this approach (SML 2011, pp.20-21; SML_D 2015). Digital games are considered to attract teens, and an advantage of the games approach is it can provide learners with control over their learning experience (SML 2011; Whitton 2014). In the 'Engineer Your Future' gallery, almost every exhibit takes a game-like approach (SML_D 2015). For instance, 'Rugged Rovers' (Figure 10.5) is a sort of open-ended game that allows visitors to design a rover, and test whether it performs better. There is also a competitive element that compares a visitor's rover with those of others in terms of which travel further.

These game approaches are based on discovery and cognitive constructivism learning theories (Hein 1998) as they allow visitors to explore the content and interpret it by themselves. Through games, learners develop their ideas and learn by doing. The simulation features of digital technology play a significant role by presenting various results, depending on visitors' choices.
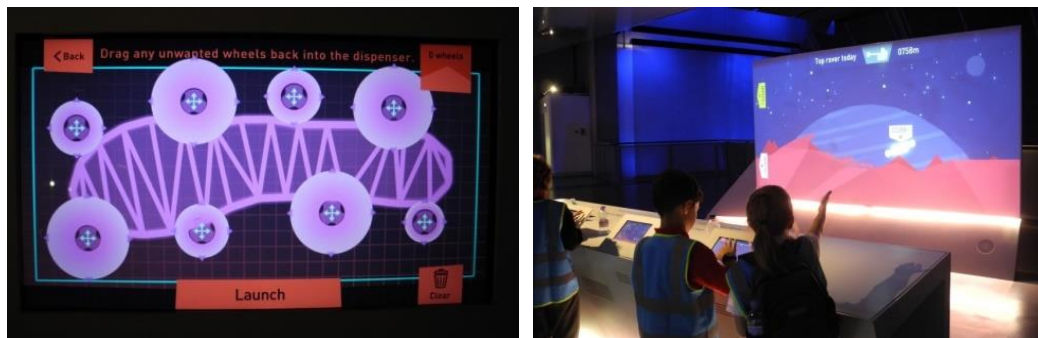
Figure 10.5 Rugged Rovers, an example of game-like approaches

Digital exhibits are also designed to encourage social interactions based on the social constructivism learning theory (Vygotsky 1978). Visitors can learn from each other when participating in group games. Although one interviewee, SML_D, said that the digital games in the 'Engineer Your Future' gallery were intentionally designed for groups due to the limited exhibition space, she also mentioned that the group activities reflect, to a certain extent, that engineers rarely work in isolation. By so doing, social learning theory underpins the games. The flat, round tables (Figure 10.6) at the centre of the 'Who am I?' gallery also cause visitors to gather and talk while interacting with the digital exhibits. This echoes the audience research where group activities around a computer interaction are encouraged (Gammon 2010).

Figure 10.6 Flat, round digital tables in the 'Who am I gallery?', which encourage social activities

The digital platform allows various points of views on a single topic to be presented at the same time. For example, in the Antenna gallery, visitors can look at how people take different positions on the same topic. It is important to comprehend that there are various points of view on contemporary science and technology issues because these are controversial subjects, and not objective (Durant 2004). Thus, the cultural model of communication (Hooper-Greenhill 1999a) is adopted through presenting diverse aspects of a scientific issue. Furthermore, visitors are not only consuming the content produced by the SML but can also vote or write comments on the topic, and can see the poll results and written comments from other visitors (Figure 10.7). This is a way to empower visitors by presenting their opinions. This digital exhibit has fundamentally adopted digital technology so that the content of the exhibition can also be presented on the web.
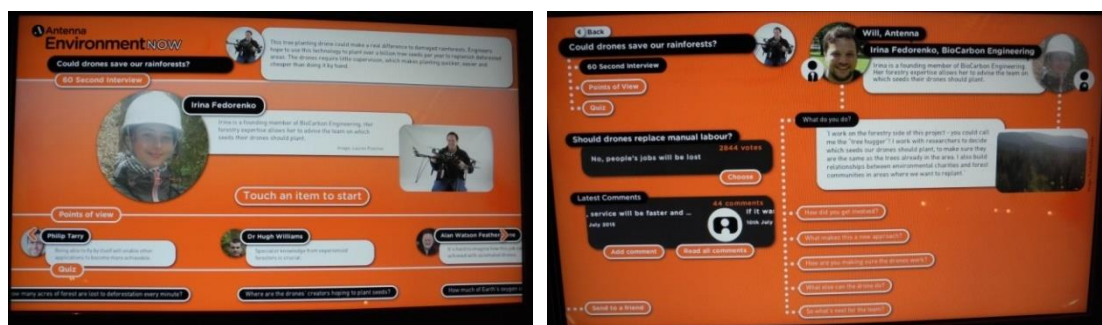
Figure 10.7 A digital exhibit in the Antenna gallery where visitors can vote or write comments on a topic

These exhibitions were developed through intensive collaborative workflows with internal staff members, external designers and makers, and the audience. According to the interviews conducted during my research, digital managers consider themselves to be interpreters and experienced designers who attempt to create digital exhibits from the visitors' points of view and link with the internal

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content teams to enable best practice if it is necessary to employ digital technology (SML_A 2015; SML_B 2015). These managers, who normally have an academic background in engineering or a relevant area, might find it easier to understand digital technology (SML_A 2015). However, they seem to adopt digital technology critically and recognise digital fatigue within an exhibition (SML_A 2015; SML_D 2015). SML_A added, about digital fatigue, that:

> '… After too many digital experiences, people start not being able to disassociate one from the other and they don't have the same curiosity towards those. Visitors had a bit of digital fatigue. So, it's kind of funny because when you put a digital exhibit in a traditional gallery, the exhibit point really becomes a kind of magnet and people are really attracted to them. But that is only because they are different from the rest. … If they only see screens everywhere, they may leave before they've had a chance to experience the value of activities.'

The AV team took charge of digital exhibit maintenance and were involved in the redevelopment of the 'Who Am I?' gallery, with the expectation that this would reduce potential errors in the digital exhibits, which might cause visitors to be disappointed (SML_B 2015). The SML has a five-year plan for exhibitions, and this makes it possible to test prototypes of exhibits before manufacturing and to develop new innovative methods over time (SML_A 2015).

The three steps of audience research, front-end, formative and summative, are systematically applied during the exhibition development process (SML_A 2015). From the early stage of exhibit design, exhibition teams work closely with the learning department, and endeavour to reflect the comments and feedback from audience research. This enables them to understand what the audience wants and how they react (SML_A 2015; SML_B 2015). Consequently, the communication that the exhibition development process adopts is two-way communication and a variety of public voices can be reflected (Hooper-Greenhill 1999a).

10.4.3 Educational Programmes and Events

The SML's educational programmes and events in terms of digital culture can be divided into two categories: improving learners' digital skills and allowing non-digital professionals to explore the potential of digital technology. Generally, the programmes for improving digital skills, such as Code Builder workshops, have been designed for school children. In these workshops, they can learn basic computer coding and can explore the interactions between hardware, robots, software and computer programs (SML 2014). According to the teachers' guide, this workshop aims to develop students' skills in problem-solving and logical thinking through a trial-and-error method, rather than learning led by an educator. Therefore, these workshops adopt a cognitive constructivist approach (Hein 1998).

Learners gradually improve their skills and computing knowledge through experience of failure and construct knowledge based on it.

Events that introduce digital technology are more likely to be targeted towards adult visitors. The 'Lates' programme of the SML is only designed for and only accepts adult visitors, and these sessions are held after the museum has closed. Recent events relevant to digital culture include 'Computer Stay Lates'; 'Gaming – Game on'; and 'Big Data – How safe is your data?'. At the 'Computer Stay Lates' event, various activities that visitors could participate in were offered; for instance, making a simple circuit via a drop-in programme, attending talks to discuss digital culture, participating in research programmes, and volunteering programmes to facilitate children learning to code and so on. Based on my data analysis, cultural theory of communication (Hooper-Green 1999b) underpins this event. This is because there is no fixed knowledge delivered from the museum, rather this event is open space that diverse voices of audience with different backgrounds and contexts are allowed and can be shared. Recruiting volunteers at these events is interesting in terms of linking adults who are interested in digital culture to groups who organise coding workshops for kids. This approach can potentially further engage the volunteers to digital culture through their participation. Moreover, the pool of volunteers with various backgrounds may also bring benefits and encourage the learners at the workshops who also have diverse backgrounds.

10.4.4 Multimedia Guides

Although there is no available mobile guide in the SML at the moment, the museum first developed audio guides in the 1960s (Rich 2016). Recently, the SML launched an app, 'the journeys of invention', to provide additional stories about its collections. However, my research only focuses on contemporary science and technology galleries in order to enable a comparison with the GSM in Korea. Thus, analysing this app is excluded from this research.

10.4.5 Online Research

The initial website of the SML, which was launched in 1995 was criticised due to its simple advertisement of the museum's physical galleries (Jones 2005). For example, the early website of the Wellcome Wing, which was built using Virtual Reality Modelling Language (VRML) (SML 2001, pp.46-47; Bowen et al. 2005, p.382) allowed online visitors to 'fly' through 3D model of the galleries. However, this type of transmission approach (Hooper-Greenhill 1999a) only delivers content created by the museum.

Another aspect of online projects is that the SML has attempted to harness the internet network to obtain a range of voices. The museum is involved in collaborative projects with other international

science museums and science centres to create learning resources, and has worked with local communities and schools[82] to explore the benefits of the web for the public. This endeavour to explore online possibilities has resulted in a platform where the public can discuss science and technology. The initial website for the Dana Centre exemplifies this approach (Bowen et al. 2005, p.383) and the Antenna gallery's webpage also harnesses this feature (Bowen et al. 2005, p.382) through online polls for controversial topics within contemporary science and technology. This approach is based on the cultural approach of communication as it attempts to reflect different voices (Hooper-Greenhill 1999b).

Recently, the website has been reconsidered as a platform for conducting research and collecting data by inviting the public to participate in research through the internet. For example, the Craving experiment (SML n.d.c) was part of a temporary exhibition, 'Cravings', which showed how food affects our body, brain and eating habits, and research data was collected through the website at the same time. Online visitors could participate in this experiment if they wished. Digital technology made it possible for researchers to approach various participants without the limitations of physical space and time. Meanwhile, this approach provides a chance for the ordinary public to encounter current science research by directly participating in it. This kind of citizen science project, in which the public takes part in scientific research experiments, is perceived as an area of research for the SML (SMG 2016c). This approach seems to further empower the public through volunteering, and while the Craving project was limited to data-gathering, distributed internet digital technology enables the public to explore scientific research.

10.4.6 Online Learning

The SML presents its online games as 'Play' in Online science and provides 17 games (4 April 2017). Some of these are directly associated with the museum's galleries; for example, Rugged Rovers can also be played in the 'Engineer Your Future' gallery. This could enhance the museum visiting experience by linking the game to pre- or post-visiting activities.

Based on the analysis of my data, the purposes of the online games of the SML can be divided into three groups: to deliver scientific knowledge; to develop learners' scientific skills, such as logical thinking; and to provide a chance to consider current scientific issues. Energy Ninja aims to inform the player about ways to reduce carbon dioxide emissions. Game players (online learners) choose places on a map, such as a house and a power station, and watch a short animated scene where several

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[82] The Students' and Teachers' Educational Materials project was an internet competition to create database resources by students and teachers (Bowen et al. 2005, p.381).

characters talk about how to save energy. Players do not have many activities and in general, consume the content produced by the museum. This kind of game approach can be understood as a transmission communication approach, where messages are only delivered from a sender to receivers (Hooper-Greenhill 1999b; Hooper-Greenhill 1999a; Whitton 2014).

Grain Strain has a different approach, as players have to drag machines from the bottom of the screen to move the falling grain into a bucket. This game does not deliberately convey fixed knowledge, but players can gradually improve their logical thinking by testing their approach through a trial-error method to move the grain efficiently in a limited time. Level-up means that players face increased challenges to achieve the game goals. Cognitive constructivism learning theory underpins this type of games as it allows learners to determine a solution by themselves (Hein 1998). Learners develop their knowledge from previous experience, and failure in a trial-error method even fosters them to adopt new knowledge by accommodating the existing one to fit a new challenge (Piaget 1952).

Rizk[83] exemplifies the last group of the online games of SML. It encourages game players to think more about real life issues in contemporary science and technology, and while climate change is the subject of the game, it does not refer specifically to climate change terminology (Clipson 2012). Within this game, players control what they collect and how they respond to threats in order to save a planet. The game sometimes provides hints to help players choose, but the game only provides the condition whereby players can explore in order to make their decisions. Through this kind of game, players can potentially understand and learn about real life issues, although applying it in real life could be a different matter (Whitton 2014; Gee 2007).

Initial motivation for each online game development and the targeted audience might be different. Some simple games seem to be designed for school children, while others like Rizk, are assumed to be suitable for adults as well as teens (SMG 2012, p.50). Although the learning goals of each game may be different, overall, the learning approaches of these online games do not seem only to aim to deliver knowledge from the SML to learners but also to provide opportunities for learners to consider their attitudes and perspectives on contemporary science and technology through playing these games.

10.4.7 Summary

Various types of digital projects have been found in the SML, and these have been integrated on-site and online, as that is anticipated in museum practice today (Parry & Sawyer 2005), although each

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[83] Rizk is 'a tower defence game about risk management. It involves the user growing a plant through collecting energy. Collecting energy results in spores being released, which attack the plant. The user must manage the risk to the plant through deciding where to collect energy and buying and positioning defenders to protect the plant' (Clipson 2012).

project has a different degree of online integration. In the Antenna gallery, exhibits are fundamentally linked to online content, and the online Craving project is an example that connects on-site and online together.

The SML's learning philosophy and theories, discovery and cognitive constructivism, can be recognised in its digital projects. Through harnessing the simulation feature of digital technology, a game-like approach has been widely adopted, and this provides learners with the opportunity to explore for themselves and discover knowledge, rather than directly distributing scientific knowledge. Additionally, in order to make the public's voice heard, discussion and debate programmes are provided, based on social constructivism, and internet technology further encourages the public's participation. By so doing, new museology has been partially actualised at the SML.

10.5 Summary of the Science Museum

This chapter has investigated the actors of the SML who have influenced its digital projects, their roles and rules that are followed. The public is a well-recognised actor, which contributes through audience research during the digital project development process. Dynamic collaborative workflows between internal members of staff, external companies and audiences seem to make the network of the SML more active and allow each actor to present their opinions in a relatively easy manner. The recent foundation of a digital department can also be interpreted as an extension of the digital network.

Chapter 11 - Comparative Discussion

11.1 Introduction

The previous six chapters each presented the six case museums. In this chapter, I compare the three Korean national museums with the UK ones, relating to Research Question 3 (see Section 1.2). First, the identified actors of the museums, their roles and networks with others are compared. I especially discuss the differences in power relationship between governments and the museums, and how this has influenced the museums and museum practitioners to be active/hidden actors when responding to, or shaping, digital museum culture. Second, the types of digital projects developed by the Korean national museums and the communication and learning approaches of the projects are compared with the UK ones. Although there are general trends in digital museum projects, different approaches in communication and learning are found in the museums of the two countries. I further point out that these result from the actors involved in the projects, and I explain how museum practitioners and the public, as key actors, can be empowered.

11.2 The Dynamics Between Key Actors of the National Museums in the Digital Culture

In this study, six national museums in Korea and in the UK are investigated. Each chapter of the case museums starts from how the government and government bodies have interconnected with the museums to promote digital culture. This is because I have assumed, in my research questions, that governments are actors that have influenced national museums to embrace digital technology. However, due to the different relationships between the governments and the museums in the two countries, the extent to which the governments have extended their network to the museums, and the ways they do that, are different. This is also associated with the relationships of other actors to the museums. In this section, the identified active/hidden actors of the Korean national museums, including the government, museum practitioners and the public are compared with the UK. In so doing, I discuss how the extent of the centralised or distributed power relationship between the actors affects the network of museums becoming dynamic. Moreover, I point out that although the ANT perspective provided me with an insight to analyse power relationships between actors, it is limited in terms of explaining the hierarchical relationship of the Korean museums with the Korean government.

This is further discussed with the emerging Asian museology (Sonoda 2016), which attempts to understand Asian museums in their own contexts rather than from a Western perspective.

11.2.1 The Relationship of Governments With Their National Museums

It can be argued that the Korean and UK governments have actively encouraged their national museums to involve digital culture. As funders' role, the division of labour in activity theory (Engeström 2015), the governments financially supported initial digital projects of the museums with special funds, such as the Informatisation Promotion Fund in Korea, and the New Opportunities Fund in the UK. Moreover, following the policy-makers' role, the governments announced digital policies. The policies, as rules (Engeström 2015) and devices (Callon 1986), have further attracted the museums towards digital culture, and shaped their digital projects in a certain way. More recently, digital literacy has been highlighted to be taught in schools. As computing is introduced in the national curricula in both countries, the national museums are also expected to respond to this, mainly through educational programmes.

Although the national museums of the two countries show similar trends to embrace digital culture, there are several differences. The ways that the Korean government and government bodies extend their networks to persuade the national museums to embrace digital culture have been done by explicit rules (Engeström 2015). The government enacted laws, such as the Framework Act on Informatisation Promotion, and the KCISA, which specialises in cultural informatisation, was established. Furthermore, in the case of the GSM, the government organises the KSMA for museum practitioners' professional development by financially supporting the establishment of academic courses in science communication. By doing so, the government influences not only the museums as institutions, but also individual museum practitioners.

In the case of the UK national museums, the UK government has been less involved in digital projects than the Korean government. Although the UK government encourages museums to embrace digital culture through strategic policy reports, as devices (Callon 1986), only about 30% of the museums' annual budget is funded by the government from an 'arm's-length' policy. So, museums can be more independent. In other words, the UK museums should actively attract other actors, such as commercial sponsors, to actualise their digital offerings. This situation can lead to other issues of editorial control by the sponsors (Alexander 1996; Wu 2003; Hewison 2014) and copyright issues with digital products. My interviewees, TA_A, TA_C, BM_A, BM_B and SML_A, denied that these problems would arise with their projects, but said they were aware of the issues. However, commercial sponsors can indirectly affect content control and could dispute the ownership of the digital products or disagree with the open data policy of the museums. Therefore, having secure

funding from government, like the case of the Korean national museums, is good in terms of this issue, although it also has a drawback due to the unbalanced power relationship between the government and the museums.

Additionally, based on the analysis of my data, organisational structure and culture, as implicit rules in activity theory (Engeström 2015), affect the relationship of the governments with the national museums. The organisational structure and culture of the Korean national museums that are government-operating bodies directly funded and managed by the government, are relatively more hierarchical and bureaucratic than in the UK. Thus, when the Korean government attempts to build its network with its national museums regarding digital culture, there are few conflicts between the government and the museums. The roles and work scope of the museums tend to be allocated by the government. Digital experts have even been posted to the museums from the government. Thus, it is certain that the power relationship of the government with the museums cannot be equal in the Korean context. The museums have less power to respond or to shape digital culture.

Therefore, the theoretical framework, which partially adopts ANT, is limited in terms of explaining the relationship of the Korean museums with their government. For the Korean national museums, the government is only one strongly visible actor, although museum practitioners and the public are significant also, as discussed below. The assumption of ANT, which considers every actor to have equal power, regardless of whether they are micro or macro, and believes that they continuously negotiate, cannot adequately describe the network of the Korean cases. Rather than being a follower of Western-centred museology, I argue that Korean museology must reconsider the role of government and discover how Korean museums can improve their digital culture under the secure funding provided by the government. There are pros and cons to this stable funding. Furthermore, it is true that Korean museums do not attract commercial sponsors willing to support large museums, as with the BM, due to the different size of target audience. Therefore, actors in the Korean museum sector should find an alternative way to motivate themselves to remain open and innovative. The government-funded project of the GSM in collaboration with universities and private exhibition firms (see Section 7.3.1) could provide a good starting point from which the government can cultivate research culture in museums with other sectors.

Another significant difference between Korean national museums and the UK is how their internal organisation structures have changed in response to digital culture. Because the Korean museums are government-operating bodies, it seems to be difficult for the museums to restructure teams, set new positions and employ digital experts, even though the MMCA and the GSM are responsible

administrative agencies intended to be independent in terms of management.[84] In contrast, the three UK national museums have successfully set up new digital departments recently, and announced their own digital strategies that suit their organisations. By doing so, the UK museums and their museum practitioners, particularly digital experts, become much more active actors.

In sum, the two governments have influenced their national museums' digital projects differently. The Korean government has been more directly and strongly interconnected with its national museums to embrace digital culture than the UK government has. The funding source and government-related bureaucratic organisation structure of Korean national museums causes this situation. The next section compares Korean museum practitioners and their network with those in the UK.

11.2.2 Museum Practitioners and Networks of Digital Culture

In the previous section, I compared the roles and the relationship of the governments with their national museums in terms of digital culture. As I briefly mentioned above, this also affects museum practitioners becoming active/hidden actors. Through Chapters 5 to 10, in each museum case, I discussed how museum practitioners are important actors, and that the underpinning communication and learning approaches of digital projects differ depending on them and their professional identity (Wenger 1998). This section compares UK museum practitioners and Korean museum practitioners in the ways in which they extend their network to digital culture and are interconnected with others.

As digital technology is recognised as an actor, and the types of digital projects have become diverse, new job positions for those who have expertise in digital skills have appeared in museum sectors. Especially in the UK cases, the museums have employed digital experts depending on how a museum considers the potential of digital technology. In other words, the museum digital experts are recognised as actors. For example, digital media managers at the SML take charge of developing digital exhibits in physical galleries; digital learning managers at the SDDC; the BM further sees new learning opportunities for school pupils and family visitors with digital devices and technologies. Recently, digital data analysts have been employed at the Tate and the BM. These digital experts play a significant role as brokers (Wenger 1998), linking two different domains, the digital and museums. Wenger (1998) explains that the role of brokers is crucial to making a learning community dynamic and innovative, because they can introduce new insights from one practice into another. Moreover, because different communities have their own perspectives and languages that only members of a community can understand, brokers who sit on the boundaries of the two communities can foster

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[84] The MMCA and GSM had set up departments/teams that respond to digital culture; however, they were disbanded after new directors came (see Sections 5.3.2 and 7.3.2 for detail). Changing director in short interval is also a barrier for the museums to be active and constant actors.

continuous negotiation between the communities to increase understanding of each other. This connection between the communities then leads to new approaches in digital museum projects. This finding echoes the Eid (2016) framework for innovation in museums, which explains how museums can achieve social innovation by adopting a social enterprise business model and utilising open innovation strategies. Regarding innovation, museums should adopt a culture of openness to cross boundaries.

This UK situation differs from the Korean one in that museum practitioners at national museums have rotated to other teams in their museums or other government bodies, sometimes regardless of their expertise. Because of this, those with no work experience/knowledge of digital projects can be assigned to new digital projects in Korean museums. If the digital projects are not relevant to their professional identity, learning about digital culture might not be in his/her interests. Instead of being brokers (Wenger 1998), they do not seem to consider the projects as potential research topics. For instance, curator NMK_C, who was responsible for the development of the AR Curator application (see Section 6.4.2.1), told me that he was not willing to publish an academic paper or similar regarding the digital project because he did not think it was relevant to his expertise. Thus, this attitude can negatively affect the project.

Based on the analysis of my data, although digital experts are employed in the Korean museums, they are not recognised as major players, and remain marginal because of the dominant culture of the curatorial staff (MMCA_A 2015; MMCA_C 2015; NMK_B 2015). Thus, there is a limitation on the voice of digital experts in Korean museums. The linear working process and the hierarchical structure of the organisations also make it difficult for museum practitioners to share different issues and views on digital projects and reduce and negotiate the gap between them.

The difference in professional identity has also influenced the way they develop their expertise and the way of they interconnect with others. From the interview data with Korean museum practitioners, CoP (Wenger 1998) dedicated to digital museums have not been found, except for the one organised by the umbrella agency, KCISA, for digital experts. This is very different from the UK cases, in which various types of CoP (Wenger 1998) were found.

There are several reasons why Korean museum professionals seem to lag behind in this digital museum area. First, in general, the community of digital museum experts is not large enough to be recognised. As my Korean interviewees mentioned (MMCA_A 2015; MMCA_C 2015; NMK_F 2016), only a few national museums have in-house digital experts, and other museums take an outsourcing approach. Therefore, only a few digital experts work in Korean museums. However, this depends on the definition of 'digital experts' in a museum context. If we include those who work on

developing digital exhibits and digital learning programmes, there are many Korean museum practitioners. Another issue is that, based on the analysis of my data, Korean museum practitioners prefer individual cognitive learning methods to social learning ones, such as CoP (Wenger 1998). Instead of learning from conferences at which social learning process can occur, they are more likely to search the internet. However, this learning approach, which relies on an individual's cognitive process, cannot facilitate learners (e.g. the Korean museum practitioners) to develop further to a level of proximal development (Vygotsky 1978) because this development requires support (e.g. help by peer groups). Therefore, the absence of CoP relating to digital museums in Korea is a significant barrier to improving and extending the digital culture of Korean museums.

Furthermore, the lack of, and non-empowered, digital experts in the Korean museums causes another issue. Companies who develop digital offerings tend to take crucial roles in the decision-making process, and they are sometimes recognised by the museum practitioners as digital experts rather than Korean museum practitioners themselves. Overall, this situation makes the network of the Korean national museums and museum practitioners less dynamic, and museum practitioners less empowered.

Potentially positive change movements to empower museum practitioners in the Korean museums and to extend their network to the digital realm were also found. For instance, the maker space Idea Factory at the GSM was originally designed for museum practitioners' internal usage, to develop their capabilities through exchanging ideas, debating and making objects based on their ideas. If the space is used for this initial purpose, this can cultivate internal CoP in the GSM. Additionally, the MMCA Seoul has prioritised the embracing of digital culture as a unique character of the branch and has endeavoured to be an actor that can create and lead digital culture. The maker spaces, Art Fab Lab at the MMCA and the one at the GSM, have the potential to be spaces that connects the museums' internal actors to their external actors. Having a physical space in the museums can even make the network with actors stable (Law 1992). Furthermore, I maintain that Korean museum practitioners are required to actively fulfil learning citizenship (Wenger 2010) to develop their own capabilities, especially regarding digital literacy and digital museum practices. The Korean museum practitioners should not wait for innovation to be driven by the government and institutional facilities. Digital museum experts as actors should present their voices enthusiastically and continuously by forming a CoP (Wenger 1998) with their peers and those with similar interests. With this community, they will learn more and their presence will be recognised more in the museum sector.

The UK museums, by contrast, displayed various types of CoP (Wenger et al. 2002). Internally, the Digital Learning Group of the Tate has a function to gather members of staff, across departments, who have interests in employing digital technology in museum practice. They learn together, exchanging

their working experience and thoughts on digital projects. They tend to have critical approaches to digital elements. This case exemplifies well-developed learning citizenship (Wenger 2010). Similarly, the recently-formed digital department at the BM also attempts to spread their knowledge about digital culture to other colleagues through internal workshops/seminars (Pim 2017). In the case of the SML, they have further presented their ambition about digital technology by announcing the potential forming of Digital Lab, in which the museum and academy conduct an experimental study collaboratively. By doing so, the museums extend their network and show their agency to others continuously. These informal social learning approaches are associated with the formation of new digital departments/teams in the museums. In other words, the museums not only change their organisational structure in response to digital culture, but also support and cultivate the professional development of individual museum practitioners regarding digital culture.

Furthermore, activities to extend the network of museum practitioners to others can also be found through external CoP (Wenger et al. 2002). It was not difficult for me to encounter and collect conference papers and presentations about digital museum projects delivered by UK museum practitioners. There are several well-recognised CoP regarding digital museum practices, for example, UK Museums Computer Group, the international conference on Museums and the Web, and Museum Next. These external CoP provide participants with learning opportunities for exchanging working experiences with other practitioners in annual meetings and via website. As my interviewee, the Chair of UK Museums Computer Group (MCG_A) said the number of members of the community is increasing, and their professional identities are diverse, from digital collection managers and website managers, to digital learning managers and digital exhibit designers. This shows that Korean museums professionals need to extend the definition of digital experts, because they broadly share similar interests.

Although there are several differences between the Korean and UK cases, museum practitioners' academic background and job positions, which are the bases forming their professional identity (Wenger 1998), influence the communication and learning approaches of digital museum projects. In the museums of the two countries, curator-led projects tend to adopt a transmission model of communication (Hooper-Greenhill 1999a) and didactic and behaviourism learning approaches (Hein 1998), which are close to old museology. Throughout Chapters 5 to 10, I explained that the way to reduce the gap between curators' points of view and the public's is by performing cross-departmental approaches, adopting collaborative working processes, and involving education staff in a certain way to be representative of the public (or non-subject experts at least). Also, constant visitor study is vital to reflect the various public thoughts. By doing so, the public can be involved in the digital network of museums as an actor.

In the Korean case study, however, some barriers were revealed to fulfilling the cross-departmental collaborative working processes in practice. The Korean museum practitioners, who are essentially civil servants, are evaluated based on their performance. Therefore, rather than collaborating with other staff members in the same museum, these practitioners tend to work alone on their project so they can receive recognition (GSM_E 2015). Additionally, the definition of museum education/learning is narrow in the Korean museum context, referring only to educational programmes that normally take place in learning centres/lecture rooms in museums, rather than broadly involving public programmes/events (MMCA_B 2015; MMCA_F 2016; NMK_A 2015; NMK_D 2015; GSM_A 2015). Thus, the work scope of the museum educators is limited, and they are not involved in other museum projects such as planning exhibitions and developing multimedia guides. It is necessary for Korean museums to reconsider the meaning of museum learning and the role of museum educators from the visitors' perspective, rather than that of the museums' departmental structure. The next section discusses further the extent to which the public is recognised as an actor in the two countries' national museums.

11.2.3 The Public

The public is widely acknowledged as an important actor in all the case museums in both countries. Yet, it is also true that the extent to which the public has agency, and the ways they can present their voices are different in each museum. This is associated with how museums consider their roles in society to be reflecting new museology, and again this is linked to the communication and learning approaches they have adopted.

Based on the analysis of my data, the approaches that Korean museums have do not seem to collect and reflect the public's thoughts. For example, visitor studies of the museums, normally in the form of a questionnaire survey about visitor satisfaction, have been conducted after launching their digital projects. During the development of projects, what the public want to know, and how they think about the projects, cannot be involved in the projects. Although some of the Korean museums (e.g. NMK) run an advisory group consisting of school teachers and the parents of pupils, they are not involved in the development of the projects.

This study revealed several reasons that cause this situation. First, Korean museum practitioners consider the public to be non-experts, and believe that museum practices, such as developing exhibitions, should be curated by museum professionals (NMK_A 2015). Members of museum staff also regard knowledge as concrete and factual. By doing so, they generally adopt a transmission model of communication (Hooper-Greenhill 1999a) in their digital projects, which sees a message sent by a sender and delivered to a receiver who passively absorbs it. Moreover, those museum

practitioners who have a strong identity as civil servants tend to have an interest in increasing the number of visitors/participants, rather than improving the quality of museum programmes/projects, because programmes have their success evaluated according to the numbers visiting (MMCA_D 2016; NMK_D 2015; GSM_A 2015). The stable financial support from the government makes the museums less competitive when embarking on initiatives for extra funding and when attracting potential visitors and non-visitors to visit the museums compared with the UK museums. In other words, the Korean museums have never been required to justify their role in society. The museums have developed their digital projects using the government's top-down approach, rather than a bottom-up approach from the perspective of the public. These findings support the view that cultural sectors in Korea have been developed by and are dependent on the government (Lee 2014). Therefore, the public still do not have many opportunities to present their thoughts and remain as hidden actors.

Recently, however, the MMCA Seoul introduced a new approach to collecting visitor data via a digital platform, the MMCA Friends (see Section 5.4.1.2). In this project, digital technology fostering the public can be visible by allowing the MMCA to collect and analyse the digital data. This data-driven approach might enable the museum to reflect its public, and the public can be empowered further.

By contrast, the UK museums have attempted to involve the public in the process of developing digital projects in many ways. Visitor studies are widely acknowledged in the museums, especially through education departments. The public participation process, for example, focus group interviews and workshops, before and during the development of the projects is considered vital to reflect the public's real thoughts, rather than an assumption about visitors by museum practitioners. In the case of the Tate, children's thoughts on feminism can be reflected and involved in the Tate Kids content via a visitor study, and the development of a multimedia guide at the BM also began with a visitor study. This process enables the public to be visible in the network of the museums and provides opportunities for the public's voice to be heard. Nonetheless, most visitor studies conducted by the museums are about testing/evaluating what the museums want to do. The museums still have more power to control their content than the public. The unequal power relationship between the museums and the public is also found in their crowdsourcing projects. I return to this issue in the next section.

11.2.4 Summary

As discussed in the above sections and as presented in the actor-network maps of each museum in Chapters 5 to 10, the two countries' national museums have different types of actors and shapes of network regarding digital culture. The Korean museums have a government-centred network, while the UK museums have museum- and museum practitioner-centred networks in which power is distributed. This difference affects how the museum practitioners develop networks with digital

sectors. Moreover, by fulfilling learning citizenship (Wenger 2010), digital museum practitioners in the UK are well recognised as actors. The Korean museums, which only rely on external companies to develop digital projects, are also required to empower their digital museum practitioners to be experts in their field and to cultivate a research culture that leads to the professional development of museum practitioners. Finally, although the public are widely recognised as actors in both countries, the public in Korean museums are less likely to be visible than in the UK museums. This difference also influences the museology and communication and learning approaches they adopt in their digital projects, as I discuss in the next section.

However, it should be borne in mind that the theoretical framework, which partially adopts ANT, reveals a challenge to analyse the relationship of the Korean museums to the Korean government. It is necessary for researchers to understand Asian museums from a non-Western perspective with an emerging Asian museology (Sonoda 2016).

11.3 Digital Projects

This section compares the trends of digital museum projects in the national museums of the two countries, Korea and the UK. Although several differences were found among the museums, a game-like approach has been, in general, widely uncovered. I further address this, below. Then, how the learning philosophies of each museum influence the communication and learning approaches of digital museum projects is discussed, along with the expected pedagogical roles of digital technology.

11.3.1 Trends of the Digital Museum Projects from the 1990s to the Present

As discussed in Chapters 5 to 10, the six national museums in Korea and the UK have a general tendency to develop digital projects both in the past and today. The museums have begun to embrace digital technology for collection management and documentation, especially for institutional purposes and research. Digital technology has been further embraced in various ways for the public for educational purposes. For example, learning resources such as a type of CD-ROM and virtual museums have been introduced to deliver educational content produced by the museums. With new interpretative media and new types of exhibits, digital media have been involved in physical galleries, especially when the target audience is children. These new approaches are more frequently found in the science museums. Using third-party internet services, for instance, Google, Facebook and YouTube, to present the museums' content and to communicate with wider public has recently been extended. Korean online services, such as NAVER, seem to actively work with the Korean museums.

Furthermore, digital learning that can foster the younger generation to improve their digital literacy has been offered recently more as the two governments have shown their ambition towards computing education in their new national curricula. Therefore, recent digital museum projects tend to provide the public with diverse entry points to approach museum content through digital media and services, while earlier digital projects were more concentrated on accurate knowledge delivery. This might be one of reasons that digital game-like approaches are apparent in many cases.

Nonetheless, differences in the trends of digital museum projects between the two countries' national museums have been found because they are set in a different society and culture, and are interconnected with different actors. First, the Korean national museums seem enthusiastic to introduce new technologies, such as VR and AR technology, as interpretation media, and are relatively quicker to adopt them than the UK museums have done. This might result from Korean museums regularly changing their permanent galleries, and, when they do it, the curators taking charge of the exhibition developing projects attempt to employ new interpretation media because the new galleries are expected to have something innovative. Through the benchmarking of museums abroad, the curators seem to be aware of new technology.

However, there are several challenges for building a stable network of Korean museums with museums abroad to exchange museum practices and research. On an individual museum practitioner level, the regularly rotating job positions of the museum practitioners, sometimes regardless of expertise, cause a disconnection and discontinuity among international relationships (GSM_A 2015; MMCA_B 2015). On an institutional level, the different priorities of museum managements, depending on the directors of the museums and a lack of awareness of the necessity of expertise for the development of international relationships, could lead to the network becoming less stable. Thus, the network of Korean museums is less dynamic, the connection with museums abroad is less durable, and, ultimately, this leads to a lack of opportunities to develop practitioner expertise with other museum practitioners abroad.

Furthermore, the curators, who are the experts of the content, have decided that communication and learning approaches to the digital interpretation media could be a barrier to adopting the technology from a new museology point of view. This is due to a lack of process involving the public as actors in the development of digital offerings. In other words, there are no visitor studies during the development, and the education departments of the museums have not involved either. From a public perspective, most visitors to Korean museums are Koreans with a relatively high digital capacity (OECD 2011) who tend to be familiar with digital culture and prefer to use new technology. The

interviewees MMCA_B, NMK_A, NMK_C 2015 and GSM_B acknowledged this, and they assumed that the embracing of new digital technology could attract more visitors.

Another difference is that most digital projects of the Korean national museums in this research are of the static/situated type in the museums, rather than online projects. There are several reasons for this. While the Korean government provides the museums with strict guidelines when they plan to develop mobile applications, the government encourages digital maker culture across the country with financial support to establish maker spaces in the museums. Because most of the budget of the Korean national museums comes from the government, the approach the government has directly affects digital museum projects. Finally, the digital projects of Korean museums tend to target children visitors more than adults, for example, children's galleries that embrace a variety of digital exhibits. This might be associated with the relatively high ambition in the formal (and informal) education of Korean parents and the familiarity with digital media of Korean children.

In the UK cases, interestingly, most digital projects have been found in online/mobile platforms rather than in physical sites. Digital exhibits are not commonly found on-site at the Tate and the BM, while their digital learning resources and digital asset videos, audios and mobile applications have been developed constantly. There are several reasons for this. The big three museums, the Tate, the BM and the SML are tourist attractions with rich collections. To open them to a diverse audience, to provide opportunities to gain access to collections and knowledge as well as to contribute to producing knowledge from the public's point of view, online offerings, rather than static/situated ones in the museums, seem to be preferred. Additionally, a digital game, as one of learning approaches, is more likely to be adopted in the UK museums than the Korean ones. This point is further discussed in the subsection, below.

Second, but related to the first, crowdsourcing projects have been continuously developed in the UK museums, while I could not find any in the Korean cases. The dynamics of key actors of the museums, for example, museums, government, academics and public, promote this experimental approach. The three examples, AnnoTate at the Tate, MicroPasts at the BM, and the Craving project at the SML are collaborative projects with academics, in terms of developing and managing the projects. This approach is not only for children, but also for adults with an interest in the field. By recognising this, these projects seem to aim at motivating them to participate in the projects, based on serious leisure theory (Stebbins 2001). This is because, through the volunteering, the participants can experience being involved in a community that can represent their identity. As Stebbins (2009) maintained, the volunteers expect to build social interactions as well as developing their personal interests in the volunteering area. Ridge (2013) argues that building communities of the contributors to

crowdsourcing projects is one important element for keeping them motivated and deeply engaged in volunteering. This approach to facilitating the development of the public's interests differs from the approach that Korean museums adopt (i.e. focusing on children to educate them). Nonetheless, based on my analysis of the data, it is also true that the authority granted to the participants in the crowdsourcing projects is limited to data collection/generation for the museums or experts such as researchers. This echoes the finding of Rotman et al. (2012), which shows the existence of unequal power relationships between museums and participants of crowdsourcing projects. Therefore, there is a limit to saying that the public are real co-producers. The extent to which new museology is implemented is also minimised by considering knowledge objective and viewing the public as having a lack of authority to produce knowledge (Hooper-Greenhill 1999b).

Finally, the UK museums tend to develop programme-based projects first, rather than the establishment of physical spaces, although the SDDC at the BM could be an exceptional case. This might result from the UK museums being relatively old and already having established spaces so that it might be difficult to extend and reform the physical spaces. Their funding structure might require attracting more actors to raise funds, compared with the Korean museums that rely on the Korean government. This could be another reason why it is difficult to establish new physical space. Although the space was extended in the Tate Modern in 2016, the new learning space in the new building is an open, flexible and multi-purpose space, rather than limiting its function. This programme-based approach can be beneficial to the museums to explore the possibilities of digital technologies and strategically consider what the necessary requirements are when they decide to form new space that may be dedicated to digital programmes.

In this research, various types of digital museum projects, on-site and online projects, are presented and discussed. Although a study by Parry and Sawyer (2005) guided me to consider how digital media have evolved in exhibition space, it can be said that there are diverse factors that affect the way museums adopt digital technology. This could be target audience, type of museum collections (e.g. the digital approach to archaeological objects can differ from an approach to contemporary science and technology) and the museology that museums adopt. This latter factor is especially important, and affects the way digital technology is employed. This aspect is discussed in next section, comparing Korean museums' overall museology with the UK ones. The following subsection considers a game-like approach, which is found within most of the museums studied in this research, and compares the Korean museums' approach to the UK ones.

11.3.1.1 Game-like Approaches

In this research, game-like approaches have been found widely in all types of digital projects, from kiosks at orientation halls to multimedia guides, and online games are even distinguished from other types. In general, game-like approaches are more adopted in projects that target children and young visitors. The museum practitioners of the NMK and SML even point out that they adopted a game-like approach because the target audience, school pupils, prefer it to other approaches. Although it can be true that this approach is commonly found in the six case museums, there are differences in how the museums of the two countries have recognised and adopted it.

In the case of the Korean national museums, online games have been not widely developed. I could not find any online game of MMCA, only few in the NMK and the GSM. Digital games are generally embedded as a sub-menu in digital signage and kiosks at orientation halls of the museums or as a form of digital exhibits in exhibitions, mainly targeting children. However, Korean museum practitioners have a tendency not to call the digital exhibits adopted game-like approaches as 'games' (NMK_A 2015; GSM_F 2015). Because of negative attitude of the museum practitioners to digital games and of a lack of recognition of how and what learning can be raised by digital games (Whitton 2014; Gee 2007), the game-like approaches are further intended to contain and deliver information and knowledge by adopting a transmission model of communication (Hooper-Greenhill 1999a). Furthermore, the games are generally deigned to find right/wrong answers based on behaviourism (Whitton 2014) rather than to encourage constructing content with visitors' own interpretation. This result is associated with the cost allocated to the development of games (NMK_A 2015), as a rule in activity between the museum and the developers (Engeström 2015). Because building games underpinning behaviourism is relatively easy, the budget required might be low (Whitton 2014). Thus, the museums tend to choose this approach. Nonetheless, the MMCA Friends that adopts gamification for a membership programme exemplifies an innovative approach that can generate the public' data.

In the case of the UK museums, they comparatively well acknowledge benefits of game-like approaches to children and novices. The SML is a museum that adopts game-like approaches widely to digital exhibits in galleries as well as online games. This approach is supposed to attract young visitors who have not familiar with scientific contents (SML_B 2015; SML_D 2015). Online games have been widely developed by the three UK museums although the BM currently has not provided its games on its website. Games are one of popular elements in Tate Kids indeed. Some games are only focusing to find right/wrong answers while others, mostly, link contents of games to not only individual players but also social issues (for example climate change) and stories that can be associated with them. Furthermore, as adopting game approach to audio guide for family at the BM, they can foster members of families learn together based on social constructivism (Vygotsky 1978),

and compete each other as encouraging them to engage the museum at the same time. According to Kidd (2014), it is necessary to understand game-like approaches in museums, not only as a tool for learning museum content from the cognitive perspective, but also as a way that visitors can become emotionally engaged. The game-like approach has the potential to further enhance the visitor experience. Therefore, it can be said that the extent to which game-like approaches facilitate visitors' museum experience depends on communication and learning theories that underpinned the games. Thus, next section will see how each museum's learning philosophy is linked to communication and learning approach of their digital projects.

11.3.2 Communication and Learning Approaches of Digital Museum Projects

I presented each museum's mission statement and overall learning philosophy and goals in each museum chapter, although I could not find written statements for some of the museum. In theory, the museums generally have recognised the change of museology from old to new in response to contemporary, postmodern society. Based on my analysis of the data, however, the extent to which the museums have implicated the new museology differs. This section compares how each museum's mission statement and learning philosophy have influenced their digital museum projects through underpinning communication and learning theories.

The first case museum, the MMCA, clearly states its educational purpose in its mission statement. Through education programmes, they aim to link local and global communities with arts. This is not only about individual cognitive development (Hein 1998), but also the recognition of difference between individuals and societies. Therefore, social constructivism (Vygotsky 1978) is an underpinning learning theory. The Tag Cloud service and an exhibition at the children's museum in 2016 using a big screen (see Section 5.4.1.1 and 5.4.2) can be regarded as implementations of the theory. Additionally, the artist-led workshop programmes are an example of situated learning theory (Lave & Wenger 1991). The MMCA Friends project can be understood to be a holistic communication approach (Hooper-Greenhill 1999a). In these projects, learners (visitors) are considered to be active learners who construct meaning that reflects their culture, and their companions and the programme facilitators are recognised as important factors who can foster learners to develop further.

The overall approach of learning at the Tate is similar to the MMCA regarding employing social constructivism (Vygotsky 1978) and situated learning theory (Lave & Wenger 1991) in their digital projects. For example, the Digital Drawing Bar at the Tate Modern allows visitors to present their ideas and interests to others via a big screen, and digital technology fosters this content construction and sharing process much easier than analogue media (see Section 8.4.1.1). They attempt to involve

diverse perspectives on art works in the content of its multimedia guides, and adopting digital technology can facilitate this multiplicity. The development of Tate Kids also attempts to rethink why and what content should be presented, based on critical pedagogy (Lindauer 2007). Thus, subjects such as feminism in art can be addressed. Also, employing digital technology allows online learners to remix existing content and images in a game.

The archaeology museum of Korea, NMK, has two directions in its mission. One is being a representative museum presenting the official 'correct' history of Korea. Another is being a culture space where everyone can enjoy their time. Based on my analysis of the data, however, the first mission affects its digital projects more, although its intended learning approach is cognitive constructivism (Hein 1998), which accepts diverse interpretations. Thus, the meaning and interpretation of the museum objects are supposed to be objective and fixed by the museum. This is why the 'innovative' digital projects of the museum that employ cutting-edge technology normally take a transmission model of communication (Hooper-Greenhill 1999a) and a didactic and behaviourism learning approach (Hein 1998) that consider learners to be passive. By so doing, the role of digital technology is minimised to deliver content or to react to the input of users.

Similarly, the BM, which has a long history as a home of rich collections, also tends to adopt a research-based museum approach and a traditional museology in which the content of the museum and the meaning of museum objects are only produced by museum curators who have authority. By embracing digital technology, especially internet network, the BM even aims to enhance its encyclopaedic/imperialist approach as conveying its knowledge, which is believed to be factual. Exceptionally, their digital programmes and services, which normally target school pupils and family visitors, for instance, programmes at the SDDC (see Section 9.4.3) and multimedia guides for family visitors, are more likely to adopt a constructivist approach (Hein 1998) that allow learners to create their own content.

The GSM, a science museum in Korea, fundamentally aims to popularise science culture. Based on my analysis of the data, however, their 'experience-centred' learning approach to fostering creativity has not been achieved. Although, in theory, they attempt to avoid a lecture-style didactic approach (Hein 1998), they still consider learners to be passive consumers rather than active producers. Thus, in most of the digital projects of the GSM, scientific knowledge is seen as static and fixed by adopting a transmission model of communication (Hooper-Greenhill 1999a), although contemporary science and technology is unfinished and a controversial topic (Durant 2004). There are not enough spaces where the public are welcome to discuss and talk about the topics. The Idea Factory, a maker space, is an exceptional case in which people can exchange their ideas and create something together based on

situated learning (Lave & Wenger 1991). By so doing, the public can produce new knowledge with others, and they can be co-producers and active actors.

By contract, the SML, a science museum of the UK, which principally aims to engage people in a dialogue about science and technology as its mission, harnesses digital technology to implement this. They even clearly state that their learning philosophy is based on discovery and constructivist learning theory (Hein 1998). Furthermore, social factors that might impact on learning, such as group activity with digital exhibits, are considered when developing phases in advance, and online networking technology is even employed to allow the public to present their thoughts on contemporary science and technology. Because the SML attempts to be a forum in which people can discuss and debate, rather than a space where all scientific knowledge can be found, the museum attempts to link and introduce diverse resource so that people can judge it for themselves.

Figure 11.1 I developed illustrates the above discussion on communication and learning approaches adopted in the digital museum projects of the six case museums. There are three points that I highlight with this figure. First, the museums of the MMCA, the Tate and the SML, which adopt a cultural theory of communication and a social constructivist and sociocultural learning approach and critical pedagogy, are more likely to follow the new museology, which considers the public as actors. This is because, by adopting these approaches, various voices of the public can be reflected in the projects.

Second, the Korean museums, compared with the UK museums, tend to adopt a traditional museology by adopting a transmission model of communication. This is because of a lack of visitor studies, and from not involving learning departments in the development of digital museum projects. Kang (2011b), a well-known scholar in museum learning in the Korean context, maintains that museum learning is an alternative to formal school education. However, her argument is based on cognitive constructivism and does not widely discuss how Korean museums can involve different voices from local communities based on a cultural theory of communication and a social constructivist and sociocultural learning approach and critical pedagogy. More research needs to be done in this area.

Finally, in terms of museum subject, archaeology and history museums, the NMK and the BM, adopt a relatively traditional museology. The NMK, as a representative museum, concentrates on the delivery of correct Korean history from an official point of view. In the case of the BM, it tends to maintain its encyclopaedic/imperialist approach on delivering knowledge in its digital projects. History can be a conservative subject in museums. However, it is also true that how to interpret the past depends on whose point of view is represented and what the purpose of history in museums is. In other words, the involved actors and the missions of historical museums determine the way to

interpret the past. If museums adopted critical pedagogy (Darder et al. 2009), the digital projects might have been shaped differently.
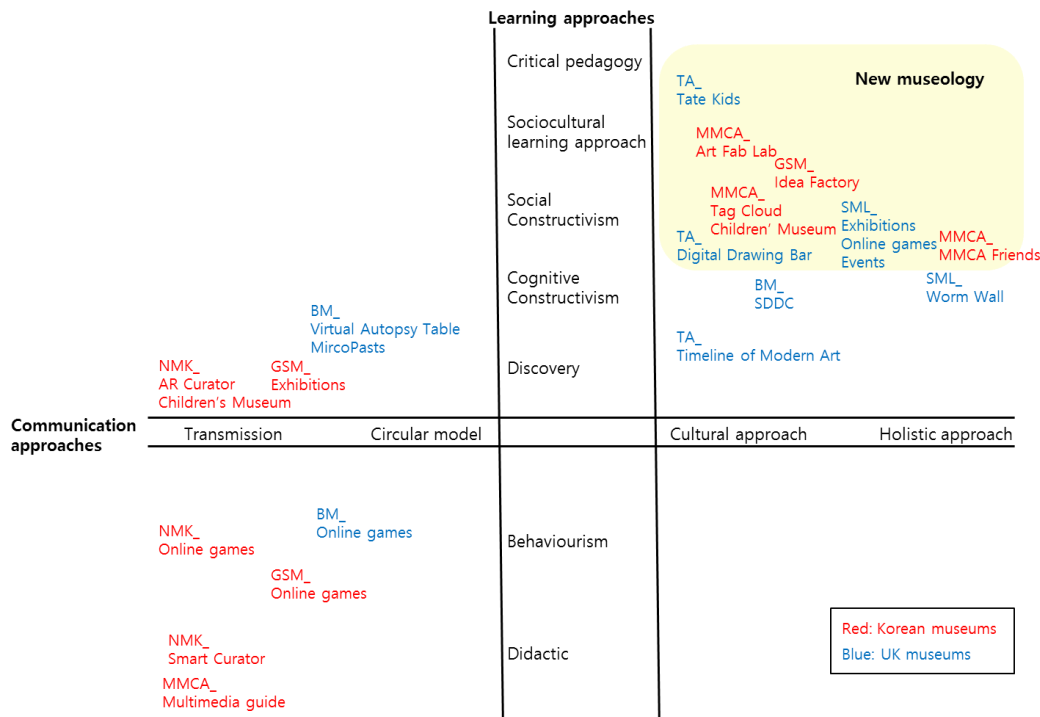
Figure 11.1 Communication and learning approaches adopted in digital museum projects

Overall, underpinning the communication and learning approaches of digital museum projects is not determined by the digital technology employed itself. Instead, as shown with the activity triangle (Figure 11.2), the learning philosophy and museology that the museums adopt (artefacts), and involved actors in the projects (subject and community), constantly negotiate how to employ digital technology (artefacts) to achieve the mission of the museum (outcome). In other words, if a digital project only functions to convey fixed content, this is a result of the museum having a traditional museology that understands knowledge as factual and considers the public to be passive, having less agency. In this case, the power relationship between the museum and the public is not equal. Digital technology only fosters the implementation of new museology when it is harnessed for content construction, content remixing, sharing thoughts and social interaction with others, based on a cultural theory of communication, social constructivism and sociocultural learning theories (see Appendix 8). This is because, from these approaches, knowledge is understood to be subjective, based on culture that the public bring with them, and learners are considered to be active, meaning-makers with others. In other words, when the technology is adopted in a project to empower the public, who have

authority to add value of meaning to museum content, we can say the digital museum project is an example of new museology.

This research demonstrates that there is a gap between the literature of the new museology and its practices. Unequal power between actors continues to exist, and the voices of the public are less heard than those of experts. As Kidd (2014) points out, to implement the new museology with digital culture, it is necessary for museums and governments, who evaluate the museums, to reconsider the organisational structure and outcomes of museums and make a great effort to change the mindset of museum practitioners.

Digital Technology as a technical tool
Museology as a psychological tool

Artefacts

Subject
Museum practitioners

Object
Aims of
digital projects

Outcome
Missions of museums

Rules
The rules that influence
the interactions among subject,
tools, object, and community
*(such as laws, policies,
contract,
organisational culture etc.)*

Community
The stakeholders who can
influence the museum
decision-making process
*(such as government bodies,
museum professional communities,
museum practitioners,
public etc.)*

Division of Labour
The roles of subject/community
for archiving the object
*(such as funding, supervising,
evaluating, advising,
(re)training,
using etc.)*

Figure 11.2 Activity triangle that describes the dynamic components in the development of digital museum projects

11.4 Summary

This chapter presents a comparative discussion between the Korean and the UK national museums regarding their networks in digital culture and communication and learning approaches adopted in their digital museum projects. According to my data analysis, although the government-centred digital network of the Korean national museums is designed to spread digital culture wildly across the country, it also has a negative impact on its national museums, especially on the professional development of museum practitioners regarding digital culture. This means they are less empowered and have weak professional identity. The linear working process and excluding the public from the

development process of the project also lead the museums to adopt a traditional museology. This again impacts on their approach to digital technology and their pedagogical role is minimised to mainly deliver content.

By contrast, the museums- and museum practitioners-centred digital network of the UK museums are designed to enhance the professional identity of museum practitioners regarding digital culture. They build digital CoP informally, and the CoP is also formally cultivated at an institutional level by forming digital departments. With visitor studies in educational departments, the public's voice can be further heard. Cross-departmental collaborative working processes also enable the UK museums to reflect various stakeholders' points of view. By doing so, social constructivist and sociocultural learning approaches, which values learners' agency considering their culture, can be adopted in digital museum projects. On the other hand, the issue with an unsecured funding system for the UK museums is the potential problem of editorial control by commercial sponsors.

Chapter 12 - Conclusion

This study explored the networks of digital culture surrounding six national museums in Korea and the UK. Via qualitative research methods, it answered the following research questions: 1) How do the dynamics between the key actors in the museum sector affect the use of digital technology as a foundation of visitor experience? 2) How have museum practices evolved to accommodate digital technology? This study also draws comparisons and contrasts between the two countries' different approaches to digital culture in museums. Through these research questions, I developed my argument about how the relationship of museums with other actors has shaped their digital projects and influenced the communication and learning approaches of them, which are associated with the museology that the museums adopt.

The previous chapter, Chapter 11, has already offered a comparative summary of the case studies. Therefore, in Section 12.1, this chapter provides a brief summary of the core findings of this research, and some continuing contributions and future research directions in Section 12.2.

12.1 Museums as Part of Networks in Digital Culture

In this research, I investigated three Korean national museums (MMCA, NMK and GSM) and three UK national museums (Tate, BM and SML) using a qualitative multiple case-study methodology. Drawing inspiration from ANT (Callon 1986; Law 1992; Latour 2005) and activity theory (Engeström 2015; Kaptelinin & Nardi 2006), I identified human and non-human actors of digital museum projects and followed them to uncover their purposes and intentions and relationships to others in their network. In particular, the way in which museum practitioners extend their social network, and the way their professional identity affects digital museum projects were uncovered based on CoP theory (Wenger 1998). Because I believed that every actor involved affected the digital projects of museums in a certain way (Research Questions 1 and 2-3), bottom-up approaches using the theoretical framework were adopted. Moreover, this approach contributes to the understanding of the networks of museums in a digital age that the collective and the individual are interconnected with. In other words, my findings showed that social system (e.g. government, structure of institutions, policy, laws) is not the only influence on digital museum projects, but museum practitioners and individuals are also crucial actors. That is why museum practitioners should be empowered to make the network of museums dynamic. I return to this argument, below.

Digital museum projects have been regarded in this study as one of ways in which museums achieve their missions and learning goals expected of them in contemporary society. Thus, I examined how digital museum projects have corresponded with the overall goals and direction of the museums, and what is required for them to improve their projects. By linking the museums' mission statements to the museology, the underpinning communication and learning theories of digital museum projects were investigated to see how new museology (see Section 3.2) has been implemented (Research Question 2-2). I particularly considered that adopting a cultural theory of communication (Hooper-Greenhill 1999b), social constructivism (Vygotsky 1978) and sociocultural learning approaches (Lave & Wenger 1991) can further make the projects an example of new museology. This is because these approaches consider the public to be actors who negotiate, resist and reject museum content depending on their culture.

With my findings, I would like to highlight four points that can foster digital museum projects with new museology: the necessity of diverse networks of museums; collaborative work process as a way of power balance among actors; cultivating CoP regarding digital culture in museum sectors; and the redefinition of the public as co-producers of museum content. This is because the development of a digital project is a continuous negotiation process between various actors who have particular roles and rules to follow (Engeström 2015). The actors have different ultimate goals, however, so that the network they have built is constantly changing for their own purposes (Latour 2005). The network is fundamentally fragile. One actor cannot dominate it; the power should be shared and distributed among actors through continuous negotiation. A collaborative work process can help this because actors understand each other. Cultivating CoP (Wenger 1998) is another way to empower museum practitioners by developing their expertise. The way in which the public can be an actor with equal power with museums is by recognising them as co-producers, and by allowing them to produce knowledge. I further discuss these four points, below.

Dynamic networks of museums for digital culture: Digital museum projects are associated with diverse actors, not only museum practitioners but also funders, developers and the public. This study identified actors relevant to each museum's digital projects and investigated their roles and the rules they need to follow (Research Question 1). Compared with the UK national museums, the digital network of the Korean national museums is simply centralised to their government and government bodies, probably due to their funding structure. Furthermore, depending on the museum directors, the direction of their projects was easily changed. For example, AR Curator at the NMK was embarked on following a suggestion from its director, and a cyber museum team was formed and deformed because the GSM's directors changed. Thus, power relationships among the relevant actors are not equal in the Korean cases. Furthermore, there are fewer opportunities to reflect the public's voice in

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the Korean digital museum projects because visitor studies have been not conducted systemically, and education departments of the museums have not usually been involved in the projects. This generally differs from the UK cases. During the development process of digital projects in the UK museum cases, visitor studies are embraced from the beginning of the projects, and in the case of the Tate, the learning department was involved in some way in all the digital projects investigated in this study. Additionally, networking with digital companies and academics to explore new approaches can be found in the UK cases. To encourage this diverse network further, social networking events such as REMIX SUMMIT have been organised to link museum practitioners to other human actors who belong to other museums, as well as the digital and creative industry sectors. That dynamic and diverse network and distributed power relationship encourage museums to be actively linked to digital culture.

Collaborative work process as a method of power distribution among actors: The dynamic network between various actors might lead to a complicated work process to negotiate matters between actors. The development process of the digital projects of the Korean museums, which have less dynamic networks, is more likely to follow a linear communication process, and collaboration is less encouraged with other departments in the same museum and external organisations. In contrast, cross-departmental approaches can be found in the UK cases. For example, a new virtual programme in the BM was made with collaboration between the digital department and SDDC. In the case of SML, digital companies also work as partners rather than only being technology providers, and the companies and museums learn together through digital projects.

Cultivating CoP regarding digital culture in museum sectors: To make their voice as potent as experts', it is necessary for museum practitioners to keep developing their expertise. This is associated with museum practitioners' professional identity (Wenger 1998). Through interviews with both Korean and UK museum practitioners, I found that they have different professional identities, although they are both involved in digital projects. Korean museum practitioners tend to consider themselves as government officers, and the identity and frequently rotating job positions in museums, or to other government bodies, influence the communication and learning approaches of their projects. Although the government bodies of the KCISA and KOFAC provide retraining programmes (lecture-type) for those who take charges of digital projects, the topics of the programmes only focus on technological aspects. The KMA and KSMA do not seem to link well with museum practitioners either. In the Korean cases, staff empowerment and their professional development should be considered as important factors that can influence institutional change (Seig & Bubp 2008; Ash et al. 2012). Learning citizenship (Wenger 2010) is highly necessary for digital museum practitioners in Korea to continuously develop and display their expertise and make their voices louder in the museum

sector. In contrast, various types of CoP are found in the UK cases. For example, the Tate's Digital Learning Group is a type of internal CoP, and the UK Museums Computer Group is an external one across museums. Newly formed digital departments in the UK museums also cultivate digital culture and make museum digital experts further visible. Museum digital experts can be a broker (Wenger 1998) standing in between the two boundaries of domains: the digital and cultural sectors. Linking the two domains could be one of the important roles of CoP regarding digital museum projects.

Redefinition of the public as co-producers of museum content: Throughout this study, my perspective on museology is towards a new museology, and I investigated how to implement it using a cultural model of communication, social constructivist learning and sociocultural learning approaches in digital museum projects. In the new museology, the public are considered important actors. This means they are not only consuming museum content but also have a right to consult it as co-producer. Because each visitor has a different cultural background, it is required for museums to reflect the various possible interpretations and to facilitate the meaning-making process of visitors. When we implement the new museology, digital technology can foster it in diverse ways. The pedagogic roles of it should be not limited to delivering content produced by museums by adopting a transmission model of communication (Hooper-Greenhill 1999a) and a didactic and behaviourist learning approach (Hein 1998). The technology should encourage the public to remix content, re/deconstruct it, share it, co-work with others, and link to people and different resources, etc. When the technology is adopted in these ways, the public can present their voices. The Digital Drawing Bar at the Tate is an example of this approach. Moreover, crowdsourcing projects in the UK museums allow public access to authentic content and help the museums collect data, although there are still several issues concerning access and authority. Recognising the participants of the projects as members of a community in which experts and novices learn together is further recommended (Rotman et al. 2012) to empower them as co-producers.

This study only investigated national museums in two countries. Museums that have different funding sources, for example local authority museums, may have different shapes of networks regarding digital culture. Yet, similar to the national museums, in the Korea cases, the KMA funds the development of digital museum learning programmes,[85] while in the UK cases, the ACE supports museum professional development programmes regarding digital skills (Museum of London 2017). Therefore, my findings can contribute to understanding other cases. Additionally, as I noted in the methodology chapter, Chapter 4, I was unable to conduct interviews with some museum practitioners

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[85] The MCST has partially funded middle and small-scale museums (local authority museums, private museums etc.) to develop additional learning programmes including digital learning programmes (MCST 2014b).

who were involved in the digital projects I investigated. Although I attempted to approach and conduct various museum professionals, such as curators, educators, digital experts and members of staff in marketing and management departments, this was a limitation. Moreover, during this study, the case museums continuously launched new digital projects. It was necessary for me to select the digital projects to study. Only the selected projects were examined; however, this research attempted to provide a holistic picture and understanding of the museums in digital culture, rather than focusing on individual projects. Although this research has limitations, some contributions on existing literature in museum studies and museum practices were made, as explained below.

12.2 Concluding Thoughts: Contributions and Future Directions

This study contributes to the theoretical and practical aspects of museums. First, there was no existing literature that provided a historical discussion on digital projects in Korean museums. By examining museum practices in three Korean national museums since the 1990s, this study showed the general trend of the development of digital projects in Korean museums. It also pointed out that the Korean government-led approach to employing digital technology in museum practice causes an unbalanced power relationship between the government and its museums, and between and beyond departments in the museums. This study also showed that it is necessary to reconsider the roles of the Korean government and museum policy regarding museum digital culture. The current role of the government, as an actor and funder of digital museum projects, might not be enough to encourage the museums to become involved in digital culture. Investing in human resources (e.g. digital experts) and supporting professional development opportunities regarding digital culture, which involve not only digital skills but also social learning opportunities to empower museum practitioners and to link them to others, is recommended.

The UK cases showed the importance of social learning for museum practitioners regarding museum digital culture. The boundaries of the community of digital experts in cultural sectors could be extended further to include theorists and practitioners in the field of digital humanities, computer engineering, media design, etc. Moreover, forming digital departments in the UK museums, which is a way to respond a digital age, is understood not only as a benefit for the museums to be active actors by showing its leadership in the field, but also a benefit for individual museum digital experts by supporting their voice to be heard. Therefore, the institutional level change can be further beneficial by engaging individuals to be actors actively expressing their voice. This study also showed the importance of involving educational departments in the development process of digital projects as a

bridge linking content experts (e.g. curators) to the public. The digital museum projects involving staff from educational departments were more likely to adopt a new museology. The unequal power relationship between the museums and the public in the crowdsourcing projects was raised as an issue to be discussed further. If the museums adopt new museology, the public may be understood to be active actors who constantly negotiate with other actors to extend its power (Latour 2005), and who create their own knowledge by reflecting their culture and society (Hooper-Greenhill 1999b).

In terms of theory, the complementary theoretical framework of ANT, activity theory and CoP theory of this study provides a new lens for understanding the complicated networks of museums in digital culture. This framework allowed me to approach the social system systematically from bottom-up. By analysing the collective and the individual, human and non-human actors at the same time, this approach contributes to connecting museum practitioners' individual contexts to wider social situations. In so doing, a holistic understanding can be made possible. Moreover, in practice, the link of pedagogic roles of digital technology to communication and learning approaches can help museum practitioners who take charge of digital projects understand the potential of the technology, and can help design digital experience towards social activities beyond content delivery.

Finally, this study concludes with some suggestions for future research directions. My research was concentrated on comparing/contrasting Korean museums with UK museums. However, during my research, I recognised the ways in which museums adopt digital technology could be different, depending on what subjects museums deal with, by considering museum collections as actors (Latour 2005). Thus, it would be interesting to consider a comparison among different subjects of museums (e.g. art museums, archaeological museums and science museums). This may be also associated with investigating the relationship of 'real' objects to their digital surrogates, and how they reinforce or resist the existing meanings that 'real' objects have (Cameron 2007). This is because my findings, especially in the archaeology and history museums, showed that the museums embraced digital technology to emphasise the existing values of their collections for nation building, or as another method of imperialist approaches to museum objects.

It would be also valuable to conduct action research in a Korean museum context that puts into practice and evaluates my suggestions relating to a cross-departmental approach and collaborative working process, when the museums plan digital projects, to reflect the public's point of view based on the new museology. This may particularly require the involvement of an education department in the development process with visitor studies.

Finally, this research considered digital technology *singular*. It could be plural, however. Different kinds of digital technologies might be associated with different actors. For example, third-party digital

services (e.g. Facebook) could have different actor-network shapes comparing digital learning programmes. In any case, the study offered in previous chapters provides a platform for understanding museums as part of a network of digital culture, and this could be extended within the countries' context and beyond, as the museum world becomes ever more digital.

Appendices

Appendix 1: Abbreviation

ACE   Arts Council England

AHRC   Arts & Humanities Research Council

AR   Augmented Reality

ANT   Actor-Network Theory

BM   British Museum

CoP   Communities of Practice

DCMS   Department for Culture, Media and Sport

DfES   Department for Education and Skills

DfE   Department for Education (now called DfES)

GLO   Generic Learning Outcomes

GSM   Gwacheon National Science Museum

HLF   Heritage Lottery Funds

ICT   Information and Communications Technology

KCISA   Korea Culture Information Service Agency

KCTI   Korea Culture & Tourism Institute

KMA   Korean Museum Association

KOFAC   Korea Foundation for the Advancement of Science and Creativity

KOCCA   Korea Creative Content Agency

KSMA   Korean Science Museum Association

MA   Museums Association

MCST   Ministry of Culture, Sports and Tourism

MEST   Ministry of Education and Science Technology

MLA	Museums, Libraries & Archives Council
MMCA	National Museum of Modern and Contemporary Art
MOCT	Ministry of Culture and Tourism (now called MCST)
MOE	Ministry of Education
MOGAHA	Ministry of Government Administration and Home Affairs
MOI	Ministry of the Interior
MOIS	Ministry of the Interior and Safety
MOIC	Ministry of Information and Communication
MOSF	Ministry of Strategy and Finance
MOST	Ministry of Science and Technology
MSIP	Ministry of Science, ICT and Future Planning
NCA	National Computerization Agency
NIA	National Information Society Agency
NESTA	National Endowment for Science Technology and the Arts (now called Nesta)
NIA	National Information Society Agency
NMDC	National Museum Directors' Conference
NMK	National Museum of Korea
OPP	Obligatory Passage Point
SDDC	Samsung Digital Discovery Centre
SMG	Science Museum Group
SML	Science Museum, London
STEM	Science, Technology, Engineering and Maths
VR	Virtual Reality

Appendix 2: Method Metrics

Each research question was answered by data from one or more than one method combined. Depending on research questions and expected data, more suitable methods were adopted.

Research Question 1: How do the dynamics between the key actors in the museum sector affect the use of digital technology as a foundation of the visitor experience?

Methods / RQ 1	Secondary data	Interview protocol (No. of interview themes, see Appendix 4)	Visual data
RQ1-1) What is the impact of government policies promoting consumer electronics on museums?	The governments' museum policies and related white papers and reports regarding the use of digital technology in museums and general digital culture. Annual reports of the museums.	How has government associated with digital museum projects? What expectation does the government have in relation to the projects? (1-2,4, 5, and 6)	
RQ1-2) How do museums work with government agencies and external actors to promote the use of digital technology for interpretation?	Articles/reports published from the professional museum community. White papers, government reports, policy papers. Mission statements of the professional museum community (such as associations; societies; groups). Previous/planned conferences, workshops, or seminars relating to digital culture in museums in Korea/the UK.	Who are involved in the projects and from when? What are their roles? Have their roles (or expected roles) changed? How can you define the relationship with them (e.g. the stakeholders such as government agencies and external actors)? How do you describe your professional identity? How do you develop your professionalism? (1, 1-1, 4, 4-1, 6, and 6-1)	
RQ1-3) How do funders' requirements influence digital projects?	The governments' policies and related white papers regarding the use of digital technology. Funding agreements. Annual reports of the museums.	What are the requirements of funders? How and why do the funders intend to use the digital tools? (1-2, 4, 5 and 6)	

| RQ1-4) What is the balance of influence between government agencies, public and industry funders for digital museum projects? | Annual reports/reviews of the museums
Government policy paper | How are different opinions among stakeholders negotiated? What process do you have to collect diverse voices of stakeholders? How is the voice of the public reflected in the projects? (4, 4-1, and 6) | |

Research Question 2: How have museum practices evolved to accommodate digital technology?

Methods RQ2	Secondary data	Interview protocol (No. of interview themes, see Appendix 4))	Visual data
RQ2-1) What types of digital projects have been developed by museums since 1990?	Annual reports/plans of the museums. Reports/press releases/ news articles regarding the museums' new digital projects. Internet sources/data from the museums' websites/blogs	Could you explain the types of digital projects of your museum and their initial motivation? Why did you choose the technology? (1,1-2,2,3,and 7)	Where on site, photographs were taken at the location of the digital projects. Where outputs are online, the websites were captured.
RQ2-2) What communication and learning approaches have been adopted for digital projects?	Annual reports of the museums (mission statement). Reports/news articles relating to new digital projects/concepts (ex, digital strategies).	What are the aims of the digital projects? What can visitors do with the digital offerings? How can the digital projects be linked to the overall goals of your museum? What do you think museums should be like? (3 and 7)	Photographs of the digital projects.

| RQ2-3) What internal organisational changes have been made to deliver digital projects? | Annual reports of the museums. Job advertisement / Job description. | What changes have been made in the development process of digital projects after your museum formed a digital department? What are the roles of the digital department? (1,5 and 6-1) | |

Research Question 3: How do Korean national museums compare with the UK?

Methods / RQ3	Secondary data	Interview protocol ((No. of interview themes, see Appendix 4))	Visual data
RQ3-1) How are the networks of Korean national museums with other actors different from/ similar to the UK?	The governments' museum policies and white papers relating to the use of digital technology in museums. Annual reports of the museums. Articles/reports published from the professional museum community.		
RQ3-2) What are the similarities and differences regarding the types of digital projects developed by the two countries' national museums since 1990?	Annual reports/plans of the museums. Reports/press releases/ news articles regarding the museums' new digital projects. Internet sources/data from the museums' websites/blogs.		

RQ3-3) How are the communication and learning approaches of digital projects in Korean national museums different from/ similar to the UK?	Annual reports of the museums (mission statement). Reports/news articles relating to new digital projects/concepts (ex, digital strategies).		Photographs of the digital projects.
RQ3-4) How are the ways that the Korean national museums have made internal organisational changes in response to digital culture different/similar to the UK?	Annual reports of the museums. Job advertisement / Job description.		

Appendix 3: A List of the Secondary Data Analysed

Electronic versions of secondary data were mainly collected via the websites of the case museums, government bodies, and professional bodies. In addition, press releases and news articles were included.

1) National Museum of Modern and Contemporary Art (MMCA)

A total of 55 documents and web pages were collected and analysed.

Data	Year	Pages	Description	Note
Annual reports	2000	Partly	The work of the museum from that	The museum
	2001	collected	year, including exhibitions; education	has released
	2002		programmes; projects; marketing;	annual
	2003		activities and so on	reports since
	2004	pp.1-106		2000. Those
	2005	pp.1-146	The mission statements; budget;	prior to 2004
	2006	pp.1-91	organisation structure; job	cannot be
	2007	pp.1-239	descriptions of each teams	accessed via
	2008	pp.1-163		its website.
	2009	pp.1-164		I partly
	2010	pp.1-93		photocopied
	2011	pp.1-380		them when I
	2012	pp.1-276		visited the
	2013	pp.1-332		MMCA'
	2014	pp.1-361		library.
	2015	pp.1-398		
White paper on art museums in Korea	2005	pp.1-283	General information/trend in relation to	
	2006	pp.1-544	art museums in Korea.	
Research papers on art museums	1995	Web pages	Discussions on	Published by
	1996	Web pages	-museum documentation system	the MMCA
	1997	Web pages	-how to spread the information of art	since 1990.
	2006	pp.36-43	works via the Internet	
	2007	pp.23-28	- need national standardisation for	
	2012	pp.90-101	artworks computerisation	
	2013	pp.113-160	- a project 'u-museum'(since 2005) of	
			MMCA, especially RFID system for	

			managing the collection and interpreting exhibitions - new roles of and social expectations towards MMCA in the twenty-first century - insights on digital archive.	
A study on the establishment of the MMCA Seoul	2004	pp.1-274	This study examines the validity of establishing another branch of the MMCA in Seoul.	Cited as (Yang 2004) in text.
A report on a survey of visitor satisfaction at MMCA	2006	Partly collected	Mainly statistical data (%) Their reasons for visiting the MMCA; which exhibitions/programmes they participated; their level of satisfaction with the MMCA etc.	
A report on visitor study at MMCA	2007	Partly collected	A study on understanding how visitors use the MMCA and its website	
A basic study of the establishment plan of the MMCA Seoul	2009	pp. 1-463	This study suggests basic guidelines to build the MMCA Seoul in terms of its location, building, exhibitions, programmes, and management.	Cited as (Jung 2009) in text.
A research report on the discussion of incorporating the MMCA and the management of the MMCA Seoul	2010	pp.1-119	This report addresses issues relating to the incorporation of the MMCA, which has been continuously mentioned by government.	Cited as (Baek 2010) in text.
A study on the way to promote the MMCA children's museum (Edu-Studio)	2012	pp. 1-123	This study examines visitor demographics, popular exhibits, requirements (mainly opinions from parents and school/pre-school teachers)	Cited as (Park 2012) in text.
A demand survey on the MMCA Seoul	2012	Partly collected	This study looks at the expected demands (for example, visitor demographics, types of programmes, etc.) of the MMCA Seoul visitors.	Cited as (PIO 2012) in text.
A master plan of the MMCA Seoul	2013	Partly collected	Mission statements; roles; functions; organisation structure; budgets; brief plans for education programmes and	Cited as (MMCA 2013b) in

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			exhibitions, etc.	text.
A consulting report on a strategic plan of the MMCA informatisation for the grand opening of the MMCA Seoul	2013	pp. 1-76	This report mainly suggests technological aspects of digital approaches in the MMCA, but also highlights the importance of a visitor-centred approach.	Cited as (Lee 2013) in text.
A workbook of the children's museum of MMCA (aged 10-12)	2014		An introduction to the exhibition and relevant activities	Cited as (MMCA 2014b) in text.
Art Fab Lab brochure	2015		An introduction to the facility (number of, types of digital devices)	Cited as (MMCA 2015b) in text.
Job recruitment	2013	Web page	A notice in relation to recruitment (including a digital expert)	Cited as (MMCA 2013c) in text.
Code of MMCA	2014	pp. 1-269	Rules that the members of MMCA staff should follow	Accessed by its website.
History of MMCA	n.d.	Web page	A full history of the MMCA	Cited as (MMCA n.d.b) in text.
Introduction of the MMCA's four branches	n.d.	Web page	Introducing the unique characteristics of the four branches	Cited as (MMCA n.d.c) in text.
Organisational structure of the MMCA and the work scope of each museum practitioner	n.d.	Web page	The organisational structure of the MMCA and the work scope of each museum practitioner	Cited as (MMCA n.d.d) in text.
A notice in relation to a public lecture	2015	Web page	A title of the lecture "Connecting to Visitors at Scale: How a data-driven approach to visitor engagement can help museums reach large audiences effectively."	Cited as (MMCA 2015c) in text.
A press release	2015	Web page	MMCA started to develop MMCA Friends with the DMA.	Cited as (MMCA

				2015d) in text.
A press release	2015	Web page	MMCA launched MMCA Friends	Cited as (MMCA 2015e) in text.
A notice in relation to learning programmes for children (aged 9-12) at the Art Fab Lab	2015	Web page	The programme would introduce various types of digital devices to children.	Cited as (MMCA 2015f) in text.
An introduction to a new 2016 children's museum exhibition	2016	Web page	The new exhibition was planned to inform children about the roles of the MMCA as an art museum.	Cited as (MMCA 2016a) in text.
A programme for artists and makers	2016	Web page	A programme for adult users of the Art Fab Lab, which linked artists to engineers	Cited as (MMCA 2016b) in text.
A digital magazine article	2016	Web page	Art Fab Lab programmes for children	Cited as (MMCA 2016c) in text.
A brochure from the KCISA (Korea Culture Information Service Agency)	n.d.	pp.1-16	History of the organisation; roles; functions; and previous/ongoing/future projects	Cited as (KCISA n.d.) in text.
White paper (and extra paper) on Culture Informatisation	2013	pp.1-515	This describes: the degree to which national culture organisations (including national museums) have become to 'informatisation'; a list of informatisation projects (2010-2013) in the organisations (usually managing websites, launching apps, digitalising resource); a list of information service; the number of staff who deal with	Cited as (KCISA 2013) in text.

			informatisation; annual budget for informatisation and current condition of database.	
An announcement about new maker spaces to be funded by MSIP	2015	Web page	A notice to announce new maker spaces, including the MMCA Seoul, which would be funded by MSIP.	Cited as (KOFAC 2015) in text.
The second basic plan of culture informatisation (2002-2006)	2002	pp.1-104	This reviewed previous culture informatisation projects and posed issues on relevant policy and technological aspects. It also provided future directions to improve the projects.	Cited as (MOCT 2002a) in text.
An evaluation report on responsible administrative agencies	2016	pp. 1-940	Evaluation criteria set by government.	Cited as (MOI 2016) in text.
The fifth basic plan of national informatisation (2013-2017)	2013	pp.1-155	Fundamental plan for nation informatisation from 2013 to 2017	Cited as (MSIP 2013) in text.
Plan of nation informatisation	2008	pp.1-185	Brief summary of nation informatisation plan since 1993; new visions and strategies	Produced by MOGAHA.

2) National Museum of Korea (NMK)

A total of 62 documents and web pages were collected and analysed.

Data	Year	Pages	Description	Note
Annual reports	From 1990 to 2005	Partly collected	The work of the museum from that year including exhibitions; education programmes; projects; marketing (plus social media), activities and so on.	The museum has released annual reports since 1990. Those prior to 2006 could not be accessed via its website. I partly photocopied them when I visited the NMK's library.
	2006	pp.1-485	Moreover, these reports contain information about Korean Museum Association (KMA).	
	2007	pp.1-212		
	2008	pp.1-520		
	2009	pp.1-600		
	2010	pp.1-597		
	2011	pp.1-699		
	2012	pp.1-651		
	2013	pp.1-635		
	2014	pp.1-743		
	2015	pp.1-544		
The twenty-first century plan for the National Museum of Korea : Medium-and long-term development plan of National Museum of Korea	2001	pp.1-260	This report suggests that museums should: -embrace online elements; -employ more experts (in education; marketing; and archive) -continuously build collection database - think visitor-centred management - make it possible for collection database to be searched by the public.	Research commissioned by the NMK, was conducted by the KCTI.
New Vision 2020 of National Museums	2006	pp.1-180	This report states that Korean national museums should: -involve themselves online by opening and providing collection information on the Internet and offering an ubiquitous environment system as well as e-learning	Cited as (NMK 2006b) in text.

			- employ more experts in education, marketing, management, and archive sectors - work together by networking actively - and have visitor-centred exhibition planning	
A report on methods of visitor development and museum service improvement	2007	Partly collected	This study aimed to develop new approaches to enhance the various functions of the NMK as a leisure place and tourist attraction.	Cited as (NMK 2007b) in text.
A evaluation report on the NMK organisation and performance	2007	pp.1-155	This study argues that the NMK needs more experts in education, marketing and digital.	Cited as (Jung 2007) in text.
A study on the improvement of the exhibition hall of Children's Museum	2007	pp.1-133	This report addresses the need to extend the NMK children's museum. Exhibitions which specifically feature hands-on, interactive exhibits are recommended.	Cited as (Park 2007) in text.
A study on NMK visitor satisfaction	2010	Partly collected	This study found that visitors are not particularly satisfied with the NMK mobile guide. It also suggests that the museum needs attractions to encourage visitors to explore the exhibitions on the first and second floor.	Cited as (PIO 2010) in text.
A report investigating the NMK organisation and its function	2011	pp.1-145	This study found that the NMK should recruit more digital experts and that their work scope should be extended. Digital learning programmes for the public are also recommended.	Cited as (KMAC 2011) in text.
A study on a basic direction and strategy for education within national museums in Korea	2011	pp.1-193	This study suggests a new direction and vision for museum education responding to the changes of time, as well as drawing on strategies for education within the new museum.	Cited as (Yang 2011) in text.

A basic study on the establishment of a (new) Children's museum of National Museum of Korea	2012	pp.1-286	This study argues the need for an independent building for the Children's museum of the NMK.	Cited as (Park 2012a) in text.
A study on NMK visitor satisfaction	2014	Partially collected	This study examines visitor demographics of the NMK, and found satisfied/unsatisfied elements of the NMK service, based on a structured survey.	Cited as (Research & Research 2014) in text.
Education in the National Museum of Korea	2015		The Director of the Education Department of the NMK presented the mission and goals of its education programmes and introduced its learning approaches with specific cases. This presentation was delivered at the international conference, which was organised to celebrate the 10 year anniversary of the NMK reopening in Yongsan, Seoul.	Cited as (Lee 2015) in text I attended her presentation at this conference.
Children and Play, Museum Education	2016	pp.146-153	A museum practitioner working at the children' museum team in the NMK, presents how the exhibitions of the NMK children's museum have adopted the concept of 'playing' to explain history.	Cited as (Cho 2015) in text.
Code of NMK	2014	pp.1-308	Rules that the members of NMK staff should follow	Accessed by its website.
History of the NMK	n.d.	Web page	A description of NMK's history from the early 20th century to the current day	Cited as (NMK n.d.b) in text.
Introduction to the children's museum	n.d.	Web page	This explains the aims and goals of the children's museum	Cited as (NMK n.d.c) in text.
Quizzes for children	n.d.	Web page	Online activities designed to suit children online	Cited as (NMK n.d.d) in text.

A notice about the Oegyujanggak Uigwe website opening	2011	Web page	This introduces the highlighted features of the website (digitised documents and the VR images).	Cited as (NMK 2011b) in text.
A notice regarding a public event in relation to the Oegyujanggak Uigwe	2011	Web page	A public event encouraging the public to creatively write poems about the Oegyujanggak Uigwe	Cited as (NMK 2011c) in text.
A notice regarding Smart Curator programmes	2013	Web page	The Smart Curator programmes have been extended due to their popularity.	Cited as (NMK 2013b) in text.
A notice regarding recruiting a group of parents as an advisory committee	2013	Web page	The advisory committee would be invited to participate in education programmes and exhibitions to give feedback on them.	Cited as (NMK 2013c) in text.
New Smart Curator programmes	2014	Web page	This introduces two new programmes, 'Silk Road' and 'Love Stories,' which were developed as reflecting visitor interest in the topics.	Cited as (NMK 2014b) in text.
Digital world which changes museums	2015	Web page	This explains various types of digital projects in museums, mainly in the USA.	Cited as (NMK 2015b) in text.
A notice regarding a new Smart Curator programme	2015	Web page	This introduces a new programme relating to conservation science.	Cited as (NMK 2015c) in text.
A notice regarding a seminar organised by the NMK children's museum	2016	Web page	This seminar dealt with issues on embracing digital technology in children' museums.	Cited as (NMK 2016a) in text.
A notice regarding a VR learning programme which the NMK makes with Google Cultural Institute	2016	Web page	Google and the NMK developed a new digital programme and offered it to child patients in a hospital.	Cited as (NMK 2016b) in text.
NMK launched a new mobile application	2016	Web page	This described how to install and use the NMK mobile application.	Cited as (NMK 2016c) in text.

Brief Report (2003-2012) on Culture Technology projects	2012	pp.1-350	A list of, and a short description of, research and technology developed by the projects.	Cited as (KOCCA 2012) in text.
A memorandum of understanding of KOCCA with the NMK	2016	Web page	KOCCA agreed to complete a memorandum of understanding with the NMK.	Cited as (KOCCA 2016) in text.
History of the Korea Museum Association	2007	Partially collected	This explains how the KMA was established and the kind of work it has carried out.	Cited as (KMA 2007) in text.
A notice regarding a museum's professional development programme	2014	Web page	Introducing a museum's professional development programme	Cited as (KMA 2014) in text.
A conference programme brochure	2015	pp.1-30	A list of museum societies/groups which have participated in the conference and their programmes	Cited as (KMA 2015) in text.
A notice regarding a museum's professional development programme	2016	Web page	Introducing a museum's professional development programme	Cited as (KMA 2016) in text.
Government 3.0 and a plan to open/share data relating to national heritage	2014	Web page	A plan of opening information/data relating to national heritage	Cited as (MCST 2014a) in text.
A evaluation report on government bodies and public organisations managed/funded by the MCST	2016	pp.37-41	The NMK was evaluated by the MCST, concluding that its performance in 2015 was not good enough, especially since the museum could not achieve the number of visitors it envisaged.	Cited as (MCST 2016) in text.
The second basic plan of culture informatisation (2002-2006)	2002	pp.1-104	This reviews previous culture informatisation projects and poses issues on relevant policy and technological aspects. It also provides future direction to improve the projects.	Cited as (MOCT 2002a) in text.

An action plan to promote Culture Informatisation	2002	pp.1-208	The plan was divided into eight areas, including arts and culture; culture heritage; culture industry; tourism; sports; services for adolescents; libraries; and the development of the infrastructure for informatisation.	Cited as (MOCT 2002b) in text.

3) Gwacheon National Science Museum (GSM)

A total of 36 documents and web pages were collected and analysed.

Data	Year	Pages	Description	Note
Annual reports	2009 2010 2011 2012 2013 2014	pp.1-43 pp.1-50 pp.1-50 pp.1-56 pp.1-62 pp.1-62	The work of the museum from that year, including exhibitions; education programmes; projects; marketing (plus social media); activities and so on Mission statements; budget; numbers of visitors; organisation structure; job descriptions of each team.	The GSM opened in November, 2008.
A study on basic policy for promoting science museums	2006	pp.1-227	This study provides analysis of science museums (and centres) in Korea and general global trends of science museums. It also reviews relevant laws and policies to extend science museums across Korea.	Cited as (Park 2006) in text.
Information Strategy Planning of the Gwacheon National Science Museum	2007	pp.1-202	This study suggests a way to build digital infrastructure which suits the GSM; including cyber education system and web site as a total system.	Cited as (Kim 2007) in text.
A study regarding improvement methods of operating systems for the Gwacheon National Science Museum	2008	pp.1-1128	Discussion on operation systems, such as general administration organisation, executive agency, independent corporation, and contracting-out.	
An agenda for new exploratorium : Reforming Gwacheon National Cyber Science Museum	2010	pp.1.485	This study analyses the current GSM's cyber museum and the trends of global cyber museums. It also provides comparative analysis on 12 cyber museums. New visions and directions of a cyber museum are suggested featuring: community based; game-based; and integrated	Cited as (Kang 2010) in text.

			service using social media.	
A visitor study report on the Gwacheon National Science Museum	2010	pp.1-329	This study investigates the GSM's operation, accessibility, facilities, exhibition guides and so on. It suggests that the GSM should address current science issues and the explanation of its exhibitions should be suitable for children.	Cited as (Kim 2010) in text.
A Study on Strategy for Incorporating the Gwacheon National Science Museum	2011	pp.1-198	This reviews a discussion on the possibility of incorporating the GSM. It looks at relevant policies and laws and suggests organisation structure, human resource and budget needed for the incorporation process.	Cited as (Lee 2011) in text.
A study on the development of contents and system of Gwacheon National Cyber Science Museum	2011	pp.1-274	This looks at a way to build a cyber-science museum which supports school students studying science relative to the national curriculum.	Cited as (Kim 2011) in text.
Development of emotional exhibition using imaging method	2011	pp.1-111	This reviews and analyses, relating cases of the science exhibitions that embrace technologies to enhance visitors' experiences.	Cited as (Kim 2011) in text.
Research and development of science education contents for utilisation of smart mobile devices	2011	pp.1-90	This study suggests a way to develop an e-learning system that can link the GSM contents to other learning resources by embracing location-based and crowd computing technology.	Cited as (Jeon 2011) in text.
A study for the interactive science of emotion & sensibility experience type contents development	2012	pp.1-132	This develops a method of embracing motion sensing technology for a science exhibit which explains the circulatory system in the human body.	Cited as (Choi 2012) in text.
A case study on the science and maths	2012	pp.1-23	This explains the aims and learning goals of science and maths game	Cited as (Lee 2012) in

			developed by the GSM. This presentation was delivered by a museum practitioner of the GSM in a Korea-France G-Learning (Game Based Learning) conference.	text
A study on development and implementation methods for science and culture projects in Gwacheon National Science Museum	2013	pp.1-364	This analyses culture events in the GSM, and suggests future directions of science shows, science festivals and performances to encourage PUS.	Cited as (Jang 2013) in text.
An evaluation report on maker spaces	2014	pp.45-89	This report looks at the benefits and challenges of the maker space at the GSM.	Cited as (MSIP and KOFAC 2014) in text.
A report regarding the GSM management: the way to innovate the GSM	2017	pp.1-244	This report explains the future direction of the GSM, in terms of museum policy and practices.	Cited as (GSM 2017a) in text.
A report regarding the GSM management: the way to reflect costumers' thoughts	2017	pp.1-72	This report explains how the opinions of the GSM visitors and members of staff have been reflected in museum practice.	Cited as (GSM 2017b) in text.
A notice regarding the recruitment of a digital expert at the GSM	2012	Web page	Recruiting an expert on digital learning	Cited as (GSM 2012c) in text.
Introduction of programmes at the Idea Factory	n.d.	Web page	An explanation of the available programmes at the maker space	Cited as (GSM n.d.b) in text.
Introduction of the Idea Factory	n.d.	Web page	Available devices and facilities at the maker space	Cited as (GSM n.d.c) in text.
Information regarding Pechakucha events at the GSM.	n.d.	Web page	Description of and aims of the events	Cited as (GSM n.d.d) in text.
A brochure of Kids	n.d.	Web page	This provides information about	Cited as

maker space			Kids maker space and its programmes.	(GSM n.d.e) in text.
A series of online science and maths educational games 'Milc & Seereal'	n.d.	Web page	The online game developed by the GSM	Cited as (GSM n.d.f) in text.
A website for maker spaces, Idea All.	n.d.	Website	General information regarding the maker spaces which have been funded by the KOFAC.	Cited as (KOFAC n.d.) in text.
History of Korean Science Museum Association (KSMA)	n.d.	Web page	This explains how the KSMA was established.	Cited as (KSMA n.d.) in text.
An evaluation report on responsible administrative agencies.	2016	pp.1-940	Evaluation criteria set by government	Cited as (MOI 2016) in text.
The plan to develop science and technology culture.	2003	pp.1-200	This report explains the government's plan to extend science museums across Korea.	Cited as (MOSF 2003) in text.
The second five-year plan to develop science and technology culture.	2007	pp.1-147	This report explains the achievement of the previous plan and a future direction.	Cited as (MOST 2007) in text.
The third five-yearly basic plan to promote science museums (2014-2018)	2014	pp. 1-36	A plan to extend and enrich science museums across Korea from 2014 to 2018	Cited as (MSIP 2014a) in text.
Korean government legislated a special law to encourage research and development of ICT	2014	Web page	A press release explaining a special law to encourage ICT from research to relevant industry	Cited as (MSIP 2014b) in text.
New research projects to develop technologies for experience-based exhibitions	2015	Web page	A press release announcing research projects that would be funded by the MSIP, to develop technologies for science exhibitions	Cited as (MSIP 2015) in text.
A plan of software	2015	Web page	A press release explaining software	Cited as

education for students from elementary schools to universities.			education will be introduced in the national curriculum	(MSIP and MOE 2015) in text.

4) Tate Modern (Tate)

A total of 45 documents and web pages were collected and analysed.

Data	Year	Pages	Description	Note
Biennial/Annual reports	1990-92 1992-94 1994-96 1996-98 1998-00 2000-02 2002-04 2004/06 2007/08 2008/09 2009/10 2010/11 2011/12 2012/13 2013/14 2014/15 2015/16	Partially collected pp.1-430 pp.1-96 pp.1-80 pp.1-64 pp.1-68 pp.1-76 pp.1-98 pp.1-109 pp.1-100 pp.1-92	Visions; exhibitions; digital activities and projects; partnership in the UK and international partnership (the role of the private sector); visitor services and research; public events and education; the number of audiences, financial report etc.	The reports prior to 2002 (and one for year 2004/06) could not be accessed via its website. I partly photocopied these when I visited the Tate's library.
Tate and DCMS funding agreement 2011-15	2011	pp.1-3	Priorities; compliance; performance and monitoring	Cited as (Tate 2011b) in text.
Tate and DCMS funding agreement - Key information sheet	2014	pp.1-24	Priorities; financial allocation; delegated financial limits; performance measures; engagement; management information	
Tate Vision and Plan 2016-19	2015	pp.1-16	Tate's vision and the planned works for 2016-2019	
History of Tate	n.d.	Web page	History of Tate, including Tate Modern	Cited as (Tate n.d.b) in text.
Introducing Tate Learning	n.d.	pp.1-11	The vision, aims, approach and value of Tate learning	Cited as (Tate n.d.c) in text.

A conference brochure of the Archive and Access project	2015	pp.1-10	Introducing the project and a short description of each talk delivered in the conference	Cited as (Tate 2015b) in text. I attended the conference.
Digital Britain	2009	pp.1-245	This report explains the government's Building Britain's Future plan and draft legislative programme. It proposes the practical action, and embracing digital is supposed as the centre of it.	Cited as (DCMS & BIS 2009) in text.
DCMS Digital Strategy- Becoming digital by default	2012	pp.1-43	Strategies to embrace digital technology for delivering better policy, best practice and programmes. It also introduces case study and actions suggested.	Cited as (DCMS 2012) in text.
National curriculum in England: computing programmes of study	2013	Web page	Aims of the national curriculum for computing, and content to be taught in Key stage 1,2,3, and 4	Cited as (DfE 2013) in text
Using digital technology in heritage projects: Good practice guidance	2012	pp.1-35	This guidance is designed to help writing an application to HLF for a project which uses digital technology. It addresses several points, including staff and skill requirements; management of digital outputs; digital engagement; and evaluation methods.	Cited as (HLF 2012) in text.
Young Digital Makers	2015	pp.1-63	This report explores the emerging field of digital making for young people in the UK. It charts the organisations providing opportunities for young people to make things with technology; looks at how these opportunities relate to what young people learn in school; and explores the attitudes of young	Produced by Nesta.

			people, parents and teachers towards digital making.	
Tate Kids: audience research and evaluation report	2015	pp.1-6	This study investigates the users, how they got to Tate Kids and what they were did there. Methods: Google Analytics and heat maps; qualitative research (interviews with a wide age range of kids, 5-12 years); and desktop research (analysing reports and publications about digital trends for children, which helped to understand the current and future external context for Tate Kids).	Cited as (Box & Villaespesa 2015) in text.
Tate Learning: Vision and Practice.	2014	Web page	This paper outlines the philosophy and approach that Tate Learning has established in order to inspire and invite the widest range of participants, with the aim of sharing and shaping the profound opportunities that arts' learning affords. The Tate recognises that art is a powerful catalyst for creativity, critical thinking, emotional reflection and social connectivity	Cited as (Cutler 2014) in text.
Researching and evaluating young audiences on Tate's digital platforms: Tate website, Tate Collective website and social media channel	2015	pp.1-19	This study investigates the motivations of the Tate Collectives website users; who the users are and why they use the platform. Methods: Google Analytics (visits, traffic sources, content, location); heat map; survey on the websites; social media analytics: Tate Collectives Facebook, Twitter, Tumblr and Instagram.	Cited as (Ohlson & Villaespesa 2015) in text.
Perceptions, Processes and Practices around	2014	Web page	Main points: research-led practice; from a 'delivery' model to a model of 'enquiry'; aiming open questions	Cited as (Pringle & DeWitt 2014)

Learning in an Art Gallery			and creative practice; an experiential process of conceptual enquiry that embraces critical thinking and the questioning of meanings; artistic practice and research-based; the purpose of learning is perceived to go beyond knowledge acquisition and to act 'as catalysts for change in habits of mind'; art-making with artists/authentic and unique experience	in text.
Behind the scenes: Interpretation	2013	Web page	Scott explains the roles of the Interpretation department at the Tate, as a bridge of the Tate to the public.	Cited as (Scott 2013) in text.
Digital audience research report: Understanding visitors' motivations and usage of the online collection	2014	pp.1-20	Audience research on the Tate website, especially the Art & artists service, to understand why people visit it, what are the main activities they do and to obtain feedback from users for future improvements.	Cited as (Villaespesa 2014) in text.
Tate Website Audience Segmentation	2014	pp.1-17	A result of website analysis using Google Analytics and website survey	Cited as (Villaespesa et al. 2014) in text.
Cultural Value: Modelling Cultural Value within New Media Cultures and Networked Participation	2014	pp.1-33	The Cultural Value Project seeks to understand how we think about the value of arts and its culture to individuals and to society. The project attempts to establish a framework that will advance the way in which we talk about the value of cultural engagement and the methods by which we evaluate it.	Cited as (Walsh et al. 2014) in text.
Digital Drawing at Tate Modern	n.d.	Web page	It explains the development process of the Digital Drawing bar	Cited as (Walter &

			project.	Scott n.d.) in text.
Transforming Tate Learning	n.d.	pp.1-41	This document explains the approach that Tate has undertaken in the last years to transform Tate Learning. Overall, it describes how learning at a large museum can be placed at the heart of the organisation.	http://www.tate.org.uk/download/file/fid/30243 [Accessed 21 August 2017].
Tate's priorities	n.d.	Web page	Tate's mission; vision; objectives; and plans	Cited as (Tate n.d.d) in text.
Digital at the Tate	n.d.	Web page	This explains how the Tate will embrace digital media to reach a new audience and to develop high quality digital experiences for its Tate's loyal fans.	Cited as (Tate n.d.e) in text.
New learning spaces at the new Tate Modern	n.d.	Web page	It introduces a new range of learning facilities which will provide groups and individuals with a space for discussion and reflection in view of the galleries, and the opportunity to engage with practical activities and programmes.	Cited as (Tate n.d.f) in text.
Tate Online Strategy 2010–12	2010	Web page	Ten principles for Tate Online: Tate's website is for its online audience; it is both a platform for publication and for interaction; it must be alive with thoughts, conversation and opinion; online content, commerce and community are intermixed; all web pages are the start of a range of possible user journeys; content owners manage their content; online content needs to be open and shared; content and interaction should be taken to the	Cited as (Stack 2010) in text.

			online audience; personalisation will improve visitors' experience; and it must be sustainable	
Tate Social Media Communication Strategy 2011–12	2011	Web page	Goals of Tate social media (Facebook, Twitter and YouTube are Tate's main social media platforms): Be one of the world's leading social media platforms for culture; engage current audiences in innovative ways and build new online communities; communicate through many voices from across the organisation; distribute its content where audiences are active online; direct traffic to the Tate website; integrate its social media channels into its marketing campaigns; generate sales across its income streams; encourage fans to act as advocates for Tate; build developmental audiences; increase awareness of Tate's key strategic messages; and cultivate partnerships to increase Tate's online following	Cited as (Ringham 2011) in text.
Tate Digital Strategy 2013–15: Digital as a Dimension of Everything	2013	Web page	This describes Tate's digital principles; content as a digital publisher; digital community (blogging; social media; learning and social collections- Creative Commons); revenue (ticketing; e-commerce- online shop; multimedia tours to visitors' devices; digital fundraising; customer relationship management) and the organisation (staff skills and engagement; new	Cited as (Stack 2013) in text.

			ways of working-a hub-and-spoke model; and governance and leadership)	
Digital transformation	2013	Web page	This project aims to embed digital skills, processes and a digital culture across the organisation to make digital a dimension of everything that Tate does.	Cited as (Tate 2013b) in text.

5) British Museum (BM)

A total of 55 documents and web pages were collected and analysed.

Data	Year	Pages	Description	Note
The British Museum Report of the Trustees	1990-93 1993-96 1996-97 1997-98 1998-99	Partially copied	Types of collections; public services; finance	The reports prior to year 2000 could not be accessed via its website. I partly photocopied them when I visited the British Museum's library,
Annual review	1999/00 2000/01 2001/02 2002/04 2004/06 2006/07 2007/08 2008/09 2009/10 2010/11 2011/12 2012/13 2013/14 2014/15	pp.1-100 pp.1-56 pp.1-51 pp.1-72 pp.1-78 pp.1-79 pp.1-75 pp.1-86 pp.1-87 pp.1-75 pp.1-79 pp.1-79 pp.1-71 pp.1-67	Public programmes; new displays; museum collaborations; the Internet; management and finance (government funding); digital projects (COMPASS; websites; CD-ROM Journeys in the Roman World; the Portable Antiquities scheme; Virtual mummy; digitising collections; an online First Empire pack for schools; a public engagement broadcasting and online project with the BBC, A History of the World in 100 Objects; SDDC; Time Explorer; wikipedian-in-residence; apps; a Hajj online campaign; QR code; Virtual Autopsy; projects with the Google Cultural Institute; a project in Minecraft; MicroPast etc),	
The British Museum	2008-09	pp.1-62	Structure, governance and	Published by

Account	2009-10	pp.1-59	management; strategic direction and performance against objectives; plans for future periods; fundraising and finance; DCMS' performance indicators	the Stationery Office.
	2010-11	pp.1-64		
	2011-12	pp.1-67		
	2012-13	pp.1-68		
	2013-14	pp.1-67		
	2014-15	pp.1-67		
Museum of the future : A Preliminary Report	2015	pp.1-27	This report explains the findings of the surveys and feedback from the initial work and consultations of the Museum of the future initiative. It also makes recommendations for next steps and future activities.	Cited as (BM 2015b) in text.
Towards 2020 The British Museum's Strategy	2012	pp.1-9	Principles and purpose; the museum now (collection, conservation; visitors, management, public engagement); aims of the BM towards 2020 (especially, highlighting digital technologies that allows the Enlightenment ideal to be given a quite new reality, to be the museum for the global citizen)	Cited as (BM 2012a) in text.
The British Museum: Funding Agreement 2008-11	2008	pp.1-5	Key objectives; financial allocation; performance and monitoring; performance indicators	Cited as (BM 2008b) in text.
Job posting	2012	Web page	A job recruitment notice, including the expected roles of Head of Digital Media and Publishing within the British Museum.	http://www.nationalmuseums.org.uk/media/job-pdfs/job-2684.pdf [Accessed 21 August 2017]
The British Museum - using GLOs as part of	n.d.	Web page	A short description relating to how the BM has adopted GLOs as part	http://www.artscouncil.org.

understanding the visitor experience			of understanding the visitor experience	uk/case-studies-0#section-2 [Accessed 21 August 2017]
On Air, Online and Onsite: The British Museum and BBC's 'A History of the World.'	2011	Conference paper (online)	This paper explains the 'A History of the World' project of the BM and shows how the partnership used a cross-platform approach to develop and sustain engagement and participation across the ten months of the project.	Cited as (Cock et al. 2011) in text.
Digital technologies and visiting school groups: A case study at the British Museum	2012	pp. 1-125	This study investigates the potential of digital learning programmes for school groups. It analyses the case of Multimedia Magic at the BM as an example.	Cited as (Doll 2012) in text.
Children's COMPASS: The British Museum's new interactive learning site	2002	Web page	A short description about the children's COMPASS	Cited as (Howitt 2002) in text.
Samsung Digital Discovery Centre (SDDC)	2009	pp.1-25	Mannion explains school and family programmes at the SDDC, findings of visitor research on the programmes, and future directions of this learning centre.	http://www.slideshare.net/s.mannion/samsung-digital-discovery-centre [Accessed 21 August 2017]
Strategies for Digital Learning: How technology changes and challenges museum education	2011	pp.1-22	This presentation explains how embracing digital elements can be beneficial for learning (new interaction styles; participatory learning; new programming models; space as canvas) and the challenges which may be faced within digital programmes (role of	Cited as (Mannion 2011) in text.

			the educator; conflicts with other digital work in the organisation; conflicts around institutional authority; permissions and copyright; challenges to curatorial control over narratives; and collaboration versus competition).	
Athens Augmented: Mobile learning for the Parthenon sculptures	2014	pp.1-44	This presentation explains the development process and testing of two tablet-based learning activities for the BM's Parthenon gallery: a simple mobile trail adapted from a traditional worksheet and a sophisticated AR game.	https://www.slideshare.net/s.mannion/athens-augmented [Accessed 21 August 2017]
An audio state of mind: Understanding behaviour around audio guides and visitor media	2015	conference paper (online)	This paper explains the development process of the BM's new audio guide. A cross-disciplinary project team interviewed, observed, and tested paper prototypes with more than 250 visitors. Based on this, the team found six key factors that influence the take-up rate of audio guides and common patterns of behaviour in their use. This paper describes how the team reflects the result in the audio-guide development.	Cited as (Mannion et al. 2015) in text.
Use of Social Media within the British Museum and Museum Sector	2012	pp.83-102	This paper explains how social media can be used and implemented within the museum sector.	Cited as (Pett 2012) in text.
MicroPasts: Crowd- and community-fuelled archaeological and museum research	2016	pp.1-63	This talk explains the MicroPasts project with three strands: crowdsourcing; 3D via crowdsourcing; and crowd-funding. It also briefly explains the	Cited as (Pett 2016) in text. I attended this talk.

			way in which the project team approached potential participants and the results of surveys on its contributors (their motivation etc).	
Back to the Future: Time Explorer at the British Museum	2011	pp. 246–259	This explains how the game 'Time Explorer' was developed.	Cited as (Prudames 2011) in text.
New digital learning initiatives for family and teen aged visitors at the British Museum	2015	Presentation	Juno Rae, an education manager at the SDDC, BM, talked about how they identified gaps in their digital learning provision, and how they tried to build digital initiatives from elsewhere in the museum into the programme. She also pointed out how their programmes can facilitate learners to develop digital literacy.	Cited as (Rae 2015) in text. I also attended the conference 'UKMW15 Museums on the Web' in which this presentation was delivered.
Virtual reality at the British Museum: What is the value of virtual reality environments for learning by children and young people, schools, and families?	2016	Conference paper (online)	This paper introduces the development of a VR event at the BM. Critical learning from the project and future plans for the technology within the SDDC's digital learning programme are also discussed.	Cited as (Rae & Edwards 2016) in text.
Shaping a Culture of Lifelong Learning for Young Audiences: A Case Study on The Samsung Digital Discovery Centre at the British Museum	2015	pp. 1-33	This study provides an understanding into how a museum digital learning centre such as the SDDC responds to growing societal needs for lifelong learning and development of skills and aptitudes in venues and spaces that are no longer confined to formal education establishments.	Cited as (Sabiescu & Charatzopoulou 2015) in text.
Collection Online: the	2007	pp.1-6	This paper explains the	Cited as

British Museum Collection Database goes public			background of the 'Collection Online' project and concludes with future directions.	(Szrajber 2007) in text.
Public Access To Collection Databases: the British Museum Collection Online (CoI): a Case Study	2008	pp.1-14	This paper provides context of the 'Collection Online' project with a history of the collection database development at the BM. By posing issues on data content and terminology, the museum has decided to open the database to the public. This paper explains the advantages and problems of this approach and concludes with public response.	Cited as (Szrajber 2008) in text.
Harnessing Technology: Transforming Learning and Children's Services	2005	pp.1-71	This report provides overall context as to why digital technology should be embraced in education.	Cited as (DfES 2005) in text.
Time Explorer Game	n.d.	Web page	This webpage explains the development process of Time Explorer game with its screen shots.	Cited as (Smith n.d.) in text.
Museum of the citizen	n.d.	Web page	This website describes how programmes and projects of the BM facilitate the public with access to enjoy the BM's collections. For example, public discussion; Google projects; Museumcraft in the computer game Minecraft; Micropasts project; A History of the World in 100 objects.	Cited as (BM n.d.c) in text.
The Digital Transformation of The British Museum	2015	Web page	This website introduces an interview with Chris Michaels, the Head of Digital & Publishing at the BM, and presents the museum's new digital strategy.	Cited as (Blooloop 2015) in text.

Museum of the future	n.d.	Web page	In 2014 the BM hosted a series of debates with high profile speakers on different aspects of the museum of the future. This web page provides video and audio recording of the event and a report as a result.	Cited as (BM n.d.d) in text.
Portable Antiquities Scheme	n.d.	Web page	This webpage explains the context and purpose of the PAS.	Cited as (BM n.d.e) in text.
British Museum announces new audio guide.	2015	Web page	A short description about new audio guide	Cited as (BM 2015d) in text.
Digital workshop: Egyptian photo booth	2016	Web page	A short description about the digital workshop: Egyptian photo booth.	Cited as (BM 2016a) in text.
Virtual autopsy: discover how the ancient Egyptian Gebelein Man died.	2012	Web page	This explains how the virtual autopsy was developed.	Cited as (Antoine 2012) in text.

6) Science Museum, London (SML)

A total of 49 documents and web pages were collected and analysed.

Data	Year	Pages	Description	Note
Science Museum Review	1991		History; framework for operation; management; achievement; employee involvement; mission statement and core objectives; sponsorship, grants and donations; access and outreach; capital projects; attendance etc.	Reports prior to 2000 could not be accessed via its website. I partly photocopied these when I visited the Science Museum's library.
Review 1993 The National Museum of Science & Industry	1993			
National Museum of Science and Industry Account	1994-95			
	1995-96			
	1996-97			
	1997-98			
	1998-99			
	1999-00	pp.1-60		
	2000-01	pp.1-72		
	2001-02	pp.1-72		
	2002-03	pp.1-74		
	2003-04	pp.1-63		
	2004-05	pp.1-66		
National Museum of Science and Industry Annual Report and Accounts	2005-06	pp.1-66		
	2006-07	pp.1-64		
	2007-08	pp.1-62		
	2008-09	pp.1-75		
	2009-10	pp.1-76		
	2010-11	pp.1-78		
Science Museum Group Annual Report and Accounts	2011-12	pp.1-81		
	2012-13	pp.1-72		
	2013-14	pp.1-78		
	2014-15	pp.1-78		
Science Museum Group Annual Review	2011-12	pp.1-73	This explains the achievements of the SMG each year.	https://group. sciencemuse um.org.uk/ab out-
	2012-13	pp.1-79		
	2013-14	pp.1-81		
	2014-15	pp.1-81		

				us/annual-review/ [Accessed 21 August 2017]
History of the Science Museum	n.d.	pp.1-9	The history of the Science Museum since 1851	Cited as (SML n.d.b) in text.
Three-year Funding Agreement between NMSI and DCMS: 2005/6–2007/8	2006	pp.1-12	Core targets (total numbers of visits to museums, number of unique users visiting the website etc.); strategic priorities (children and young people; communities; economy; delivery)	Cited as (NMSI 2006b) in text.
SMG Digital Strategy 2015-17	2015	Web page	Digital principles (audience centred; sustainable and scalable; entrepreneurial and innovative; open, reusable and sharable; embedded across the organisation). Objectives (experience; culture - using audience data, initiating a Digital Lab and building organisation-wide digital capability; collection - providing digital access, improving user interface, and inviting audiences to contribute to the digital work; narrative content; and infrastructure).	Cited as (SMG 2015a) in text.
Science Museum Group's Learning Vision, Philosophy, Approach and Framework	2016	pp.1-4	This introduces the vision and philosophy, and the approach to learning in the Science Museum Group Learning team.	Cited as (SMG 2016b) in text.
Wellcome Wing	2001	pp.1-48	This introduces the Wellcome Wing: its vision; architecture; exhibitions; IMAX cinema; website; funding etc.	Cited as (SML 2001) in text.
Welcome to the	2000	p.259	A short introduction to the	http://www.sc

			Wellcome Wing	iencedirect.com/science/article/pii/S0140673600024946 [Accessed 21 August 2017]
Science Museum's new Wellcome Wing			Wellcome Wing	iencedirect.com/science/article/pii/S0140673600024946 [Accessed 21 August 2017]
Atmosphere Gallery Summative Evaluation Report	2011	pp.1-67	This explains how the gallery content, design and interactive elements have influenced visitor learning/experiences and the barriers to learning. It also provides recommendations for future development.	Cited as (SML 2011) in text.
Understanding your visitors through prototype testing	2015	Presentation	This explains the goals of prototyping exhibits and programmes; methods which the museum has used; and their impact on visitor experience. Presenters: Lauren Souter and Jack Gelsthorpe (Audience Research and Advocacy, Science Museum, London).	A presentation at the Museums and Heritage Show. I also attended the event.
Rizk – Online Game Summative Evaluation Report	2012	pp.1-25	This provides a brief introduction to the online game Rizk and key findings of evaluation via Google Analytics data and interviews with a target audience. (Player numbers and profiles; dwell times; player types; player behaviour; engaging elements and barriers to engagement; learning outcomes) Author: Hannah Clipson (Audience Research and Advocacy, Science Museum)	Cited as (Clipson 2012) in text.

Developing interactive exhibits for the Science Museum Version 2.0: A guide to standard requirements and good practice	n.d.	pp.1-27	This explains the Science Museum's process for developing and testing interactive exhibits. It also provides advice and guidance on how to create outstanding interactive exhibits.	https://www.museuminsider.co.uk/wp-content/uploads/2013/06/Appendix_Guide_To_Developing_Interactives_V4.pdf [Accessed 21 August 2017]
CodeBuilder workshop teachers' guide	n.d.	pp.1-8	This guide briefly introduces learning approaches adopted in the CodeBuilder workshop and provides tips for teachers, including how to deal with common problems in the workshop.	http://www.sciencemuseum.org.uk/educators/plan_and_book_a_visit/things_to_do/events_for_schools/~/media/B31110DD155348A1B04A087095528CFF.ashx. [Accessed 21 August 2017]
Antenna, Science News Now, Science Museum, London	n.d.	pp.1-4	A brief description on how the gallery was designed and developed	http://researchonline.rca.ac.uk/1381/1/AB%20Rogers_Antenna%20Exhibition%20Science%20Museum_2010.pdf [Accessed 21 August 2017]
Using the Web to	1998	Conference	This paper explains a project which	http://www.m

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Change the Relation Between a Museum and its Users		paper (online)	encouraged students and teachers to develop their own educational resources, reflecting their own perspective. Authors: Roland Jackson, Martin Bazley, Dave Patten (Science Museum, London) and Martin King (Bulbourne Internet Training)	useumsandth eweb.com/m w98/papers/j ackson/jacks on_paper.ht ml [Accessed 21 August 2017]
Think Globally, Act Locally: The Role of Real Teachers in Community Science Issues	2002	Conference paper (online)	This paper introduces a project which US and UK On-line Museum Educators (OMEs) worked with The Franklin Institute Science Museum, Philadelphia and the SML to create a series of online learning resources. It also provides suggestions for similar online projects. Authors: Martin Bazley, Lyndsey Clark (Science Museum, UK) and Barbara Bottaro, Karen Elinich (The Franklin Institute Science Museum, USA)	http://www.m useumsandth eweb.com/m w2002/paper s/elinich/elini ch.html [Accessed 21 August 2017].
Getting the Most Out Of Our Users Or The Science Museum Lab: How the Dana Centre Lets Us Play	2005	Conference paper (online)	This paper examines a range of Web and broadcast technologies and their application - in particular focusing on the Dana Centre, SML. It shows the potential of the web as a platform allowing users to contribute content for use both on- and offline. Authors: Ellis, Mike; Patten, Dave; Evans, Dan (SML).	http://www.m useumsandth eweb.com/m w2005/paper s/ellis/ellis.ht ml [Accessed 21 August 2017].
Web Lab: Bridging the divide between the online and in-museum experience	2013	Conference paper (online)	This paper looks at the development and installation of Web Lab and how visitors both at the Science Museum and online have responded to this exhibition.	Cited as (Patten 2013) in text.
Parallax Error? A	2010	pp.111-135	This chapter explains how the	Cited as

Participant's Account of the Science Museum, c.1980-c.2000			dialectic between science education and history of science was played out in the late 20th century as the Museum become more independent after the National Heritage Act of 1983. (reorganisation; interpretation).	(Boon 2010) in text.
The Development of Science Museum Web Sites: Case Studies	2005	pp. 366-392	This chapter surveys the history, development and features of a number of websites of science museums, including the SML.	Cited as (Bowen et al. 2005) in text.
Visitors' Use of Computer Exhibits: findings from five gruelling years of watching visitors getting it wrong	2010	pp. 281-290	The author who worked at the SML summarises findings of visitor research on computer exhibits and provides comments on the development of interactive exhibits.	Cited as (Gammon 2010) in text.
Behind the scenes at the Science Museum	2002	pp.1-293	By tracking the history of a particular exhibition in the SML, Macdonald explains how exhibitions are created and how public culture is produced. By doing so, this book describes actors relating to the exhibition projects, and how the exhibitions are shaped by them.	Cited as (Macdonald 2002) in text.
Shut down or restart?: The way forward for computing in UK schools	2012	pp.1-122	This reports the outcome of the Computing in Schools project which looked at the current provision of education in Computing in UK schools. It explains the main reasons for the current delivery of Computing education in many UK schools as being highly unsatisfactory. It maintains that computer science should be recognised as an academic discipline of great importance to the	Cited as (Royal Society 2012) in text.

			future careers of many pupils and students should have the opportunity to learn Computing at school.	
Next Gen	2011	pp.1-86	The authors found that the UK education system did not provide the skills that the video games and visual effects industries need, and they recommend several ways of which the UK can be transformed into the world's leading talent hub for video games and visual effects. For example, this report points out the necessity of computer science on the national curriculum alongside maths and physics.	Cited as (Livingstone & Hope 2011) in text.

Appendix 4: Interview Themes

Interview Themes	Detail	RQs	Theoretical Framework
1. Context of museum practitioners	This theme focuses on understanding the personal (sub-theme 1-1) and societal (1-2) contexts of museum practitioners. In terms of the personal context of museum practitioners, their profile, identity, and work experience were dealt with. In terms of their societal contexts, the expected or forced work of museums, and their qualifications as a museum practitioner were investigated.	1-2 2-1 2-3	Activity theory: subject CoP ANT: translation, devices
1-1. Personal contexts (such as profile, identity, work experience)	Who are they?; Departments they work for; Academic background; Work experience; How long are they working for this occupation? How they were introduced to their professional identity (such as expert or government officer)? How do they develop their expertise?	1-2 2-3 3-2	Activity theory: subject CoP
1-2. Societal contexts (such as expected works, skill, qualifications)	What is considered as important abilities and knowledge when fulfilling digital projects?; What is expected to be done?; Emerging issues or qualification regarding digital culture in museums, and the ways in which they are evaluated	1-1 1-3 2-1 3-1	ANT: translation, devices
2. Object of digital projects	This is for seeking the purpose and motivation of digital projects that the museum practitioners have planned or already done.	2-1 3-3	Activity theory: object Communication and learning approaches
3. Mediating artefacts (technological tools and theoretical tools)	This theme defines the digital technology that the museum practitioner has employed (technological tools) and the notion based on the activity (mental tools). In particular I asked	2-1 2-2 3-1	Activity theory: tool ANT: digital technology as

	about the significant functions and features of the tools for the museum practitioner from his/her point of view. Technological (physical) tools: what kind of tools? The reasons for deciding to employ the tool (digital technology such as app)? Characteristics of the tool; Significant features? Issues concerning development/management of the tool Theoretical (mental) tools: ideas/notions based on the object (such as traditional or new museology)	3-3	an actor Communication and learning approaches
4. Community (profile; identity of community)	This theme concerns the link between network museum practices and internal and external stakeholders. I attempted to determine which are strong/hidden stakeholders, and their relations with/among others. During the development process of the projects, some stakeholders' power would be extended while others excluded. Who is involved in the project intentionally? From when? (planning; developing; marketing; evaluation phases); Who intends to use the tools? Purpose of the community The process by which the tool is being adopted and developed	1-1 1-2 1-3 1-4 3-1 3-2	Activity theory: community ANT: translation, devices, OPP
4-1. Relations	How can you define the relation with the stakeholders? Vertical/horizontal (membership); work process (linear/collaborative)	1-2 1-4 3-2	CoP Communication theories
5. Rules	Rules are sets of conditions with which a museum practitioner is concerned when doing the activity. For example, these may include budget; contract; policy; law; social conditions;	1-1 1-3	Activity theory: rules CoP

	organisational culture; and sub-culture.	2-3 3-2	
6. Division of Labour (roles)	This theme is investigating the ways in which the community works together in fulfilling their distributed/expected roles. Roles members of community played/expected; how are their roles changed? Opportunities? Barriers regarding digital culture?	1-1 1-2 1-3 1-4 3-1	Activity theory: division of labour ANT
6-1. Social learning (skill development)	This is one of the roles assumed by museum professional bodies. How they are (re)trained and through which resources, from where? What resources do they use for (re)training? Is (re)training supposed to be important? What is the topic/skill they want to learn? Is this related to digital culture?	1-2 2-3 3-2	CoP
7. Ultimate goals, values, and beliefs	This theme is seeking the broader/wider purpose of the activity. Museum practitioners may carry out their work in line with the museum's overall vision. What should museum practices be (in the digital culture)? Shared common value in a museum? Expected/intended/actual results; value/purpose of museums in a society	2-1 2-2 3-3	Activity theory: outcome

Appendix 5: A List of Interviewees

Organi sation	Code	Job Title	Department	Date of interview	Note
MMCA	MMCA_A	Assistant Director	Department of Planning and General Management	22-Apr-15	
	MMCA_B	Educator	Education & Information Service Team	08-May-15	Not recorded
	MMCA_C	Officer	Education & Information Service Team	14-May-15	Not recorded
	MMCA_D	Educator	Education & Information Service Team	20-Sep-16	
	MMCA_E	Senior Educator	Culture Education Division (Gwacheon branch)	21-Sep-16	
	MMCA_F	Officer	Customer Support and Development Team	22-Sep-16	
NMK	NMK_A	Educator	Children's Museum Team	17-Apr-15	
	NMK_B	Officer	Planning & General Management Division	17-Apr-15	The Deputy Director joined in the interview.
	NMK_C	Associate Curator	Department of Fine Art	22-Apr-15	
	NMK_D	Associate Curator	Visitor Service Team	24-Apr-15	Not recorded
	NMK_E	Associate Curator	Research and Development Department	30-Apr-15	
	NMK_F	Senior Officer	Planning & General Management Division	20-Sep-16	
GSM	GSM_A	Researcher	Science Culture Exhibition Division	07-Apr-15	
	GSM_B	Researcher	Science Culture Exhibition Division	10-Apr-15	
	GSM_C	Researcher	Infrastructure Exhibition Division	14-Apr-15	
	GSM_D	Senior Researcher /Manager	Astronomy and Space Exhibition Division	14-Apr-15	
	GSM_E	Senior Researcher	Advanced Technology Exhibition Division	16-Apr-15	
	GSM_F	Senior Researcher	Advanced Technology Exhibition Division	21-Apr-15	Not recorded
	GSM_G	Officer	Exhibition Planning Division	21-Sep-16	
KCISA	KCISA_A	General Manager	Strategic Planning Division/IT Planning Department	06-May-15	
BM	BM_A	Education Manager	Learning department	26-Nov-16	I conducted an interview of both BM_A

	BM_B	Education Manager	Learning department	26-Nov-16	and BM_B together
	BM_C	Lead of Digital Humanities	Digital & Publishing department	10-Mar-16	
Tate	TA_A	Curator (Convenor)	Learning department (Digital Learning)	07-Jan-16	
	TA_B	Tate Kids Producer	Digital department	22-Jan-16	
	TA_C	Curator	Learning department (Interpretation)	23-Feb-16	
	TA_D	Curator: Learning Outreach/ Digital Learning	Learning department (Digital Learning)	24-Feb-16	
	TA_E	Assistant Curator	Learning department (Interpretation)	02-Mar-16	
	TA_F	Digital Director	Digital department	03-Mar-16	
SML	SML_A	New Media Manager	Digital department	05-Oct-15	
	SML_B	(former) New Media Manager	Digital department	03-Nov-15	SML_B currently works at other museum.
	SML_C	New Media Developer	Digital department	11-Nov-15	
	SML_D	(former) New Media Manager	Digital department	18-Dec-15	SML_D currently works as a freelancer. This interview was conducted via Skype.
	SML_E	Digital Director	Digital department	11-Jan-16	Former Head of Digital, Tate
Museums Computer Group	MCG_A	Chair		16-Feb-16	

Appendix 6: Information Sheet

Information Sheet for Museum Practitioners

You will be given a copy of this information sheet.

Title of Project: **Museums as part of the ecosystem of digital culture: a comparative study between South Korea and the UK**

This study has been approved by the UCL Research Ethics Committee.

Name	Juhee Park
Work Address	UCL Institute of Archaeology, Museum Studies 31-34 Gordon Square London WC1H 0PY
Contact Details	juhee.park.13@ucl.ac.uk

I would like to invite you to participate in this research project. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Before you decide whether you want to take part, it is important to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form.

This study examines how museums, as a part of the ecosystem of digital culture, interconnected with other social system. I would like to examine: 1) How do the dynamics between the key stakeholders in the museum sector affect the use of digital technology as a foundation of the visitor experience?, 2) how have museum practices evolved to accommodate digital technology?, and 3) how do Korean national museums compare with the UK?

I have selected a number of possible case studies, including the museum where you work. The research will generate new understanding about the holistic context of national museums in the South Korea and the UK, regarding embracing digital technology for facilitating museum visitors' experience. I expect the results to particularly benefit the museums that strive to facilitate visitor engagement in museums through the advantage of digital technology. I will supply a copy of the final report to all participating museums.

I am requesting your participation as a member of staff who have responsible to work the Museum's work with using digital technology, in terms of interpretation in/out of exhibitions, educational programme, or websites/social media. If you agree to take part, I will need you to take part in one formal interview, which will take about 1hour, at a time convenient for you. It can take place in your office or in an alternative location to suit you. That interview will be electronically recorded. It will then be transcribed (written up) and the electronic file will then

be wiped clear. In the interview, I will be asking for details of your work itself and process of work embracing digital technology/media (AR, VR, touch screen, tablet, smartphone, QR code, and so on) and for your opinions about museum practices in the digital age. After the formal interview, additional questions could be asked in case via email or phone.

All data will be collected and stored in accordance with the UK Data Protection Act 1998. I will be the only person accessing the physical data. The results of the research will form the basis of my doctorial thesis and academic papers, and I hope to publish them.

I will not publish any personal details about you. I will however identify your job title and the name of your museum in any publications of the research. This is because this is important information regarding the choice of the sites. Please therefore be aware that any information you give me might be attributable to you by others in the future. I will provide the draft text to be used for any publications for you to look over, and you will have a two week period in which to amend or delete any particular comments you wish to withdraw from the research.
Please note that any data from informal conversations or observation of your work may also be included in the research unless you ask me to keep particular comments or observed information confidential. If you ask me to keep anything confidential I will immediately strike a line through it in my notes and will not include it in the results of my research.

It is up to you to decide whether to take part or not. If you decide to take part, you are still free to withdraw your data from the project at any time until data collection at your museum has been completed and the formal interview transcript has been agreed, without giving a reason.

All data will be collected and stored in accordance with the Data Protection Act 1998.

- This information sheet was translated into Korean for Korean interviewees.

Appendix 7: Informed Consent Form

Informed Consent Form for Museum Practitioners in Research Studies

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Project: **Museums as part of the ecosystem of digital culture: a comparative study between South Korea and the UK**

This study has been approved by the UCL Research Ethics Committee.

Thank you for your interest in taking part in this research. Before you agree to take part the person organising the research must explain the project to you.

If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you to decide whether to join in.   You will be given a copy of this Consent Form to keep and refer to at any time.

Participant's Statement

I

- have read the notes written above and the Information Sheet, and understand what the study involves.

- understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately.

- consent to the processing of my personal information for the purposes of this research study.

- understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.

- agree that the research project named above has been explained to me to my satisfaction and I agree to take part in this study.

Signed: Date:

- This informed consent form was translated into Korean for Korean interviewees.

Appendix 8: Analytical Framework for Communication and Learning Approaches

Communication approaches	Learning approaches	Indicators	The pedagogical roles of digital technology	Examples
One-way (transmission) model (Hooper-Greenhill 1999a; 1999b)	Didactic, Expository (Hein 1998)	A sequential and intended orders Specified learning objectives determined by the content to be learnt.	Content delivery	Smart curator (NMK)
	Behaviourism (Hein 1998)	Reinforcing components that repeatedly impress the stimulus on the learner and reward appropriate response.	Interaction for control.	Automatic feedback on right/wrong answer.
Encoding/decoding model (Hall 2006) Circular model of communication with feedback loop (Hooper-Greenhill 1999a; 1999b)	Discovery learning (Hein 1998)	A range of learning materials that learners can explore Some means for learners to assess their own interpretation against the "correct" interpretation set	Reflective interaction	Virtual Autopsy (BM)

		by the museums.		
Cultural model of communication (Hooper-Greenhill 1999b)	Constructivism (Hein 1998; Hein 1999)	Many entry points, no specific path and no beginning and end. A range of points of view and no correct answers predefined. A range of activities and experiences that utilise their life experiences.	Reflective data collection Content construction Link to other resource	Online games (SML)
	Social constructivism (Vygotsky (1978)	Emphasis on working together with others; interaction with parents, siblings, teachers, and peers are considered and encouraged. Different culture/social background of learners is acknowledged.	Sharing Collaboration Link to other people	An exhibit at the children's museum (MMCA)
	Situated learning (Lave & Wenger 1991)	Authentic situations where learners can participate on expert	Digital technology as a learning subject	Maker spaces

		performances.		
	Serious leisure (Stebbins 2011)	Motivation of participants is considered not only as personal aspects but also social ones.	Data generation	MicroPasts(BM)
	Critical pedagogy (Lindauer 2007; Hooper-Greenhill 1999b)	Focus on what knowledge is taught and what purpose knowledge is constructed. Learners' contribution to the production of knowledge through debate, discussion etc.	Multiplicity Content remixing	Tate Kids
Holistic approach (Hooper-Greenhill 1999a)		The consideration of various elements that influence visitor experience and the museums' image, such as physical space.	Building immersive environment	The orientation space at the Welcome Wing (SML)

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