Artful
Curating the invisible:
Design, development and evaluation of a social media tool for cultural learning in museum settings

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LIST OF MAIN ABBREVIATIONS

APK Android Package Kit
AR Augmented Reality
CoP Community of Practice
CH Cultural Heritage
MoMA Museum of Modern Art
UI User Interface
VCoP Virtual Community of Practice
VR Virtual Reality
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ABSTRACT

The current thesis proposes the design and the development of an efficient technology-based solution that could facilitate the creation of an online learning community for museum staff and museum visitors, aiming to enable information sharing and many types of interactions among them. Specifically, a user friendly, cost-effective and minimally demanding technically tool that curators could use to offer expert commentaries on highlight exhibits, follow and monitor visitors’ activity, and interact with them. On the other hand, the proposed tool could also be used by visitors as a self-guided tour tool with Augmented Reality features for exploring museum exhibitions. However, the audience is not expected to remain passive, but on the contrary is encouraged to adopt an active role. The main aim of this study is to test the hypothesis that the educational use of such a social media tool could help museums transform in more democratizing, inclusive and polyphonic spaces by enhancing knowledge sharing, social learning and knowledge assessment attitudes.

Initially, the thesis’ theoretical background analysis is presented focusing mainly on the analysis of social educational theories, such as social Constructivism, Communities of Practice and Connectivism, that highlight the social and active nature of learning. Next, a current state of the art analysis is conducted by reviewing related research works with respect to the application of Web 2.0 practices in the Cultural Heritage sector. Specifically, the two aforementioned analyses provided both direction and impetus to the following design process and research inquiry. Next, the main functionalities of the proposed tool, designed and developed in the form of a social media mobile application, are presented. Moreover, a small-scaled controlled experiment was performed to assess the proposed tool’s educational potential and effectiveness. Results showed that the use of such a tool could be efficient as positive feedback was obtained. However, one should keep in mind that the degree of integration of Web 2.0 practices by museums depends on their readiness to redefine their relationship with their audience, a matter that it is understandably not a simple one to approach. Therefore, it is of great importance the further and ongoing research of both successful and unsuccessful case studies. In this context, the current thesis’ future work will consider improvements derived from users’ feedback and will pursue further research in close cooperation with curators, visitors and other museum staff on how such a tool could adapt better in museum settings to better fit its purpose.
ΠΕΡΙΛΗΨΗ

Αντικείμενο της παρούσας διπλωματικής εργασίας αποτελεί η σχεδίαση, ανάπτυξη και αξιολόγηση ενός Web 2.0 εργαλείου με σκοπό την ενίσχυση της κοινωνικής και ενεργής μάθησης στο μουσειακό χώρο. Συγκεκριμένα, προτείνεται η χρήση μιας εξαιρετικά οικονομικής και ελάχιστα απαιτητικά τεχνικά εφαρμογής κοινωνικής δικτύωσης για κινητές συσκευές, που σκοπός της αποτελεί η διευκόλυνση της συγκρότησης μιας εικονικής κοινότητας μάθησης για επιμελητές και επισκέπτες μουσείων, επιτρέποντας την ανταλλαγή πληροφοριών και πολλούς τύπους αλληλεπιδράσεων. Ένα εύχρηστο εργαλείο μέσω του οποίου επιμελητές εκθέσεων θα μπορούσαν να προσφέρουν εξειδικευμένα σχόλια για εκθεσιακά αντικείμενα και να παρακολουθούν τη δραστηριότητα των επισκεπτών, οι οποίοι με τη σειρά τους θα μπορούσαν να το χρησιμοποιήσουν ως ένα σύστημα αυτόνομης ακουστικής ξενάγησης, που, όμως, δεν τους περιορίζει σε ένα παθητικό ρόλο, με χαρακτηριστικά Επαυξημένης Πραγματικότητας για περιήγηση σε εκθεσιακούς χώρους. Κύριος σκοπός της παρούσας μελέτης είναι να ερευνήσει αν η εκπαιδευτική χρήση ενός τέτοιου εργαλείου θα μπορούσε να βοηθήσει τα μουσεία να μεταμορφωθούν σε πιο δημοκρατικούς, συμμετοχικούς και πολυφωνικούς χώρους, ενισχύοντας διαδικασίες ανταλλαγής γνώσεων, αλληλεπιδράσεων και αναστοχασμού.

Συγκεκριμένα, η ανάλυση του θεωρητικού υπόβαθρου της εργασίας, που αφορά κυρίως τις εκπαιδευτικές θεωρίες κοινωνικής μάθησης (κοινωνικός Κονστρουκτιβισμός, Κοινότητας Πρακτικής και Κοινωνικού Κοσμοσκόπα), καθώς και η βιβλιογραφική ανάλυση πρόσφατων ερευνών, που σχετίζονται με τη χρήση Web 2.0 πρακτικών σε πολιτιστικούς χώρους, συνέβαλαν στη σκιαγράφηση των κατευθυντήριων γραμμών της διαδικασίας της σχεδίασης και της ερευνητικής μελέτας. Έπειτα, για την αξιολόγηση του προτεινόμενου εργαλείου πραγματοποιήθηκε ένα πείραμα μικρής κλίμακας, όπου ζητήθηκε από τους συμμετέχοντες να αξιολογήσουν την αποτελεσματικότητα και την εκπαιδευτική χρήση της προτεινόμενης εφαρμογής. Τα σχετικά θετικά χαρακτήρα δεδομένα της αρχικής διαδικασίας αξιολόγησης μπορούν να θεωρηθούν ενθαρρυντικά, όμως, κανείς δεν πρέπει να υποτιμά το ζήτημα ότι η εφαρμογή Web 2,0 πρακτικών στα μουσεία είναι σαφώς θέμα λεπτής ισορροπίας, που συχνά έρχεται σε σύγκρουση με τον παραδοσιακό χαρακτήρα τους και συχνά εξαρτάται από την ετοιμότητά τους να επαναπροσδιορίσουν τη σχέση τους με το κοινό τους. Για αυτό το λόγο η ανάγκη διερεύνησης των πρακτικών του Web 2.0, είτε επιτυχημένων είτε όχι, είναι σημαντική, εφόσον και οι δύο περιπτώσεις μας παρέχουν χρήσιμες πληροφορίες για τη βελτίωση των υπαρχόντων πρακτικών. Το μελλοντικό έργο της
παρούσας εργασίας θα επιδιώξει περαιτέρω και μεγαλύτερης κλίμακας έρευνα σε στενή συνεργασία με το μουσειακό προσωπικό και κοινό σχετικά με το πώς η χρήση ενός τέτοιου εργαλείου θα μπορούσε να προσαρμοστεί περαιτέρω, ώστε να εξυπηρετήσει σε μεγαλύτερο βαθμό το σκοπό της δημιουργίας του στο μουσειακό χώρο.
“I am responsible to anyone (that is to say, to any other) only by failing in my responsibility to all the others, to the ethical or political generality. And I can never justify this sacrifice; I must always hold my peace about it... What binds me to this one or that one, remains finally unjustifiable. I will always be held to secrecy in respect of this, for there is nothing to say about it.” (GD 70-71)

Jacques Derrida
INTRODUCTION

One of the emerging themes in societies – particularly European societies – is that old approaches to the management of cultural diversity are no longer adequate to communities in which the degree of the diversity is unprecedented and ever-growing. Modern societies contain various socio-cultural groups which are characterized by factors such as social background, race/origin, special needs, and educational level. The Cultural Heritage (CH) sector has always acted as catalyst in allowing groups to co-exist harmonically in one place by investing in cultural diversity and intercultural dialogue. However, the vast majority of the cultural experiences offered by cultural institutions are designed to address the mainstream audience and rarely take provisions for making these experiences inclusive for groups with diverse socio-cultural characteristics. Inclusiveness and social cohesion may be hindered by a number of factors ranging from poverty, cultural misalignment between visitors and the provided experience, to experiences insufficiently targeted to attract diverse audiences. For instance, it might prove challenging for migrants to experience an increased level of cultural reflection when visiting a museum that almost none of its exhibits relates to the culture and history of their race/origin. In addition, cultural institutions, especially thematic museums, focus on a specific type of audience while failing to take into consideration different types of audience.

Taking as fact that excluded socio-cultural groups are not attracted in cultural institutions per se, because their cultural interests are not sufficiently reflected-connected to the offered experiences, making them co-creators of the offered museum cultural experience could increase their interest and foster their cultural inclusion and cohesion with the rest of the society. When people can actively participate with cultural institutions, those places become central to cultural and community life. Similarly, cultural institutions can reconnect with the public by inviting visitors to actively participate not as passive consumers, but as cultural participants. In particular, the current information revolution requires the adoption of learning models that cultivate skills like creative and critical thinking, reflection and collaboration.

Nowadays, the Social Web has ushered in a varying set of Web 2.0 tools and design patterns that make public’s participation more accessible than ever. Visitors expect the ability to discuss, share, and remix what they consume becoming more and more accustomed to participatory learning experiences. However, the adoption of Web 2.0 philosophy is understandably not a simple matter to approach for museums, as it surely
requires the establishment of a delicate balance between different priorities. In addition, although learning theories that take into account the social and active nature of learning have gained authority among educators, in most cases learning in museum settings still largely remains a top-down activity up to this point. Therefore, the adoption of Web 2.0 technology should not be viewed as a kind of panacea in the museum sphere. Instead, museum specialists should pursue a cautious re-examination of current practices in order to redefine their relationship with their audience.

In this context, it is of great importance the further research of both successful and unsuccessful cases of Web 2.0 museum practices studying the matter of how visitors can be engaged in cultural learning processes where identity can be shaped merging both the domains of individuality and collective cohesion. In order to increase democratization of culture and wider participation, while at the same time respecting museums’ authority and identity, the current thesis proposes the design and development of an efficient technology-based solution that could facilitate the creation of an online learning community for curators and museum visitors, aiming to facilitate the exposing of cultural experiences and information, and many types of interactions among them. Thus, the ability of these individuals to reflect-connect with the cultural offerings could be restored by engaging in a process of collective learning in a shared domain of cultural endeavor.

In more detail, the scope of this thesis is to provide a user friendly tool where curators could offer expert commentaries on artifacts, follow and monitor visitors’ activity, and interact with them. On the other hand, the proposed application could be also used by visitors as a self-guided tour tool with Augmented Reality (AR) features for exploring museum exhibitions encouraging them at the same time to adopt an active role by interacting with other visitors, sharing content and providing feedback. The sharing of cultural learning episodes aims to enhance awareness, participation, and contribution of new cultural material for visitors and enable cultural institutions to expose their audience to diverse cultural content aggregated through the ever passing of visitors. Taking into consideration the propositions of modern social learning theories and the state of the art analysis, the main aim of this study is to test the hypothesis that the educational use of such a social media tool could help museums transform in more democratizing, inclusive and polyphonic spaces by enhancing knowledge sharing, social learning, reflection and knowledge assessment attitudes.
To evaluate the proposed approach, a preliminary small-scaled experiment was conducted in Thessaloniki to test the educational potential and effectiveness of the developed application. In more detail, in order to assess the perceived quality of the proposed app a questionnaire was used for evaluating cognitive, emotional and behavioral elements of the participants’ attitudes toward the use of the proposed app as a self-guided tour tool, and its potential to enhance further cultural learning and social interactions among the visitors of an art exhibition.

Specifically, the structure of the current thesis is organized as follows:

- **Section 1** elaborates on the introduction of educational theories in the field of Museum Education, and focused mainly on the impact and principles of more radical educational theories, such as social Constructivism, Communities of Practice and Connectivism, that highlight the social and active nature of learning.
- **Section 2** summarizes the current state of the art by reviewing related research works with respect to the creation of inclusive cultural experiences in CH sector.
- **Section 3** presents in detail the functionalities’ of the proposed tool that it was designed and developed in the form of a social media mobile application for knowledge sharing in the museum space.
- **Section 4** presents the methodology adopted for evaluating the proposed application’s efficacy and the analysis of the experimental results.
- **Section 5** concludes the work and discusses future work.
1 THEORETICAL FRAMEWORK

This section presents the thesis’ theoretical background and grounds it in theoretical constructs by providing both direction and impetus to the following design process and research inquiry. Specifically, sub-section 1.1 briefly presents George Hein’s work that analyzes educational theory establishing a theoretical base for learning in museum settings. Next, sub-section 1.2 describes Lev Vygotsky’s learning theory of social Constructivism, highlighting the effect of social interactions in the enhancement of knowledge acquisition. Following, in sub-section 1.3 the key features of Communities of Practice (CoP) learning theory are defined and their role to the definition of learning as a trajectory into a community process. Sub-section 1.4 studies the connection between Web 2.0 tools and the learning theory of Connectivism, and their impact in learning. Last but not least, sub-section 1.5 concludes the current section.

1.1 Learning Theories Introduction to the Museum Context

Eric Kandel et al. (2000) defined learning "as the process through which we acquire knowledge of the world", while Gregory Kimble (1980) defines further the term as: "a relatively constant change in one's ability to learn. Behavior that occurs as a result of enhanced practice". As it is understood, definitions of learning vary widely across disciplines, driven mainly by different approaches within diverse contexts used to describe its occurrence, and new definitions are still being proposed (Barron, 2015). Therefore, it has been proved difficult to establish a unique adequate scientific definition for learning (Mazur, 2015), since it is a major focus of research in many scientific fields besides education, such as psychology, neuroscience, behavioral ecology, evolutionary theory, and computer science.

The present thesis turns its focus on the specialized educational field of Museum Education that conceives museums as important educational environments with a unique learning potential. In more detail, it studies the development of the educational role of non-formal education spaces and institutions, such as museums, that provide the potential for experimentation by listening and adapting to public’s needs, in order to offer richer learning

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1 Philip Coombs defined non-formal education as "...any organized educational activity outside the established formal system—whether operating separately or as an important feature of some broader activity—that is intended to serve identifiable learning clienteles and learning objective". Coombs, Philip H. "New Paths to Learning for Rural Children and Youth: Non formal Education for Rural Development." (1973). p. 11.
Learning experiences that not only help the process of cognitive information, but, in addition, aim to enhance visitors’ skills (e.g. critical thinking, self-knowledge, self-regulation, etc.). According to Philip Coombs (1973), non-formal education has the potential to satisfy the learning demands of both individuals and collectivities, because unlike formal education, that is rigid with its rules and programs, it is flexible and, when conceiving and designing educational activities, it considers local diversities of culture and society.

In the past, Museum Education practices and research have been challenged by abstract terms’ confusing use and the absence of agreement on the definition of appropriate educational goals and expected outcomes, due to the lack of a coherent approach towards the use of educational theories in the museum space. A key factor in understanding how modern museum’s educational strategy and operation are closely interconnected. George Hein’s (2002) analysis helped the establishment of a theoretical base for Museum Education that encourages learning of all kinds — changes in an individual’s knowledge, skills, attitudes, beliefs, feelings, and concepts. His vision regarding the educational character of museums acted as a trigger for the introduction of new educational theories, which adopt a holistic approach to education. Therefore, George Hein’s (2002) analysis of educational theories and their relationship to Museum-educational practice is still a point of reference today.

Specifically, in his analysis (see Figure 1) presented a classification of educational theories based on three components: a theory of knowledge (epistemology), a theory of learning, and, deriving from the first two, a theory of teaching (pedagogy). By showcasing theories of knowledge on a continuum, placed on the vertical axis, where its two ends define on the one hand the realistic position, which supports that the real world and knowledge exist independently of the learner’s mind, and the idealistic position, which defines knowledge as a personal reconstruction of the individual’s mind. Respectively, learning theories are spread along a continuum on the horizontal axis. At the left edge is placed the position that learning is achieved by gradually adding information to the already established knowledge of passive learners. On the contrary, learning at the other end of the axis is considered to be an active intellectual process leading to the restructuring of the mind. These two parameters essentially refer to what and how a person learns. The resulting quadrants of the figure represent a pair of positions in relation to the learning and knowledge that characterize a particular educational theory. Theories are labeled as Didactic\Expository, Stimulus-response, Discovery, and Constructivism. George Hein's choice
to shape such an imaginative analysis to classify learning and knowledge theories besides
the offered ease of understanding, also confirmed that there are no strict divisions between
educational theories of learning and knowledge, and each quadrant encompasses an
infinite number of combining positions, which essentially means that multiple educational
approaches can coexist in the museum space.

![Diagram of learning and knowledge theories]

Figure 1 George Hein’s diagram classifying learning and knowledge theories (Hein, 2002, p. 25).

Furthermore, in George Hein’s analysis an appropriate museum-pedagogical approach is
proposed for each aforementioned educational theory. Specifically, the Didactic one
suggests that the learning process is characterized by passivity, and knowledge is the
product of the accumulation of cognitive information, meaning that objective conquest of
reality is feasible and independent of the learner. It is a teacher-centered learning model
with the instructor being a figure of authority and expertise, while the learning object is
placed at the museum exhibitions. Curators assume the role of authority, while visitors’
unique identity is not taken into account during the conceptual exhibition design. According
to Edward Taylor and Amanda Neill (2008), the cognitive load of such an exhibition is linear
in nature, and usually text captions are used to convey information. Also, acts of interaction
between audience and exhibits, or other visitors, are not encouraged.

Stimulus-response educational theory derives from behaviorism, the psychology theory
concept that refers to the belief that behavior learning manifests as a result of the interplay
between stimulus and response. In other words, the process of learning is distinguished by a
relation of stimulus and response, with the learner being rewarded for every correct
reaction and reprimanded for every wrong one. Learners’ individuality as well as the social
context, where learning is achieved, are not taken into consideration. Subjects' learning performance is assessed using quantitative scales and standard assessment methods, such as written exams. Stimulus-response educational activities in the museum context consist of a set of stimuli, designed to generate a predetermined public reaction (Taylor & Neill, 2008). Such a learning approach suggests short-term educational activities, where participants are rewarded for their correct response, and the curator or the museum educator present their personal interpretation of reality.

Derrick Huang and Ravi Behara (2007) stated that traditional approaches to teaching, such as the above, were developed in an environment where knowledge was rare and only held by experts. The focus was on the educator transmitting knowledge to the learner, who remained passive. The learning theories of Constructivism and Discovery learning, placed at the right quadrants, adopt a more modern approach towards learning by placing the learner at the center of the learning process, while the educator acts as a guide. Active-learning theories describe the learning as the process where learners are actively involved in a process of meaning and knowledge construction, focusing on the interconnection and reorganization of established knowledge, as opposed to passively receiving information. Active learners build their own understanding when new information is supplied using the context of their current knowledge, meaning that all knowledge is constructed from a base of prior knowledge.

Regarding Experiential learning, John Dewey’s theory (1998), the learner has to make their own choices about how they learn, while the educational process must encourage inquiry, creative thinking, reflection and knowledge construction. Jerome Bruner in his analysis defined learners as problem solvers (Black, 2005). A museum that applies an Experiential learning approach should adapt its methods based on visitors’ cognitive skills and abilities. Nowadays, active learning has grown popular among museology educational programs, where participants construct their personal knowledge while interacting with exhibits. Similarly, Discovery learning theory is an active research-based process, and it occurs whenever learners are not provided with an exact answer, but rather with the materials in order to find the answer themselves. Students act as scientists, motivated by their own curiosity. They define problems and their characteristics, make assumptions, which they then attempt either to verify or to reject (Black, 2005). The belief that learning characteristics are highly individual and vary for every learner is emphasized. However, as the Discovery learning theory is based on a realistic approach towards knowledge, the
learning outcome discovered, is considered predetermined. At the Discovery museum, the non-linear museum exhibition design motivates visitors to explore the exhibition space, interact with exhibits, and curate information material, while questions are placed at critical points to guide the audience towards a breakthrough and the desired conclusion. Training programs, respectively, are usually interactive workshops or simulations that adopt play-centered explorative approaches.

Constructivism’s learning approach supports that people actively construct their own knowledge and that reality is determined by learners’ prior experiences (Elliott et al., 2000:256). Jean Piaget (1952), who led the evolution of Constructivism, supported that subjects are motivated by an innate desire to learn. People shape their knowledge through constructing one logical structure after another. Knowledge is constructed, rather than innate, or passively absorbed, and a person’s prior knowledge influences what new or modified knowledge an individual will construct from new learning experiences. Furthermore, all knowledge is personal, meaning that learners create their own subjective point of view, based on existing knowledge and values. Therefore, same stimulus may result in different learning outcomes in each person, as their personal interpretations differ. Constructivism also suggests that conclusions reached by the learner are not validated by some external standard of truth but only within the experience of the learner.

George Hein (2002) is a strong advocate that Constructivism is the most appropriate choice of a learning theory that would serve best the educational character of a museum. According to his analysis, in order for a museum to be transformed into a Constructivist one, three key issues have to be addressed: i) What methodology should be followed to determine if knowledge is constructed in the learner’s mind? ii) How is learning activated? iii) How the learning process is designed to be physically, socially and mentally accessible to every visitor. Then, he goes on describing a set of features that the Constructivist Museum should include:

i) Ensuring that visitors can establish meaningful connections to the cognitive content offered by an exhibition.

ii) Adaptation of educational processes to the needs of each visitor.

iii) Providing sources of knowledge beyond exhibits.

iv) Collaboration with external organizations that will make a museum’s character more open and will offer more learning opportunities for visitors.

v) Encouraging social interaction between visitors and not only.
vi) Providing demanding intellectual activities that will motivate visitors to learn and acquire new meanings and cognitive loads.

vii) Developing self-awareness and self-regulation techniques in a museum's workforce, so that all employees can evaluate themselves and the museum’s functions.

viii) The museum's pursuit of continually improving its effectiveness through visitor studies.

ix) The choice of the linear presentation of exhibition objects is not preferred, but the visitor's tour of the museum space is dynamic.

x) The one and only truth is not supported, but rather a range of views, a variety of interpretations of a particular theme or an exhibition exhibit.

xi) Visitors are invited to reflect, to express their views and to provide feedback based on their museum experience.

xii) Problem-centered and discovery-based learning is encouraged.

Curator Ted Ansbacher (1998) offered constructive criticism to George Hein’s analysis mentioning that, despite the invaluable contribution of his work to the Museum Education field, he failed to address some ambiguities of Constructivism. George Hein accepted the criticism admitting that he did not manage to cover issues such as the significant differences between social and personal Constructivism. Specifically, he highlighted this issue by stating that “Personal Constructivism is inevitable, but does little to socialize the learner into a larger intellectual community. Social Constructivism – as described so brilliantly by Lev Vygotsky and many since – is what education is about” (Ansbacher, 1998: p. 6).

1.2 Social Constructivism learning theory

Constructivism can be currently considered the dominant research perspective in the scientific field of learning. Although, different versions of Constructivism share basic core ideas, it comes mainly in two varieties: individualist and social. According to the former, based on the influence of Jean Piaget (1952), the individual is the source of everything, whereas according to the second knowledge is constructed within social groups. Social Constructivism was developed by Lev Vygotsky who suggested that “Every function in the child’s cultural development appears twice: first, on the social level and, later on, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological)” (Vygotsky, 1978: p. 57). Lev Vygotsky (1962) emphasized the importance of the social nature of learning into Constructivism and of the social context for cognitive development. According to social Constructivism, learning is considered a collaborative process and knowledge is constructed while individuals interact with their
culture and society. The individual is enriched by society and society is enriched, in return, by the individual.

The "Zone of Proximal Development" (ZPD) is a term, developed by Lev Vygotsky, referring to the range of tasks a learner is given in the process of learning. The lower limit is the level of competence the learner has gained by working independently (also referred to as the learner's actual level of development). The upper limit is the level of potential that the learner is capable of conquering with the help of a more capable guide. Specifically, Lev Vygotsky (1978) defined the ZPD as a way to better explain the relationship between learning and cognitive development. He states that each person's cognitive-learning potential can be enriched with environmental assistance. Through the mediation of social interactions (of the teacher, parents, peers, etc.) the individual can interactively achieve a higher level of cognition than they possess. In other words, the difference between what a learner can achieve on their own and what they could achieve through provision of assistance (i.e. scaffolding). According to individualist Constructivism, development always precedes learning. Therefore, learners first need to reach a certain level of maturity before learning. Lev Vygotsky rejected this position arguing that learning precedes development. In other words, through the help of a more capable person, a learner is capable of learning skills when they exceed their actual level of maturity and development. Thus, development always follows a person's potential for learning. The aforementioned theory applies to peer-to-peer teaching and sheds new light on a person's cognitive development.

According to Lev Vygotski, when two people collaborate there is a mutual involvement and knowledge-building, resulting in the development of new structures that a person would not develop on their own. His learning theory insisted on the social component suggesting that the true direction of thinking during activities with our peers in a defined social environment does not go from the individual to the social, but from the social to the individual. Spontaneous knowledge (unprocessed) and non-spontaneous (scientific) are working together, and are mutually reinforced.

Last but not least, in social Constructivism a significant element is the acquisition of language. Language is the key mediator for the development of thought and is social in nature. According to Lev Vygotsky (1962), language (and especially reason) is fundamental to learners' cognitive development, because language provides purpose, so that behaviors can be better understood. Through the use of discourse, learners are able to communicate and learn from others through dialogue. Through dialogue, non-systematic, disorganized and
spontaneous thinking is met with more systematic, rational and correct perceptions. He also suggested that language has a social character, not a self-centered one, that later, in the mature person, will evolve into an internal, silent language. Learners’ interactions with others play a dominant role in the development of their perception and sensibility.

1.3 Communities of Practice (CoP) Learning Theory

Etienne Wenger formulated the learning theory of CoP (1999). According to his theory, a CoP can be defined as a group of people sharing one common interest in a field of human activity and is committed to a collaborative learning process that creates links between a community’s members (Lave & Wenger 1991). Etienne Wenger also argued that “not every community of people is necessarily a CoP. For example, a neighborhood is often a community, but usually not a CoP” (1999: p. 2339). Members of a CoP should share a common passion for something they know how to do, and regularly interact for the purpose of improving their skill.

Etienne Wenger’s work (1999) defined the four necessary components of social learning theory: meaning, practice, community and identity. These four key components are interconnected and mutually defining. Specifically, meaning is a way of talking about a learner’s ability to experience their life and the world as meaningful. Practice refers to a way of talking about the shared information that can sustain mutual engagement in action. For example, members of a CoP develop a collective stock together and over time resources (experiences, stories, tools, etc.), or in other words they form a common practice, and in many cases members are not even aware of this happening. They learn by doing. Community means a way to talk about the social configurations in which “enterprises are defined as worth pursuing and participation is recognizable as competence”. The mere exercise of the same interest/activity is not considered a sufficient condition for the existence of a CoP, or better explained is considered necessary but not a sufficient condition. In order to form a CoP, interaction is required between its members and the development of a sense of belonging. Via their interaction members have to share practices, experiences and knowledge. They learn collectively by influencing each other. Last but not least, identity refers to a way of talking about how learning and participating changes members and their idea of their self, and influences their personality to better fit in the CoP context.

According to Etienne Wenger (1999: 12) in a CoP different levels of participation and integration are observed. These levels are as follows:
- **Core group**: a small group of people that mobilize the practice community.
- **Full membership**: members of the practice community who are recognized as professionals or main practitioners of the core community work.
- **Peripheral membership**: community members with lower degree of integration than the previous two groups, either because they are newcomers, or because they do not have the same degree of personal commitment to the CoP.
- **Transactional participation**: external members to the CoP that occasionally interact with it by providing or receiving some services.
- **Passive access**: a wide group of people who have access to the results of CoP processes.

Although Etienne Wenger claimed that the concept of CoP was not influenced by previous theories, according to Shaoxin Jing’s analysis (2017), social Constructivism offered a solid foundation for the development of CoP learning theory, since it was Lev Vygotsky’s work (1962) that introduced the importance of social context, viewing learning procedure from a new angle. Indeed, these two learning theories differ with each other from the starting concept of the nature of learning, because Constructivism locates learning at acquisition, while CoPs locate learning at participation. In addition, Constructivism defines knowledge as mind constructions within the learner’s mind, while CoPs view knowledge as valuable resources shared by group members. Conversation and discourse appear in both theories as a tool for negotiation and participation, however learners do this because of different reasons. As it is understood, Lev Vygotsky (1962, 1980) and Etienne Wenger (1991, 1999) attribute the same emphasis on the social context, which people are learning in, by adopting, however, different perspectives and assumptions.

Recently, in the literature there has emerged the notion of virtual CoPs, where members make use of Web 2.0 technologies to communicate and interact (Moore, 2008). In more detail, online communities create virtual spaces that enrich knowledge beyond narrow geographical boundaries, and at the same time allow learners to interact and support each other. Consequently, a virtual Community of Practice (VCoP) is a network of people who share an area of interest and communicate about it online. Such kind of communication helps participants to improve their knowledge within their field of interest. VCoPs and virtual learning communities are increasingly being disseminated to modern societies, thanks to technological developments that enhance interactive communication between participants and the integration of collaborative pedagogical models, mainly through Information and Communication Technologies (ICT).
1.4 Web 2.0 Connection to Connectivism and their Impact in Learning

Surely, learning communities existed before Internet technology, but with the provision of efficient Internet access services they have grown rapidly, since virtual communities offer the ability to combine modern and asynchronous communication increasing the number of learner–educator and learner–learner interactions (Yuen et al., 2011; Liou & Peng, 2009; Ajjan & Hartshorne, 2008). Tim O’Reilly (2005) introduced the term Web 2.0 to describe the change in the information and communication technology world that transformed the Internet to a shared place where users can act creatively. The Web 2.0 term is commonly used to describe web applications (e.g. blogs, wikis, social media platforms, etc.) that are characterized by interactive information sharing, interoperability, and collaboration on the World Wide Web (Paily, 2013). In comparison to Web 1.0, Web 2.0 technologies allow users to be social producers, rather than just consumers, while their active participation enhances the tools through their use in return.

There is a rather rich body of research reporting that the introduction of Web 2.0 in learning has significant potential to support and enhance learners’ overall learning (Ajjan & Hartshorne, 2008; McLoughlin & Lee, 2010). Learners using Web 2.0 technologies are currently able to participate directly in the creation, refinement and distribution of shared content, in contrast to being merely passive receivers of information (Selwyn, 2008). Web 2.0 tools make knowledge decentralized, accessible and co-constructed by and among a broad base of participants (Greenhow et al., 2009). In addition, they empower the sense of belonging in a learning community (Yuen et al., 2011) and enhance the quality of the collaboration (Yuen et al., 2011; Crook et al., 2008a) by stimulating new modes of enquiry, knowledge creation and sharing (Crook et al., 2008a; Yuen et al., 2011). Studies also suggest that the use of Web 2.0 tools seem to enhance learners’ engagement, confidence, autonomy and motivation (Chen, 2009; Crook et al., 2008a; Kessler and Bikowski, 2010). Furthermore, Web 2.0 enabled learners to become information evaluators as opposed to passive learners who merely reflect their instructor’s knowledge (McGee & Diaz, 2007). As evaluators, they are encouraged to think critically about the information and actively engage in the production and evaluation of it through these technologies by providing feedback. Finally, and most importantly, all these result in the production of quality work (Crook et al., 2008a), since participants tend to develop a sense of ownership, (Harrison & Thomas, 2009; Crook et al., 2008a) that is closely connected with the construction of their identity within virtual learning spaces and how fellow members view them.
However, it is of special importance that the value of the Web 2.0 should not be exaggerated, because the crucial matter is how such practices can be incorporated organically and effectively into the learning process (Palaigeorgiou & Grammatikopoulou, 2016: p. 15). Therefore, with this new generation of learners, who are using the Internet as part of their daily lives, and are growing less and less satisfied with being passive users, pedagogical approaches needed to adapt. The learning theory of Connectivism was conceived as an answer to the belief that there was a need for a learning theory that took into account the manner in which society has changed as a result of the new technologies of the digital age. Connectivism, introduced by George Siemens (2005), pulls together the understanding of learning with and into the Web, meaning that the efficient use of Web 2.0 technologies is the key to the connectivist pedagogical practice.

**Connectivism** argues that learning (defined as actionable knowledge) can reside outside of people (e.g. within an organization or a database), and focuses on connecting specialized information sets. Learning becomes a process of connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing (Siemens, 2005). In more detail, the acquisition of new knowledge is established when connections between ideas, concepts, opinions and perspectives are made, with technology having a key role in facilitating the connections necessary for learning to occur (Dunaway, 2011). Such connections enable learners to acquire more knowledge. The ability to draw distinctions between important and unimportant information is also vital. The key principles of Connectivism are summarized (Siemens, 2005) as below:

- **Learning is enhanced by opinion diversity and is a process of connecting specialized nodes or information sources.**
- **Learning and knowledge may reside in non-human appliances and currency (accurate, up-to-date knowledge) is the purpose of all connectivist learning activities.**
- **Developing and maintaining connections is needed to facilitate continual learning.**
- **Capacity to know more is more critical than what is currently known.**
- **Self-regulation and decision making in the learning process is vital.** Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. A correct answer today, it may be wrong tomorrow, thanks to changes in the information climate affecting the decision.
As it is understood, the fundamental insight offered by Connectivism concerns learners’ ability to construct their own chosen social networks, that act as personal learning environments fostering and sustaining the flow of knowledge and information.

1.5 Conclusions Regarding the Analysis of the Theoretical Framework

Sir Kenneth Robinson (2001) suggests that currently a paradigm shift is taking place regarding the composite matter of education and learning, due to of the increasing complexity of modern societies, generated by the intersection of diverse fields of study, such as culture, technology and communication. Therefore, dominant educational models developed in the past century in response to the industrial revolution are rapidly becoming obsolete. The current information revolution requires the adoption of learning models that cultivate skills like creative and critical thinking, reflection and collaboration.

Therefore, the current section elaborated on the introduction of educational theories in the field of Museum Education, and focused mainly on the impact and principles of more radical educational theories, such as social Constructivism, CoPs and Connectivism. However, it should be kept in mind that even though learning theories that take into account the social nature of learning have gained authority among educators, in most cases learning in museum settings still largely remains a top-down activity up to this point. In this context, the main purpose of the analysis of the aforementioned social learning theories’ key principles was to help the design process of the proposed tool, meaning that its functionalities were influenced by the intention to create a technological solution that serves their main propositions, so that its use could potentially enhance the social character of learning for visitors in the museum space.
2 REVIEW OF RELATED LITERATURE AND STUDIES

This section presents a state of the art analysis regarding current research works that study how and to what degree the integration of Web 2.0 techniques is managed by museums, along with the question of how their practices, their role and their relationship with their audience is influenced by such a shift of paradigm.

Museums have long invested in digital forms of presence as proved by the numerous virtual museums and on-line exhibitions (McTavish, 2008). However, such paradigms are based mostly on top down practices with very little input sought from visitors. The rise of Web 2.0 tools offers the possibility for the public, on the contrary, to get engaged, to make the museum offer their own, or even to produce and share content, rejecting vertical hierarchical structures. Web 2.0 practices can contribute to the transformation of the museum from a space where there are just exhibits on display to a place of interaction between citizens and society, and of construction of meaning and connective knowledge through a collective and social process among different subjects (Mancini & Carreras, 2010: p. 61).

In more detail, cultural institutions are often considered as a medium where emerging social issues of various social groups can be discussed. As it is suggested their role should not be limited to the conservation of objects; memory has not only to be preserved, but also relived through processes that enable its preservation and its process (Mancini & Carreras, 2010: p. 61). In this case, cultural institutions have to face the issue of integration not only of the material culture, but also of their oral history into the framework of CH experiences (Naguib, 2013). Material culture and oral history can be related through personal or collective memories and views. Artifacts are related to autobiographies and storytelling because of the meaning and the resonance they hold with a person’s memory.

However, Lois Silverman (1995) supported the idea that museum visitors construct deeply personalized (or totally detached) meanings from the explicit content of the exhibition. Therefore, the collection of oral history testimonies should not be restricted to specific target groups. On the contrary, a wide range of diverse views can shape a more complete representation of the information plurality concerning a certain artifact. Especially views of marginalized groups often neglected by society due to the problem of “othering”. In more detail, one’s identity is constituted of the beliefs, values and qualities, and the expressions within they are trained that construct the sense of self and how they perceive
themselves. At the same time, our identity also creates the idea of the constitutive “Other”, and how we perceive the other people, according to our similarities and dissimilarities with them. John Powell & Stephen Menendra (in press) suggest pluralism and multiculturalism as an answer against the issue of othering, that could provide space for not only acceptance or diversity, but also for the recreation of new inclusive narratives, identities, and structures. Museums and cultural institutions in modern societies can act as agents of cultural understanding by mirroring diversity and tolerance, and by calling to actions that increase social cohesion through the design of cultural experiences that take into account diverse socio-cultural groups (i.e. people from various origins/races, people with disabilities, low educational level, etc.).

Oliver Koenig (2012) describes inclusive and participatory approaches of research with marginalized people instead of on or about them. According to Kelley Johnson & Jen Walmsley (2003), both inclusive and participatory research share the same principles, which are: i) the research theme must be one that is familiar to socially marginalized groups, ii) it should further the interests of the groups addressed, while academic inquiry should stand at their side, iii) it should be collaborative – members of the groups addressed should be involved in the research process, and should obtain at least some control over the process and end results. IT developers in collaboration with cultural institutions need to capture the needs of the end user, identify the limitations and characteristics of their cultural offer, along with the possibilities and limitations of the technology used to analyze the audiences. Therefore, this understanding is not possible without the inclusion of the target audiences in the development of the processes and technologies. The upper goal is to gain access to the public’s ideas, views and knowledge, in order to propose together technological solutions that could enhance co-creation processes and polyphony in the museum context.

IT developers and museum specialists have in their disposal a wide selection and variety of Web 2.0 tools (blogs, Wikis, microblogging tools etc.) that can be used in a variety of educational scenarios. As well as a plethora of creative digital tools with a higher degree of specialization, such as Storybird\(^2\) for creative writing short stories alongside illustrations, PowToon\(^3\) for creating videos or MakeBeliefsComix\(^4\) for creating comics. Another instance

\(^2\) Storybird Web 2.0 tool [http://storybird.com](http://storybird.com)  
\(^3\) Powtoon video maker Web 2.0 tool [http://powtoon.com](http://powtoon.com)  
\(^4\) Make beliefs Comix Web 2.0 tool [http://makebeliefscomix.com](http://makebeliefscomix.com)
concerns PicBreeder\(^5\), a collaborative art application, based on the idea of evolutionary art, that stores images created through interactive evolution by users in a public gallery, and users can further edit each other’s creation. Recent cases also concern cultural awareness games developed by CrossCult\(^6\) project, where a badge system rewards users that explore how to combine paintings on a virtual gallery wall (Kontiza et al., 2018), while levels and badges reward players who explore the city and contribute their stories, pursuing to enhance interactive narratives that maximize situational curiosity and learning.

More recently, a new generation of attempts to combine technology and cultural heritage in order to enhance visitor’s experience has emerged, including, projects such as PLUGGY, a social platform providing innovative curation tools by which audiences will be able to behave as storytellers. Specifically, participants can create personalized stories and share them through social networking with friends, associates and professionals. The shared material is both crowd-sourced and retrieved from digital collections, allowing users to establish links between seemingly unrelated facts, events, people and digitized collections (PLUGGY, 2017).

Although it is difficult to detect all of the practices associated with Web 2.0 tools in the museum sphere, Mathilde Pulh and Rémi Mencarelli’s analysis (2017) identified three forms of participation that a museum can assign to visitors: the “communicator-visitor”, the “curator-visitor” and the “artist-visitor”, and presented for each one of them a number of representative examples. The first defined role allows visitors’ involvement in defining museum communication. It usually involves the adoption of Web 2.0 practices like a proactive presence on the web and on social networks, involving the general public in diffusing content while maintaining close control over the content generated. For example, The Museum of Modern Art (MoMA) of New York joined Facebook in March 2008 and since then has shaped a present and active community of more than 2.1 million followers. Other examples, that stand out due the higher level of interaction they offer, include the use of blogs by Toulouse Natural History Museum, the MoMA and the Guggenheim, essentially as a digital version of traditional visitors’ books, where visitors are invited to share their own audio or video testimonials, which are then posted on the museums’ channel, after they have been approved.

\(^5\) PiBreeder Web 2.0 tool [http://picbreeder.org/](http://picbreeder.org/)
\(^6\) CrossCult H2020 European project [https://www.crosscult.eu/](https://www.crosscult.eu/)
The second defined role considers visitors as museum mediation agents, allowing them to arrange the museum content and define its mediation components, a role traditionally held by the curator. Like the example of Brooklyn Museum that encouraged its audience to help in indexing collections by associating their own key words (tags) with the on-line museum content and by reviewing other visitors’ tags. Another example concerns the Museum of Fine Arts in Boston that in 2013 designed the establishment of a ‘crowdsourced exhibit’, named ‘Boston Loves Impressionism’, where visitors were invited to select their personal favorites, highlighting them with a heart symbol, among 50 impressionist artworks. The three most liked exhibits were displayed at the entrance to the exhibition. Such practices introduce an alternative form of intuitive navigation, different from the official visit based on the expertise of curators.

The third and last role redefines visitors as artists, enabling them to create their own exhibits for inclusion in art collections. Like the example of a temporary exhibition dedicated to Bob Dylan by the Cité de la Musique, where participants could perform one of the American musician’s song and share the outcome on Dailymotion. The published videos were then exhibited to the exhibition, attributing to them a marginal role. In other instances, visitors’ input may be more central. For example, in 2012 the National Museum of American History of Washington invited its audience to share family media on Flickr, a selection of which was included in the ‘Growing Up in 1950–1965’ exhibition.

Such innovative approaches place interaction at the heart of the museum strategy and are considered by researchers as emblematic cases of Web 2.0 practices that enhance visitors’ skills and redefine their relationship with the museum. However, these initiatives can be considered as the exception and not the rule. Paul Capriotti et al. (2016) in their study conclude that museums currently pursue a low level of interactivity regarding the presentation of information, relying mostly on traditional forms of reporting, and practice a medium level of interactivity with regard to the interaction resources. For example, Lesley Langa (2014) conducted a study researching the ways in which U.S. museums engage with online users in their Twitter feeds through analyzing the content and the frequency of a sample of relevant tweets to detect how often museums are creating the opportunity for two-way engagement. The research outcomes revealed that Twitter platform was mostly used as a means to enhance museums’ marketing practices, while the opportunities for online visitors to participate were less frequent and less common than it is possible, since Twitter intentionally places a premium on direct connection between users. Her research
confirmed the fact that up to this moment museums are not using the potential of Web 2.0 to establish dialogue with their audience, but, on the other hand, are slowly starting to invest in more interactive and dialogic sources (Capriotti et al., 2016).

Nevertheless, it should be highlighted that such paradigms of shift are, as expected, followed by consequences for the visitor–museum relationship. Yet, the possible challenges and limitations of such efforts are rarely addressed and discussed in the literature, unfortunately, since the addition and analysis of unsuccessful cases could also contribute to the improvement of current Web 2.0 practices (Holdgaard & Klastrup, 2014). Paradoxical tensions may be induced by challenging museums’ authority and legitimacy and by disenchanting their visit experience (Pulh & Mencarelli, 2017). Nina Simon (2012) further argues that visitors’ ability to produce quality content should not be exaggerated as often happens by Web 2.0 practices, and a balance must be maintained between visitor input and curator expertise to ensure the quality and coherence of museum content and exhibition interpretation. She also reports several tension triggers such as:

- Museums shape clearly defined spaces, while Web 2.0 tools define blurred boundaries allowing users to outline their own space.
- Museum exhibitions are usually fixed without many alterations after their completion, whereas Web 2.0 content is constantly updated.
- Museum specialists own authority in museums, but Web 2.0 practices hand power and control to users.

However, despite the challenges, the experimentation with Web 2.0 practices, besides promoting greater educational opportunities for the audience and society, offers also other more straightforward benefits for cultural institutions’ operation. For example, such practices can grant access to a wide range of observable visitor data in a cost efficient and easy way. Valuable data that can be translated into a stream of continuous visitor feedback, offering insight on how audiences perceive their museum experience or even information on their thoughts regarding exhibits. Such invaluable input can contribute to cultural institutions’ practices improvement, social empowerment and economic growth.

Specifically, the information collection around artifacts is widely known methodology in cultural institutions (Cimoli, 2014). Currently, several sources of information about
autobiographies, artifacts and intangible CH can be found from DBPedia\textsuperscript{7}, Europeana\textsuperscript{8} and other sources. At the core of figuring out the ways people perceive a given cultural item to serve large scale research initiatives, there is the need to describe in a computer-understandable manner how they interact with it. More generally, computer-audience interaction is needed for precise user modeling and content analysis in order to provide successful user experiences and generated content metadata. With the rapid rise of social networks and media in recent years, many research approaches focus on social interactions in order to design a general understanding of people’s behaviors and their cultural background (Kapoor et al., 2018). On top of this, social media and networking sites is the virtual space where subjects publicly interact and exchange views on several emerging issues. In particular, large scale information for what people believe about any given topic remains present online in the form of social networks activities. Typically, hashtags are used to facilitate the process of discovering content and connecting audiences.

Another part of research in this direction focuses on online experiences like behaviors, tendencies and preferences related to a user’s activity. General user modeling techniques can be classified based on how much information they need from users and how they extract such information from their behavior. In particular, such techniques can either directly ask the user their personal information (explicit feedback), or simply extract it from specified user activities (implicit feedback) (Jawaheer, 2010). Directly asking information can be considered invasive, therefore, studies are focused mainly on the latter case, where audience does not provide personal info and the modeling is based on how they behave in certain times, like the recording and analysis of users’ clicks in web page navigation (Fenstermacher & Ginsburg, 2003).

Last but not least, an important component for the connection of cultural identities is the digital tagging of data which is the extraction of human-understandable information about digital content. An important breakthrough in data connection came from the introduction of linked open data, which allows disparate databases to share and reuse their data to make it accessible, interoperable, and amenable to a range of analytical approaches (Candela et al., 2018). Specifically, linked data offers opportunities in cross-cultural connections and reuse of content among cultural institutions. Recently, cultural institutions

\textsuperscript{7}DBpedia https://wiki.dbpedia.org/
\textsuperscript{8}Europeana https://www.europeana.eu/en
have begun to explore linked data capabilities to catalogue their exhibits and knowledge, as well as to connect with other content repositories. For example, the Europeana cloud\textsuperscript{9} delivers quality digital assets in standardized format and content metadata for CH stakeholders across Europe, enabling them to share, explore, interrogate and use their collections for education and innovative research purposes. Other relevant instances concern repositories specific to migration, cohesion and identity, such as the Mela Critical Archive\textsuperscript{10} and the CoHERE Critical Archive\textsuperscript{11}, that play a significant role in interconnecting the experiences of individuals with CH sites and exhibitions.

To conclude, one of the most important experiences that art, ICT science and cultural institutions can provide is to construct virtual and shared spaces that will encourage visitors to create their own personal narratives that best reflect their goals and needs. However, the degree of integration of Web 2.0 practices by museums surely depends on their readiness to redefine their relationship with their audience, and each case should be studied on its own. The adoption of Web 2.0 philosophy is understandably not a simple matter to approach and requires the creation of a completely new vision, one many museums are not familiar still. Although many already speak of a new digital and participatory revolution (Jenkins, 2008), this evolving process in the relationship between museums and their visitors is actually part of a movement that started many years back with many unresolved difficulties (Holdgaard & Klastrup, 2014: p. 190). As presaid, the matter of maintaining a certain degree of control over published content and reconciling quality of information with users’ freedom of participation is of great importance for a museum’s authority and reputation (Mancini & Carreras, 2010: p. 62; Simon, 2012). A problem that surely requires the establishment of a delicate balance between different priorities. Therefore, the ongoing talk about Web 2.0 tools viewed as a kind of panacea in the museum sphere, calls for a cautious re-examination of current practices (Pulh & Mencarelli, 2015: p. 13). According to Bernard Cova (2008), many institutions are using these tools rather by imitation, without necessarily targeting to obtain a substantial participation from consumers. As Federica Mancini and César Carreras conclude (2010: p. 73), there is a lack of awareness of the potential of Web 2.0 for creating virtual communities around cultural institutions.

\textsuperscript{9} Europeana cloud \url{https://pro.europeana.eu/project/europeana-cloud}
\textsuperscript{10} Mela Critical Archive \url{http://www.mela-archive.polimi.it}
\textsuperscript{11} CoHERE Critical Archive \url{http://cohere-ca.ncl.ac.uk}
Instead of simply identifying technology tools, museum specialists should define specific goals before selecting appropriate technology solutions (Pulh & Mencarelli, 2015: 11). On the other hand, the adoption of Web 2.0 practices, even if they are well designed, unfortunately, does not guarantee the creation of a virtual meeting point in the museum settings (Mancini & Carreras, 2010: p. 62). Usually, successful museum virtual communities are created by already existing active communities, and social media tools are used to enhance communication among its members (Mancini & Carreras, 2010: p. 64). However, it is of great importance the further research of both successful and unsuccessful cases of Web 2.0 museum practices that experiment with the concept of how visitors can be engaged in cultural learning processes, where identity can be shaped merging both the domains of individuality and collective cohesion.
3 PROPOSED TOOL

Due to recent technological advances, the development of practical solutions using Web 2.0 applications is currently limited only by the developers’ imagination. Taking into careful consideration the sections of the social learning theories and the state of the art analysis, the scope of this thesis is to design, to develop and to provide an efficient and creative technology-based solution that could facilitate the creation of a virtual learning community for curators and museum visitors, aiming to enable information sharing and many types of interactions. In order to introduce an adequate Web 2.0 technology in museums, that are typically less open to innovation, the proposed tool should facilitate such outcomes in an extremely cost-effective and minimally demanding technically way for museum specialists.

A user friendly tool where curators could offer expert commentaries on highlight artifacts from the museum exhibition, follow and monitor visitors’ activity, and interact with them. On the other hand, the proposed tool could also be used by visitors as a self-guided tour tool for exploring Museum exhibitions. However, the audience should not be expected to remain passive, but on the contrary should be encouraged to adopt an active role by offering input, expressing feelings, accessing each other’s generated content and providing each other feedback. Therefore, the upper goal is to foster such a museum network activity that will encourage a collective discussion with audiences by enabling visitors to relate to the exhibits by interacting with fellow museum visitors, learning from each other and questioning their own understanding, while being exposed to a range of different perspectives concerning the same matter.

During the design process special consideration was given to implement such a tool that could meet both visitors’ and museum experts’ needs. Specifically, to create an efficient and easy to use mobile app, the 10 heuristic usability rules proposed by Jakob Nielsen (2001) were followed and heuristic evaluation was performed by having a number of individual evaluators inspect the interface by themselves. Furthermore, during the design process certain constraints of designing for mobile devices had to be taken into account, striving to provide a balance between the best possible user experience, a long battery life, and efficient connections to the wireless network. Finally, prior to the implementation of the application, early usage scenarios were created (storyboards), which showcase a detailed description of the key features of the application using images and comments, and acted as guiding resources for its development (see Figure 2).
Figure 2 A storyboard example concerning the addition of comments functionality for visitors when an AR target is detected.

The produced outcome of the design and development process was named ‘Artful’. Figure 3 depicts screenshots of its intro video, designed in Adobe After Effects\textsuperscript{12}. Artful’s logo was designed to express diversity, acceptance and inclusion. Therefore, Gilbert\textsuperscript{13}, the attribute font to honor the memory of Gilbert Baker, was used. He was the creator of the iconic Rainbow Flag, which according to Paola Antonelli, senior curator of architecture and design at the MoMA of New York, has served as a "politically powerful, meaningful, and also aesthetically effective symbol"\textsuperscript{14}. The font’s shapes cross over and its colors are blended, representing the forming of an open, participatory and fluid community. Therefore, it was considered appropriate since museums in modern societies are aspiring to serve as agents of cultural understanding by mirroring diversity and acceptance, and by calling to actions that increase social cohesion (Watson, 2007).

\begin{itemize}
  \item\textsuperscript{12} Adobe After Effects \url{https://www.adobe.com/gr_en/products/aftereffects.html}
  \item\textsuperscript{13} Gilbert Typeface \url{https://befonts.com/gilbert-free-font.html}
  \item\textsuperscript{14} See \url{https://www.dezeen.com/2015/06/17/new-york-moma-adds-gay-pride-rainbow-flag-to-permanent-design-collection/}
\end{itemize}
Following, in sub-section 3.1 the technological framework of the Artful’s mobile app is briefly explained. Next, sub-section 3.2 describes how the application can be downloaded and installed. Sub-section 3.3 presents the registration and login phase a user has to go through to use the app. Furthermore, sub-section 3.4 describes the components of the user interface (UI) of the application and the bottom menu for navigating through the screens hosted inside the app. Sub-section 3.4 presents the addition of certain gamification features that aim to acquire, engage, and retain users. Finally, Sub-section 3.5 provides some brief conclusions regarding the design and development process.

3.1 **Artful’s Mobile App Technological Framework**

Figure 4 presents Artful mobile app’s technological framework. The proposed social tool was developed using Unity 3D\textsuperscript{15}, a commercially available multiplatform game development platform.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{artful_logo.png}
\caption{Artful’s logo presented in app’s intro video.}
\end{figure}

\textsuperscript{15} Unity Real-Time Development Platform \url{https://unity.com/}
engine used for the production of 2D and 3D video games, as well as non-game interactive simulations and visualizations, along with the C# scripting language. Artful was also built as an Augmented Reality (AR) app, using Unity’s Vuforia\(^\text{16}\) SDK, that features computer vision functionality to recognize images and objects, and interact with spaces in the real world. In addition, Firebase\(^\text{17}\) real-time database was selected as a cloud-hosted database for data storage and retrieval, where application data is being stored in JSON format and synchronized in real-time for all Artful mobile app’s users.

![Artful mobile app's Technological framework](image)

**Figure 4** Artful mobile app’s Technological framework.

### 3.2 Download and Installation Process

The commercially free Artful mobile app has been added to the Google Play Store\(^\text{18}\) since February 2020 after extensive testing and bug fixing. Currently, the application is available in the Google Play Store under https://play.google.com/store/apps/details?id=com.agramma.artful. Potential users can easily install it on their Android smartphone or tablet device by choosing to download and install the offered APK after visiting the aforementioned link.

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\(^{16}\) Vuforia Developer Portal [https://developer.vuforia.com/](https://developer.vuforia.com/)

\(^{17}\) Firebase [https://firebase.google.com/](https://firebase.google.com/)

3.3 Login and Registration

The first time the application is launched, if the device that the application runs on has Android version 6.0 or higher, the user is presented with a popup message requesting permissions for the app to access the phone camera and storage space for its proper functionality. Right after the permissions are granted, an intro video follows greeting and informing the users about the purpose of the app (see Figure 3).
Figure 6 presents Artful’s mobile app registration form. It consists of a number of input fields, reserved for the user’s email, name, surname, occupation, gender, age and password. Data that shape each user’s profile structure. Figure 7 presents an example of a JSON structure created after a user’s registration, stored in the Firebase real-time database. After user registration is complete, users can login by inserting their email and password (see Figure 8).

Taking into account Wenger’s theory (1999: p.12) stating that a CoP has to define different levels of participation and integration, two types of user roles are possible at the moment, visitors and museum experts, leaving space for the addition of more different types of users in the future. Visitors’ accounts can be created by the users themselves through Artful’s registration form, while museum expert accounts can be created and authorized by the app developer. As we will see in sub-section 3.4, the Artful mobile app has certain functionalities common to both groups of users and other user-specific.

Future additions may concern two other options: 1) “Remember me” and 2) “Forgot your password?” intended to store the login data of the user locally (which will be immediately available in the next login) and to recover the password (which will be sent to the e-mail linked with the user account).
3.4 Artful’s User Interface (UI), Navigation and Available Functionalities

Artful’s UI color palette was selected with the purpose of producing an impression of unity and harmony between its logo and its interface design, resulting in an appropriate and corresponding branding concept that will make them mutually support each other and satisfy users’ visual perception sense.

In addition, considering that users possibly would have to access prior knowledge in their use of certain Web 2.0 tools, in order to draw upon similarities between familiar Web 2.0 tools and Artful mobile app, the design of its functionalities and UI elements was influenced by popular Web 2.0 tools and social networks, such as Facebook and Twitter.

Users can navigate inside the app using the bottom menu (see Figure 9). Its menu icons correspond to the following available options:

- The user’s Profile screen, where a user can edit their profile and personal timeline.
- The news feed screen, where a user can view the stream of all available posts.
- The AR exhibition navigation screen, where a user can experience an interactive and participative exhibition audio guide.
- The user’s friend list screen, where a user can manage their selection of friends.
- The messaging system screen, where a user can view their message history.
The settings screen, where a user can exit the app and edit their info.

The most important of them, along with the functionalities they provide, are being described in detail in the following sub-sections.

3.4.1 **User’s personalized profile and app’s main functionalities**

Web 2.0 tools should provide users with interactive services and control over their own content (Maloney, 2007). As mentioned in sub-section 2.2, users’ identity and its social formation within a virtual learning community is a central point to the CoP learning theory. Therefore, the Artful mobile app enables users to differentiate themselves from other users by personalizing their profile. Figure 10 presents an example of a created user profile along with the elements it contains. Users can upload a profile picture (see Figure 10-2) and feeds (see Figure 10-4) that can contain video, text and images, providing in that way in-depth multimodal information about subjects that interest them.

Specifically, the users’ timeline (see Figure 10-6) acts as a digital log of their activity in reverse-chronological order containing their updates. The functionality of creating, updating and retaining their profile’s content aims to help users to develop a sense of ownership for their contribution (Harrison and Thomas, 2009; Crook et al., 2008). A feeling that might motivate users to try to share posts of higher quality (Crook et al., 2008).

Figure 10-5 presents a user’s friend list feature. Users can visit their friends’ list (see Figure 11) screen and manage their connections by searching, inviting, removing and adding other users.

After two users become friends, they can further interact with each other through the messaging system (see Figure 12).
Figure 10 Example screens of a visitor’s user profile and timeline containing the following elements: 1) the user’s profile image upload buttons, 2) the user’s uploaded profile image, 3) the user’s personal info, 4) the user’s post input field and selection of its modality buttons, 5) the user’s friend list, and 6) the user’s post timeline.

Figure 11 Friends list screen
3.4.2 Artful’s news feed screen

Learning cannot be constrained to formal educational environments, since it often is occasioned, not caused or premeditated. Thus, Art concepts are infused into all aspects of daily life and the blurring of temporal and spatial boundaries between learning, leisure and work. Art learning and discussing may derive from any related activity, such as reading a book, visiting an exhibition, or creating an artifact. By exposing cultural experiences in social media, democratization of culture and wider participation is enhanced. Therefore, Artful mobile app aims to encourage users to share their cultural stories. Specifically, its news feed (see Figure 13), where users can view posts of all users (or only their friends’), can serve as a discourse media by providing learners with opportunities to socialize, express feelings, access each other’s content, and offer each other feedback by commenting or liking a post. In addition, the new creation of knowledge and reflection is further supported by making available to visitors knowledge and information, such as fellow visitors’ cultural learning episodes, that otherwise it would be either not accessible or time consuming to trace them on their own.
3.4.3 **AR enhanced exhibition navigation**

Artful can be used as a social media tool for sharing Art glimpses, but also as a user-friendly tool for creating interactive AR exhibition audio guides, where visitors can read/listen to expert commentaries and other visitors’ comments concerning exhibits, share their own piece of information, offer and receive feedback, and interact with them. Therefore, the AR enhanced exhibition navigation screen is considered the core of the Artful mobile application.

Specifically, museum experts’ accounts have the right to create and publish posts regarding chosen exhibits, consisting of an image of the artifact, a unique hashtag and their expert commentaries about it. Figure 14 presents an example of such a post. This kind of expert posts constitutes the main content of Artful’s interactive AR exhibition audio guides. In more detail, when a visitor navigates the exhibition space, they can visit the AR enhanced exhibition navigation screen by enabling the AR camera of the app. Then, each time they target an exhibit that has been added to the AR exhibition audio guide, the menu presented in Figure 15 appears to them. It consists of the following options:
• **Listen to expert commentary about the targeted exhibit:** By pushing the headphones button (see Figure 15(a)) the visitor can listen to expert’s commentary concerning the exhibit, which was published in their post. The feature of audio narration was considered important, so not to interrupt visitors’ viewing experience of the exhibit.

• **Read / Listen other visitors’ shared content about the targeted exhibit:** By clicking the messages button (see Figure 15(b)), the visitor can view posts shared by other visitors and choose to listen to them by pushing the listen button. Filtering options are also offered that can help visitors locate more easily the most interesting for them comments. Specifically, they can search for posts containing a specific word or sentence (see Figure 17(b)), and they can also order comments by their popularity (see Figure 17(c)). Then, they can listen to all or only to the filtered posts by pushing the listen to all button (see Figure 17(a)). They can also offer feedback by commenting on a post or by liking it.

• **Share your own content regarding the targeted exhibit:** By pushing the plus button (see Figure 15(c)), an input form (see Figure 16) appears to the visitor, where they can insert and upload their own personal comment about the targeted exhibit.

• **View keywords of most popular visitors’ shared comments about the exhibit:** By pushing the lock toggle button (see Figure 15(d)), the visitor can either enable or disable the appearance of floating words above the targeted exhibits (see Figure 18). The content of the words are the keywords of the five most popular visitors’ posts for that specific moment. By clicking on the ones that seem most interesting to them, visitors listen to the content of those posts. Hence, visitors can find in a more immediate way posts that seem interesting to them, without interrupting their viewing experience by navigating through the comments screen.
Figure 14 Example of a museum expert post regarding an exhibit.

Figure 15 AR menu appearing when an exhibit is targeted by the device’s camera. It includes the following options: a) the headphones button for listening to the expert’s commentary, b) the messages button for reading/listening to and interacting with other visitors’ posts, c) the addition
button in case a user would like to offer their own comment about the exhibit, and d) the keywords button for selecting to view exhibits keywords of most popular visitors’ posts.

Figure 16 Share your own content regarding the targeted exhibit example screen.

As aforementioned, the ultimate purpose of the functionalities’ design of the AR enhanced exhibition navigation screen is to provide many types of interactions constructing a virtual meeting point for the audience. According to the learning theory of social constructivism the educator should offer scaffolds to learners adequate to their ZPD (Brown & Ferrara, 1985; Vygotsky, 1978). Web 2.0 tools, and in this case the Artful social media app, not only allows more interaction between museum experts and visitors, but also enables the interaction with other visitors, making it more possible for visitors to learn from each other, reflect and question their own understanding while being exposed to a range of different perspectives and information concerning the same matter (Ferdig and Trammell, 2004; Wiltse, 2004). Hence, Artful, as a Web 2.0 tool, has the potential to create a new time-space for communication (Palaigeorgiou & Grammatikopoulou, 2016) providing opportunities for more interaction between not only a visitor and a museum expert, but also between visitors themselves, even if they don’t co-exist in the exhibition space at the same time. Users may provide relevant material, discuss, comment and share content. Therefore, the learning dialogue could last more and be enriched with even more perspectives.
Figure 17 Read / listen to other visitors’ shared content about the targeted exhibit screen. Its key features are: a) the ‘listen to all’ button which narrates the text content of the shared posts, b) the search input field, where a visitor can filter posts by keywords, c) the likeness button which orders posts by their popularity, d) uploaded posts, and e) listen to a specific post button.

However, the adoption of such Web 2.0 techniques by museums apart from redefining their relationship with their audience by reinforcing the relationship with the public via the democratization of collections, may also introduce tensions by challenging their authority, the legitimacy and the identity of these institutions (Pulh & Mencarelli, 2015: 11). Therefore, in order pacify the potential worries of museum experts and curators, certain capabilities were added for museum experts accounts to help them obtain more control over the visitors’ generated content. Specifically, when a museum expert approves a visitor’s post, they endorse it by enhancing its visibility. In more detail, when a post is liked by a museum expert account, the star icon (see Figure 19) is highlighted and, in addition, these posts appear before all the others when the visitors’ shared comments view is loaded on the screen. Moreover, a language and profanity filter has been added to Artful for providing a variety of text filters, like bad words and profanities filters that can be edited and extended, including also a punctuation filter, to prevent users to upload inadequate and inappropriate content.
Figure 18 Enabled view of floating keywords surrounding the targeted exhibit behaving as buttons that narrate the corresponding visitor's comment once they are clicked.

Figure 19 Example of a visitor's post liked by a museum expert account.

Future additions may concern implementations such as: 1) Giving users more options for how to express their feelings toward content by introducing a variety of reactions (e.g. if their reaction concerns a post's sentimental, cognitive or aesthetic aspect), motivating them to reflect in a more elaborate way on why a post appeals to them, 2) Creation of private groups of visitors, where users can interact without being exposed to public (e.g. the
definition of private groups intended as space interaction for school classrooms or either type of visiting groups).

3.5 Gamification features for enhancing engagement

Web 2.0 tools adopt social engagement to help motivate users in participating and learning by enabling them to be interactive with each other and involved in the making of educational content. Apart from Web 2.0 techniques, another method for enhancing users’ engagement is gamification, which is also using social functions and involves implementing game mechanism and elements in non-game applications to help learner gain motivation and engagement in using a learning application (Muntean, 2011). Kapp Karl (2013) defines two types of gamification, structural gamification and content gamification. Structural gamification focuses on the gamified environment, while content gamification focuses on the content. Below are presented the main Artful mobile app’s functionalities that can be considered its most prominent gaming elements.

- **Badges**: Gamification badges usually consist of simple virtual symbols that show a certain users capability to do something. They are considered structural gamification elements that symbolize rewards given to learners for their achievements, making the users feel skilled and standing out in a virtual community. Artful mobile app supports two types of assigned badges (see Figure 20). One for participation, awarded to users with an intense post sharing activity, and one for popularity, assigned to users whose posts tend to receive a high number of likes and replies. The badges’ icons are placed next to a user’s profile picture and are visible to the whole community.

- **AR elements**: VR and AR technologies allow individuals to imagine differently, making the brain believe that what is being experienced is ‘real’ as the brain itself is rewired in response to the experienced stimuli and new connections are built (Cheung et al., 2014). Therefore, AR technology has grown popular in educational processes for improving user engagement and performance. Specifically, the Artful mobile app uses AR elements like pop up key word buttons (see Figure 18) and navigation menus to enhance users’ touring experience with a fun element of unpredictability.

- **Post sentiment analysis**: Sentiment analysis is the process of computationally detecting if a specific body of text has a positive, negative or neutral meaning. Artful uses the Unity asset
of Sentiment Analysis\textsuperscript{19} as a content gamification element to encourage in a playful way users to focus on posts’ content by helping them to identify the writer’s sentiment towards a subject, and at the same time nudges them to contemplate if the computational analysis agrees with their own by reflecting further on the meanings presented in a post text (see Figure 21).

![Figure 20](image1.png)

**Figure 20** Artful’s gamification badges awarded to users for intense participating activity and popularity.

![Figure 21](image2.png)

**Figure 21** Example of a post text sentiment analysis computational result. The three loading bars at the bottom right of the picture along with their corresponding percentages estimate the positive, negative and neutral feeling derived from the content of the post.

In recent years, the diffusion of gamification in educational applications is increasing. There is an extensive body of research studies presenting several features that can be used in gamification mechanisms and should be taken into consideration for future additions. Such additions, that could further enhance the Artful mobile app’s gamified character, may concern the option for presenting visitors with challenges during their exhibition viewing.

\textsuperscript{19} Unity 3D Sentiment Analysis asset [https://assetstore.unity.com/packages/tools/sentiment-analysis-41832](https://assetstore.unity.com/packages/tools/sentiment-analysis-41832)
experience, and the possibility of rewards earning when visitors meet certain standards of engagement and participation.

3.6 Design and Development Phase Conclusions

This section described the Artful mobile app’s main functionalities. As aforementioned, the aim of its design was the provision of an easy to use Web 2.0 tool for both visitors and museum specialists that could facilitate the interconnection of visitors’ virtual experiences, by connecting individual interactions of users, as happens in popular social networks. The creation of a social network of posts, ratings and comments aims to enable visitors to connect with others who have interacted with similar content, cultivating relationships and developing exchanges between users. The design and development was influenced by the principles of the social learning theories of social Constructivism, CoP and Connectivism, presented in section 1. Specifically, Table 1, Table 2 and Table 3 provide a detailed analysis related to how closely Artful mobile app’s feature correspond to the aforementioned learning theories’ key principles.

Table 1 Description of how Artful mobile app’s design and development was influenced by the principles of Constructivism and Social Constructivism learning theories.

<table>
<thead>
<tr>
<th>Principles of Constructivism and social Constructivism learning theories</th>
<th>Artful mobile app’s related features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment of meaningful connections to the offered cognitive content.</td>
<td>Users are offered the possibility to contemplate the offered content and provide their own feedback, which is the result of a cognitive process influenced by both their personal knowledge structures and the shared information.</td>
</tr>
<tr>
<td>Adaptation of educational processes to the needs of each visitor.</td>
<td>Currently, users are offered certain, although limited, features of adaption (e.g. filtering and selection of certain users’ posts to process).</td>
</tr>
<tr>
<td>Providing sources of knowledge beyond exhibits.</td>
<td>Besides experts’ commentaries, users can read or listen to other users’ feedback and input.</td>
</tr>
<tr>
<td>Collaboration with external organizations</td>
<td>The Artful mobile app’s current system architecture can support the development of numerous cultural institutions’ profiles, which can all coexist. A feature that could perhaps encourage a cultural dialogue and interconnection among them.</td>
</tr>
<tr>
<td>Encouraging social interaction between visitors and not only.</td>
<td>The Artful mobile app offers many features of interaction between its users (e.g. message system, likes, comments, etc.).</td>
</tr>
<tr>
<td>Providing demanding intellectual activities for</td>
<td>The Artful mobile app’s exhibition tour surely can be considered a more demanding intellectual</td>
</tr>
</tbody>
</table>
visitors. activity than a traditional audio guide tour, since users are exposed to a different range of opinions and are encouraged to share their own input and feedback.

Developing self-awareness and self-regulation techniques. The Artful mobile app’s features (comments, likes and posts’ sentiment analysis) offer cognitive triggers to users encouraging them to evaluate other users’ perspectives and re-considerate their own.

Museum’s pursuit of continually improving its effectiveness through visitor studies. Currently, this feature is not supported, but in the future as the collection of user data is increased, certain machine leaning techniques can be used for user behavioral modeling processes.

Dynamic and not linear presentation of exhibition objects. The Artful mobile app does offer a dynamic presentation of exhibits, since users can view artifacts’ related content in any order they wish.

A variety of interpretations of a particular theme is supported. The Artful mobile app allows interaction not only between museum experts and visitors, but also between visitors, making it possible for them to construct their personal meanings, while being influenced by a range of different perspectives.

Reflection and provision of feedback is encouraged. Users are encouraged to reflect and provide feedback by liking or commenting on selected posts. Furthermore, the posts’ sentiment analysis scores further invite them to contemplate on a post’s content and meaning.

Problem-centered and discovery-based learning is encouraged. Problem-centered learning and discovery-based learning are not currently supported.

The acquisition of language and use of discourse is encouraged. Discourse is a core element of Artful mobile app since many channels of communication and types of interaction are offered (e.g. message system, comments, posts etc.).

Provision of scaffoldings that can expand visitors’ ZPD. Users can search and select certain content, which consider more interesting and familiar, to view (e.g. keywords search functionality).

<table>
<thead>
<tr>
<th>Principles of CoP learning theory</th>
<th>Artful mobile app’s related features</th>
</tr>
</thead>
<tbody>
<tr>
<td>The definition of the meaning component of a CoP</td>
<td>Users are encouraged to interact with the offered cognitive content and share their own input, a process that helps them establish more</td>
</tr>
</tbody>
</table>

Table 2 Description of how Artful mobile app’s design and development was influenced by the principles of CoP learning theory.

20 Machine learning (ML) is a subset of artificial intelligence that focuses on the study of computer algorithms that improve automatically through experience. It is closely related to computational statistics, which focus on making computational predictions. See Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.
meaningful connections to exhibits. In addition, are enabled to interact with other visitors that otherwise they would not have the chance to.

**The definition of the practice component of a CoP**

Users are invited to process content related to Art content and are offered the possibility to cultivate the skill of Art talking in a public context.

**The definition of the community component of a CoP**

The Artful mobile app enables the construction of a social network within museum settings, offering a variety of communication and interaction features that can be considered fundamental for the creation of an online community.

**The definition of the identity component of a CoP**

Users can create, personalize and maintain their profile, which is visible to the community. A feature that enables them to construct and adjust their online identity.

**Different levels of a participation**

Two levels of group users are defined at the moment: visitors and museum experts.

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**Table 3** Description of how Artful mobile app’s design and development was influenced by the principles of the learning theory of Connectivism.

<table>
<thead>
<tr>
<th>Principles of Connectivism learning theory</th>
<th>Artful mobile app’s related features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning is enhanced by the diversity of opinions and is a process of connecting nodes of information.</td>
<td>Users could potentially be exposed to a different range of perspectives. Such influence could encourage them to reconstruct their personal view by combining a number of inputs.</td>
</tr>
<tr>
<td>Learning and knowledge may reside in non-human appliances.</td>
<td>All user and interaction generated data is stored in a real-time cloud-hosted database hosted by Firebase. In the future, adequate machine learning techniques can be applied to the aggregated data and metadata to reveal hidden insights and trends related to users’ behavioral patterns.</td>
</tr>
<tr>
<td>Development and maintenance of connections to facilitate continual learning.</td>
<td>Users can befriend each other, if they wish to maintain a connection with other visitors or museum experts.</td>
</tr>
<tr>
<td>Capacity to know more is more critical than what is currently known</td>
<td>Users are enabled to review and contemplate, besides experts’ commentaries, other visitors’ content, and to combine the offered information by establishing more complex connections to exhibits.</td>
</tr>
<tr>
<td>Self-regulation and decision making in the learning process is vital. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality.</td>
<td>Users are enabled to choose which content they want to view and process. In addition, through the passing of time, the content size is expected to be increased and not remain static as in traditional exhibition experiences. In more detail, emerging sociopolitical and cultural events may influence users’ shared input from time to time. The collection of data related to exhibits that is labeled by timestamps could offer significant</td>
</tr>
</tbody>
</table>
However, although it can be considered that the proposed tool’s functionalities can theoretically support the key points of the aforementioned social learning theories, it should also be highlighted that the creation of an online functioning learning community should under any circumstances be considered self-evident. On the contrary, visitors’ attitude along with the proactive and the reactive stance of museum staff towards the adoption of such Web 2.0 practices is, of course, also of critical importance to the development and maintenance of an efficient virtual community, but unfortunately is also unpredictable and may vary from case to use.

Last but not least, nowadays, mobile applications pass through many design, development and release cycles. This section presented in detail the initial design and development phase of the Artful mobile app. Mentioned notions regarding future work along with feedback gained from how users and museum stuff are interacting with the proposed app in experimental settings, will further define the required improvements, additions and fixes of future releases.
4 EVALUATION METHODOLOGY AND EXPERIMENTAL RESULTS

The evaluation of the Artful mobile app as a social media tool for cultural learning was split into two phases comprising the preliminary evaluation which investigated both technical issues and user issues to identify development priorities. Following this evaluation, a formative assessment took place during the spring 2020. This phase included a limited user controlled experiment conducted in Thessaloniki. In more detail, in order to assess the perceived quality of the proposed app, content from the AR art exhibition *Poetry meets AR*\(^{21}\) (see Figure 22) was used. The aforementioned exhibition was co-organized with the museologist Anastasia Panagou (concept, workshop coordinator and exhibition curator) along with the author (AR development and workshop coordinator) of the current thesis in collaboration with Labattoir Project\(^{22}\). Specifically, the exhibition was the result of a creative workshop that sought from its participants to study what can AR and photography offer in the representation of poetry by creating a dialogue between poetry and technology. During the workshop, participants photographed the area of the old municipal slaughterhouse neighborhood in West Thessaloniki, drawing inspiration from selected poems, which all had a common point of reference the city of Thessaloniki. For each poem three photos were selected, which were then used as image targets. Once the images were recognized, users were able to see the generated AR content (videos, sounds, 3D animations and objects, etc.), that was co-designed with the workshop’s participants.

Initially, for the realization of the controlled study, a museum expert account was created for the *Poetry meets AR* exhibition, where the curator’s commentaries were posted along with the corresponding exhibit photos (see Figure 14) regarding one of the four available poems, *Vykani*, written by the Greek poet Nikos Engonopoulos. During the preliminary small-scaled experiment, participants were asked to download the Artful mobile app, register and view the content of the AR exhibition regarding the selected photos. They were also encouraged to use the social features of the proposed app to interact with the curator of the exhibition and other visitors by sharing content and by providing feedback. In total, participants shared ten posts (see Figure 24) concerning the selected photo exhibits. Some of them offered chunks of scaffolding information about the poet Nikos Engonopoulos (see Figure 24a, c), that could help other users to discover more about his work. Other participants shared posts commenting about the exhibits by choosing a sociopolitical (see

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21 Poetry meets AR Workshop homepage [https://www.labattoir.org/poetry-meets-ar.html](https://www.labattoir.org/poetry-meets-ar.html)

22 Labattoir Project homepage [https://www.labattoir.org/](https://www.labattoir.org/)
Figure 24b) or sentimental approach (see Figure 24d). In addition, users also published a number of other posts to their timeline wanting either to comment further on the exhibits or to share their own personal art glimpses (see Figure 25). Last but not least, they also interacted with other users’ content, mostly by liking their content. Some incidents of discourse also occurred (see Figure 25), however, they can be characterized as scarce and of limited quantity.

![Image of exhibition](image1.jpg)

**Figure 22** The AR photograph exhibition of images derived from the *Poetry meets AR workshop*.

![Image of AR profile](image2.jpg)

**Figure 23** Created profile for the *Poetry meets AR* exhibition that was assigned the museum expert role.
Figure 24 Examples of users’ posts shared regarding the selected AR photo exhibits.

Figure 25 Examples of users’ posts shared to their timelines.
4.1 Survey instrument

Subsequently, a questionnaire (see APPENDIX I) was used for evaluating cognitive, emotional and behavioral elements of the participants’ attitudes toward the use of the Artful mobile app as a self-guided tour tool for exploring the Poetry meets AR exhibition, and its potential to enhance further cultural learning and social interactions among the visitors of an art exhibition. Specifically, the survey instrument was a structured questionnaire that has two substantial parts. The first one was related to the demographic characteristics of the respondents, the analysis of which is presented in sub-section 4.2. The second one included closed-ended questions that used the five-point Likert scale (from 1 to 5): (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4) agree and (5) strongly agree. Specifically, the subjects were asked to answer six groups of questions that concerned the set-up of the mobile app, its visual aesthetics, its usability, the offered learning experience, its potential to create a virtual learning community, and overall its perceived performance. Attention was also paid to the alternation of positive and negative statements formulation, in order to check whether the users responded randomly without reading the questions. In addition, an open-ended question was also included to the questionnaire that asked the participants to express freely any comments or improvements they would like to suggest.

4.2 Sample

The subjects of the evaluation were twelve people (4 female, 8 male), all of which were adults (average age 34.1, SD 6.0) that had completed at least secondary school education (see Figure 26). The majority of participants supported that were adequately experienced with art engagement (see Figure 28) and art discussing (Figure 27). Furthermore, the majority of them also stated that are experienced users of mobile applications and social networks. Such a group of subjects was considered adequate for the first phase of pilot studies regarding the assessment of the proposed app’s efficacy, since because of their aforementioned attributes they probably belong to the mainstream audience that most likely would show interest in using a web 2.0 tool like the Artful mobile app in museum settings in the future.
Figure 26 Participants’ education level

Figure 27 Participants’ level of experience with art discussing.

Figure 28 Participants’ level of engagement with arts.
4.3 Experimental results

This sub-section presents the key outcomes derived from the analysis of the data obtained through the participants’ questionnaires. The results for each aforementioned group of questions are presented below.

4.3.1 Application set up

The first set of questions concerned the attitude of the subjects toward the setup and use of the proposed app. This group consisted of four questions, shown in Table 4. The average ratings are displayed in Figure 31, and the average value of users’ ratings is 4.40 (SD 0.52). Therefore, it can be assumed that participants shaped a positive attitude toward the use and setup of the Artful mobile app, since they stated that it would not be a challenge for them to use it on their own in the future (Q4).

<table>
<thead>
<tr>
<th>#Q</th>
<th>Questions</th>
<th>Avg.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>I easily understood how I should install the Artful mobile application.</td>
<td>4.58</td>
<td>0.48</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Q2</td>
<td>It was comfortable and easy to use and navigate the artful mobile application</td>
<td>4.33</td>
<td>0.48</td>
</tr>
<tr>
<td>Q3</td>
<td>The profile set up did not cause any disturbance to me.</td>
<td>4.25</td>
<td>0.48</td>
</tr>
<tr>
<td>Q4</td>
<td>It will be easy for me to use the artful mobile application by my own as an educational social media tool for art exhibitions.</td>
<td>4.42</td>
<td>0.66</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>4.40</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Figure 31 Average ratings of participants’ attitude regarding the setup of the proposed app.

4.3.2 **Visualization**

The second set of questions consisted of six questions presented in Table 5 regarding the evaluation of the visual elements and graphics of the proposed app. The average ratings obtained are displayed in Figure 32. The results show that, in general, participants found the visual elements of the Artful mobile app pleasant, satisfactory and helpful. Furthermore, concerning their opinion about the posts’ depicted sentiment analysis scores (Q3), they did not express very strong positive feelings regarding the sentiment analysis score’s accuracy. However, even their neutral responses can be considered positive since it can be concluded that participants paid attention to the analysis of the sentiment analysis asset and contemplated if the result was consistent with their own perception regarding the tone the posts’ texts, meaning that they at least tried to process the posts’ cognitive content.

Table 5 Questions and average ratings of participants’ attitude concerning the visual appeal of the Artful mobile app’s UI design.

<table>
<thead>
<tr>
<th>#Q</th>
<th>Questions</th>
<th>Avg.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>I found pleasant the Artful mobile app in terms of design and aesthetics.</td>
<td>4.08</td>
<td>0.51</td>
</tr>
</tbody>
</table>
**Q2** I found satisfactory the appearance of design of its interface.  
**Q3** I found accurate the depicted sentiment analysis scores offered for each shared post.  
**Q4** I found helpful to watch sentiment analysis of the posts offered by the Artful application and to analyze how they correspond to the character of the post content.  
**Q5** How comfortable do you think it is to listen or read the offered posts’ cognitive content while visiting an exhibition?  
**Q6** The Augmented Reality (AR) features offered by the app made the experience more fun and entertaining.

<table>
<thead>
<tr>
<th>#Q</th>
<th>Questions</th>
<th>Avg.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>The process of creating posts with cognitive content about exhibits was easy and understandable.</td>
<td>4.67</td>
<td>0.48</td>
</tr>
<tr>
<td>Q2</td>
<td>The process of creating posts with cognitive content about</td>
<td>4.08</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Figure 32 Average ratings of participants’ attitude regarding the UI’s visual aesthetic elements of the proposed app.

### 4.3.3 Usability

The next set of questions (see Table 6) included seven questions regarding the usability of the proposed app. The average ratings are displayed in Figure 33. Their average value was 4.11 (SD 0.67). Although results show that both groups found it easy to learn to navigate and use the Artful mobile app, participants also stated that the existence of several buttons on the screen sometimes caused to some of them a degree of confusion (Q6), suggesting that future improvements should concern its navigation usability.
exhibits was easy and fun.

### Q3
Following exhibition’s and visitors’ activity in the Artful mobile application was easy.  
- **Average**: 4.25  
- **SD**: 0.64

### Q4
In the future it will be easy for you to use the Artful tool by yourself?  
- **Average**: 4.33  
- **SD**: 0.66

### Q5
In the future you would like to use the Artful mobile application to view and create educational content for exhibition purposes?  
- **Average**: 4.17  
- **SD**: 0.57

### Q6
I found the existence of several buttons in the screen not to be confusing and annoying.  
- **Average**: 3.25  
- **SD**: 1.21

### Q7
I found the general feedback provided by the application satisfactory.  
- **Average**: 4.00  
- **SD**: 0.51

**Average**  
- **Average**: 4.11  
- **SD**: 0.67

---

**Figure 33** Average ratings of participants’ attitude concerning the usability of the Artful mobile app.

### 4.3.4 The learning experience

Next, participants were asked about the educational effectiveness of the proposed app. This group consisted of eight questions, presented in Table 7. The average ratings are displayed in Figure 34. Taking into account their average value (4.39, SD 0.67), it can be assumed that they expressed a positive attitude toward the educational character of the proposed app, declaring that art discussing experience would be easier with the use of such an app, compared to more traditional exhibition techniques (Q1). They also stated that they found its use fun (Q5) and not stressful (Q4). Moreover, participants expressed a positive attitude toward the idea of using a similar app in museum settings (Q7), and its potential to create a virtual meeting point for visitors and museum specialists enhancing interaction among them (Q2, Q3).
Table 7 Questions and average ratings of participants’ attitude concerning the learning experience offered by the proposed app.

<table>
<thead>
<tr>
<th>#Q</th>
<th>Questions</th>
<th>Avg.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>I think that this application makes art learning and discussing experience easier compared to traditional exhibition techniques (exhibition texts, acoustic guides).</td>
<td>4.25</td>
<td>0.72</td>
</tr>
<tr>
<td>Q2</td>
<td>I think that this application would help the creation of more interactive and participatory exhibitions.</td>
<td>4.50</td>
<td>0.66</td>
</tr>
<tr>
<td>Q3</td>
<td>I would recommend the use of a similar app for the creation of virtual learning communities where visitors and curators can interact and practice art discussing.</td>
<td>4.25</td>
<td>0.72</td>
</tr>
<tr>
<td>Q4</td>
<td>I did not find the application stressful in any way.</td>
<td>4.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Q5</td>
<td>I had fun using the application.</td>
<td>4.42</td>
<td>0.64</td>
</tr>
<tr>
<td>Q6</td>
<td>I think that the application respects the exhibits’ value, for which visitors can discuss and share opinions and information.</td>
<td>4.58</td>
<td>0.66</td>
</tr>
<tr>
<td>Q7</td>
<td>I would like to see such an application or similar technologies included in the educational process of other museums / art institutions.</td>
<td>4.42</td>
<td>0.88</td>
</tr>
<tr>
<td>Q8</td>
<td>Other visitors’ posts offered me valuable cognitive information, that otherwise would be hard to grasp.</td>
<td>4.17</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>4.39</strong></td>
<td><strong>0.67</strong></td>
</tr>
</tbody>
</table>

Figure 34 Average ratings of participants’ attitude concerning the learning experience offered by the Artful mobile app.

4.3.5 **Creating a virtual learning community potential**

The next set of questions concerned the potential of the proposed app to create a virtual learning community in cultural settings. This group consisted of ten questions, presented in Table 8. The average ratings are displayed in Figure 35. Their calculated average value is 3.59 (SD 0.75). Participants claimed that they enjoyed reading other visitors’ shared content (Q3)
and using the proposed app made them feel more connected to other users, although they had not met in person (Q7). They also stated that the use of such an application enhanced social interactions (Q8) and the feeling of participating and belonging during their exhibition experience (Q10). Therefore, they sought to share meaningful content (Q1) for other users too, although they did not seem to be rather worried about how other users would perceive the information they shared (Q9). In general, it can be concluded that subjects showed a rather positive attitude toward the use of such a tool for the creation of a virtual meeting point in museum settings that seeks to enhance interconnection of visitors’ virtual experiences, by connecting individual interactions of users.

Table 8 Questions and average ratings of participants’ attitude concerning the potential of the Artful mobile app to create a virtual learning community in cultural settings.

<table>
<thead>
<tr>
<th>#Q</th>
<th>Questions</th>
<th>Avg.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>I was trying to share piece of knowledge that would be useful or interesting to both myself and other visitors.</td>
<td>3.67</td>
<td>0.96</td>
</tr>
<tr>
<td>Q2</td>
<td>I tried to develop a critical look on my own, personal way about appreciating and discussing art.</td>
<td>3.92</td>
<td>0.64</td>
</tr>
<tr>
<td>Q3</td>
<td>I especially enjoyed reading the other visitors’ perspective in their posts. It was also useful for me.</td>
<td>4.58</td>
<td>0.49</td>
</tr>
<tr>
<td>Q4</td>
<td>I liked the informal style of other visitors’ posts.</td>
<td>3.92</td>
<td>0.76</td>
</tr>
<tr>
<td>Q5</td>
<td>The social part of the activity (knowledge sharing) was of no particular value to my personal understanding of the exhibition.</td>
<td>2.41(2.49)</td>
<td>1.18</td>
</tr>
<tr>
<td>Q6</td>
<td>Everyone has their own perspective on art appreciation, and so most of the time I was not interested in the knowledge shared by other visitors.</td>
<td>2.08(2.92)</td>
<td>0.76</td>
</tr>
<tr>
<td>Q7</td>
<td>Using the app made me feel more connected to other visitors, even though I did not meet them in person.</td>
<td>3.33</td>
<td>0.75</td>
</tr>
<tr>
<td>Q8</td>
<td>Compared to other art exhibitions, interaction with other visitors due to application usage increased.</td>
<td>4.08</td>
<td>0.76</td>
</tr>
<tr>
<td>Q9</td>
<td>I was worried about what other visitors would think about the information I shared.</td>
<td>2.58</td>
<td>1.11</td>
</tr>
<tr>
<td>Q10</td>
<td>I think that the use of such an application enhances the feeling of Participating and Belonging while visiting an art exhibition.</td>
<td>4.33</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>3.59</td>
<td>0.75</td>
</tr>
</tbody>
</table>
4.3.6 Perceived performance

The last set of questions (Table 9) consisted of four questions regarding the general perceived performance of the Artful mobile app by the subjects, i.e. to what extent visitors considered the proposed app to be effective, efficient, satisfactory and innovative. The average ratings are shown in Figure 36. The average outcome of the questions was 4.30 (SD 0.68), showing that participants shaped a quite positive attitude toward it.

Table 9 Questions concerning the perceived performance of the Artful mobile app.

<table>
<thead>
<tr>
<th>#Q</th>
<th>Questions</th>
<th>Avg.</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>The application is effective (if the app meets its objectives).</td>
<td>4.55</td>
<td>0.67</td>
</tr>
<tr>
<td>Q2</td>
<td>The application is efficient (if the app responses satisfactorily and in a short time).</td>
<td>4.00</td>
<td>0.63</td>
</tr>
<tr>
<td>Q3</td>
<td>The application provides satisfaction (if the app provides satisfaction to the user).</td>
<td>4.18</td>
<td>0.75</td>
</tr>
<tr>
<td>Q4</td>
<td>The application is innovative (if the app offers novel tools/techniques in CH management).</td>
<td>4.45</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>4.30</td>
<td>0.68</td>
</tr>
</tbody>
</table>
4.4 An example of behavioral data use

There is a long history of observing visitors in museums, with the majority of the systematic observational work being done in the past 30 years or so. The acceptance of visitor observation has been considered a valid and reliable method of understanding and measuring the success of an exhibition (Yalowitz & Bronnenkant, 2009: p. 47). New technologies, for sure, have facilitated and automated such data collection processes identifying trends and patterns in visitor behavior that can inform the design of future exhibitions. When it comes to Web 2.0 tools, in particular, the great advantage they offer is the construction of a virtual shared space where subjects freely interact and exchange views. Such social networks activities enable the aggregation of large scale information for what people believe about specific topics, information that otherwise would remain invisible and abstract.

Unfortunately, such a limited control study as the current one cannot provide adequate data for exploring user modeling processes. However, a simple example of data exploration would be the presentation of data collected through the Sentiment Analysis module that identifies visitors’ prevailing emotional opinion within their posts’ text, to determine their expressed attitude as positive (associated with green color), negative (associated with red color), or neutral (associated with white color). Nevertheless, it should be noted that negative expressed sentiments does not necessarily mean that visitors shaped a negative image regarding an exhibit or an exhibition, but that the derived feelings generated by a certain interaction were characterized by a negative (e.g. sad, melancholic, angry, etc.) tone. Such experimentations could enable museum specialists not only to obtain audiences’ sentimental reactions toward exhibits, but also to observe their evolution, gaining significant
insights on how visitors, who are always being influenced by events of the ever-changing reality, can provide diverse meaningful connections to artifacts from time to time. For example, Figure 37 shows a graphic representation of the overall sentiment scores generated by participants shared content at a certain point of time. Such a graphic illustration could even be animated showcasing its evolution through the duration of an exhibition, or other modalities could be used to express such a flow of data (e.g. an exhibition’s sound landscape installation of the memory of visitors’ sentimental reactions).

![Figure 37](image)

In more detail, a network of otherwise invisible information of this type could make possible the shaping of a sentimental aura in the museum space aiming to function as means of activating the relationship between the museum and its visitors and their engagement in actions that result from it or aim at it. By adopting such technological approaches to represent cultural sources though virtual illustrations and augmented modeling, cultural institutions could contribute to the development of social networking monuments, cultivating a new image for museums, where their spaces are not seen as static, but as interactive living environments that could foster multi-collection systems of past, present and future cultural stimuli.
5 CONCLUSIONS

The current thesis presented the design, development and evaluation of a novel and efficient Web 2.0 tool that its use could facilitate the creation of a virtual learning community for curators and museum visitors by enabling information sharing and many types of interactions in an extremely cost-effective and minimally demanding technically for museum specialists way. The proposed Web 2.0 tool’s architecture aim is to connect individual interactions of users creating a virtual meeting point and a space for publishing content, as happens in popular social networks.

Evaluation results, derived from a preliminary small-scaled experiment in cultural settings with potential users, have shown the positive potential of the Artful mobile app. Specifically, participants considered the proposed app satisfactory and efficient, its visual elements pleasant and helpful, and its set-up as easy to do. Furthermore, they evaluated positively its educational character stating that art discussing experience would be easier with the use of such an app. They also expressed a positive attitude toward the idea of using a similar app in museum settings to enhance their interactions with other visitors and museum specialists, since they claimed that they enjoyed reading other visitors’ shared content. In general, they perceived the proposed app as efficient, satisfactory, and as an adequate and novel tool for use in cultural settings. Furthermore, regarding its potential to create an online learning community, participants stated that that the use of such a tool enhanced their feeling of participating and belonging during their exhibition experience, an incident that motivated them to share meaningful content. One could conclude that participants showed a rather positive attitude toward its potential to create an online community in museum settings that could enhance interconnection of visitors’ virtual experiences, however, although the majority of them shared relevant information regarding the exhibits, their interactions remained on a superficial level since incidents of discourse among them were of limited quantity.

Therefore, it should be reminded that the creation of an online functioning learning community should under any circumstances be considered as the result of merely using a social media tool, even a well-designed one. On the contrary, it is usually the task of museum staff to develop the community and improve discussions and debates (Mancini & Carreras, 2010: p. 73). Their stance along with the audience’s attitude toward the adoption
of such Web 2.0 practices plays a principal role to the development and maintenance of an
efficient virtual community, but, unfortunately, such parameters are also unpredictable and
tend to vary from case to use.

Recent studies have shown that the experimentation with Web 2.0 practices in museum
settings holds the potential to foster positive educational opportunities for the audience and
society, and can also offer other more straightforward benefits for cultural institutions’
operation and its marketing strategy. However, in order to introduce Web 2.0 technologies
in museums that are typically less open to innovation, inherent risks should be taken into
careful consideration. As aforementioned, one of the most common issues regarding the use
of Web 2.0 practices in museums is the issue of giving visitors permission to generate
content (Simon, 2012). An action that comes against the traditional top down practices of
hierarchical institutions such as museums and may challenge the maintenance of
museum content’s quality and coherence. The degree of integration of Web 2.0 practices by
museums depends on their readiness to redefine their relationship with their audience,
although it is understandably not a simple matter to approach and requires the creation of a
completely new vision, one many museums are not familiar still.

The truth is that proposals for the transforming museums’ vision and functions have
become commonplace in several research studies and political initiatives (Holdgaard &
Klastrup, 2014: p. 191), during which the museum institution has repeatedly been
“reinvented” (Anderson, 2012). However, whether the transformation of the entire museum
institution has in fact taken place is questionable, and as Gail Anderson (2012) emphasizes
such transforming actions should be considered an ongoing and evolving process. One that
should be kept under constant consideration in order to fight the danger of museums’
educational strategy becoming disconnected from the real needs of the coming generation
(Cachia et al., 2010).

Therefore, it should be further studied how the addition of such an information stream
could influence the audience’s overall museum experience, since there are already
exhibitions which rely on text too heavily. John Falk and Lynn Dierking (2016) highlight the
need of finding the right balance of text in museums, making sure that objects are supported
by concise and effective interpretive text. In more detail, they note that inexperienced
visitors face a higher risk of being overwhelmed in comparison to experienced visitors that
are able to group, filter and classify the shared information they encounter. In this case, a
potential research question of great interest could be the effect of the Artful mobile app to
the Interactive Experience Model (Falk & Dierking, 2016), which suggests that a museum visit takes place within three contexts: the personal, social, and physical. Specifically, elaborating on the use of such a tool in museum settings and on the issue of under which circumstances its addition enhances or deteriorates visitors’ experience, regarding each and all the aforementioned levels, could yield useful information concerning both the proposed tool’s functionalities and audiences’ behavioral patterns.

As is understood, it is of great importance the further research of both successful and unsuccessful cases of Web 2.0 museum practices studying how cultural institutions can transform in more democratizing, inclusive and polyphonic spaces by enhancing visitors’ participation, knowledge sharing and social interactions, while at the same time respecting museums’ authority and identity and visitors’ expectations. What’s more important, though, is that the analysis of such surveys’ outcomes should not be limited to theoretical discussions, but instead their transformation to sets of critical guidelines for policy makers and for educating the museum specialists should be pursued.

In this context, the current thesis’ future work will consider improvements derived from mentioned notions along with feedback gained from how users interacted with the proposed app during the control study, in order to define required improvements, additions and fixes of future releases, so its use can become more efficient. In addition, further research should be conducted and, in particular, more large-scale controlled experiments should be organized in close cooperation with museum staff and different types of audiences to study how such a tool adapts in museum settings and influences visitors’ experience under varying circumstances.

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23 John Falk and Lynn Dierking (2016) in their work suggest that visitors’ personal context is made up of their preconceptions and expectations for the museum experience and often is the product of previous experiences and existing knowledge. The physical and social settings are not of secondary importance, since they influence the behavior people exhibit.
REFERENCES


Jawaheer, Gawesh, Martin Szomszor, and Patty Kostkova. "Comparison of implicit and explicit feedback from an online music recommendation service." proceedings of the 1st international workshop on information heterogeneity and fusion in recommender systems. 2010.


APPENDIX I

Questionnaire

for the evaluation of the Artful mobile application
QUESTIONNAIRE

SECTION 1: RESPONDENT DETAILS

1. Gender: Male □₁ Female □₂

2. Age (in years): .............................................

3. Educational level (tick the highest):

<table>
<thead>
<tr>
<th></th>
<th>Primary</th>
<th>Secondary</th>
<th>College</th>
<th>University</th>
<th>Post Grad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

4. Familiarity with art discussing:

<table>
<thead>
<tr>
<th></th>
<th>Very poor</th>
<th>Not much</th>
<th>Adequate</th>
<th>Good</th>
<th>Very good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

5. Experience in arts:

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Not much</th>
<th>Adequate</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

6. Experience in using mobile applications:

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Not much</th>
<th>Adequate</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

7. Experience in using social media tools:

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Not much</th>
<th>Adequate</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

8. Respondent’s ID: Expert □₁ Simple user □₂

9. User ID: ..............................................................

10. Date: ..............................................................

2.1 Application Set-up
<table>
<thead>
<tr>
<th>No.</th>
<th>Please indicate your level of agreement with each of the following statements</th>
<th>Completely disagree</th>
<th>Completely Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1       2       3   4   5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>I easily understood how I should install the Artful mobile application.</td>
<td></td>
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<tr>
<td>2</td>
<td>It was comfortable and easy to use and navigate the artful mobile application</td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>The profile set up did not cause any disturbance to me.</td>
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<tr>
<td>4</td>
<td>It will be easy for me to use the artful mobile application by my own as an educational social media tool for art exhibitions.</td>
<td></td>
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</tr>
</tbody>
</table>

### 2.2 Usability

<table>
<thead>
<tr>
<th>No.</th>
<th>Please indicate your level of agreement with each of the following statements</th>
<th>Completely disagree</th>
<th>Completely Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1       2       3   4   5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>The process of creating posts with cognitive content about exhibits was easy and understandable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The process of creating posts with cognitive content about exhibits was easy and fun.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Following exhibition’s and visitors’ activity in the Artful mobile application was easy.</td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>In the future it will be easy for you to use the Artful tool by yourself?</td>
<td></td>
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<tr>
<td>5</td>
<td>In the future you would like to use the Artful mobile application to view and create educational content for exhibition purposes?</td>
<td></td>
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<tr>
<td>6</td>
<td>I found the existence of several buttons in the screen not to be confusing and annoying.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I found the general feedback provided by the application satisfactory.</td>
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</tbody>
</table>

### 2.3 Visualization

<table>
<thead>
<tr>
<th>No.</th>
<th>Please indicate your level of agreement with each of the following statements</th>
<th>Completely disagree</th>
<th>Completely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1       2       3   4   5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>I found pleasant the Artful mobile app in terms of design and aesthetics.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2  I found satisfactory the appearance of design of its interface.

3  I found accurate the depicted sentiment analysis scores offered for each shared post.

4  I found helpful to watch sentiment analysis of the posts offered by the Artful application and to analyze how they correspond to the character of the post content.

5  How comfortable do you think it is to listen or read the offered posts’ cognitive content while visiting an exhibition?

6  The Augmented Reality features offered by the app made the experience more fun and entertaining

### 2.4 Learning Experience

<table>
<thead>
<tr>
<th>No.</th>
<th>Please indicate your level of agreement with each of the following statements</th>
<th>Completely disagree</th>
<th>Completely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>I think that this application makes art learning and discussing experience easier compared to traditional exhibition techniques (exhibition texts, acoustic guides).</td>
<td></td>
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<tr>
<td>2</td>
<td>I think that this application would help the creation of more interactive and participatory exhibitions.</td>
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<tr>
<td>3</td>
<td>I would recommend the use of a similar app for the creation of virtual learning communities where visitors and curators can interact and practice art discussing.</td>
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<tr>
<td>4</td>
<td>I did not find the application stressful in any way.</td>
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<tr>
<td>5</td>
<td>I had fun using the application.</td>
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<tr>
<td>6</td>
<td>I think that the application respects the exhibits’ value, for which visitors can discuss and share opinions and information.</td>
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<tr>
<td>7</td>
<td>I would like to see such an application or similar technologies included in the educational process of other museums / art institutions.</td>
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<tr>
<td>8</td>
<td>Other visitors’ posts offered me valuable cognitive information, that otherwise would be hard to grasp.</td>
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</tr>
</tbody>
</table>

### 2.5 Knowledge sharing and the creation of a learning community
<table>
<thead>
<tr>
<th>No.</th>
<th>Please indicate your level of agreement with each of the following statements</th>
<th>Completely Disagree</th>
<th>Completely Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>I was trying to share piece of knowledge that would be useful or interesting to both myself and other visitors.</td>
<td></td>
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<tr>
<td>2</td>
<td>I tried to develop a critical look on my own, personal way about appreciating and discussing art.</td>
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<tr>
<td>3</td>
<td>I especially enjoyed reading the other visitors' perspective in their posts. It was also useful for me.</td>
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<tr>
<td>4</td>
<td>I liked the informal style of other visitors' posts.</td>
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<tr>
<td>5</td>
<td>The social part of the activity (knowledge sharing) was of no particular value to my personal understanding of the exhibition.</td>
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<tr>
<td>6</td>
<td>Everyone has their own perspective on art appreciation, and so most of the time I was not interested in the knowledge shared by other visitors.</td>
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<tr>
<td>7</td>
<td>Using the app made me feel more connected to other visitors, even though I did not meet them in person.</td>
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<tr>
<td>8</td>
<td>Compared to other art exhibitions, interaction with other visitors due to application usage increased.</td>
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<tr>
<td>9</td>
<td>I was worried about what other visitors would think about the information I shared.</td>
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<tr>
<td>10</td>
<td>I think that the use of such an application enhances the feeling of Participating and Belonging while visiting an art exhibition.</td>
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</tbody>
</table>

### 2.6 Perceived performance of the artful application

<table>
<thead>
<tr>
<th>No.</th>
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<th>Completely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>The application is effective (if the app meets its objectives).</td>
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<tr>
<td>2</td>
<td>The application is efficient (if the app responses satisfactorily and in a short time).</td>
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<tr>
<td>3</td>
<td>The application provides satisfaction (if the app provides satisfaction to the user).</td>
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<tr>
<td></td>
<td>The application is innovative (if the app offers novel tools/techniques in CH management).</td>
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</tbody>
</table>

2.7 Fill in the box below with any comments/improvements/comments for the Artful mobile application.

Thank you very much for your co-operation.