Extending Civic Participation (in Public Spaces)

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Abstract. In this chapter we analyse how digital applications dedicated to coloured collection could enhance civic participation through the Open Space Museum prototype, curiosity and social cohesion. The first section deals with the Open Space Museum, designed by Arthur Clay and N55, that features a portable, modular exhibition showcasing diverse artworks to foster public engagement and artistic interaction. It includes Case Study and Chroma Elements, AR technology, and engagement applications, creating a versatile, immersive, and pandemic-ready cultural space that extends traditional museum hours. The second part focuses on how curiosity can foster civic participation by prompting exploration and learning. It transforms from a negative trait to a valued tool for motivation, encouraging people to resolve uncertainties and seek knowledge. Berlyne's concept of curiosity defines it as a response to environmental complexity and gaps in knowledge, leading to active inquiry. This positive feedback loop aids engagement in cultural heritage, supported by PERCEIVE's curiosity-driven interactive design. CNR researchers conducted a four-day campaign at MANN in June 2023, digitizing statues with polychromy traces and analyzing public curiosity. Visitors participated in guided tours, viewing diagnostic techniques and 3D acquisition, which sparked high interest in ancient sculpture coloration, diagnostic methods, and digital reconstruction. The last section is dedicated to Social cohesion, essential for stable relationships in society. Encouraging civic participation through cultural activities strengthens democracy and fosters community connections, bridging social boundaries and empowering citizens to feel engaged and cohesive within their communities.

Keywords: Participation · Curiosity · Social Cohesion

We have already introduced the concept of "Participation" in Chapter 4. In this chapter we further develop it, introducing the idea of how to extend civic participation through Open Space Museum and Social Cohesion practices in the digital domain. Furthermore, we analyse the curiosity triggers that could contribute to engage citizens in these practices.

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1 Designing an Open Space Museum

The Open Museum project is a collaborative effort between Arthur Clay and the N55 group. It involves creating a portable and modular exhibition space designed to showcase diverse artworks from the PERCEIVE project. The main objective is to engage the public and provide a unique place for artistic interaction. Additionally, the Open Museum will offer a tranquil retreat for visitors, making it a versatile and immersive cultural experience. Especially in today's world, where pandemics and health concerns have become a significant part of our lives, the design of the Open Museum takes into account the need for safety and adaptability. The structure is thoughtfully planned to ensure that visitors can enjoy the artworks and cultural experiences while adhering to necessary health protocols. The use of modular components allows for easy reconfiguration to accommodate social distancing and crowd management. Moreover, the Open Museum is not limited by traditional museum operating hours. It offers a novel approach by opening its doors when other museums might be closed. This extended accessibility allows for increased public engagement, reaching a broader audience and providing an alternative platform for museums to showcase their holdings. By collaborating with established museums, the Open Museum becomes a collaborative extension, enriching the cultural landscape with diverse artworks and fostering creativity and cross-exhibition opportunities. The urgency to create a pandemic-ready structure, combined with its extended operating hours and collaboration potential with established museums, makes the Open Museum an innovative and timely solution to address the challenges faced by the art and cultural community today. It offers a safe, immersive, and inclusive cultural experience, ensuring that artistic expression and appreciation can continue to thrive even during uncertain times.

1.1 The Elements of the Open Museum

The key components of the Open Space Museum are its so-called Case Study and Chroma Elements. In this section, the integral role that these elements play within the project will be explored, in order to reveal how they were designed to showcase diverse artworks and provide an immersive experience for visitors for each one of them. In brief, the Case Study Elements act as gateways to artistic exploration and scientific understanding, while the Chroma Elements delve into the interplay between natural light and digital artworks. Combined, they let visitors discover the diverse scenarios of the PERCEIVE Project in an engaging and playful manner (Fig. 1).

The Case Study Elements are integral components of the Open Museum project, designed to showcase diverse artworks that serve as case studies for the research conducted within the PERCEIVE project. These elements utilise space frame structures made square aluminium tubing, providing a durable and visually appealing framework for housing the artworks. At present, there are eight unique Case Study Elements, each with made up of cubes with a volume of 1.5 cubic meters. Visitors can explore the beauty of these artworks while gaining an understanding of their ephemeral nature and the scientific aspects that contribute to their preservation. The Case Study Elements can be exhibited individually or combined into the larger Open Museum structure, providing a socio-cultural area for shared experiences.

Fig. 1. A design sketch of the Chroma Tower depicting the coloured plates with their design motifs, accompanied by the capstan used to rotate the tower. The rotation alters the mixture of coloured light produced as sunlight passes through the Chroma Tower.

The Chroma Elements serve the distinct purpose within the Open Museum project of showcasing aspects of presenting and preserving Born Digital Artworks, particularly AR Artwork. Resulting from a study involving select AR Artworks, these elements let the visitor explore the interplay between natural light and the virtual assets in the AR artworks. The interplay is made possible by the transparency factors in the coloured plates of the Chroma Tower and the in the textures of the assets used in the AR artworks, which when combined leads to a clearer understanding of how light can have an impact on colour perception.

The AR Portal Elements act as gateways to AR Artworks, enabling viewers to experience digital artworks on their smart devices. The Chroma Tower Element serves as a "colour perception modifier," enhancing the visual experience and interaction with digital artworks featuring transparency. The experiences with the Chroma Tower contribute to further research on presenting and preserving Born Digital Artworks, providing valuable insights into the interconnection of natural light and digital artwork aesthetics. Unlike the Case Study Elements, the Chroma Elements are exhibited independently, creating a unified and coherent Open Museum Space for a cohesive and enriching cultural journey (Fig. 2).

1.2 Case Study Elements Examples

In this section, we explore two case study elements that are integral parts of the Open Space Museum: the GREATWALL CLIMB and the GREATWALL PRINT.

The case study element designed for the Open Museum referred to as the GREATWALL CLIMB is a unique addition to the Open Museum project, presenting a captivating case study on polychromic sculptures from ancient times that were apparently coloured. The element uses a series of space frame elements to form a climbing wall. The wall features hand-foot grips made from casts of various parts of ancient sculptures. Perforated plates on the space frame facilitate the secure attachment of the grips, allowing visitors to climb the wall safely. The artworks used in this Case Study element are three Venus

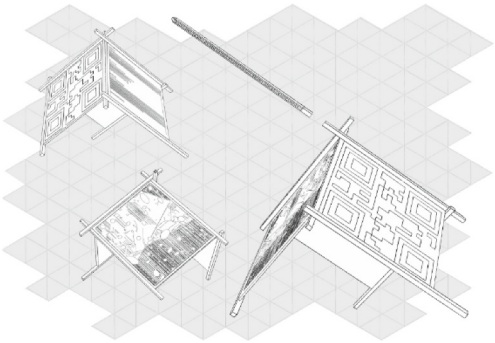

Fig. 2. A design sketch of an AR Portal which acts as gateway to each of the AR artworks on display. The plates of the AR Portals provide access to the AR artworks via QR Codes, information about the artworks, and reflect and refract the coloured light emitted by the Chroma Tower.

sculptures. This tactile learning approach communicates the beauty of ancient sculpture and enriches the methods used to teach about the history of ancient arts, making it particularly effective for engaging youth (Fig. 3).

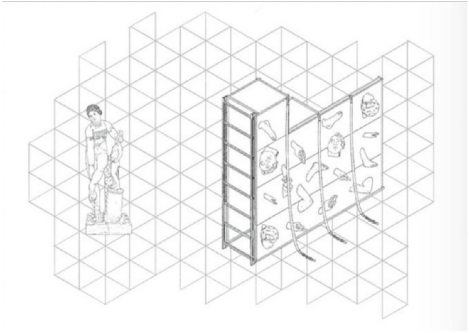

Fig. 3. Sketch of the Case Study Element, the GREATWALL CLIMB, with hand-foot grips segmented from three different Venus sculptures to create climbing routes. By physically interacting with the grips, climbers gain a deeper understanding of the sculptures' intricate details, size, and textures, fostering a tactile appreciation for ancient artistry, creating a truly enriching and educational experience within the museum."

Visitors to the GREATWALL CLIMB element not only enjoy a thrilling climbing experience but also benefit from an educational encounter with the sculpture parts. By physically interacting with the hand-foot grips, climbers gain a more attentive perspective on the sculptures' intricate details, size, and textures. Being able to come in close contact with these artistic elements provides a unique opportunity for tactile learners to better understand the beauty and craftsmanship of ancient sculptures. As climbers navigate the climbing routes, they can examine each grip closely, marvelling at the skill and artistry of the sculptors from ancient Rome and Greece. This hands-on encounter offers a deeper appreciation for the artworks, as visitors actively engage with history, culture,

and aesthetics, creating a truly enriching and educational experience within the Open Space Museum (Fig. 4).

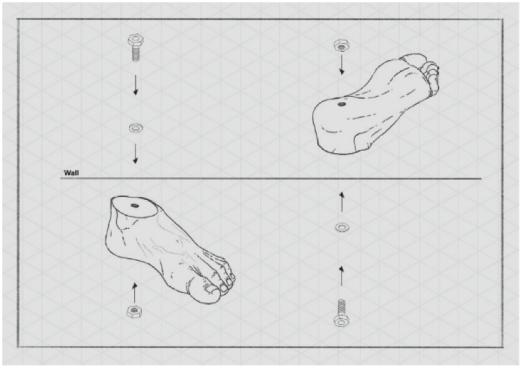

Fig. 4. A climbing hold made from cast plastic with intricate montage details. The hold is won by segmenting digital copies of Venus sculptures and then using a 3D printer to create it.

The case study element designed for the Open Museum referred to as the GREATWALL PRINT is like the GREATWALL CLIMB in that it uses a number of space frame elements to form a wall. Instead of hand-foot grips, a series of panels are mounted to the wall. The GREATWALL PRINT is the element that is dedicated to presenting case study assets from the PERCEIVE scenario on painting. Here, frescos from Pompeii are used which have undergone a loss of colour or which have suffered loss of media due to damage over time. These frescoes are in different areas within Pompeii and are known for their historical and artistic significance. However, due to time and environmental factors, these frescoes have experienced deterioration and loss of data, resulting in areas where restoration is needed to gain a full appreciation of their grandeur.

The Case Study Element presents a novel approach to showcasing frescoes from Pompeii that have been affected by time and damage. The method creates an engagement that places visitors into the role of the heritage scientists on a journey of restoring the frescoes to see how they might have looked at the time of their creation. This is achieved by printing opaque layers on both the front and back surfaces of a two-way mirror. On the front surface of the mirror, a print of the original fresco is overlaid with transparent areas indicating those sections of the frescoes that are missing. On the back surface, the missing parts of the fresco are generated using Artificial Intelligence and printed. When a strong light is directed onto the mirror's front surface (such as the light from a personal smartphone) the mirror is made translucent and the missing sections of the fresco become visible and seamlessly integrate into the fresco, effectively 'restoring' it (Fig. 5).

In this manner, viewers can observe present and restored versions, gaining insights into restoration processes. Authenticity is also present as the visitors can discern between what media is historical and what has been added to it to produce the impression of a restoration. The presentation of the frescoes using the Open Museum offers visitors a sense of authenticity and care by showcasing cutting-edge technology and providing

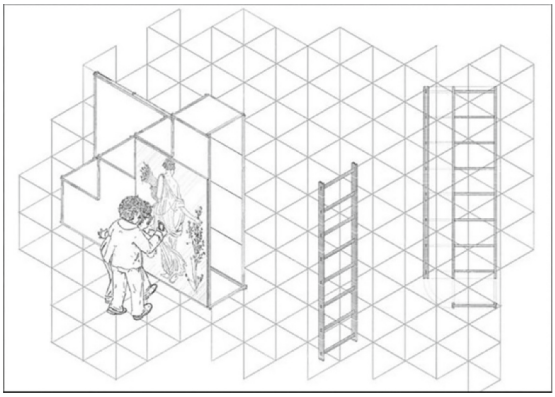

Fig. 5. Design sketch of the GREATWALL PRINT, a Case Study Element in the Open Museum. Using innovative technology, opaque layers on a two-way mirror reveal missing sections of the frescoes when illuminated by light, seamlessly integrating restoration efforts. Visitors witness both present and restored versions, gaining insights into restoration processes while discerning historical authenticity.

a unique educational presentation. It allows visitors to engage with history, restoration processes, and the artistic significance of the frescoes from Pompeii. The element's integration within the Open Space Museum project enhances the immersive cultural experience, making it an enriching and captivating attraction for visitors.

1.3 Engagement Applications

The Open Museum's Engagement Applications represent a groundbreaking approach to enriching the museum experience, fostering a hybrid experience between the real and the virtual that results in profound engagement with cultural heritage for visitors. By scanning the QR code located on the space frame of each Case Study Element, visitors can easily gain access the application. These applications are seamlessly woven into the museum fabric, inspire exploration, learning, and active contribution among visitors.

Like all the engagement applications for the Case Study Elements, the applications for the GREATWALL CLIMB and GREATWALL PRINT feature a user-friendly interface that greatly enhances the usability of the applications, which were designed to ensuring a seamless transition between the physical offerings of the Open Space and the virtual one provided by the application. Overall, by integrating digital applications with the physical engagements offered by the Open Space Museum, the museum's design can be seen as hybrid, which significantly enhances the overall visitor experience (Fig. 6).

The Engagement Application for the GREATWALL CLIMB allows users to identify each hand-foot grip object on the climbing wall, including those inspired by "Venus in a Bikini" and the "Statue of Isis," provides detailed information about these objects' origin and significance, offers instructions for wall climbing, and showcases diverse climbing routes. The interactive application adds a layer of engagement and educational value to the unique GREATWALL CLIMB experience. The application for the GREATWALL Print guides the visitor through the virtual restoration process. By simply using a fingertip

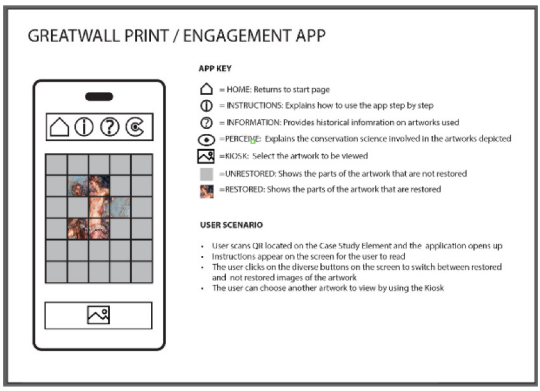

Fig. 6. A mock-up GUI for the GREATWALL Print Engagement Application which is designed to guide the visitor through the virtual restoration process. By simply using a fingertip to glide over the image of the fresco on the screen, visitors gain awareness of how it is possible to provide digital restoration of the frescoes without infringing on the authenticity of the fresco.

to glide over the image of the fresco on the screen, visitors gain awareness of how it is possible to provide digital restoration of the frescoes without infringing on the authenticity of the fresco. Although not all the frescos could be shown in the Open Space Museum, all of them can be seen using the Engagement Application.

1.4 Post Pandemic Museum

In 2020, museums, like many other public spaces and businesses, faced significant challenges due to the COVID-19 pandemic. When museum doors closed in response to the crisis, several notable changes and developments occurred, with one of the most demanding being the crisis of adapting to the absence of physical space and the lack of experience in utilizing alternatives. The Open Space Museum stands out as a model of virtuous practices to adopt in the context of this new pandemic and, more broadly, in the post-COVID-19 era. Its design not only delves into the socio-technical value of museum spaces but also highlights their contemporary, hybrid nature. This approach adeptly navigates the complexity of closed-door policies due to pandemic restrictions, showcasing the museum's ability to blend physical and digital elements to ensure continued engagement and accessibility for visitors.

It is evident that the post-pandemic landscape has witnessed a significant shift toward a comprehensive and inclusive approach. This transition demands that a museum space seamlessly merge digital and physical experiences to cater to a diverse audience, directly responding to the lessons learned during the pandemic, particularly in the realm of digital innovation, which experienced accelerated development during that time. The Open Museum focus on virtual replicas and the potential of digital twins to replicate physical objects and processes, the approach further demonstrates how these technologies can create immersive, engaging, and informative museum experiences, offering innovative ways to present exhibition content and enabling fresh interactions with visitors. Extending civic participation in public spaces through art is a transformative approach to fostering

engagement, inclusivity, and pride in communities and the Open Space Museum project serves as a protype example of this in terms of how art can create dynamic and immersive cultural spaces, transcending boundaries, and encouraging active participation.

Through the Case Study and Chroma Elements, the Open Space Museum offers visitors to creatively engage across the five Scenarios of the PERCEIVE Project by integrating a wide range of case study elements dedicated to painting, sculpture, photography, textiles, and digital arts and providing novel ways to interact with them. Two Case Study Elements, along with the Chroma Tower and AR Portals, were discussed in detail as examples. Along with these, it also linked Engagement Applications with these elements, proposing a hybrid entity that extends the physical with the virtual, making digital experiences tangible and accessible. These Case Study Elements, like all the others, not only engage visitors with historical as well as modern artworks, but also enhance their understanding of the significance in the use of technology in cultural heritage. Therefore, all the elements of the Open Space Museum provide immersive encounters with art, providing opportunities for both tactile learning and virtual exploration. The use of modular components allows for easy reconfiguration, ensuring that the Open Space Museum can be implemented in a wide variety of spaces, large and small. With its extended operating hours, it provides a valuable solution for the art and cultural community during challenging times. By offering an alternative platform for museums to showcase their holdings and collaborating with established institutions, the Open Museum becomes a versatile and inclusive cultural space, promoting artistic expression and civic engagement beyond traditional museum hours.

In conclusion, the Open Space Museum's innovative and timely approach, prioritizing safety, and accessibility, stands as a possible model for museums in the future. As a prototype, it showcases the potential of art to create vibrant and engaging public spaces that celebrate creativity, culture, and community, even in the face of the pandemic. It offers a transformative and adaptive experience, inviting visitors to actively participate in shaping the cultural narrative and fostering a sense of ownership in their public spaces (Fig. 7).

2 Curiosity as a Trigger to Extend Civic Participation

2.1 Curiosity and Interest as a Trigger to Extend Civic Participation

Extensive research has unveiled the multifaceted aspects of curiosity and its positive influence in contributing to learning and engagement. Curiosity can be employed as an effective trigger to generate active involvement in individuals, as it can be a powerful motivator of behaviour, initiating actions directed at exploring topics and environments and always aimed at resolving some states of uncertainty and acquiring new knowledge [1]. It was only in the '50s that the meaning behind curiosity shifted from the negative connotation of lacking self-restraints and prying into others' matters, to the positive meaning associated with having inquiring minds, raising questions and seeking answers, doubting and learning [2]. As soon as this shift occurred, researchers and experts from a wide variety of fields worked to give it a valid and complete definition. A definition that has remained as the base ground, even for latest analyses, was provided by Berlyne,

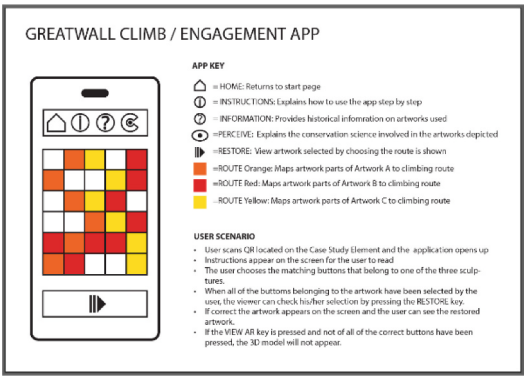

Fig. 7. A mock-up GUI for the GREATWALL CLIMB Engagement Application allows users to identify each hand-foot grip object on the climbing wall from each of the Venus sculptures that were used to create them. The app provides detailed information about these objects' origin and significance, offers instructions for wall climbing, and showcases diverse climbing routes. Selecting all parts of a single sculpture and pressing the "play" button triggers the sculpture to appear as a 3D model on the user's screen.

a British and Canadian psychologist, involved in research surrounding the topics of experimental and exploratory psychology.

"*Curiosity is a state in organisms induced by environmental situations rich in complexity, incongruity, doubt, difficulty, and similar conditions all of which are characterised by the fact that they arouse a state of uncertainty and response conflict. The aroused state can be observed as emotional tension and physiological and neurological arousal […] that leads to the exploration of the source of the disturbance.*" [2].

Later definitions have been built upon the former, followed by multiple classifications aiming at differentiating among theories and dimensions, with these depending on the object of curiosity, the type of stimuli or the source of the drive. A relevant distinction occurs between *trait curiosity* [3] that is deeply dependent on one's personality, and *state curiosity* [4] that is strongly connected to environmental features and is activated by specific and directed intellectual stimulation caused by unsolved questions and the opportunity to resolve them. Due to its situation-specific form and its dependency on external stimuli, *state curiosity* can arise regardless of ones' innate characteristic and can be directed towards specific topics as long as its triggers manage to produce some sort of disequilibrium or a state of arousal in the individual [2]. This state of arousal is perceived as a keen sense of urgency, a drive to act and to explore the object that raised the curiosity; the state of arousal persists often accompanied by feelings of excitement, agitation, and delight. What Berlyne defined as "state of uncertainty", later developed in the concept of "knowledge gap" (introduced by [4]) that is indeed a perceived "gap" in ones' knowledge base. It refers to the lack of information pertaining to a specific topic or the recognition that there is a disparity between what is known and what one desires to know. The presence of the gap alone doesn't necessarily evolve into curiosity. For curiosity to arise, the subject must also *acknowledge* the gap and recognize the existence

of missing information or pieces of information regarding specific aspects of a certain topic.

Indeed, it is this process of recognition [4;5] that ensures the development of a sense of curiosity that leads to start seeking for more information and improving one's knowledge to solve and fulfil the perceived gap. The knowledge gap functions similarly to Berlyne's uncertainty, evolving into a drive to acquire new information through the emergence of exploratory behaviour. Curiosity can be described through three key attributes:

1. The presence of an information gap and a conviction that the gap can be resolved, meaning that there's the perception to have enough capabilities or competencies to fill it [6]
2. Curiosity results in heightened arousal, culminating in a strong sense of urgency to close the gap, which can manifest as excitement, delight, or agitation. Individuals feel compelled to investigate the object of their curiosity until it is either resolved or their attention is diverted.
3. Curiosity is frequently expressed through questioning, doubting or exploratory conduct.

Following these three attributes as references, the development of an individual's curiosity begins with a trigger or multi-triggered scenario [1], which is followed by a reaction, and, finally, concluded in resolution once new information has been gained. Curiosity may be linked to personal, already existing factors, or by contextual and situational aspects [1]. Once curiosity has been triggered, the need to close the gap causes the individual to actively start seeking answers and improvements. This information-seeking behaviour is mainly manifested through question asking and active exploration. Curiosity is resolved only once the acquisition of new knowledge is added to one's knowledge base and closure of the precedent lack of information is then completed. However, as individuals delve deeper into the topic that aroused their curiosity, not only may new questions arise, highlighting new gaps to fill, but also newly discovered personal interest can develop and deepen through the experience [7]. Curiosity is therefore an iterative and active process (Fig. 8), as demonstrated by the positive feedback loop based on reward learning-reinforcement learning model, combined with the features of the knowledge acquisition process [8]. Through this iterative approach that each time leads to resolution of some level of uncertainty, learning occurs, and as new knowledge is gained, visitors become invested. By captivating visitors in this self-rewarding loop [8], triggering curiosity results in a way to also engage the visitors of cultural heritage settings and enhance their participation, hooking their attention and evolving in an active and extended research for new knowledge. They become actively involved in looking for relevant resources, engaging in discussions, and seeking opportunities for learning experiences. Precisely because of this nature, curiosity should be considered as fundamental in the design of interactive media and, specifically taken as reference when designing the PERCEIVE experiences foreseen by the end of the project.

In particular the focus involves what to be considered and used as triggers that could activate curiosity, transforming them into strategies and, specifically into visual stimuli, interactive mechanics and narrative scaffolding. Among the many classifications that curiosity has undergone, some (an overview of the different studies [9]) have indeed

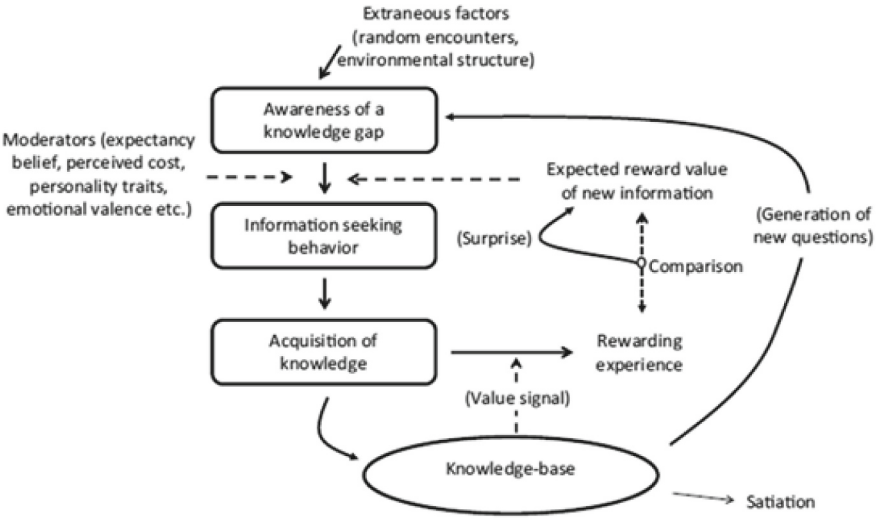

Fig. 8. Summarisation of the positive feedback loop based on reward learning-reinforcement learning model proposed by [8], combined with the features of the knowledge acquisition process.

focused on the reasons and motives that could stimulate curiosity and evolve in an explorative behaviour. The identified triggers include:

1. *Incomplete* and *poorly organised* information, ambiguity, incongruity and complexity: intended as the necessity to acquire more complete and clearer information about a topic.
2. *Unexpectedness* of an information (in the contrast with one's predictions and expectations): this trigger is usually connected to novelty and surprise and leads the individual to search specifically for the reasons why the perceived discrepancy has occurred.

What lastly resulted as an aspect to be further explored regards what can transform curiosity into interest, for the benefit and deeper engagement of PERCEIVE users and in general European Citizens towards coloured collections and their fragility. In particular, curiosity could support and enhance the effects of the caring and authenticity experiences, foreseen in the PERCEIVE prototypes. The relationship between curiosity and interest is of particular importance in educational research. Although, largely used as synonymous or interchangeable concepts, from a theoretical perspective, curiosity and interest are recognised as separate but related constructs. Curiosity typically represents an initial spark, an intrinsic desire to explore and understand, whereas interest represents a more sustained and emotionally charged engagement with a topic. Curiosity is seen as a catalyst for initiating learning. It triggers questions, exploration and active information seeking. As such, curiosity can be a driving force in the early stages of engagement with a subject. Interest, on the other hand, tends to develop as individuals delve deeper into a topic, making emotional connections and finding personal relevance. In order to better understand curiosity triggers and mechanisms that could transform curiosity into interest

in the domain of Cultural Heritage and specifically in that of coloured collections, it was designed a Cultural Probe Kit.

2.2 Cultural Probe Kit Exploration on Curiosity and Interest

Cultural probe kits have largely been used as design tools and they typically consist of a set of items and materials that may help the researchers understand their target audiences better, with the overall aim of giving the participants space to document their observations and activities, and to guide and inspire them to reflect on some issues. Probe Kits typically include several key elements, such as diaries (either blank or with guided tasks) for observing and recording information related to behaviours and thoughts; maps for understanding one's relation to surrounding space; disposable cameras for capturing and documenting places or situations; and photos, videos, and postcards to inspire and guide research topics; surveys or questionnaires which can be used to gather specific data [10]. The findings and responses collected through Probe Kits are typically intended for a qualitative analysis rather than quantitative and are mostly used to provide cues and hints for designers to reflect on.

The Curiosity Probe Kit created for PERCEIVE, included a single notebook, proposing written and online tasks, incorporating a variety of media such as images, Instagram posts and short videos to engage participants. It was thought to be divided into three main sections. The first one included an introductory questionnaire and specific tasks for the following days. The second section acted as a diary, guiding participants over eight days to observe and record aspects of their daily lives. The third last part contained advanced tasks related to cultural heritage and the theme of lost polychromy in ancient sculptures. The Curiosity Probe Kit was given to a group of students enrolled in the Interaction Media Design course taught by Professor Sofia Pescarin as part of the Master's Degree program in Digital Humanities and Digital Knowledge of the University of Bologna during the academic year 2022–2023. The main objective of the study using the Curiosity Probe Kit was to collect some *qualitative* data regarding the target group's relationship with curiosity in their daily lives and in cultural heritage related situations. The study focused on three main research questions:

Q.1 - Are there triggers of curiosity that work better than others in cultural heritage contexts?

This question seeks to identify which specific triggers (among the ones found in the literature and designated as novelty, unexpected, incongruity etc. or others that may eventually be added by participants) are more effective in piquing curiosity within cultural heritage contexts, with a particular emphasis on lost polychromy.

Q.2 - Are there aspects of the research on polychromy that specifically act as triggers of curiosity?

This question delves into the specific elements related to the topic of lost polychromy that might stimulate curiosity (history, diagnostics, meaning of colours etc.). Identifying these aspects can help in tailoring exhibits or educational materials to maximise their impact in eliciting curiosity.

Q.3 - Does previous knowledge of the topic influence the levels of triggered curiosity in cultural heritage settings?

This final question aimed to provide insights into the role of prior knowledge in triggering curiosity, It investigates whether individuals with differing levels of prior knowledge about specific topics demonstrate varying degrees of curiosity, aiming t understand the best practices for designing museum experiences to engage audiences with diverse backgrounds. The first section of the Curiosity Probe Kit opens with a general overview on the participants' background and follows with a 20 questions analysis to investigate both their levels of trait curiosity, and the predisposition of their curiosity to be triggered by certain stimuli. Moving on, the second activity of the book was intended as a first moment for the participants to reflect around the concept of curiosity, asking them to recall a time of their life, recent or not, when they felt particularly curious about something. Following, the third activity involved telling a story, but this time it had to be about a time when the participant had attended a cultural event and was particularly curious about something. The participant was then asked to read or retell the story to one of their friends or university colleagues. The fourth presented the picture of the Hercule Farnese held at the National Archaeological Museum of Naples (MANN) and a brief description of what was depicted, the task for the participant was to read two different captions and reflect if their curiosity was aroused and eventually by what. Whereas, the fifth activity was again focused on cultural heritage events, and asked to visit a monument or a museum and to take a picture of something that triggered the participants' curiosity, explaining what it depicts and why it was stimulating. Lastly, the final activity was a role reversal activity in which the participants interviewed a friend and a family member and asked them to describe/narrate an episode or experience that made them feel particularly curious.

The second section of the Cultural Probe Kit was organised as a diary that participants could fill in every day for a week following the structure and the inputs given.

The third and last section of the Probe Kit was the one more centred on the topic of lost polychromy. Here the objective of the investigation was to gather data about the aspects of the research that may attract visitors, giving insight on what triggers to use to raise their curiosity and how to communicate them best. The section was divided into three activities, in the form of questionnaires to be completed online.

The **first activity** is opened by a black and white reproduction of a drawing made by the French author Quatrémere de Quincy in the 19th century, of what he thought the inside of the Greek temple of Olympia could have looked like. After looking at the black and white version, the participants were explained that originally the drawing had colours that have now faded, and they were set before a multiple-choice decision of what the original drawing could look like between five different options of recoloration, of which just one was correct. Once they chose a possible version, the participants were redirected to an image of the original drawing and were asked to look at it and analyse it compared with their choices and finally they were asked to rate their level of curiosity for the topic.

The **second activity** focused specifically on diagnostic analysis for the identification and reconstruction of polychromy on ancient sculptures by a team of researchers at the Museum of Fine Art of Boston and the polychromy of a replica of the Athena Parthenos. A description of the workflow they followed and on the outcomes of their research was given to the participants in the form of a summary of the presentation the researchers

made at the 2022 *Polychromy Roundtable* held in Rome. The participants were once again asked to rate their level of curiosity.

The **third activity** in the diary consisted of a last moment of reflection directed on why the participant think the pigments and colours that were applied on classical statues are now completely gone, after a brief overview on the possible motives that caused that, including the meticulous removing of traces of colour during the 18th century due to ideological and cultural reasons; concluding with a last question on the general level of interest. The probe kit in its integrity can be downloaded at [11].

2.3 The Expert Room: Exploring Curiosity on Lost Polychromy at the Museum

In June 2023 CNR researchers launched a four-days mission at the National Archaeological Museum of Naples (MANN) to digitise and carry out an archaeometric campaign of some of the displayed statues that were chosen as case studies for PERCEIVE thanks to their traces of polychromy. Concurrently with the CNR mission, it was decided to organise two experiments to analyse the levels of curiosity raised in the general public of the museum and its triggers towards the topic of ancient polychromy in Roman sculptures.

In particular the CNR mission included the display hosted in room 78 (closed to the public for the occasion), part of the exhibition *"L'altro MANN. I depositi in mostra",* which contains exhibits many statues examples of the same iconography of the *Anadyomene Venus*, according to various iconographies, as well as two statues of *erotes* and one of a small *satyr*. All artefacts in this display showed some traces of polychromy, particularly visible in the case of the *Lovatelli Venus*, but easily recognizable also in the other sculptures (traces between the hair of other Venuses and on their robes, colour around the eyes and lips of the erotes and the satyr). As for the second set of statues, those found inside the temple of Isis during its excavations, it was only possible to complete the diagnostic work on the *Venus Anadyomene*, while the *Isis with the sistro* and the *Dyonysus with panther* will require a second mission to be finalised.

While CNR researchers were conducting diagnostic analysis and 3D acquisition of the sculptures in exhibition, room 78 was closed, precluding the visitors' access. To repair in some way the disservice, and to retrieve useful information from the visitors, on the last day of the mission, for just a couple of hours, it was decided to allow small groups of visitors to enter the room and get a glimpse of what the experts were doing inside through a free 15-min guided tour (Fig. 9).

To guarantee the highest possible uniformity among the various visits, a specific procedure was defined on how to approach them, and guidelines were laid down on what to say:

1. Each tour began with a brief introduction to the research in progress and the theme of the PERCEIVE project: the main aims and objectives of PERCEIVE were first presented, highlighting the role of digitization and artificial intelligence and giving an overview of the different scenarios.
2. After this opening presentation the visitors were guided towards the first stop, where experts were working on the photogrammetric acquisition of some of the statues on display, while giving an overview on the different 3D acquisition techniques that

had been generally applied to the research project (both photogrammetry and laser scanner). Some preliminary output of the digitalization, point clouds and preview renderings of the 3D models were briefly showed.
3. The second stop, focused on the diagnostic processes: the visitors were guided inside the "darkroom" where experts were performing some multispectral imaging techniques, VIL (Visible Induced Luminescence) and UVF (Ultra-Violet Fluorescence).
4. To conclude, in order to allow the experts to continue working in the "darkroom", the visitors were led outside and taken to the last stop. Here, since the visitors had at this point in the visits a good overview on how diagnostic techniques worked, it was the moment to also show some of the results of the imaging analysis, explaining how they look like, what kind of information they help in collecting and how they are interpreted.

Despite its brevity, the goal of the tour was to give an overview of the whole facets and aspects of the research process of polychromy identification and recognition, explaining how much information can be acquired using different techniques and how difficult it is to imagine possible reconstructions, highlighting the workflow's obstacles and challenges, but yet suggesting the aid that digital tools could provide to speed and help the process. This first event went under the name of *Expert Room - Waiting for the European Days of Archaeology*, six slots of time of twenty minutes each were organised, and booking was mandatory to access the event, a maximum of five people were allowed for each slot. In the end, a total of twenty-one participants were therefore counted, divided in six slots, and visits both in Italian and in English (following the demand of foreign visitors asking to participate) were offered.

Fig. 9. Diagnostic analyses during the Expert Room at MANN © Museo Archeologico Nazionale di Napoli

After the visits all participants were asked to fill in a very brief questionnaire (English version[1]), that was created to gain data firstly on their previous knowledge on the topic of ancient polychromy and their level of expertise, and secondly to understand what aspects of the visit triggered their curiosity the most, to which level and why, what questions

[1] https://forms.gle/6hh6GuzRnNBup4MU6.

were triggered and concluding by asking what the visitors were planning to do with this newly found curiosity, to understand if the triggered curiosity was enough to evolve in personal interest, and if so, how to exploit it.

During the visits very high levels of curiosity had been assessed, both from visitors completely unaware of the topic of polychromy, and from neophytes and curious onlookers. Evaluating their curiosity on a scale from 1 to 10, 90% of the participants (19/21) marked high scores, between 8 and 10, resulting in an average curiosity level of 9,04/10, slightly higher in participants with a previous knowledge on the topic (9,4/10) rather than in the ones that were completely new to it (8,7/10). Interesting results came from the answers gathered from the third question on the form, regarding what aspect of the research, among the ones presented during the visit, generated the most curiosity. Wanting to group the answers in fixed categories, we could identify mainly four:

1. Diagnostic techniques and tools, archaeometric analysis
2. Digitization and photographic acquisition
3. Coloured reconstruction
4. Challenges of the entire process of identification of polychromy

A curious intake comes up from analysing these results, that is that almost 72% of the total participants claimed that the aspect that mostly triggered their curiosity was either entirely or at least partially the diagnostic techniques and the archaeometric analysis.

> "*Even if I knew about coloured statues, I didn't expect all of the different techniques to go together like this and all the various comparisons that were needed before you can create a reconstruction*"

For the majority of the participants (72%) the stated curiosity was sufficient to develop in interest, either in the form of independent follow-ups, by autonomously looking for more information on the topic on the web or in papers and books, or by looking for more events or exhibition on the topic organised in this or other museums. Lastly, another interesting factor that has been assessed during the event regarded the kind of questions that visitors asked throughout the visit. As question asking is one of the way that people show their curiosity towards something, as a way to gather answers and fill their knowledge gap, it was also worth to record and analyse the questions they made to understand what aspects of the subject matter are the ones that most deserve to be acknowledged during the design of an interactive experience. By analysing them, they could indeed, be subdivided between questions on bindings and way of applying the colour, the meaning this colour may have had, but mainly where traces were found, what are the pigments and how come they disappeared in most scenarios, or on the other hand why in the cases they were saved, was that possible indeed.

2.4 Results and Requirements About Curiosity and XR Experiences

Through the analysis of all the data gathered from the Curiosity Probe Kits and the MANN experiments, it was possible to establish some points that are indeed fundamental for the design of an experience that aims at trigger curiosity in the public towards the topic of the lost polychromy of sculptures. Thanks to the analysis of the data collected

from the Curiosity Probe Kits, it was possible to identify the most important triggers for curiosity among the students. In most cases, *novelty* was the main trigger (something completely new), followed by the *unexpected* (they meant situations where they had certain expectations, and their expectations were not met) and *unknown* (curious because they had no prior knowledge about the subject). In this last case, it's the absence of knowledge that triggered curiosity, as if the trigger was related to a sense of *mystery*:

- *"You're not expecting to see it happening every day!" (Curiosity Probe Kit, n°21)*
- *"I wanted to understand how it works, I've always found myself caught by the unknown" (Curiosity Probe Kit, n°4)*

Other identifiable triggers have been the oddness, the weirdness of the subject, (to be aggregate with the sense of unexpected); previous interest (10%) and personal connection (10%). The less quoted motivation was the usefulness.

Addressing the topic of lost polychromy, from the fourth activity of the first section, regarding the two different captions of the Hercules, it emerged that those who reported to be interested in finding more information on it, were motivated by the *novelty* trigger (that they had never seen the statue in person before and would have liked to visit it). Specifically, they reported to be interested to polychromy related aspect.

- *"I think I would look further into its history, who discovered the pigments first and if there are any reproduction of the coloured version" (Curiosity Probe Kit, n°16)*
- *"I would like to look to some documentaries or videos showing how the colours were found, and maybe why they faded away" (Curiosity Probe Kit, n°50)*

The topics that were considered worthy of being deepen were the pigments' identification process, the reason behind their fading and the sources to rely on for possible reconstructions, together with the interest in seeing some of these plausible colour reconstructions.

In the last section it was possible to follow the increasing and motivation of curiosity toward ancient polychromy. Specifically in the second activity, on Athena Parthenos colour reconstruction, carried out at the Boston MFA (link: https://blackmath.com/athena-3d-reconstruction), the reported curiosity reached particularly high levels. When asked what the participants would have added to the scientific narration to make the topic more interesting, the responses included the possibility to show more steps of the diagnostic and recolouring process, the addition of information about the painting techniques in ancient times and the way it is possible to recreate the appearance of lost colours. Other topics of interest emerged from the last question, where the participants were given the chance to hypothetically ask the team of researchers some questions. Here, the data showed that they were intrigued by researchers' expectations of what they would find during the research process and the initial clues that sparked the investigation. In addition, participants asked for more information about the specific archaeometric analyses and the origin and use of different pigments. They confirmed to be interested in the reasons why sculptures were coloured, what the colours were meant to convey and the reasons for the possible loss of colour over time. Participants were also curious about the possibility of ancient painters adopting durable materials or techniques, as well as the methods and general workflow used to recover and identify traces of colour.

Finally, they also wanted insights into the digital component of recreating 3D models of sculptures and virtually reconstructing possible colour maps.

Combining these results with the data collected from the MANN experiments, it was possible to draw up a list of priorities to be included when designing an experience dedicated to lost polychromy:

1. To stimulate curiosity the most efficient triggers to work with and with which the visitors resonated the most were the novelty of the information, the unexpected side of the research, the mystery underlying the loss of colours, and the unknown of the reason why something is visible, and something has been lost.
2. The need to focus on the workflow of the research, to let visitors wear the shoes of the researchers and accompany them step by step along the discovery of lost polychromy.
3. The experimental side of the analyses and their outcome were the most significant aspect to trigger their curiosity, even when not explained in high detail, showing how the invisible becomes information acted as a way to convince them of the authenticity of the message and made them feel closer to the topic of polychromy.
4. Understanding and giving hint on how the colours were made, how they used to stick to the marble and why they were important for the complexity of the sculptures.
5. Once letting them see the reconstruction, making clear that's only a hypothesis and showing both the comparisons to get a fuller image and to recontextualise it inside the colourful environment the statues were located in helped them catch the imagine the biggest picture. By allowing viewers to see the reconstruction and clarifying that it is only a hypothesis, we can provide comparisons that offer a fuller image. This helps recontextualize the statues within the colourful environments where they were originally found, enabling viewers to grasp the bigger picture more effectively.

These aspects combined are the basis to try to efficiently communicate lost polychromy, allowing a dialogue with the public and creating a bridge between the present and what we are now able to see and what it may have looked like in the past.

3 Extending Civic Participation Through Social Cohesion

3.1 A Definition of Social Cohesion

Social cohesion is a multifaceted and complex construct which presupposes stable and trusting relationships between different people, groups, and organizations and it defines the forces which encourage individuals to be part of and function as a joint group. Nowadays, the cohesion policy is one of the main investments of the European Union policies. It aims at strengthening economic, territorial, and social cohesion. Since the early 2000s, the Council of Europe has been engaged in the development of a strategy to promote Social Cohesion, adopting a model of society that may be increasingly capable of guaranteeing the well-being of all its members, minimizing inequalities, and avoiding marginalization (Council of Europe 2008[2]). In the last 20 years, there has been multiple attempts to measure, evaluate, and promote Social Cohesion in European Countries [13;14;15] and, while the research on this front is still ongoing, useful frameworks to

[2] https://rm.coe.int/0900001680747068 (accessed on 18 February 2023).

test the presence of cohesiveness in societies have already been defined [16, 17]. The most recent definition mentions social cohesion as in [16]:

> "*ongoing process of developing well-being, sense of belonging, and voluntary social participation of the members of society, while developing communities that tolerate and promote a multiplicity of values and cultures and granting at the same time equal rights and opportunities in society".*

In recent years there has also been a growing interest in the digitisation and digital preservation of cultural heritage (i.e., the European "Horizon 2020" program) and in encouraging citizen curation for cultural objects (i.e. [18, 19]). Thus, it is essential to understand how to enhance civic participation in public spaces in order to stimulate a general cohesiveness among citizens and cultural institutions.

3.2 Social Cohesion Dimensions

In 2011 the Bertelsmann Stiftung developed the Social Cohesion Radar as an empirical instrument for studying social interactions on national and local level [13]. It is divided into three interconnected domains: social relations, connectedness and focus on the common good; each is subdivided into subdomains. For every subdomain, group cohesiveness indicators are identified (Fig. 10).

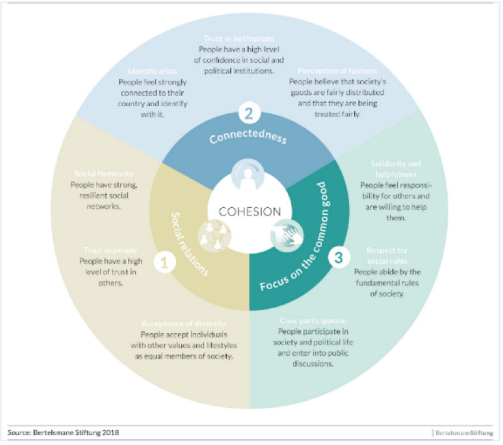

Fig. 10. The Social Cohesion Radar

In particular, the "Focus on the common good" domain includes the "Civic participation" subdomain, that regards the extent to which "people participate in society and political life and enter into public discussions".

3.3 Citizen Engagement and Social Cohesion

The European Commission describes the phenomenon of citizen engagement as "an invited form of citizen participation where public institutions invite citizens to openly

discuss matters of concern and care" [17]. At the same time, the concept of "museum" is widely perceived as an *agora* or *forum*: "a gathering place for people and an assembly of minds and ideas – is the privileged understanding". Accordingly, the museum institutions should ideally serve and represent the people visiting them, encouraging the establishment of new relations with the public and inspire **democratic engagement** with cultural heritage [16]. The UK Soundmap project of The British Library (2010) clearly shows the citizens' interest in voluntary participation in Cultural Heritage-related projects [18]. The project concerns a digital collection of pieces of sounds created through *crowdsourcing*. Social media, digital technologies and the Internet are thus useful tools for citizens to access, explore and add to cultural heritage content. In June 2023, the European Commission published a report on civic engagement, explaining how participation in cultural activities strengthens democracy and social cohesion. The report shows that those participating regularly in cultural activities are more likely to vote, volunteer and participate in community activities, projects and organizations. Because of their strong emotional, creative, expressive and collaborative nature, cultural activities can build spaces of dialogue, community gathering, sharing, social interaction and connection between individuals, features which are deeply related to the social cohesion dimensions. The report clearly states that "investing in citizens' cultural participation is essential in any effort to promote civic engagement, democratic vitality and social cohesion in the EU". Cultural activities involving citizens can thus help people bridge social boundaries of ethnicity, religion, gender, age, nationality and occupational status. There is a clear correlation between enticing citizens to vote, making them develop positive social and personal attitudes, nurturing the understanding of different perspectives and facilitating conflict resolution. Citizens who are conscious of their cultural heritage are likely to feel empowered, more active in their community and to perceive a greater sense of cohesiveness.

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