

D9.4 Summative Evaluation of Final release (platform and experiences)

Maria Economou¹, Hilary Young¹, Emilia Sosnowska¹, Claire Maguire¹, Akrivi Katifori², Maria Roussou², Kristen O'Connor³, Charlotte Bishop³, Emmeline Batchelor³, Sara Perry³, Cyril de Mengin Fondragon⁴, Maxime Chambefort⁴, Karolina Badzmierowska⁵, Klemens Kopetzky⁵

Reviewed by:

Hara Stefanou (EXUS), Niall Ó hOisín (NOHO)

Abstract

This deliverable presents the summative evaluation results from Year 3 of the EMOTIVE project. It offers an overview of the methodologies employed; presents the findings that came out from the extensive and diverse programme of evaluations carried out of both EMOTIVE authoring tools and experiences; and outlines the lessons learned from the whole process. The deliverable concludes with policy implications and recommendations coming out of our EMOTIVE experience for the cultural heritage sector.

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TABLE OF CONTENTS

1	EXECUTIVE SUMMARY.....	4
2	INTRODUCTION	5
3	SUMMATIVE EVALUATION OF EMOTIVE AUTHORIZING TOOLS	6
3.1	The EMOTIVE Visual Scenario Editor	6
3.1.1	Overview	6
3.1.2	Methodology.....	8
3.1.3	Findings.....	9
4	SUMMATIVE EVALUATION OF EMOTIVE USE CASES.....	11
4.1	Hunterian experiences	12
4.1.1	Hunterian onsite experience ‘Views on Verecunda’s Life: a digital window to the Scottish Roman past’ ..	12
4.1.2	Hunterian offsite virtual experience ‘Ebutius’s Dilemma’	17
4.2	Çatalhöyük Experiences	19
4.2.1	Çatalhöyük Offsite VR Experience	19
4.2.2	Çatalhöyük Family and Group Dialogues with 3D Moulds.....	23
4.2.3	Çatalhöyük Audio-Enhanced Models	26
5	POLICY IMPLICATIONS AND RECOMMENDATIONS	30
6	CONCLUSION	32
7	REFERENCES.....	33

TABLE OF FIGURES

Figure 1: User interface of the EMOTIVE Visual Scenario Editor in its final release	6
Figure 2: Creating in the VSE an AR effect view by pattern recognition for a Roman dagger in the Verecunda experience to appear when the user scans the Corotica silhouette marker	7
Figure 3: Creating interactive experiences with the VSE using simple modules linked together to create a whole experience.....	7
Figure 4: Developing the AR Module within the VSE, where all the complexity is hidden behind one module block in the final experience (shown in Figure 3)	8
Figure 5: Users' satisfaction with the VSE	10
Figure 6: The facilitator explains the use of archaeological/historical evidence underpinning the Verecunda story in front of the gravestone engraved with the name Verecunda in the Hunterian's Antonine Wall gallery (part 1).....	13
Figure 7: Using the idea of the real window on display shaped the metaphor of the 'magic window' encasing the mobile phones in the Verecunda experience	14
Figure 8: Four users trying the VR (part 2) of the Verecunda experience.....	15
Figure 9: User trying out the AR effects integrated in the storytelling of the Verecunda experience	16
Figure 10: The four characters used in Part 3 and discussed in Part 4 of the Verecunda experience	16
Figure 11: A group of users during the facilitated discussion (Part 4) of the Verecunda experience	17
Figure 12a & 12b: The Virtual Offsite Ebutius experience which a 360° recreation of the museum space that allows users to click on hotspots to see enlarged views and information	18
Figure 13: Presenting the results of the evaluation of Virtual Ebutius with schools at the Demo event ..	18
Figure 14: Screenshot from the experimental replica house IBR rendering in ÇVR.....	20
Figure 15: Screenshot from the hunting shrine replica house IBR rendering in ÇVR.....	20
Figure 16: Screenshot from the vulture shrine replica house IBR rendering in ÇVR.....	21
Figure 17: Screenshot of the excavation site IBR rendering showing users' archaeological impacts in ÇVR.....	21
Figure 18: User applying a stamp to the wall during an evaluation workshop	22
Figure 19: The EMOTIVE Metamolds. Top Left: Leopard Stamp Metamold. Top Right: Horse Figurine Metamold. Bottom Left: Human Figurine Metamold. Bottom Right: HandStamp Metamold	24
Figure 20: A replica hand stamp positioned above its Metamold	24
Figure 21: Examples of selected Çatalhöyük artefacts made by using the Metamolds	25
Figure 22: Participants testing the Building 77 sound experience	27
Figure 23: Screenshot of a section of Building 77, as navigated on the computer during the second and third parts of the audio-enhanced models experience	27
Figure 24: Stitched panorama of Space 337 (Storage room)	27
Figure 25: Floorplan of Building 77 (House and Yeoman 2008).....	28

List of Abbreviations

AR: Augmented Reality

VR: Virtual Reality

EAT: EMOTIVE Authoring Tool

FPE: Floor Plan Editor

HMI: Human Machine Interfaces

SBE: Storyboard Editor

UoA: University of Athens

VSE: Visual Scenario Editor

AW: Antonine Wall



1 Executive Summary

This deliverable presents the summative evaluation results from EMOTIVE's Year 3. It covers the findings of evaluating the final release of the Visual Scenario Editor, and of five EMOTIVE experiences for our two cultural heritage partners, the Hunterian Museum, Glasgow, Scotland and Çatalhöyük, Turkey.

SUMMARY OF CONTENTS

A brief introduction to this last summative evaluation phase is presented in **Section 2**. **Section 3** details the evaluation of the final release of the Visual Scenario Editor, first providing an overview, and then describing the evaluation method and findings. Similarly, **Section 4** takes five EMOTIVE experiences (Hunterian Onsite Verecunda in 4.1.1; Hunterian Offsite Ebutius in 4.1.2; Çatalhöyük offsite VR in 4.2.1; Çatalhöyük Family and Group Dialogues with 3D Moulds in 4.2.2; and Çatalhöyük Audio-Enhanced Models in 4.2.3) and summarises their evaluation methodology and findings. **Section 5** presents the Policy Implications and Recommendations coming out of EMOTIVE. **Section 6** rounds the deliverable off with conclusions.

METHODS OF RESEARCH AND ANALYSIS

EMOTIVE's summative evaluation of final release (platform and experiences) reflects the overall vision articulated in the project's Evaluation Framework (see D9.1), while building on the previous stages of evaluation methodology and results (D9.2 and 9.3). The evaluation methodology recognizes the specificities of the authoring tool and each experience use case approach. Focus groups, individual and group interviews, questionnaires, observations, written records, and system logs are deployed to gather data. These are analysed allowing us to consider recurring topics including usability, functionality, user engagement, emotional connection, empathy and learning and understanding.

KEY FINDINGS SUMMARISED

The Visual Scenario Editor tool is effective and stable in its final release for authoring complex mixed reality storytelling for cultural sites, as evidenced by the prototype created for the Hunterian Museum. It has proven a powerful tool that can be used by both cultural heritage and creative industry professionals with varying programming skills. The evaluation of the Verecunda Hunterian Onsite Experience showed that social interaction was appreciated, while the facilitated dialogue and use of different characters to highlight different perspectives was effective in encouraging reflection and challenging of stereotypes. Users appreciated the use of VR for contextualising the objects on display and of AR for showing their original use. The evaluation of the Hunterian Offsite Experience with school teachers and children showed its significant potential for supporting learning offsite the museum but also for preparing for a visit. The Çatalhöyük VR evaluation showed the powerful impact of social interaction, evoking feelings of connectivity and enjoyment, as well as shifts in perception and opinions, helping users to confront complex social issues. The Group Dialogues with 3D Moulds showed how the Metamolds could be used in an effective learning group experience, combining the tactile hands-on element with a dialogue concerning their thoughts and ideas on what these objects were and could be. The evaluation of the Çatalhöyük Audio-Enhanced Models showed that the use of sound to enhance reality-based 3D models for a non-specialist audience is overall successful and has great potential for learning and engagement. All evaluations showed strong evidence of EMOTIVE's capacity to engender visitor engagement with our cultural sites, and its potential for emotionally connecting audiences with the past.

2 Introduction

The aim of EMOTIVE is to develop tools and experiences to assist cultural heritage and creative industry professionals in authoring effective emotive storytelling for their diverse audiences. As we have described in the Evaluation Framework (D9.1) key elements for achieving this, are the user- and visitor-centric design approach of the project and its iterative collaborative design and evaluation process underpinning all its stages. These principles place both visitors and cultural stakeholders at the centre of defining the EMOTIVE experiences and empower them in deploying the EMOTIVE methodology and tools.

For this reason, formative and summative evaluation both play a fundamental role within EMOTIVE and are intricately interlinked. Although we focus on summative evaluation of the final release of tools and experiences here, this has been informed by **formative evaluation** throughout their design and development. Although we outlined the key findings of our formative evaluation results up to month 15 in D9.2 and of the summative evaluation of beta release of tools and experiences up to month 24 in D9.3, this type of evaluation work continued to take place and directly fed into our **summative evaluation** of the final release of the EMOTIVE tools and experiences. These two phases of evaluation work, formative and summative, are very closely linked in the evaluation cycle, with the formative evaluation feeding directly into the summative one, and the formative informing the next stage of the summative.

In Year 3 of the EMOTIVE project we carried out a diverse and extensive programme of evaluation research aiming to capture in depth the impact of both EMOTIVE authoring tools and experiences on our two key target user groups, creative and cultural industry professionals and visitors to museums and heritage sites. This allowed us to test and consolidate our evaluation methodologies and adapt them to the specific needs of each tool and use case, taking into account the specific context of the two cultural partner sites.

Below we first review the findings from our evaluation of the final-version EMOTIVE authoring tool, the EMOTIVE Visual Scenario Editor. From there, we report on the new evaluation work since D9.3 on the final versions of three key EMOTIVE experiences (described in D3.9 “Pilot Experiences based on the platform final release”) which have been subject to both formative and summative evaluation at different stages: the Hunterian Museum mixed reality storytelling (which includes ‘Views on Verecunda’s Life: a Digital Window to the Roman Scottish Past’ and offsite virtual ‘Ebutius’s Dilemma’); the Çatalhöyük offsite Virtual Reality experience; and the Çatalhöyük Family and Group Dialogues with 3D Moulds. These experiences that were our main focus in EMOTIVE, also fed into additional ones like the Çatalhöyük Audio-Enhanced Models, further consolidating and integrating the project’s innovations and embedding them in real cultural heritage scenarios. This is followed by the policy implications of EMOTIVE’s outcomes and findings and the recommendations that derive from these.

3 Summative evaluation of EMOTIVE authoring tools

3.1 The EMOTIVE Visual Scenario Editor

3.1.1 Overview

Designing and creating a complete experience of storytelling is a complex task that requires a range of various design, content, and technical skills that are rarely, if ever, mastered by one single person. In most cases three profiles are needed, museum or other content experts, story writers and game or more generally, experience developers. The aim of the EMOTIVE Visual Scenario Editor (VSE) is to provide a single authoring tool that allows all of these people with varying technical skills to individually develop their own experiences (Figure 1).

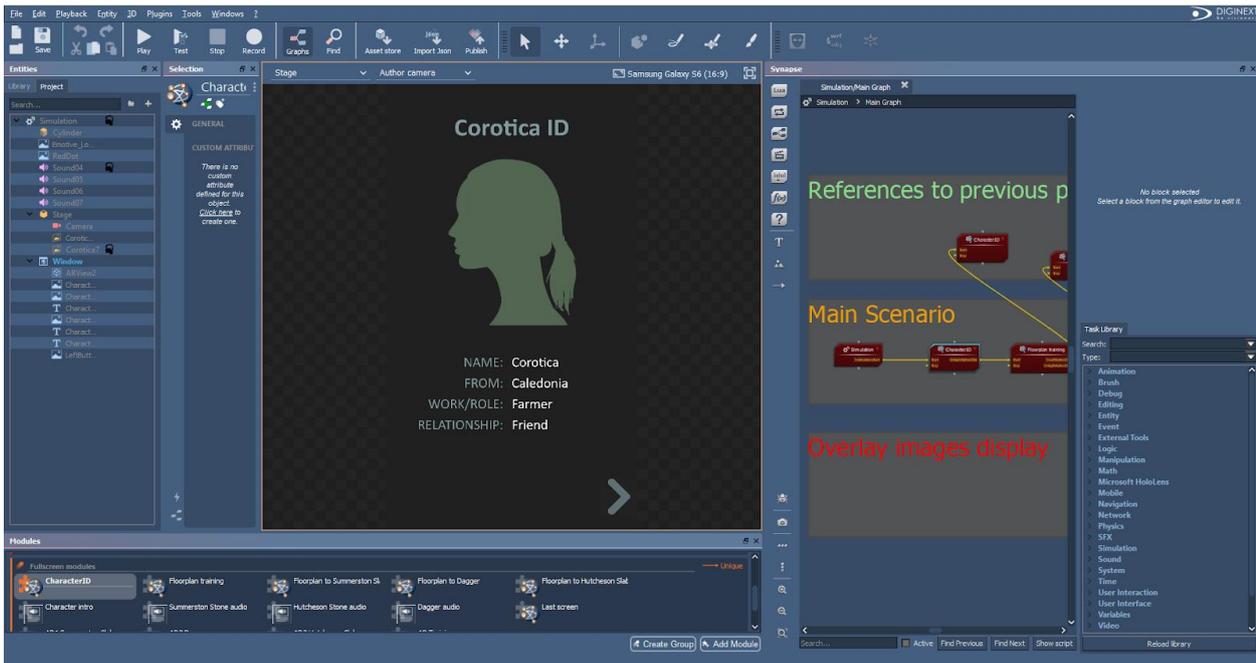


Figure 1: User interface of the EMOTIVE Visual Scenario Editor in its final release

To avoid the real complexity of the tasks needed to be developed to create the experience, the complexity is hidden behind several levels of abstractions such as the use of visual programming blocks that allow people who are not programmers to create complex behaviours. However, an even higher level of abstraction is available through the use of modules. These modules are very high-level programming blocks that include the behaviour of a complete complex activity, such as displaying an augmented reality view by pattern recognition (Figure 2). The use of modules in the VSE allows experience creators to link high-level blocks that correspond to a complete activity for the user by simply customizing them. Thus, the creation of a complex experience is reduced to only defining the sequence of these modules that the author will have previously configured.

The VSE consists of a set of components that collectively form the desktop application which enables the user to prototype scenarios, orchestrate and publish their experiences (Figure 3).

This tool enables users to create stories which can then run on a large set of devices taking full advantage of any targeted platform, their specific sensors or interaction modalities. The VSE has been used to author both the Ebutius and Verecunda EMOTIVE Hunterian onsite experiences (with Ebutius having first been prototyped on the EMOTIVE Storyboard Editor (SBE)).

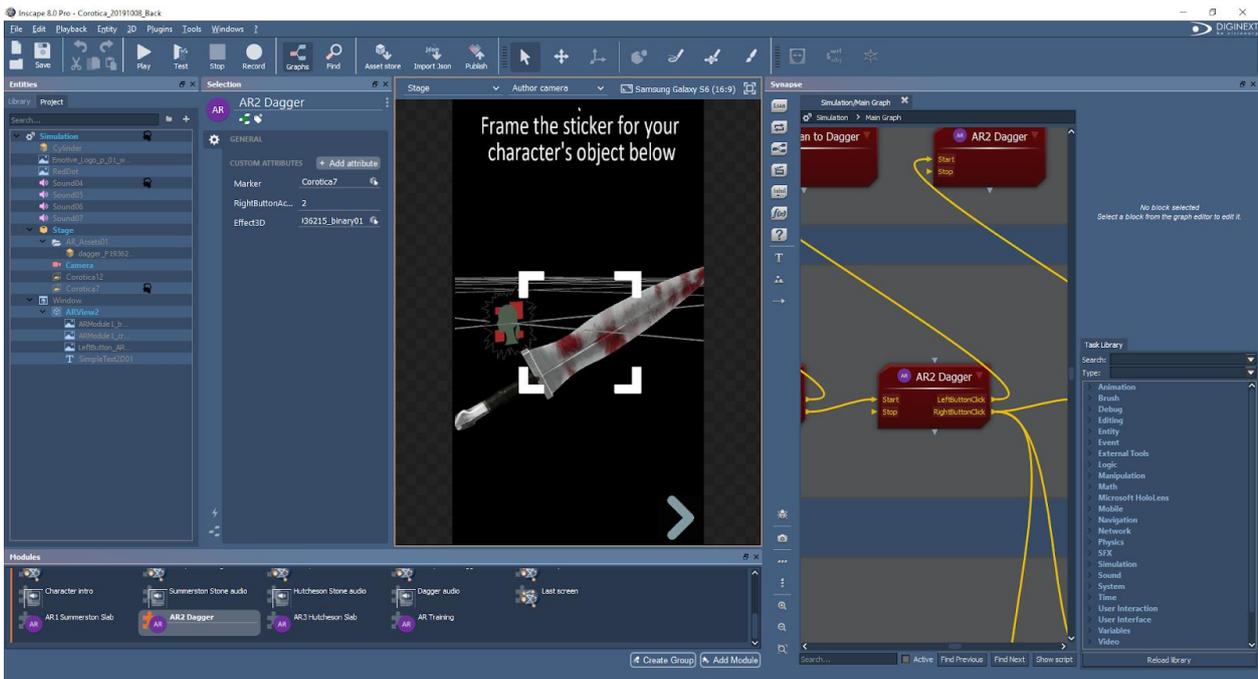


Figure 2: Creating in the VSE an AR effect view by pattern recognition for a Roman dagger in the Verecunda experience to appear when the user scans the Corotica silhouette marker

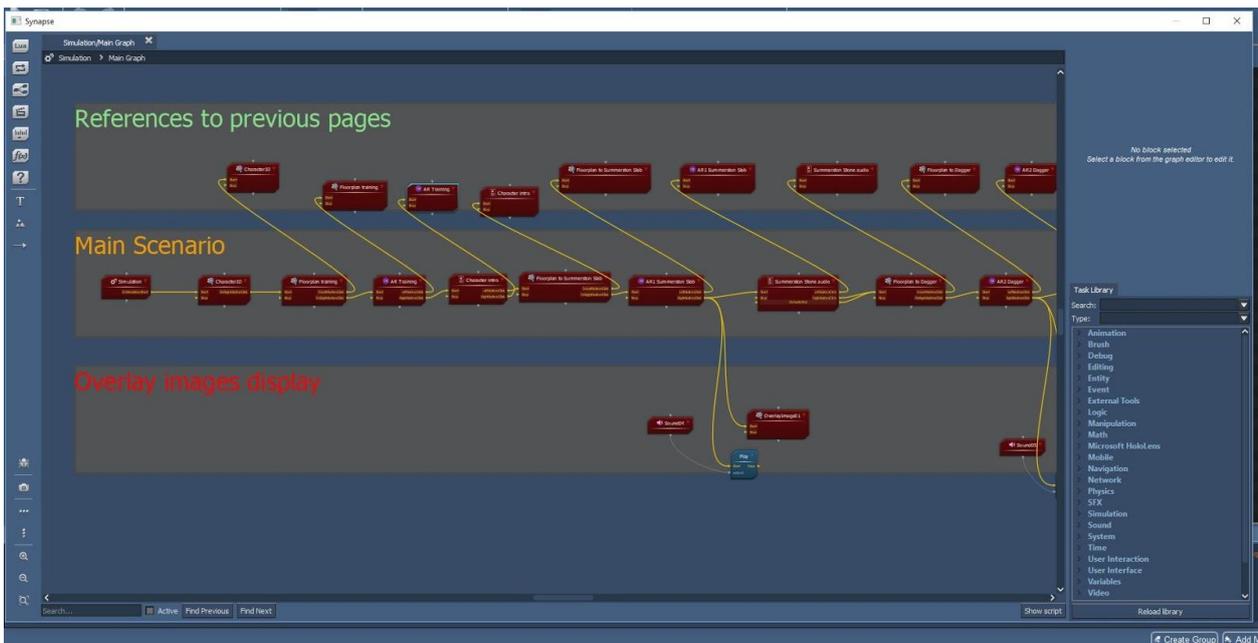


Figure 3: Creating interactive experiences with the VSE using simple modules linked together to create a whole experience

The VSE's multiple scenarios are based on predefined modules, some of which have been used to create EMOTIVE's Hunterian onsite Ebutius's Dilemma story, such as the narrative, the choices and branches, 3D model interaction, and the 360° virtual visit modules. The scenario is then orchestrated easily by joining together the different modules providing both linear and non-linear stories.

This final release version of the VSE has been significantly modified since the beta version based on the first user feedback (reported in D9.3) in order to improve usability and ease of use. The user interface of the tool has been completely redesigned to simplify its use and facilitate access to data that is really useful for end users and, in appropriate cases, to free them from having to access programmable data.



The creation of the Verecunda experience has highlighted the need to create new modules to enable VSE end-users to create a more technologically complex experience without ever having to worry about how the technology works. For example, a new augmented reality (AR) module has been developed specifically for the Verecunda experience. In the VSE, this appears as a simple block that simply needs to be configured using the pattern to be recognized and the virtual model to be displayed in the augmented scene (Figures 2 and 4).

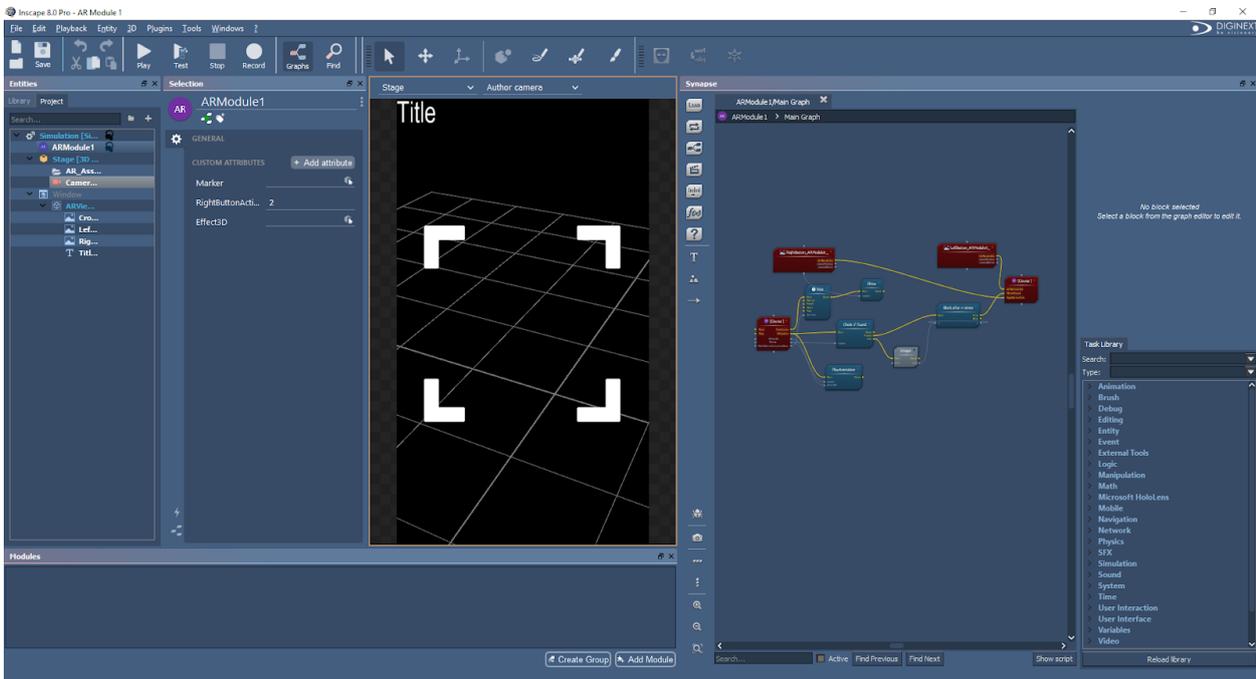


Figure 4: Developing the AR Module within the VSE, where all the complexity is hidden behind one module block in the final experience (shown in Figure 3)

3.1.2 Methodology

As part of the operational evaluation of the VSE, it was decided that the best way to evaluate its effectiveness, efficiency and user satisfaction was to implement the actual creation from A to Z of the Hunterian experience by the end users, i.e. primarily UGLA with assistance from NOHO. There was therefore no evaluation using external to EMOTIVE users, as they would have experienced the tool on the surface in any short workshop evaluation scenario. Instead, with the approach chosen, it was possible to evaluate it in depth and over several months, with the EMOTIVE partners that represented users who ranged in terms of programming skills and previous design experience, from almost novices (some of the UGLA EMOTIVE members) to advanced users (NOHO). This fitted EMOTIVE’s philosophy and user-centric approach which puts cultural heritage and creative industry users at the heart, empowering them with appropriate tools to author their own experiences.

Passing on from a model with Ebutius’s design (where the UGLA and NOHO teams had storyboarded the experience and gave access to all assets for the DXT programmers to use to import to the VSE, design and programme themselves, and return only to UGLA for quality check) to a more advanced one that was used for Verecunda after the final release of the tool, where UGLA and NOHO (as cultural heritage and creative industry professionals, respectively) authored the experience on the VSE with DXT providing support and input, mainly remotely.

In this case, for designing the Verecunda experience, the introduction to and use of the VSE was implemented in two steps. As a first step, a workshop on the structure of the experiment was held in Toulouse in May 2019, during which, the UGLA and NOHO teams were trained in the use of the final release of the VSE. At a second stage, these end users used the VSE by themselves to develop the experience, while DXT teams worked on the creation and modification of the various modules to simplify

the work of the end users, based on their feedback. The introduction of the modules and their user-friendliness has been a great step forward in terms of efficiency and user satisfaction.

During the use of the VSE by the UGLA and NOHO teams from the end of May to the end of October 2019 (covering heavy implementation until August and updates and fine-tuning afterwards), various methods were used for the evaluation: note-keeping of issues with the authoring tool and how it performs key tasks, online and face-to-face focus group discussions, interviews at key stages, observations and think aloud protocols, as well as analysis of data logs.

3.1.3 Findings

According to the user feedback from the EMOTIVE end users (but also participants including museum and cultural heritage experts and creative industry professionals to the Public Demo event in Glasgow, 30 October 2019), the final release of the VSE was well received. Users commented positively on the ability to try and test things out relatively quickly using the play button to test things they were trying out. They also appreciated the ability to control the look and feel of projects as opposed to following a rigid template or style. This is important as cultural heritage sites can then make the look and feel their 'own', matching it, for example, to their house style or particular theme or exhibition branding. At the same time, cultural heritage users also appreciated the pre-programmed modules that could still be manipulated and transformed.

However, there were still areas that the cultural heritage users, especially those with no programming background, felt needed more explanation including navigating the interface and terminology used to name the different screens, functionality and tools. Training helped to alleviate this feeling. The graphics and naming of tools were not intuitive to users with no computer science, graphics or programming background. Similarly, the module that was most difficult for these users to use was the AR module where users needed to scale and position AR effects within the VSE in relation to real space and physical objects on display, offsite from where they were using the VSE in their offices.

EMOTIVE users from the creative industry found the need for more flexibility in terms of graphic design for the look of the screens; the module specifically developed for the Verecunda experience showed some limitations in terms of graphic elements of the VSE, e.g. inability to use or include a screen-wide image, size and positions of the buttons, text editing. The module could be updated to fit more flexible needs, but at this stage of the project, the focus has been on improving the usability of the VSE AR Module for non-programmers.

Creative industry users from NOHO with advanced design skills, as well as professionals who attended the Public Demo event on 30 October have commended on the potential of the VSE for authoring cultural heritage organisations primarily because of the following features:

- ability for cultural heritage professionals to create something on their own rather than outsource the whole production of the application;
- ability to change and update things in-house;
- add value to exhibitions by offering an AR experience to view objects that are otherwise not possible to view up-close/in 3D;
- ability to combine an audio narration with AR elements that can be easily accessible and visually attractive (although users commented on the need to integrate this further in the future than what is implemented in the Verecunda experience, so that it can support concurrent audio narration when the AR effects are shown).

The following figure summarizes what we have gathered from our working session using the VSE to create experiences.

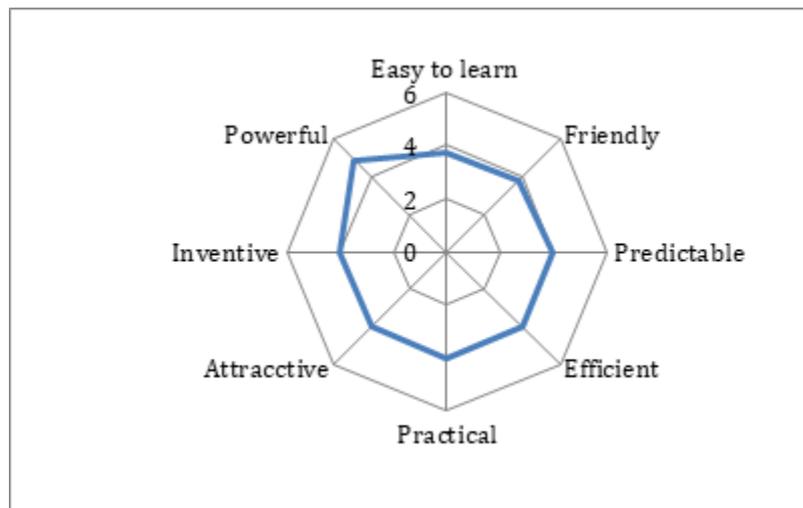


Figure 5: Users' satisfaction with the VSE

Suggestions for ways to improve the user experience of the VSE include:

- the creation of short video tutorials for specific elements
- guidelines for graphic design (clear guides, layout limitations, dimensions, best practice, etc.)
- support concurrent collaborative interaction between multiple users of the VSE, so that two users, for instance, can work on the same project
- when users hover over a tool, implement the triggering of an event with a pop-up box with the name or use of the tool to help the user understand the uses of the tools when they are looking to do something
- offer the option to update the layout of all screens simultaneously when you are editing text or layout so it is not a manual laborious job.
- improve the handling of the assets by adding compatibility with a larger number of file formats and by the addition of a real asset library management.

Within the context of the use of the VSE for the creation of the Verecunda experiences, the following profiles were involved: the authors of the stories (museum experts and scriptwriters), Diginext developers to help set up the design of the story implementations and possibly, create the modules necessary for the implementation of the stories and the creators of interactive 3D content. The goal of the EMOTIVE Visual Scenario Editor (VSE) is to provide a unique creative tool that allows all these teams with different technical skills to work jointly together to develop the experiences. The VSE has proven to be much more practical and easier-to-use by non-programmers than in the first evaluation of its beta release. The changes made since then in the final release have improved the effectiveness, efficiency and user satisfaction with the tool.

4 Summative evaluation of EMOTIVE use cases

Between November 2018 and October 2019, these evaluation sessions have been carried out at the following events:

- Final Summative testing of EMOTIVE Hunterian Onsite 'Ebutius's Dilemma' experience with Albert Sierra, Glasgow, UK (January 23, 2019).
- Formative evaluation of the Web of Knowledge design approach, using the Hunterian Virtual Museum ('Ebutius's Dilemma' online experience) to collect user questions at ATHENA, Athens, Greece (January 24, 2019).
- Final Summative testing of EMOTIVE Hunterian Virtual 'Ebutius's Dilemma' experience with UGLA MSc Museum Studies Students, Glasgow, UK (February 6, 2019).
- Prototype testing of 'Views on Verecunda's Life' with Glasgow School of Art MSc Heritage Visualisation students, Glasgow, UK (March 21, 2019).
- Demo-ing 'Ebutius's Dilemma' Hunterian onsite experience with 3D Design: Final Year students from Creative Industries Faculty, Glasgow City College, Glasgow, UK (March 22, 2019).
- Multiple summative evaluation sessions for 'Ebutius's Online' with primary and secondary school teachers from the wider Glasgow area and secondary S2 school pupils from Helensburgh High School (March through August, 2019).
- Testing 'Ebutius's Dilemma' virtual off-site experience and showcasing 'Ebutius's Dilemma' onsite experience at co-organised Historic Environment Scotland, University of Edinburgh and University of Glasgow event 'Engaging with Digital Cultural Heritage' with c. 50 delegates from cultural heritage, creative industries and academia held at The Engine Shed, Stirling, UK (April 4, 2019).
- Formative evaluation of 'Views on Verecunda's Life' prototype with Information Studies and Museum Studies staff and PhD students, Glasgow, UK (April 26, 2019).
- Formative evaluation of 'Views on Verecunda's Life' prototype with Cypriot primary school teachers and advisors taking part in Erasmus+ Museum Education training, Glasgow, UK (May 2, 2019).
- Prototype testing of EMOTIVE Family and Group Dialogues with 3D Moulds with University of York Master's students, King's Manor, York, UK (May 16, 2019).
- Prototype testing of EMOTIVE Family and Group Dialogues with 3D Moulds with EMOTIVE team members and external volunteers, King's Manor, York, UK (May 30, 2019).
- Second formative evaluation of the Visitor-Led Tours Experience with volunteers and York Minster staff at York Minster, York, UK (May 31, 2019).
- First formative evaluation of EMOTIVE Family and Group Dialogues with 3D Moulds with adults and young people at the University of York's Family Fringe Festival, York, UK (June 8, 2019).
- First summative evaluation of 'Views on Verecunda's Life' with Historic Environment Scotland, Glasgow, UK (June 10, 2019).
- Second formative evaluation of EMOTIVE Family and Group Dialogues with 3D Moulds with adults and young people at the Council for British Archaeology's Festival of Archaeology, York, UK (July 13, 2019).
- Onsite final evaluation of EMOTIVE Family and Group Dialogues with 3D Moulds with local youth at Çatalhöyük, Turkey (August 1-8, 2019).
- Onsite final evaluation with visitors, local residents and site staff of the Turkish and English versions of the Çatalhöyük Collaborative Experience, Çatalhöyük, Turkey (August 1-8, 2019).
- Formative evaluation of EMOTIVE VR Experience with adult volunteers in Nice, France, and UK (August 8, 2019).
- Formative evaluation of EMOTIVE audio-enhanced models with adult volunteers at King's Manor, York, UK (August 28, 2019).

- Second summative evaluation of 'Views on Verecunda's Life' at the EMOTIVE demo test-run event with staff and students from the University of Glasgow, Glasgow, UK (September 3, 2019).
- Final summative evaluation of 'Views on Verecunda's Life' Lower Saxony delegation, Glasgow, UK (September 4, 2019).
- Formative evaluation of the EMOTIVE How-To Guide for building bots of conviction with international PhD researchers enrolled on the Nordic Dialogues with the Past Workshop, Rome, Italy (September 16-20, 2019).
- Formative evaluation of the Web of Knowledge prototype, using the Hunterian Virtual Museum ('Ebutius's Dilemma' online experience) at ATHENA, Athens, Greece (September 19 and October 21 and 22, 2019)
- Final evaluation of EMOTIVE Hunterian Onsite 'Views on Verecunda's Life' Smithsonian Digital Cultural Heritage Lab research showcase, Glasgow, UK (October 8, 2019).
- Summative evaluation of EMOTIVE VR Experience with adult volunteers in Athens and York (October 16-17, 2019).
- Summative evaluation of EMOTIVE VR Experience with adult volunteers in Athens, Greece (October 23, 2019).
- Formative evaluation of EMOTIVE audio-enhanced models with the Young Archaeologists' Club of Sheffield, Sheffield, UK (October 19, 2019).

4.1 Hunterian experiences

4.1.1 Hunterian onsite experience 'Views on Verecunda's Life: a digital window to the Scottish Roman past'

VERECUNDA OVERVIEW

The Hunterian onsite experience 'Views on Verecunda's Life: A Digital Window to the Scottish Roman Past' (hence mentioned also as the Verecunda experience), is part of one of the main EMOTIVE use cases, the Mixed Reality Storytelling one. Verecunda is a multi-part experience (described in D3.9 section 2.1) which combines immersive VR and AR features to contextualise the objects on display. It integrates social interaction, designed for four concurrent users who are encouraged by a facilitator to work together to critically examine life in Roman Scotland. It aims to challenge stereotypes about life in the Frontiers of the Roman Empire, and link with users' life today through exploring issues of identity, in the past and today.

The experience focuses on the story of a local Caledonian slave girl, Verecunda, who worked at the Roman commander's house in Bar Hill fort, one of the Antonine Wall sites. After getting to know each other, users are immersed in a VR environment introducing Verecunda's life in the Bar Hill fort. It introduces four lively characters who knew Verecunda at different stages of her life. Users then move through the museum display guided by one of the four characters (developed with the Visual Scenario Editor). They are encouraged to explore real objects viewing these through mobile phones that act like 'magic windows', with Augmented Reality interactions bringing the objects and their role to life. The facilitator explains that the stories the users encounter via the VR and AR audio narration are fictional, however all of the characters are based on real people who lived and worked by the Antonine Wall in the 2nd century AD. These stories have been dramatically and imaginatively developed but are underpinned by historical and archaeological research (Figure 6). Finally, users share what they have discovered about Verecunda and discuss what shaped her identity.

During the experience, users first learn something about each other and the Antonine Wall (AW) (part 1), then experience the VR (part 2), —and after that, move on through the AW display to do a character-driven exploration of the related objects from life along the AW (part 3), which includes both real objects and AR information about them or related interactions that bring the objects and their role to life. In the final part, the users share what they have discovered about Verecunda and through the facilitated discussion, decide which part of her identity was most important to her (part 4).





Figure 6: The facilitator explains the use of archaeological/historical evidence underpinning the Verecunda story in front of the gravestone engraved with the name Verecunda in the Hunterian's Antonine Wall gallery (part 1)

The research questions that the Verecunda experience aimed to explore were: Can facilitated dialogic approaches to museum visiting encourage reflection about the past and challenging of stereotypes? What impact do the AR and VR elements of a museum digital storytelling experience have on the social nature of museum visits? Can VR and AR trigger emotional engagement in users with hard-to-interpret museum displays?

AR and VR are known to be often isolating experiences as people are ensconced in their own VR headsets, losing track of their physical environment or are using individual devices to view AR effects. Therefore, EMOTIVE was interested in how these technologies could be used to potentially foster a social and emotional experience for museum visitors.

METHODOLOGY

The Summative Evaluation of the final release of the Hunterian onsite experience happened in 3 stages between January 2019 and October 2019 and followed the following process: collaborative creative design; user testing including observation, focus groups and qualitative discussion; discussion with EMOTIVE partners; and further refinement.

Stage 1: Paper-based testing (Jan 2019 - March 2019)

The alpha phase of testing included paper drafts of scripts collaboratively written by the UGLA and Noho team members, development of user experience work flows, and overall scenario development. During a visit to the University of Glasgow by Albert Sierra, New Technologies Manager at the Catalan Cultural Heritage Agency (Agència Catalana del Patrimoni Cultural) (January 23, 2019) and an onsite visit from the Noho team to the Hunterian museum (March 2019), the conceptualisation of the VR (scene A and B) was defined, as well as the staging or onboarding of users to the experience; the metaphor of the 'magic window' was also developed, conceptually using the idea of a real Roman window grille on display at the Hunterian as a metaphor for opening our minds to different views and interpretations of the past. This was implemented as a 3D print from a 3D model of the Roman window on display, to encase the mobile device for users to hold up to the real object on display to reveal an AR effect (Figure 7).

Paper-based testing onsite in the gallery with Glasgow School of Art MSc Heritage Visualisation Students supported the scaffolding of the experience with the facilitated discussion. In response to this evaluation session, the facilitated script and sequence of the VR, AR and object exploration was subsequently reordered.



Figure 7: Using the idea of the real window on display shaped the metaphor of the 'magic window' encasing the mobile phones in the Verecunda experience

Stage 2: External VR scene integrated with paper-based AR

The beta phase of testing included the VR external scene of the Bar Hill Fort together with paper-based scripts which continued to be refined in collaboration with the EMOTIVE team. Testing with a group of Erasmus+ Primary Education Cypriot teachers (May 2019), revealed the strength of the facilitator script and the need to make clearer the distinction between fact and fiction. These were tested further onsite in the museum with subject specialists from Historic Environment Scotland (June 2019). This provided confirmation of the impact of integrating the Bar Hill archaeological site within the VR within an onsite experience for the Hunterian museum, as well as the effective use of the character narratives to bring the objects to life, giving users new perspectives of their original use. Following specialist input we received in relation to the portrayal of the Caledonian perspective from Dr Katherine Forsyth, Celtic Studies, University of Glasgow (June 2019), we made changes in the profile, gender and occupation of our characters as well as part of the narratives.

Stage 3: Internal and external VR scene complete and AR elements integrated with magic window prototype

Ongoing testing between June and September 2019 allowed us to finalise the introductory VR in relation to the audio narration for both the internal and external scene and refine the AR element of the in-gallery object exploration. Apart from EMOTIVE team members, these were also tested onsite with 16 external visitors during the EMOTIVE demo test-run in the Hunterian Museum (September 2019). These evaluation sessions highlighted the relationship between the audio narration and the AR effect, as well as the emotional connection developed by the narrative and visualisation of interpreting the objects in AR. We further refined the facilitator script in response to user testing by reducing the ice-breaker questions.

Final Demo

During the final EMOTIVE demo held at the Hunterian Museum, University of Glasgow (30 October 2019) we ran shortened experiences to showcase the modularity of the VR and AR components of the experience. We gathered postcard feedback from 44 users regarding their Verecunda experience. Users self-reported on the overall user experience, emotional engagement, and satisfaction.

FINDINGS

The Verecunda onsite experience aimed to act as a 'dialogic' experience in the sense that firstly, it was created in response to issues identified at the previous EMOTIVE onsite experience 'Ebutius's Dilemma' (See D3.8) and built on lessons learned from Ebutius's extensive user evaluation conducted during all its phases of development (see D9.2 and D9.3). Secondly, Verecunda's emotional narrative, which sits under the overall Hunterian experiences theme of 'The Things We Leave Behind', has its dialogic nature centred

on the issue of identity. This informs and is continually informed by different users' understanding and critical reflection on identity and what shapes it. The final evaluation of the Verecunda experience showed that most users had a strong emotional engagement with the objects on display and that the storylines, use of characters, and AR/VR elements of the experience effectively supported this. The evaluation also confirmed the hypothesis that AR and VR could be integrated successfully into a social or group museum experience.

Our findings can be categorised into three key areas:

- the modular mixed-reality storytelling implemented in Verecunda's experience which had more advanced VR/AR features than previously employed in 'Ebutius's Dilemma', although challenging for the teams involved in its design to integrate in a balanced and seamless way onsite, did work effectively for end users, bringing the objects to life and supporting visitors' engagement in the gallery.
- the social interaction built in as an integral part of this four-user experience worked well to support and amplify the emotional connection that was scaffolded around the individual engagement of each user with the objects and themes around the display.
- the human-facilitated dialogue at the beginning and end of the experience was a vital part complementing the technology-supported parts, supporting deeper reflection among users and linking with their lived experiences in relation to the universal theme of identity.

Our users reported strong responses to the potential for VR (part 2) (Figure 8) and AR (part 3) (Figure 9) to support emotional engagement with museum displays:

'Fly through of Barhill Fort was AMAZING. Very immersive and engaging experience. I can see it would offer limitless opportunities for discussion on many topics and could be used to stimulate learning experiences' (Anonymous User postcard feedback #30, Final Demo).



Figure 8: Four users trying the VR (part 2) of the Verecunda experience

'I liked that you could pause and replay the audio. I also like the animations for the 3D objects, that gave them a more vivid feeling' (Anonymous User postcard feedback #2, Final Demo).

Similarly, another user commented

'[it made me think] differently about museum objects that I ordinarily would only gloss over and look at very briefly. It made me really look at objects and think about their history/context.' (Anonymous User postcard feedback #32, Final Demo).



Figure 9: User trying out the AR effects integrated in the storytelling of the Verecunda experience (Part 3)

The EMOTIVE framework for constructing emotional storytelling around objects (D3.7) used in this experience (part 3) continued to support emotional connections between the object and the story. As one user explained, the Verecunda experience made them '[t]hink more about the story behind an object. Felt more connected to an otherwise lifeless artefact' (Anonymous User postcard feedback #26, Final Demo).

Furthermore, emotional storytelling in a group experience was evidenced as being successful from both observations, post-experience interviews, focus group discussions, and observations. Introducing different character vignettes (one for each of the four users) (Figure 10) that users then share with the group during part 4 of the experience was welcomed by users as a tool to ensure the experience retained a social and dialogic element.

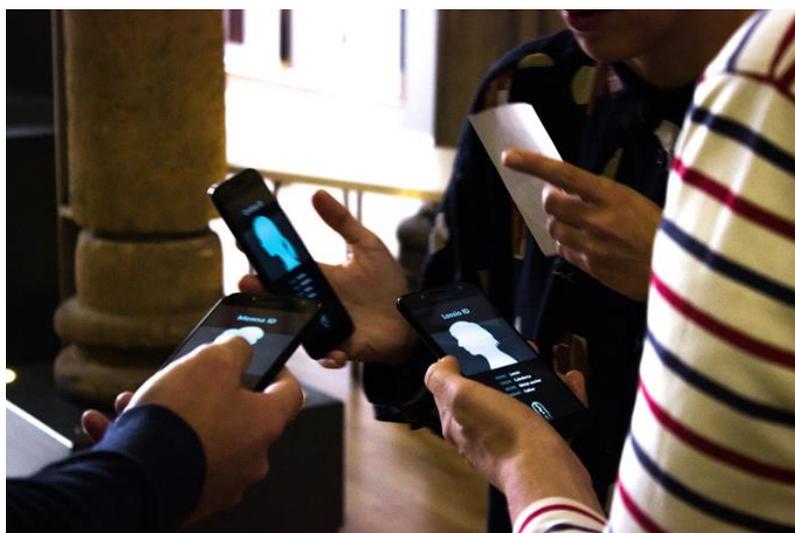


Figure 10: The four characters used in Part 3 and discussed in Part 4 of the Verecunda experience

The facilitated discussion (part 4), bringing together the four users to share the story of each of their character's story, interpretation and influence on the shaping of Verecunda's identity (Figure 11), proved for some users to underpin the whole experience as it reinforced the nature of archaeology and history:

'I like the fact that we are all different characters and that there's a final conversation about identity then and now. I like that - like very often in history - there is an open ending' (Anonymous User, postcard feedback #23, Final Demo).



Figure 11: A group of users during the facilitated discussion (Part 4) of the Verecunda experience

The evaluation showed that for some users, the relationship between the characters they see or hear in passing in the VR flyover in part 2 and the way some of them are manifested as characters in the gallery exploration part 3 was unclear. This highlighted that the transition between the VR part 2 and the character-driven exploration of the objects in the gallery in part 3 is important and needs to be planned carefully to effectively support the modular nature of this experience. Furthermore, although the use of the AR effects in part 3 was clearly very powerful for several users, the actual implementation and interface of this requires further development as the relationship between the AR effect and the related real object on display was not always easily understood by visitors. Similarly, some users felt that their immersion in the experience was negatively impacted by not being able to hear the audio narration from the character while (and not after, as it was implemented in the Verecunda experience) the user was watching the AR effect of the object. This relationship between the AR effect and the real object is difficult to achieve in a balanced way for all users. This highlights the need for more testing regarding this aspect, as in contrast to the comment from the Verecunda users we reported here, the feedback from 'Ebutius's Dilemma' (see D9.3) where users manipulated a 3D model with an audio narrative suggested that they do not like to be distracted from the audio narration by any other simultaneous tasks.

4.1.2 Hunterian offsite virtual experience 'Ebutius's Dilemma'

OVERVIEW

As was described in D3.9 (section 2.2), the 'Ebutius's Dilemma' offsite virtual experience derived from the related onsite experience (described in its beta release in D3.8, section 2.1 and its previous version in D3.7), an interactive, character-driven experience designed for the Hunterian Museum's Antonine Wall display. This offsite virtual experience recreates the museum space with a 360° panorama (Figure 12a) designed using the EMOTIVE Floor Plan Editor and the Web Experiencing System, allowing users to click on hotspots to get more information about the related objects which are integrated in the story (Figure 12b).



Figure 12a & 12b: The Virtual Offsite Ebutius experience which is a 360° recreation of the museum space that allows users to click on hotspots to see enlarged views and information about specific displays related to the story

During the summer of 2019 offsite virtual 'Ebutius's Dilemma' was tested with secondary school pupils and teachers from both primary and secondary levels to explore its potential integration in the Scottish Curriculum for Excellence (CfE), and specifically how this experience could be mapped to the Broad General Education level, namely from pre/early years of schooling through to S3 or 4 years to 14 years old. Results were presented at the final EMOTIVE demo in Glasgow, October 2019 (Figure 13).



Figure 13: Presenting the results of the evaluation of Virtual Offsite Ebutius with schools at the Demo event

METHODOLOGY

Secondary S2 school pupils from Helensburgh High School and teachers from both primary and secondary schools from the wider Glasgow area were invited to test the online experience remotely, as well as visit the Hunterian between March and August 2019. The evaluation used a mixed methodology of both quantitative (online questionnaire) and qualitative methods (observation, small focus groups, email discussion, interviews). They were also shown and asked to comment on a proposed mapping of some key areas of the CfE with features of the EMOTIVE experiences.

FINDINGS

The results of these trials with both pupils and teachers showed that there is great educational potential for using the offsite EMOTIVE experience in the classroom for a variety of subjects and in different ways, while the teachers' responses showed that this could be mapped very well to the Scottish Curriculum For Excellence. According to them, the online virtual experience fostered positive communication and learner-led learning which can lead to learning being embedded and further developed by the school



children. Furthermore, repeat engagement with these online resources could foster cultural capital and willingness to engage with museums where previously no desire or knowledge existed among this group of users. The development of these resources opens up access to the museum, in this case The Hunterian, and diversifies the museum's audience including an often difficult to reach audience group such as teenage children from a geographically distant town on the west coast of Scotland. A further impact of using the experience across the broad general education level is that it encouraged inter-year group learning.

The evaluation with teachers who were drawn from a broad selection of subject areas showed the potential of the experience to be used by subjects, which are out with the History one that is commonly associated with the Antonine Wall topic, such as Geography and Mathematics.

The evaluation highlighted that access to technology in the classroom is often limited for various reasons in schools and this sometimes curtailed or impeded use of these EMOTIVE tools altogether. Access to teachers' time to explain how these tools could support their teaching is also often ring-fenced and an important element to take into account for future broader implementation and integration of these tools in schools. Teacher intransigence was a further obstacle for the use of the experience within the classroom. More testing within the school environment, but also wider policies for supporting the use of digital resources would be required to effectively address these issues.

Future recommendations for use of the online virtual experience in the classroom that came out of this evaluation include the development of a bank of resources to support teachers in the classroom working independently with the tool; developments within the application to support children with additional support needs; and the potential to map the use of this experience with the subject area of Scottish Studies.

4.2 Çatalhöyük Experiences

4.2.1 Çatalhöyük Offsite VR Experience

OVERVIEW

Çatalhöyük virtual reality (ÇVR) is a multi-user experience providing a space for exploration, interaction, and learning within virtually reconstructed portions of the Neolithic site of Çatalhöyük (reported in D3.9, section 3.1). This explores virtual IBR renderings of replica houses and the excavation area currently on site at Çatalhöyük today. The experience aims to emotionally engage users through hands-on activities in the virtual space and a task-driven narrative. It fosters reflection on the lifeways of those who once lived at Çatalhöyük, then invites users to connect these concepts to their own lives, and more broadly to the lives of people today. The overall experience is designed for a non-specialist audience, targeting ages 18 to 35, and takes place entirely in the virtual space, with users using HTC Vive headsets.

The final release of the experience extends the narrative-driven approaches of previous releases (see descriptions in D3.8 and D3.7), differing in its storytelling tactics and theoretical focus. The pre-experience personality quiz (in D3.8) has been removed due to the complexities of administering a questionnaire outside of the headset and incorporating user responses meaningfully into an adaptive virtual story. Instead, the experience presents a more linear and abstract narrative which emphasizes social identities and practices at Çatalhöyük, without focusing on specific characters, events, or time periods.

The aim of ÇVR is to encourage users to:

- *Interact* with another player and with the virtual environment
- *Enact affect* via emotional thought, an ethic of care, and historical consciousness
- *Learn* about Çatalhöyük as an archaeological site

ÇVR prompts users to interact with one another and with the virtual environment through scripted tasks, provided via voice-over audio and text in English. The script progresses through a series of checkpoints which guide users through different tasks within virtual renderings of three replica houses and the



excavation site (Figures 14-18). Together, users enact care by mimicking some of the common practices of Çatalhöyük's people, such as mending damaged walls with plaster and painting them with symbols (see Figure 18). The experience invites participants to reflect upon human relatedness across time and space, and to think more deeply about our impacts on the world.



Figure 14: Screenshot from the experimental replica house IBR rendering in ÇVR



Figure 15: Screenshot from the hunting shrine replica house IBR rendering in ÇVR



Figure 16: Screenshot from the vulture shrine replica house IBR rendering in ÇVR



Figure 17: Screenshot of the excavation site IBR rendering showing users' archaeological impacts in ÇVR



Figure 18: User applying a stamp to the wall during an evaluation workshop (photo by Sara Perry, 2019)

METHODOLOGY

ÇVR was developed with a user-centered approach through three stages of collaborative design and user evaluations (creative design or implementation; user evaluation; and collaboration). Each stage began with script-writing and interaction design, informed by the theoretical framework of affective engagement. User evaluation workshops followed, to gather feedback on design elements. Each stage then concluded with intensive discussion of the findings and feedback with EMOTIVE partners, in order to target specific aspects of the experience requiring revision. Such discussions then led directly to the next stage's design phase.

Each of these three stages probed different aspects of the UX, and thus demanded tailor-made protocols. Stage 1 involved initial drafting of the script and evaluations through paper-based bodystorming workshops. The results from these workshops initiated script changes which were then implemented into an early-stage digital experience, referred to as the alpha version of ÇVR. This version was unstable and incomplete, lacking full implementation of interactive functionality and the script voiceover. Stage 2 tested and refined the alpha version. Remote evaluation workshops were held between partner sites, in which one user joined from YORK and another from ATHENA or INRIA and completed the experience together. User feedback was then incorporated into UX changes and implemented into a stable and more complete version of the experience. Stage 3 involved testing the latest ÇVR version. Only small changes were made to the script and final experience following Stage 3 user testing.

Evaluations employed a mix of qualitative and quantitative methods to obtain user feedback on overall perceptions of the UX, as well as to measure the impact of its affective engagement. Qualitative data were gathered through direct observation, semi-structured interviews, audio recording, and questionnaires. Quantitative data were collected from questionnaires and by tracking session time. Thematic coding was used to analyse and correlate results from observations, interviews, and recordings. Qualtrics and Google Forms were used for data analysis of questionnaire results to determine averages and to cross tabulate responses, and some longitudinal analysis was done between Stage 2 and Stage 3 questionnaire results.

FINDINGS

Evaluation results indicate that ÇVR evokes the feeling of connectivity and enjoyment, as well as shifts in perception and opinions. Participants feel more connected to one another and to the site of Çatalhöyük after participating in the experience. Users report communicating a lot with their co-player, feeling very engaged, and preferring the shared experience to the idea of doing it alone. Scenes in the experience that entailed close-looking at features in the rooms are unanimously described as being among the most

enjoyable moments, suggesting that this affective response is preferred over others in the virtual environment. Very interestingly and confirming the importance of social interaction that has also come up in the evaluation of the other EMOTIVE experiences, ÇVR evaluations also indicate that interaction between users is more impactful than interaction with the virtual environment, in that it left lasting impressions on users. Finally, the techniques of engagement applied to ÇVR have demonstrated the ability to change user opinions and perceptions on broader conceptual ideas, and participants also reported a desire to learn more about Çatalhöyük following participation in ÇVR.

Findings indicate more generally that VR is an ideal medium through which deep and thought-provoking concepts are more readily engaged with by users. Results from the Stage 3 Workshop indicate that users were more attentive to deep and open-ended questions than to didactic learning aims.

Overall, affective engagement in VR is highly dependent upon the individuals involved. Challenges such as language barriers and less communicative participants produced a significant decline in user interaction, and correlate with lower ratings of user enjoyment. Conversely, technical issues such as glitches can have a positive impact and at times brought participants together.

Further work is necessary to continue development of the experience as it was originally conceived. Ideally, this would include incorporation of a scripted scene which was cut from the current version owing to lack of time to hone its technical components. Continued development would also allow for the fine-tuning of graphical features, such as improving the avatar designs and interactive in-game objects. Evaluations show that these aspects do have an impact on user enjoyment and engagement. Additionally, further evaluations would provide more tailored results for non-heritage oriented audiences, as many of the evaluation volunteers were either directly or indirectly connected to the humanities.

Additionally, continued technical work would make it possible to develop this final version of the ÇVR experience prototype that supported our research into a stable stand-alone executable. Such a version could be downloaded and played by users independently from EMOTIVE. The largest challenge in developing this type of ÇVR executable is building the functionality which automatically pairs two users together without active assistance from EMOTIVE partner organizations. The mechanism would also have to ensure that more than a single pair of players can run the experience simultaneously, and be able to place pairs in separate instances of the experience. Therefore, it would require significant technical configuration and an increase in dedicated server space.

This type of stand-alone version would make it possible to publish ÇVR on platforms such as Steam, where people can download and engage with it for free and from anywhere in the world. However, in addition to establishing a stand-alone version, this effort would need to be coupled with an active public engagement scheme. Since ÇVR is specifically designed to facilitate emotional learning and deep conceptual reflection with public audiences, failing to actualize these project aims in a public setting would not only render the project incongruent with its own conceptual framework, but would also perpetuate wider issues of project isolation and digital abandonment in digital heritage outreach.

Further, Stage 3 evaluations made it clear that VR more generally is a powerful tool for confronting complex social topics and issues. A portion of users were willing to engage in highly personal, thoughtful, and critical discussions about their impacts on the world today. These are the types of conversations which not only spark change in personal thought, but also in behaviour. This evidence demands continued investigation into how these discussions can be incorporated into heritage and VR as a catalyst for positive social and behavioural change.

4.2.2 Çatalhöyük Family and Group Dialogues with 3D Moulds

OVERVIEW

EMOTIVE's Çatalhöyük Family and Group Dialogue Experience (reported in D3.9, section 3.3) explores the relationship between dialogue, the making of one's own artefact and the understanding of intangible human values. These short sessions for families and groups focus on making replicas of ancient material objects from Çatalhöyük and, through such tactile work, sparking critical conversation about the



relationship between past artefacts and present-day values. The sessions start with the creation of objects using novel 3D moulding tools ('Metamolds' - for more information on the research and innovation behind this technique, see Deliverable D6.2 Low-cost Physical Artefact Reproduction) (Figure 19). Groups make their objects together using modelling clay, personalise them, and then venture into dialogue with a human facilitator who guides discussion between participants. The past has much to tell us about how we live today and how we could live differently in the future. We explore these ideas in 20-minute sessions - and as participants can take home their replicas, they can carry on the conversation into the future (Figures 20, 21).



Figure 19: The EMOTIVE Metamolds. Top Left: Leopard Stamp Metamold. Top Right: Horse Figurine Metamold. Bottom Left: Human Figurine Metamold. Bottom Right: HandStamp Metamold. (Photos by Charlotte Bishop, 2019)

This experience follows a workflow centred on initiating and sustaining dialogue between participants. It proceeds as follows:

1. Welcome participants to join the society of Çatalhöyük and create an object
2. The facilitator asks an ice-breaker question, such as choosing a colour of modelling clay to soften and warm up
3. As the participant is working their clay, the facilitator speaks to the participants about the objects and the site, encouraging them to discuss what they can see in a series of images of Çatalhöyük and its artefacts presented on a tablet
4. After contextualising the site and objects, the participant chooses a Metamold of the object they wish to make
5. As the objects are being made by the participant, the facilitator begins discussion about values such as sharing that were important at the people of Çatalhöyük
6. The facilitator concludes the experience by asking participants what they plan to do with their object, and a reflective question about how they might apply the lessons learned from Çatalhöyük to their lives today.



Figure 20: A replica hand stamp positioned above its Metamold (photo by Charlotte Bishop, 2019)



Figure 21: Examples of selected Çatalhöyük artefacts made by using the Metamolds (photo by Charlotte Bishop, 2019)

These objects are considered ‘strange’ enough to initiate dialogue but familiar enough to encourage deeper engagement, reflection and connectedness with the past.

The evaluation findings showed that participants had little to no trouble engaging with the materials. Yet issues with the facilitation and with the longer-term impacts of the experience need further probing.

METHODOLOGY

The experience was evaluated from May through to early August 2019, following an iterative methodology conducted in three parts. These included two development sessions with EMOTIVE colleagues and friendly assessors; two evaluations at two-open day events in York targeted at family audiences; and a final evaluation at the site of Çatalhöyük with local young people.

The first and second development sessions involved fellow colleagues and EMOTIVE team members. They were recorded by Dictaphone and transcribed. These transcriptions were analysed via thematic hand-coding to provide insight into the engagement, interest and impact of the experience. From the first development session, a feedback form was used in order to draw the focus on some key issues, but the form was later removed from the evaluation methodology due to lack of substantive meaningful feedback which could better be garnered via interview and focus group.

The two open day events were public affairs, with participants ranging from under 10 to over 50 years old. Due to ethical compliance issues we chose to not use audio recording in our evaluations, but hand-written observation sheets instead. Here we noted down key features such as the extent of a two-way dialogue and communication; facilitator-participant dynamic; willingness and interest to converse; evidence for challenging one’s preconceptions or beliefs.

The evaluation of the experience at the site of Çatalhöyük incorporated both observations and audio recording, followed by a post-experience interview with a handful of participants several days after the event. The participants were schoolchildren, 6-14 years old. Again, these notes and transcripts were thematically analysed to see if there were any patterns or anomalies around engagement, dialogue exchange and affect.

FINDINGS

The results of this study hoped to answer some of the following questions: How did the role of the facilitator impact upon the dialogue? Did the hands-on process complement or supersede the conversation? What are the pedagogical advantages to this type of dialogue-focused experience?

Our findings can be categorised into several main areas of focus centred around the materials, the facilitator and the workflow:

The Materials

The Metamolds proved to be exceptional means to engage participants and activate their interest and curiosity. Their uniqueness, paired with the familiarity of the modelling clay, gave participants a sense of wonder, allowing them to engage in a fairly typical object-making experience in a genuinely novel fashion. The malleability and possibilities for decorating the clay presented an opportunity for participants to add their personality to the object, whilst the strangeness of the Metamolds increased their curiosity.

The artefacts used within this experience acted as excellent ice-breakers, allowing participants to engage critically in the contextualisation of the site and the narrative, and to engage in dialogue concerning their thoughts and ideas on what these objects were and could be.

The Facilitator

The facilitator was arguably the most problematic aspect to the experience, presenting a consistent problem: their authoritative voice. Each of our evaluation sessions has shown that it is very difficult for the facilitator to engage in exploratory conversation over didactic and sometimes quite overbearing speech. The facilitators struggled to explore ideas and thoughts before offering statements and facts. For instance, there were occasions where participants were beginning to question on their own what the objects could be, but rather than encouraging the participant to engage in this dialogue it was often the case that the facilitator stepped in to correct them. Accordingly, the dialogue seemed to terminate too early and too quickly and the participant may have felt less confident in their ideas, leading them to be less likely to engage in further dialogical exchange.

The Workflow

The experience was intended to flip ‘making’ sessions on their head, prioritising not the making itself, but rather the conversation around the act of making. This approach proved to be very effective. The results of these studies have shown that as the participants engage in kneading the clay, this has a knock-on effect for the atmosphere generating a more open participatory scene, increasing the dialogical exchanges.

One of the ideas brought up by the evaluation of this project was the potential to support it further with digital facilitation tools. The EMOTIVE Storyboard Editor developed by ATHENA can be used to assist the facilitator in more smoothly following the script and orienting participants to the site through visual cues displayed within the SBE. Another direction worth exploring is to test further the relationship of the facilitator, pulling back their role so that the dynamic is less teacher-student and more peer-to-peer.

4.2.3 Çatalhöyük Audio-Enhanced Models

OVERVIEW

The EMOTIVE Audio-Enhanced Models (reported in D3.9, section 4.1) aim to integrate simple compilations of sounds into reality-based 3D models of archaeological sites to incite curiosity about the past in wide public audiences. The prototype uses panoramic images of Building 77 from the site of Çatalhöyük and applies concepts from auditory archaeology, sound use in heritage sites, and the arc of dialogue. Young people (reading level 9-10 years old) in groups of up to five participants listen to sounds that refer to the purported activities of Building 77 and aim to connect these to the fragmented archaeological remains visible on the 3D model (Figure 22). Dialogue is prompted between participants via guiding questions delivered through the EMOTIVE Web app.

The experience is split into four sections as per the arc of dialogue (described above and in D5.5). Participants proceed through: (1) an ice-breaker activity, (2) a computer-based exploration of a particular ‘theme’ sound, (3) a computer-based exploration of all the model’s sounds, presented in two variations, and (4) a facilitator-led summary activity (described in detail in D3.9).



Figure 22: Participants testing the Building 77 sound experience (Photo by Charlotte Bishop, 2019)

METHODOLOGY

The methodology was split into three parts: design, implementation and testing. Design and implementation were undertaken from May-August 2019 and testing from August-October 2019.

The design phase followed steps proposed by Everett (2019) so as to ensure the development of a well-considered sound experience. This involved the development of an ice-breaker activity, and a script for all parts of the computer experiences. The purpose of the script development was to add structure to the Building 77 Sound Experience. Moscardo (1996) argues that structure in interpretive content can be helpful in allowing audiences to mindfully engage with the past.

The implementation phase focused on the integration of 360° images and sound hotspots. The computer experience was built using the EMOTIVE Floorplan Editor and the EMOTIVE Storyboard Editor. The panoramas used in the Floorplan editor were stitched together using Adobe Photoshop. A total of 6 images were stitched together for the panorama representing Space 336 (Figure 23), and a total of 5 images for the panorama representing Space 337 (Figure 24). The two panoramas were then uploaded to the Floorplan Editor app.



Figure 23: Screenshot of a section of Building 77, as navigated on the computer during the second and third parts of the audio-enhanced models experience (photo by Emmeline Batchelor, 2019)



Figure 24: Stitched panorama of Space 337 (Storage room) (Photos by Jason Quinlan, stitched together by Emmeline Batchelor 2019)

Sounds that were chosen to populate the sound experience were informed by Mills (2016) (see Table 1 below). Sound clips were then sourced from the YouTube audio library and Free sounds which are Creative Commons free-to-use licensing platforms. Edits were carried out in Audacity, a sound editor and recorder software.

A combination of sounds were placed on the floor plan (Figure 25). These sound choices are derived from research carried out by Mills (2016), and sounds are assigned to a certain area according to the information shown in Table 1.

Where?	Sounds
F6062	sleeping, breaking the floor to bury the dead, maybe surreal voices, people playing
F6050	plastering, painting, muted voice of someone telling a story, children giggling
F6060	Fire, cooking, boiling water, people eating, pestle and mortar
F6064	Crowd, wind, branches, walking on roof

Table 1. Location of sounds on platforms in B77

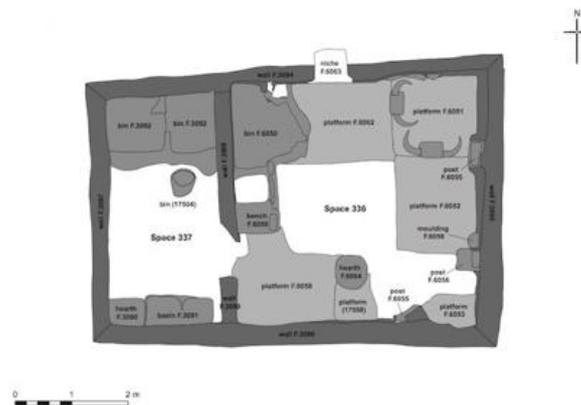


Figure 25: Floorplan of Building 77 (House and Yeoman 2008)

The testing phase focused on gathering feedback for how well the experience achieved its aims and objectives.

1. Does the experience prompt users to think about sound and past people more critically?
2. Did the use of sounds to explore the digital model get users thinking differently about what they saw?
3. Does the sound experience elicit curiosity from the user?

The first formative evaluation was carried out on the 28th August 2019 using 10 participants. As this was a session to provide critical feedback for developmental purposes, the evaluation group was made up of colleagues and friends who were recruited via an advert placed on social media and email. The second formative evaluation was carried out on the 19th October 2019 using 7 participants between the ages of 7 and 12. The latter session focused on evaluating changes to the ice-breaker activity and free explore which were changes made following the first evaluation session, and also to assess the target audience’s response to the experience. Both evaluations used qualitative observations, qualitative questionnaire, a focus group and audio recordings to collect the data. Additionally, a facilitator was present throughout the experience.

FINDINGS

Evaluations carried out in the session of the 28th August 2019 were very promising. Overall, the Building 77 sound experience was well-received and achieved its aims, with users describing the experience as insightful, emotive and curious. The use of sound as the main tool of exploring the 360° image was extremely promising with all participants either mostly agreeing or completely agreeing that the sound had made the experience engaging and informative. This provides compelling evidence that the use of



sound to enhance reality-based 3D models for a non-specialist audience is overall successful. However, participants found parts of the experience too long or too vague, with suggestions for a shorter ice-breaker activity and more connection between the ice-breaker activity and the computer experience.

The second evaluation findings from the 19th October 2019 are also extremely positive. The participants fully engaged with using sound as a tool to explore the past, often making comparisons between modern-day sounds and past sounds and modern-day activities compared to those of the past. The computer activities were changed slightly from the first evaluation and overall the sounds helped provide information about Çatalhöyük which led to some thought-provoking discussion between participants about the site. Additionally, the sounds clearly added value to what they had seen but also to the context of Çatalhöyük with participants often using something they had learnt about the site as reasoning to explain their favourite sound.

However, users still found the experience too long, not understanding why they were doing Variation 2 which provides context and information about Building 77, when they had heard and seen the same material in Variation 1. Furthermore, as the experience was carried out using laptops, the mouse trackpads hindered the usability of the experience, and the facilitator needed to provide more support with the navigation throughout the computer experiences. Suitable equipment needs to be provided from the onset in any future evaluations.

The improvements suggested during evaluation mostly focused on the sound quality and the sound integration with the visual material. There is no doubt that the sound work for this project did not live up to its potential. Going forwards, partnering with colleagues who are experts in sound recording and mixing is essential.

Another suggested improvement made by many of the participants was that sounds should automatically be heard as you explore the 360° image rather than having to click on a hotspot. The initial design had anticipated that all sounds would be heard automatically as you moved around within the panorama; yet this was not practical to achieve given technological and time constraints. It is hoped that in the future the Storyboard Editor and the Floorplan Editor will be able to include the option for sound to be embedded into the panorama rather than as a hotspot link. Furthermore, the overall length of the activity was questioned at the evaluation, indicating that we need to explore cutting sections from the ice-breaker and variations to shorten duration.

The evaluation highlighted the need to have a fully functioning, high quality experience which focuses as much on the sound as the visual. It also showed that sound specifically impacts the way that non-specialist audiences use and understand 3D-reality based data models.

5 Policy implications and recommendations

The lessons drawn from the EMOTIVE research will have important implications for both cultural heritage and creative industries, including tech innovation companies. There are also implications for education and learning professionals, working for example both within formal education (such as primary and secondary school teachers, but also higher education), but also informal education (such as museum and heritage learning officers) and online learning organisations.

EMOTIVE has shown how to design and integrate effective use of storytelling and emotional engagement so as to directly improve and enrich the experience of end users and visitors to cultural heritage sites and museums (both onsite, offsite, and hybrid combinations of these). This can have a direct impact on improving the interpretation offer of cultural heritage organisations.

These improved cultural heritage experiences have, in turn, knock-off effects on the economy across Europe, in all areas that support museums and cultural heritage sites, as improving visitor interpretation at these will have a direct impact on the local, regional, and national economies related to tourism and cultural visiting.

The EMOTIVE project has also highlighted the significance of a skilled workforce to support appropriate and effective cultural heritage interpretation that looks towards the future and has mastered the potential of digital tools using these critically to support communities and make stronger connections between our past and the present. The new generation of professionals need to be equipped with relevant skills for working in this area in order to support this economic growth.

Key messages and recommendations coming out of EMOTIVE:

1. ***Make use of the power of storytelling and emotional engagement in cultural heritage interpretation.*** The importance of emotional engagement in cultural heritage has started becoming more recognised in academic studies but it is still not exploited sufficiently in practice. EMOTIVE has shown that when combined appropriately with digital tools, it has enormous potential for engaging diverse users. Emotional connection with heritage and critical reflection about the past can help train and raise a young generation of Europeans that respect each other and understand the importance of heritage so that they can in turn, support its preservation and sharing.
2. ***Ensure that digital cultural heritage projects and programmes integrate appropriately social interaction.*** Cultural heritage visiting is primarily a social experience for individuals and communities to come together in various combinations. It is important that digital heritage interpretation work embraces, supports, and promotes this, rather than isolating visitors and breaking up communication between them. EMOTIVE tested extensively and showed the impact of various models and types of group and social experiences for cultural heritage interpretation and supporting the visit.
3. ***Promote the use of digital technologies in cultural heritage with a social sciences and humanities (not technological) focus.*** The importance of cultural heritage in society and its potential for social cohesion, economic growth and sustainable development has already been highlighted and put forward as a recommendation by Sonkoly & Vahtikari (2018) in the report on Innovation in Cultural Heritage Research - For an integrated European Research Policy they were invited by the European Commission to write. The experience from EMOTIVE showed that is of paramount importance when working on digital cultural heritage, as in the past, a lot of the European research and innovation funding was too heavily lead by the technical innovation without sufficient understanding of its social role and appropriateness for support fundamental human values and actions.
4. ***Support the pivotal role of research and in particular, for the social sciences and humanities in understanding the importance of cultural heritage in society and the potential contribution of digital interpretation tools.*** EMOTIVE has made significant progress pushing research and

innovation in this area, but it also highlighted the need for more and better-coordinated research in this area. This needs to be interdisciplinary, inter-sectoral and well supported, both financially and in terms of infrastructures, as digital cultural heritage, immersive technologies, the expansion of virtual worlds and how they affect human relationships and actions, are all complex and rapidly developing areas which need to be better researched and understood.

5. **Encourage the use of storytelling for active engagement and critical reflection, not passive entertainment and consumption.** At the foundation of all EMOTIVE's creative uses of storytelling, immersion and other forms of digital engagement was robust research and respect for the historical and archaeological context of the relevant site. The exploration of the Facts versus Fiction in the EMOTIVE Hunterian onsite experiences, for example, showed different ways to not break the immersion in the narrative, but also support ways of finding out about the material and other evidence that survives from the past. Balancing the creative storytelling while maintaining the credible research can be challenging but is possible.
6. **Ensure the balanced and equitable collaboration of both technical and cultural heritage partners in Digital Cultural Heritage projects and initiatives.** In order to effectively address the complexity of issues of work in this area, it is important that all sides are given equal importance and work in a balanced way together
7. **Encourage and allow opportunities for dialogue among users of digital heritage technologies.** Embedding a dialogic approach in digital heritage interpretation that encourages users to participate and express their views encourages critical attitude that can contribute to a more tolerant, democratic and participative European society. Reflective dialogue can be valuable for supporting alternative and multiple interpretations and viewpoints rather than promote the use of digital technologies for the single, correct, 'this is how things were in the past' approach that can also include dangerous and biased cultural interpretations and narratives. It can also help challenge stereotypes and lead to change in attitudes.
8. **Support the training and upskilling of the work force and the creation of a new generation of professionals appropriately skilled in designing, integrating, and evaluating emotionally engaging digital cultural experiences.** This type of innovative use of digital storytelling and immersive technologies to support group dialogue and emotional connection that EMOTIVE showed, is the future. This will create new jobs and needs for new type of skills. Training, professional development, and education in this area needs to be extensively and appropriately supported.

EMOTIVE brought up and pushed forward our understanding in these key areas. It also highlighted however, the need for further research, coordinated action, policy changes, and more support in this direction. These are necessary if we are to achieve in Europe what Commissioner Mariya Gabriel (2018) proposed at the 2018 conference organised by the European Commission on Innovation & Cultural Heritage – European Year of Cultural Heritage 2018 in Brussels:

“Through technological development, we can truly harness the crucial role that cultural heritage plays in fostering social cohesion, promoting a more innovative and creative economy and contributing to a stronger role for Europe’s soft power across the globe.”

6 Conclusion

The final year of EMOTIVE has seen the consortium complete and deliver powerful and improved authoring tools, as well as innovative and well-received experiences for cultural heritage site partners and end users. The evaluation of the final release of the VSE also showed how previous formative and summative evaluations had been incorporated into updates to meet users' needs, facilitating particularly those from a non-specialist programming background. By ensuring our evaluation methods were in line with the iterative design process of all EMOTIVE experiences, we were able to implement agile responses to users' needs or expectations. The EMOTIVE conceptual framework (D5.5), which underpinned the development of this work from year 2 onwards, has proven to be flexible and robust in providing a scaffold for cultural heritage sites to construct emotionally engaging digital experiences. The summative evaluation of the final release of the experiences showed the potential of this work for bringing heritage collections and sites to life; for using storytelling and immersive technologies thoughtfully to support emotional engagement and integrate group interaction so as to engage visitors more deeply; and for integrating dialogic approaches to encourage critical reflection. EMOTIVE has made significant progress in all these areas, pushing the state-of-the-art and setting an agenda for future work in digital cultural heritage and storytelling. This work has also highlighted important policy implications which are outlined at the last section of the deliverables, followed by related recommendations.

7 References

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