EMOTIVE
Storytelling for cultural heritage

www.emotiveproject.eu

D9.3 Summative Evaluation of Beta release (platform and experiences)

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Abstract
This deliverable presents the summative evaluation results from Year 2 of the EMOTIVE project. It offers an overview of the methodologies employed; presents the findings coming out from the extensive and diverse programme of evaluations carried out of both EMOTIVE authoring tools and experiences; and outlines the next steps. The authoring tools evaluation includes the EMOTIVE Floor Plan Editor Tool and the Visual Scenario Editor, while the evaluation of the experiences includes new evaluation work since D9.2 on the beta versions of three EMOTIVE experiences: the onsite Hunterian experience, the offsite virtual Hunterian experience, and the Çatalhöyük schoolkit. The deliverable concludes with the feedback we received on our evaluation tools and methodologies at the 2nd EMOTIVE Users Workshop in Athens (November 2018) from the international group of participants, experts working in evaluation in digital heritage, user experience, education, and other related fields.

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LIST OF ABBREVIATIONS

AR: Augmented Reality
EAT: EMOTIVE Authoring Tool
FPE: Floor Plan Editor
HMI: Human Machine Interfaces
SBE: Storyboard Editor
UoA: University of Athens
VSE: Visual Scenario Editor

1 Executive Summary

This deliverable presents the summative evaluation results from Year 2 of EMOTIVE. Presented here are the findings of evaluation of two EMOTIVE authoring tools, the Floor Plan Editor Tool and the Virtual Scenario Editor, and three EMOTIVE storytelling experiences or use-cases for our cultural heritage partners the Hunterian Museum, Glasgow, Scotland and Çatalhöyük in Turkey.

SUMMARY OF CONTENTS

A brief introduction is presented in **Section 2** to the background of the summative phase of the evaluation process. **Section 3** details the summative evaluation of the Floor Plan Editor and the Visual Scenario Editor authoring tools, first providing an overview, describing the method deployed to evaluate them, and then findings and next steps. In a similar fashion **Section 4** takes 3 EMOTIVE use cases (Hunterian Onsite in 4.1.1; Hunterian Offsite Virtual experience in 4.1.2 and the Çatalhöyük Schoolkit in 4.2, respectively) and summarises the summative evaluation methodology, findings and next steps. **Section 5** reports on the feedback of EMOTIVE evaluation instruments from participants at the 2nd EMOTIVE Users' Workshop in Athens (5-6th November 2018). **Section 6** rounds the deliverable off with conclusions and links to the EMOTIVE conceptual Framework and Guide - Second Release (D5.5). The subsequent **Annexes** include: (A) Virtual Scenario Editor Online Evaluation Instruments; (B) Hunterian Onsite Evaluation Instruments; (C) Hunterian Offsite Virtual Evaluation Instruments and (D) Çatalhöyük Schoolkit Evaluation Instruments.

METHODS OF RESEARCH AND ANALYSIS

EMOTIVE's summative evaluation of beta release (platform and experiences) reflects the overall vision articulated in the project's Evaluation Framework (see D9.1), while building on the formative evaluation methodology and results (D9.2). The evaluation methodology recognizes the specificities of each authoring tool's approach and experience use case (e.g. in terms of intended audience, level of expertise of users, nature of cultural heritage site, expected outcomes, etc.). Workshops, individual and group interviews, focus groups, questionnaires, observations, written records, and system logs are deployed, sometimes over multiple iterations, to gather data. These data are analysed largely through thematic hand-coding, allowing us to consider recurring topics including usability, functionality, user engagement, emotional connection, empathy and learning and understanding.

KEY FINDINGS SUMMARISED & NEXT STEPS

The Floor Plan Editor tool is effective and stable in its beta version at executing panoramic visualisations of different cultural heritage sites, as evidenced by the prototypes created for the Hunterian Museum and the Neolithic site of Çatalhöyük. The Virtual Scenario Editor has proven to be effective for use by a range of people from both cultural heritage organisations with and without a programming background and with varying pre-existing knowledge of this type of tool. The beta release of the Hunterian Onsite Experience, 'Ebutius's Dilemma' includes new screens that specify the facts behind the story and is shown to continue to elicit engagement with the physical objects and immersion in the story. The Hunterian Offsite Virtual Experience tested the efficacy of transferring the onsite Hunterian experience to an online version for remote users and identified usability problems of this first prototype. Evaluation of the Çatalhöyük School Kit showed preliminary evidence of historical empathy: throughout the evaluation, participants displayed aspects of historical contextualisation, perspective taking and the development of affective connections. Each of these authoring methodologies and use cases evaluated here have strong evidence which supports EMOTIVE's capacity to engender visitor engagement with our cultural partner sites, and – most importantly – their potential for emotionally connecting visiting audiences with the distant human past.

2 Introduction

The EMOTIVE project aims to develop tools to assist cultural heritage and creative industry professionals in authoring effective emotive storytelling for their diverse audiences. In order to achieve this, underpinning the project is a user- and visitor-centric design approach and an iterative collaborative design and evaluation process. This places both visitors and cultural stakeholders at the centre of defining the EMOTIVE experiences and empowers them in deploying the EMOTIVE methodology and tools, as we outlined in D9.1.

For this reason, evaluation plays a crucial role within EMOTIVE and takes place in the form of **formative evaluation** throughout the design and development process of both authoring tools and methodologies, as well as experiences. Although we outlined the key findings of our formative evaluation results up to month 15 in D9.2, this type of evaluation work continues to take place and directly feeds into our **summative evaluation**, which was undertaken at key stages after the beta 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. Therefore, although the results presented in this deliverable focus primarily on summative evaluation, they were informed and also include were relevant, the formative evaluation work which took place in Year 2 of the project since month 15.

In Year 2 of the EMOTIVE project we carried out an extensive and diverse programme of evaluation research aiming to capture in depth the impact of both EMOTIVE authoring tools and experiences on our two key target audiences, creative and cultural industry professionals and visitors of 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.

The authoring tools evaluation focused on the EMOTIVE Floor Plan Editor Tool and the Visual Scenario Editor, while the evaluation of the experiences includes new evaluation work since D9.2 on the beta versions of three EMOTIVE experience: the onsite Hunterian experience, the offsite virtual Hunterian experience, and the Çatalhöyük schoolkit.

Below we first review the findings from our evaluations of the beta-version EMOTIVE authoring tools. From there, we report on the evaluation of three of our beta-version use cases (described in D3.8-Pilot Experiences based on the platform beta release), which have been subject to both formative and summative evaluation at different stages. This is followed by the feedback we received on our evaluation methodologies and instruments during the 2nd EMOTIVE Users Workshop in Athens (5-6 November 2018) from the international experts from the cultural heritage and creative industry communities who participated and experienced our beta experiences demonstrations and related evaluations.

We conclude with some general reflections on next steps for the evaluation of the project.

3 Summative evaluation of EMOTIVE authoring methodologies

The development of tools to assist cultural heritage and creative industry professionals in authoring EMOTIVE experiences is one of the key aims of the project. Below we outline two EMOTIVE authoring tools that have been implemented and evaluated over Y2 of the project: a) the Floor Plan Editor and b) the Visual Scenario Editor; include a brief overview of the tools themselves; present the process and methodology followed for their evaluation followed by the evaluation findings collected; and comment on the next steps to be taken in light of the findings.

3.1 The EMOTIVE Floor Plan Editor Tool

3.1.1 Overview

The Floor Plan Editor (FPE) is a web application that allows building virtual environments based on floor plans, 360° panoramas and images. The virtual environments it creates can then be integrated with the EMOTIVE Storyboard Editor (SBE) and made available on the EMOTIVE platform for off-site virtual visits though the web.

The FPE representation of the site space has at its basis a floor plan that has a set of areas, each one having a plot image of the specific area (Figure 1). The areas have points on them that are linked with viewpoints that can be either 360° viewpoints or image viewpoints. The 360° viewpoints are equirectangular images, taken from a specific position of the area, that can be linked with image viewpoints or other 360° viewpoints via hotspots (i.e., clickable areas) (Figure 2). The image viewpoints are images taken from a specific point of view of the area and can have hotspots on them, which work just like they do on the 360° viewpoints.

More information on the tool can be found in Deliverable D4.2 'Authoring tool beta release'.

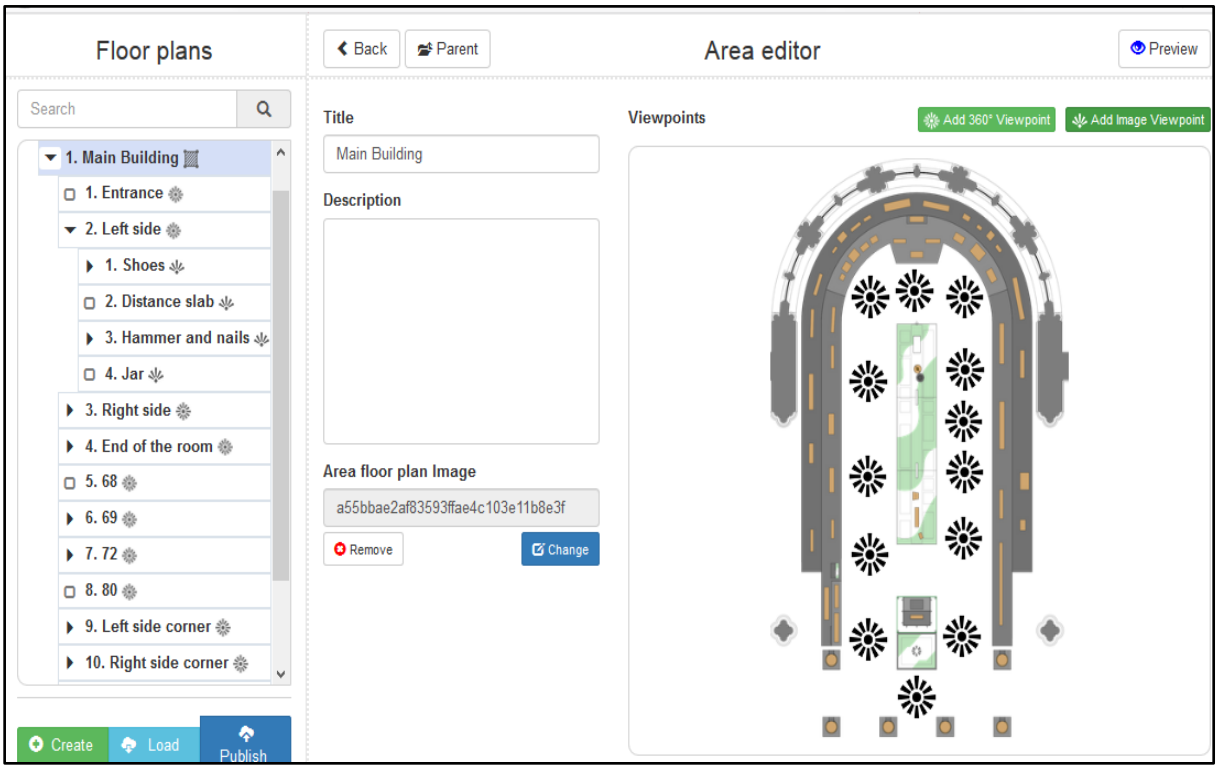

Figure 1: Floor plan of the Hunterian Antonine Wall exhibition gallery in the Floor Plan Editor (FPE)

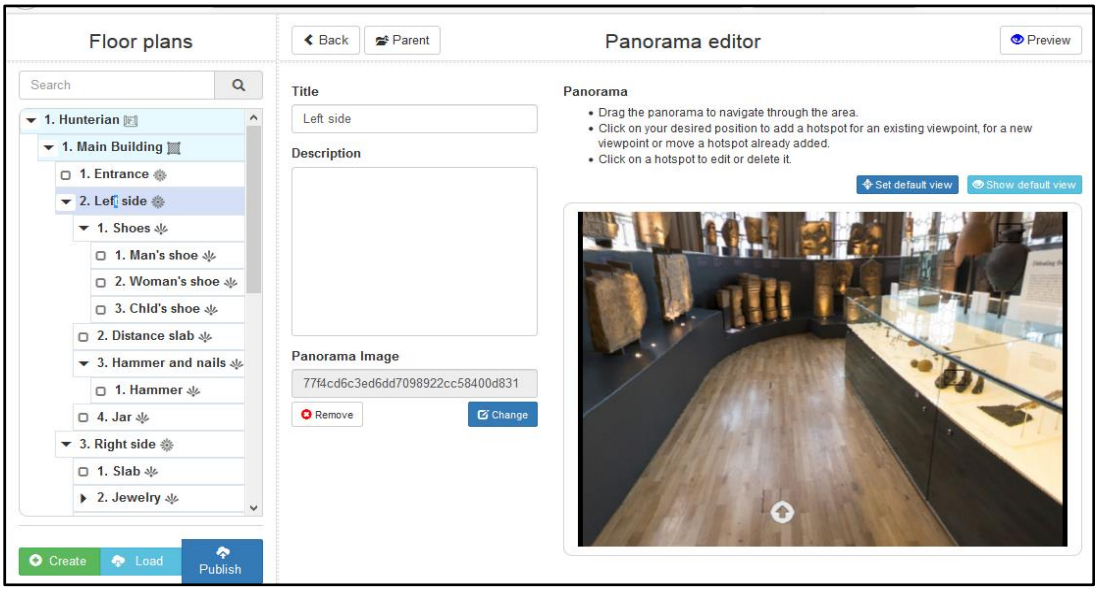

Figure 2: FPE - View of Gallery 1

3.1.2 Methodology

The FPE tool has been evaluated through its long term use by both usability and domain experts, so as to identify issues that may arise during the use in a real-world scenario.

Two cultural heritage practitioners and two usability design experts were asked to develop three virtual environments, one for the Hunterian Gallery, one for the Çatalhöyük site and one for the Athens University History Museum.

After a brief initial training which lasted about 30 minutes and presented the basic functionality of the tool, the experts worked with the tool in their own time over the course of two weeks on the aforementioned experiences. They were asked to record any comments they had and to contact the evaluators if they experienced any blocking issues. When they completed the task they were debriefed by the evaluators.

3.1.3 Findings

The FPE in its beta version is quite stable with only minor bugs identified. All users used the tool requesting minimum to no support after the initial training. The tool was on the whole characterized as “intuitive” and “easy to use”.

The usability experts identified minor bugs and usability issues to be addressed. The most common issue was placing with accuracy a linked hotspot on a 360° image. In some cases the link was not placed by the FPE in the position selected by the user but rather in an arbitrary position on the image.

Another example of an issue identified is that in some cases the specific floor plan images resulted in 360° icons which were too big creating too much overlapping (as shown in Figure 3). This is an issue that should be addressed in the next phase of development of the FPE.

Users also proposed updates on the functionality of the tool. As an example, they would like to be able to add a new 360° panorama from within another 360° panorama. A use case scenario, as recorded by one of the users, is this:

1. I just added a 360° panorama for the final room before going to the next floor
2. I now want to add the next 360° panorama (next as in “this is where the visitor would go next”)

3. I click to the point where I want users to click in order to move to the next room (where the stairs to the next floor are)
4. I am only able to add an image viewpoint or choose from existing 360° panoramas (Figure 4)
5. Now I have to go back to the area and choose a point from the floor plan to create the new 360° panorama.

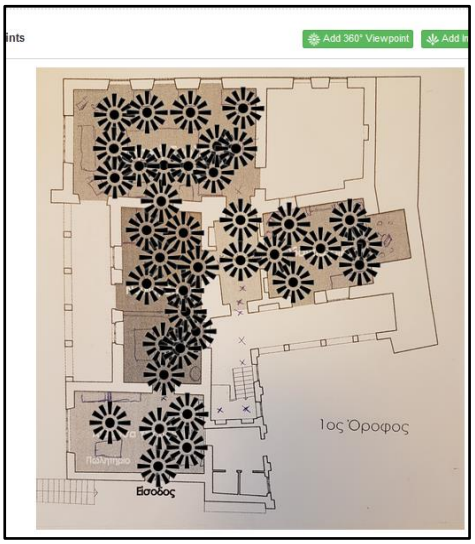

Figure 3: Overlapping hotspots

On the other hand, providing a feature like this would lead to the issue that the system is unaware of where this 360° panorama should be placed on the area's floor plan. A possible solution might be that there is some kind of annotation that a 360° panorama has not been set in position yet and then present these 360° panoramas differently, e.g. on the side of the floor plan.

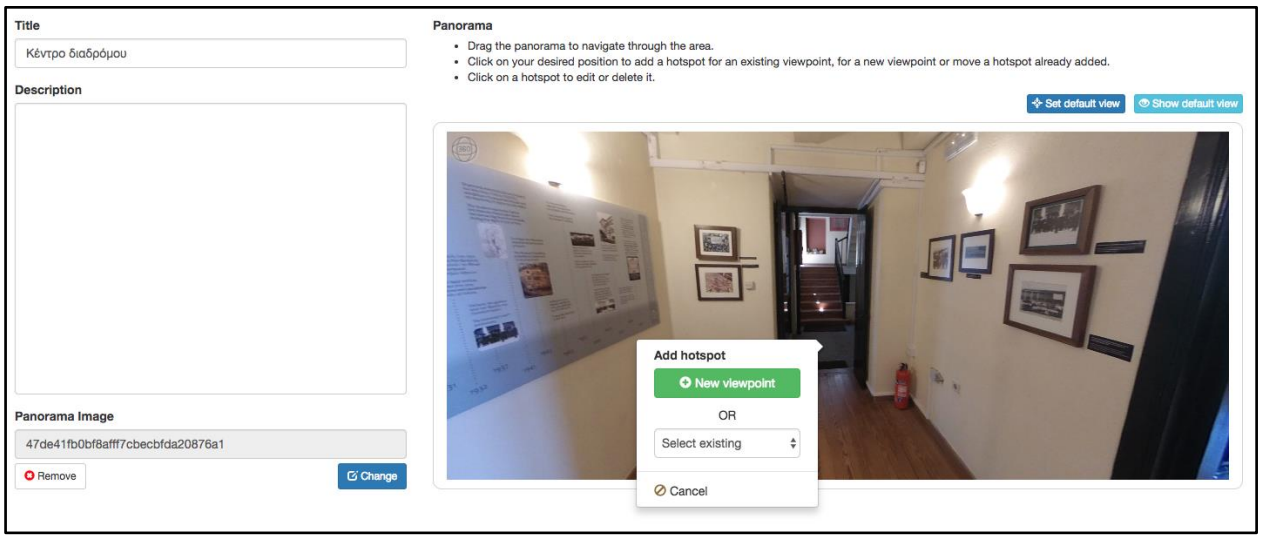

Figure 4: Example use case for creating a new 360° panorama within an existing one

3.1.4 Next steps

On the whole, the evaluation showed that although the FPE authoring tool requires some updates, it is robust and mature enough in its beta version. It is important for the tool at this stage to identify through a systematic user study the best practices and guidelines for the end product of the tool, the virtual environments. These needs will guide possible updates towards the next and final version of the FPE.

3.2 The EMOTIVE Visual Scenario Editor

3.2.1 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 of the 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 different technical skills to individually develop their own experiences (Figure 5).

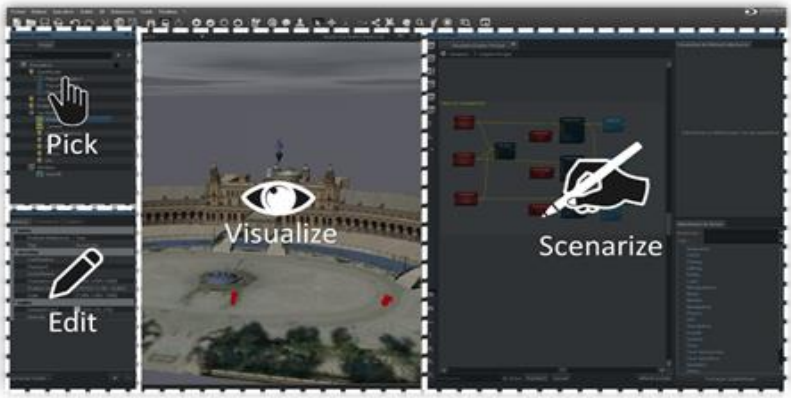

Figure 5: User interface of the Visual Scenario Editor

To achieve this, the VSE is designed as a visual programming tool. This lowers the complexity of coding by assembling low-level visual building blocks (Figure 6) thus providing users without programming skills the possibility to create their own experiences with relative ease.

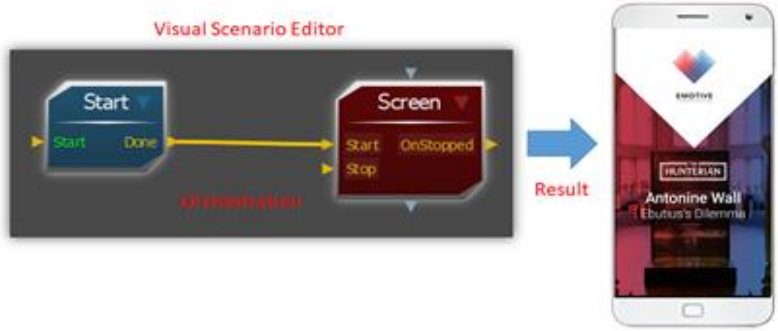

Figure 6: Creating a title screen with the VSE

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 7).

Figure 7: Creating interactive experiences with the VSE

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 the EMOTIVE on site experiences, after their initial prototyping was carried out on the EMOTIVE SBE.

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, the augmented reality (AR), 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.

3.2.2 Methodology

In the summative evaluation of the VSE beta release, the main focus of the process was on the ISO 9241 standard assessing whether the VSE achieves effectiveness, efficiency and satisfaction in a specified context of use. In order to understand how the VSE beta is used by cultural heritage and creative industry users, the targeted authors group of EMOTIVE, in real-life settings in their natural environment, we undertook an initial evaluation of the VSE in collaboration with EMOTIVE's cultural and creative industry partners. This was set up in order to allow users to test the tool and interact with it in as close as possible to their normal work environment.

The evaluation of the VSE was carried out in Glasgow during September 2018, with the participation of members from the Glasgow (2) and Noho teams (1), as well as 2 external experts on usability and cultural heritage. This evaluation brought together a panel of participants with a range of technical skills, including designers, museum / cultural heritage and programming experts. Both the evaluation and training of the tool lasted one and a half days.

Before the evaluation, two members of the DXT team provided a half-day training session, offering an overview of the tool's concepts and a presentation of the improvements since the alpha release of the VSE. After that and a Q&A session on the VSE's features, there followed a series of authoring exercises and tasks (during which the DXT team was observing and taking notes) and their evaluation. After completing each exercise, the participants were sent an invitation via email to take part in the evaluation with a link to an online questionnaire. This questionnaire was first asking about their profile and skills in creative tools and programming and then about their experience (Annex A.1, with similar forms used at the end of each exercise, for example after creating their first narration and after creating their first multiple choices), as well as one at the end asking about their overall experience, satisfaction, and usage of the tool, what they thought of its efficiency, and an evaluation of the training offered (Annex A.2). Finally, at the end of the evaluation session, there was a debrief and general discussion regarding the authoring experience using the tool which also included suggestions for possible improvements for the final release of the EMOTIVE Authoring Tool (EAT).

The VSE evaluation was based on assessing a combination of the following three key concepts (as outlined in D9.2 - EMOTIVE Evaluation Framework and Guidelines, section 4.2.4):

- **Effectiveness**: The accuracy and completeness with which users achieve specified goals and the quality of the output of those.
- **Efficiency**: The resources (i.e., amount of effort) expended regarding the accuracy and completeness with which users achieve goals.
- **Satisfaction**: The comfort and acceptability of use and users' subjective reaction to using the system.

These concepts guided also the design of the VSE evaluation questionnaires. The authoring exercises and tasks used the assets developed for the Hunterian onsite museum experience of Ebutius's Dilemma. Through a succession of exercises, the participants were asked to use the VSE in order to author different parts of the story. These were carried out in the chronological sequence that they appear in the story, with first the creation of the Ebutius's Dilemma Home screen, then the narrative presentation of Ebutius, and finally, the creation of the screen with the menu of choices. After these, the following exercises asked participants to also create by themselves a 360° view experience and an Augmented Reality (AR) one. Finally, the participants were asked to publish the scenarios that they orchestrated through the VSE on Android devices provided, so that they could directly judge and test the work they had completed.

3.2.3 Findings

The training and evaluation sessions captured a variety of comments reflecting the user experience, but overall, the initial reactions and comments from users were mainly favourable.

On the whole, the participants were able to use the tool successfully to author their stories. The main issue identified was the time required to carry out the exercises, but this is probably due to the fact that the tool was completely new to the users.

Some elements, such as the toolbars used for the story design were described as not very intuitive, however it was observed that repeated use established familiarity and was improved over time. Users' satisfaction and sense of intuitiveness was affected by the fact that in the beta version tested, there are many options providing more advanced experiences, a lot of which are not necessary and which can be confusing for beginners; this will be improved for the final release.

Similarly, some of the icons used for buttons and features of the beta release did not appear to be explicit for users who were not familiar with this kind of tool. Future work on the final release will integrate ergonomic tasks in order to provide more meaningful and standardized Human Machine Interfaces (HMIs) to improve accessibility for beginners and novices.

Furthermore, some of the shortcuts used in the VSE's beta version were not intuitive for users who took some time to get familiar with them. This may explain, in part, the duration necessary to complete the tasks. This aspect will be better integrated and improved in the new version of the tool.

On the whole, the users did not have difficulties in using the VSE's graphic design functionalities and branching. The same goes for the manipulation of the 3D environments, which is usually not a trivial task. Although the modules incorporated in the exercises, especially the audio narration and the choices were easy to understand and to reproduce by users, some adaptations and improvement are still necessary. The view window of the VSE which allows the pre-visualization of the audio narration screen currently prevents users from having a different display size on the authoring tool than that shown on the phone. For this reason, the text is much smaller on the mobile than the way it appears on the visualisation window of the VSE on the author's desktop or laptop, which confused users. The Augmented Reality and the 360° view modules seemed to be easier to use, although an improvement work is also planned for these in order to adapt their view better for the authors. In the future version, the idea is to display directly the user view with the adapted camera automatically selected when starting the AR modules.

The results below summarise user's perception in terms of Effectiveness, Efficiency and Satisfaction. Figure 8 shows the results for all the applications users created with the VSE during the evaluation.

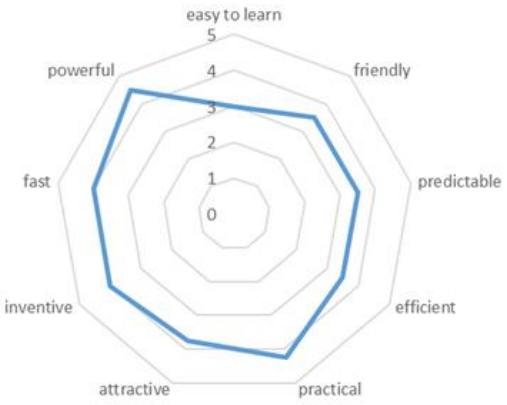

Figure 8: Users' satisfaction with the VSE

These all start from 3 upwards in the 5-point Likert scale that users were given in the evaluation questionnaires. 'Easy to learn' received the lowest score (3), followed by 'friendly', 'predictable', and 'efficient' which each received 3.5. 'Attractive' was just under 4, followed by 'fast' and 'inventive' at 4, while 'practical' received 4.2, and 'powerful' the highest score at 4.5 out of 5.

The tool appears to have met the functionality and general level of satisfaction required by users (Figure 9) but was not considered particularly easy to learn. This was affected also by the limited time devoted to the training in order to meet the allocated time. Previous experience of the DXT team which was confirmed during this evaluation session showed that some authors needed significant training to familiarize themselves with the various properties of the tool, but there was also a wide range of technical skills among participants, as for example, an external expert with advanced programming skills commented that he would have liked the training session to be shorted. DXT is in the process of preparing training materials for the final release (which will help also remote training and online consultation by users reducing the need for extensive face to face training by DXT staff) but these were not available for the beta version.

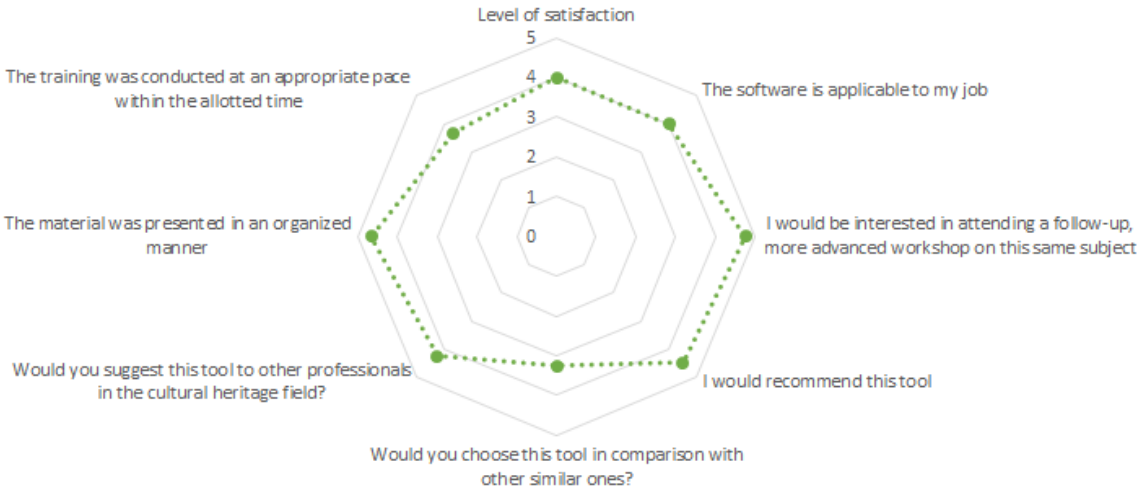

Figure 9: Overall users' satisfaction with using the VSE

After completing the evaluation tasks, the results in Figure 9 indicate users' responses regarding the overall effectiveness of the tool to achieve a complete scenario. According to the comments of the participants, the tool seems to meet the expectations of museum and cultural heritage experts, as well as creative industry professionals and programmers who design applications.

The observations and comments made during the evaluation demonstrated also the interest of participants in the VSE, both in attending other future sessions and in using it in their work. Indeed, by applying the improvements discussed, users would be more inclined to choose the VSE over other similar software (already 3.2 out of 5). The fact that the beta release version tested has many options supporting the authoring of more advanced experiences which are not all necessary for beginners, seems to be at the same time a competitive advantage (especially, for the programmers and participants with more advanced technical skills) and a drawback (for the less technically-savvy users among the participants).

3.3.4 Next steps

The comments collected during the summative evaluation were very useful because they reflected the opinion of the targeted end users and corresponded to similar points identified by the DXT team when testing the VSE internally.

Based on continuous improvement of the tool, the new releases will consider the different comments and feedback offered in order to improve the VSE and to meet the needs of its end users. The new version of the authoring tool will attempt to incorporate the recommendations regarding the user experience as well as some more general enhancements regarding everyday usage especially on human machine interaction.

4 Summative evaluation of EMOTIVE use cases

4.1 Hunterian experiences

4.1.1 Hunterian onsite experience

a) Overview

The beta release of the Hunterian onsite experience 'Ebutius's Dilemma' included updates based on the formative evaluation results (see D9.2 section 4.3). The updates included new graphics, 6 new screens on the facts behind the story and usability improvements. Usability updates included text scrolling and clearer navigation through the app, as well as editing of the story to ensure each chapter of the story was titled appropriately to make clear what the content was and to ensure the chapter remained relevant to the final decision users are asked to make (for more details, see D3.8 section 2.1).

b) Methodology

The summative evaluation of the Hunterian onsite beta release was conducted between September - November 2018 onsite in the Hunterian Museum. We specifically wanted to evaluate the new and updated elements of the beta release including the new screens that deal with the archaeological and historical facts behind the experience and how these affect emotional immersion and engagement. We amended the evaluation instruments used for the formative evaluation phase in order to incorporate questions specifically about the fact vs fiction element of the experience and more directly elicit responses regarding visitors' emotional engagement (Annex B).

In general, our evaluation focused in particular on the following components and their impact on the user:

- User interface
- Users' reaction to story narrative & characters
- User control of experience development
- Navigation within the museum display space and engagement with the objects on display
- Social interaction
- Emotional connection (engagement, empathy)
- Learning and understanding
- Critical reflection

When evaluating new elements of the experience we also linked this to the overarching EMOTIVE research question: Do the new added media components and/or functionality support emotional engagement with the specific collection, period in the past, site, objects?

We first ran a pilot evaluation session with five general museum visitors in September to test the new evaluation instruments. Based on our field notes and observations from these evaluation sessions we adapted our instruments further to attempt to isolate emotional affect within the experience.

Evaluation was conducted during the following phases:

I. Pilot evaluation session with general museum visitors, September 2018
II. User session with MUSE guides and Hunterian staff, October 2018.
III. Ongoing evaluation with general museum visitors, October - November 2018

Evaluation event I and II above involved the pilot testing of the adapted evaluation instruments. Event III included conducting evaluation over a series of weeks, scheduling sessions at different times of the day and week. In total, 25 users participated in all three summative evaluation events of the Ebutius's Dilemma beta detailed above.

We adapted the formative evaluation instruments for the purposes of the summative evaluation but as mentioned previously, we inserted new elements to the qualitative interview and the questionnaire to hone in on emotional engagement. Our methodology included the following 5 step process:

I. Observation of the user during the experience (the observation sheets we used for the formative evaluation reported in Appendix C of D9.2 remained unchanged)
II. Recording of users' interactions logs
III. Immediately after the user completed the experience, they were asked to complete the 'Where In Your Body?' form (Annex B.1)
I. Users then participated in a structured qualitative interview with memory recall using printouts of the Ebutius's Dilemma experience (Annex B.2 and B.3)
II. Finally, users were asked to complete a questionnaire focused on emotional engagement (Annex B.4).

c) Profile of participants

Most users were female and in the 20-29 age bracket, although there was a good spread of participants of all ages with the exception of 16-19 year-olds (Figure 10).

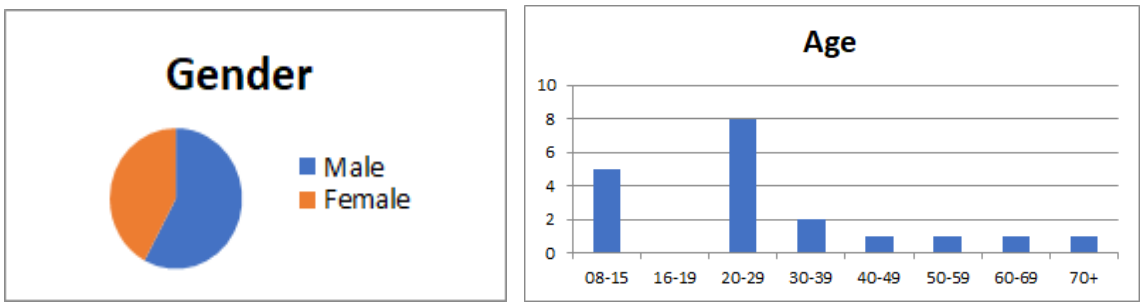

Figure 10: Participants' a) gender and b) age profile

Most had come as part of a group, as is usually the most common in museum and heritage visiting in general; were visiting The Hunterian for the first time and chose to do the experience sharing a device (Figure 11).

Figure 11: Participants' a) group composition b) pattern of visit and c) way of exploring the experience

They were unsurprisingly, relatively regular museum goers and most were not residents of Glasgow but fitting with the international profile of the University of Glasgow, spread out internationally (from Bulgaria and France to China and Luxembourg) with a large section from the rest of Scotland and the UK (Figure 12).

Figure 12: Participants' a) frequency of museum visiting and b) place of residence

d) Findings

The qualitative data that we collected yielded valuable insights about the usability of the interface, visitors' reactions, both verbal and physical, to the experience characters and narrative, their interaction with the museum objects and circulation in the exhibition space, and most importantly, emotional engagement with the objects, the experience and the heritage site. The quantitative data from the system logs and the more quantitative questions in the questionnaire helped to link back to and verify the qualitative data.

Usability and navigation

Users found the application overall easy to use and did not have any serious problems navigating through it and making choices. However, the evaluation did highlight some usability and navigation issues which require improvement. For example, there is a need to provide a pause function or button for the audio narrative, so that users can control their experience better. Most users explored the majority of the branches but offering several branches in the experience and supporting a non-linear way of exploring these resulted in some cases in users getting lost or confused. The navigation through the branches or sections of the story needs to be improved further as people interpreted the terms "back" and "skip" used in the experience differently, in some cases getting confused when navigating through it, while there is no consistent "back" functionality to allow them to return to specific pages. These navigation and usability issues will be addressed in the next development version of the experience.

Enjoyment and engagement

All users interviewed reported that they enjoyed the experience in the self-completion questionnaire (average 4.4 out of 5 with no user selecting under 3). This high score might be affected to some extent by the 'interview effect', with users tending to give positive answers in face to face interviews, as in this case the interviewers were present when they were completing the questionnaire. However, the observations also confirmed users' high level of enjoyment and engagement.

When asked to select what they felt during the experience from 11 adjectives describing different types of engagement and an additional open choice for them to complete (Annex B.4, question B2), the most popular choice was clearly "engaged", closely followed by "interested" (Figure 13). "Captivated" was the third most popular selected by 9 users, "satisfied" by 4 and "excited" by 2, while "amused", "frustrated", and interestingly "hungry" written by one of the participants themselves in the open choice, were each mentioned once. The selection of "frustrated", as was confirmed by the interview afterwards, was due to the usability issues identified above.

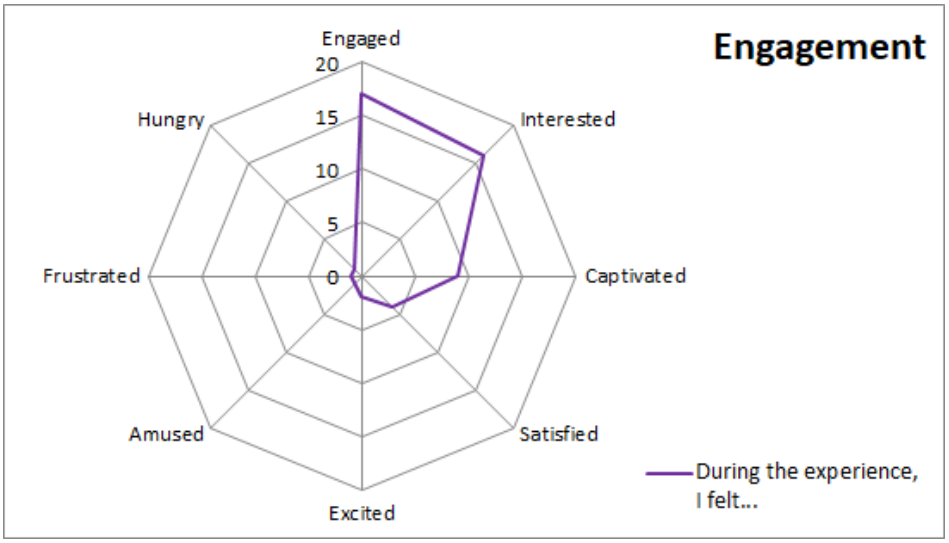

Figure 13: Users' engagement during the onsite 'Ebutius's Dilemma' experience

The participants offered also qualitative statements to describe their engagement with the exhibition and the Antonine Wall during the experience: 'I engaged with the Antonine Wall on a completely new level that I'd never experienced before' (user id 32); '[the experience made me] engage further with the exhibit and personalised the day' (user id 44). '[Made me] More interested in the story behind building the wall and the story' (user id 48). Some of them specifically referred to their engagement with the objects on display, an important element of the onsite experience: '[it made me] engage a bit more with the objects (user id 33). 'Learn more about the human element to the objects. Brought them to life' (user id 41). The personal element of the story seems to have been a key factor positively affecting some user's enjoyment: 'enjoying the interaction of exhibit with a personal story' (user id 46).

Emotional connection

As with the previous prototypes of Ebutius's Dilemma that were formatively evaluated (D9.2, 4.3.3), the summative evaluation showed that the beta release continues to support a strong emotional connection from users, who engage strongly in the story and feel empathy for its characters.

As users wrote in the self-completion questionnaires, they 'connected to story' (user id 46), which had a direct effect on how they experienced the exhibition: '[Felt] emotionally connected and enhanced my experience within the exhibit' (user id 47). The quantitative data showed that the experience made users connect with the objects on display (4.3 out of 5) and was quite memorable, with most stating that they will be thinking about it in the future and that it brought the past to life for them (both statements 4.1 out of 5) (Figure 14). Qualitative statements confirm this, with one user stating: 'I saw the past' (user id 49).

The quantitative statements are followed in rank by agreement (4 out of 5) that participants found the experience emotionally engaging and that they felt empathy for the characters in the story (Figure 14). There was a less strong effect on the relevance they felt this had to the participants' own life (3.4 out of 5) and the effect it had on changing their perception about the interaction between the Roman soldiers and the locals. The latter themes on changed perception and reflection were further explored in the Learning and Understanding section of the questionnaire and are analysed below (Figure 15).

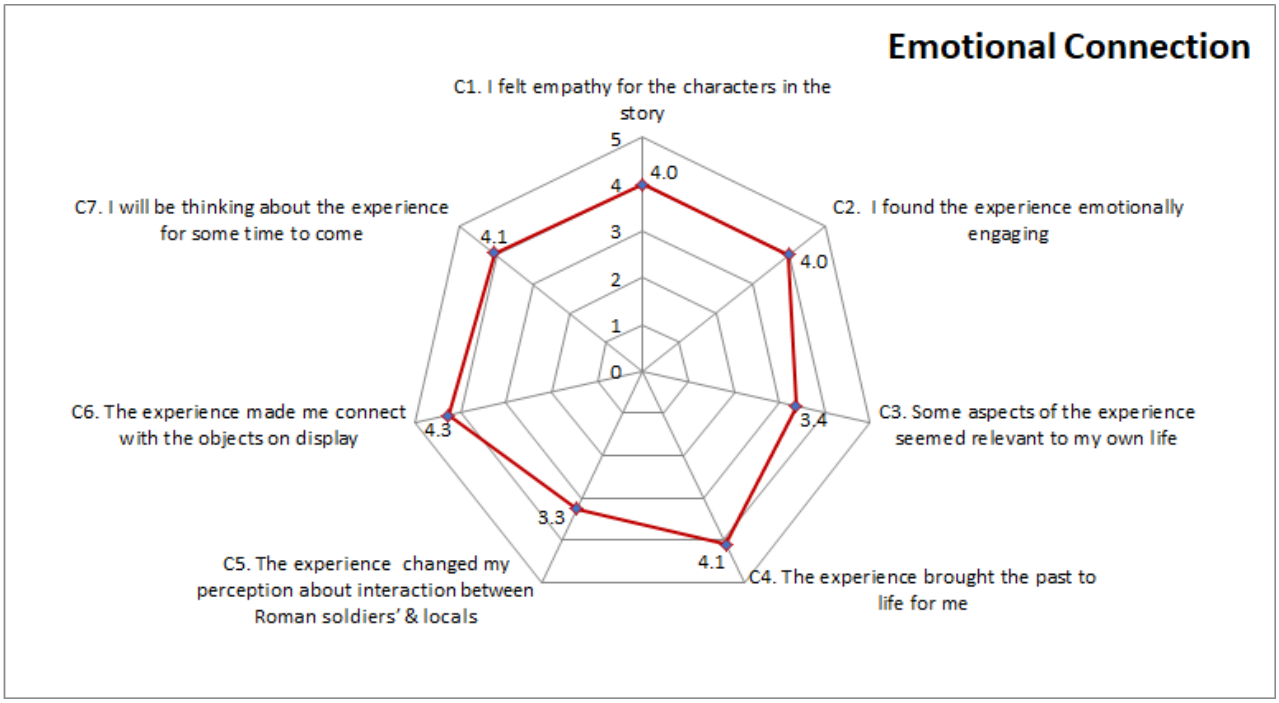

Figure 14: Users' emotional connection with the onsite 'Ebutius's Dilemma' experience

Learning and Understanding

Participants reported that the experience clearly enhanced their learning and understanding, agreeing that it helped them both learn something new about the Antonine Wall (4.6 out of 5), as well as better understand it (4.5 out of 5) (Figure 15). '[I] engaged in the interaction with the display and learnt new knowledge with interest' (user id 39); and that it helped them 'learn more about the wall' (user id 42); and 'understand and learn new things' (user id 36).

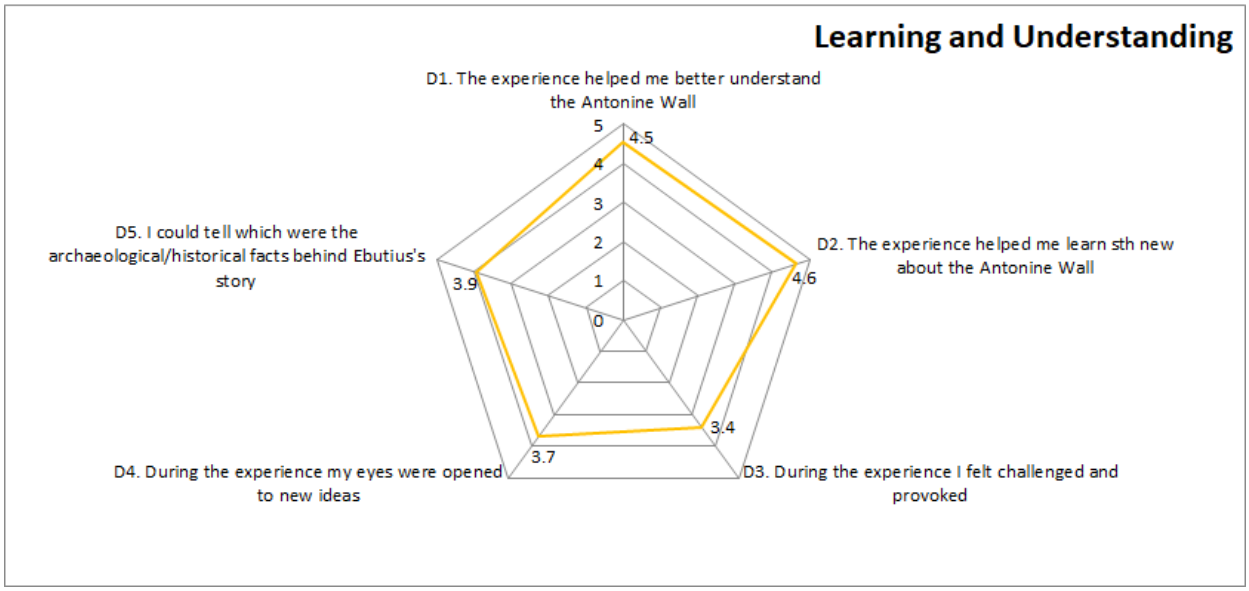

Figure 15: Users' learning and understanding from using the onsite 'Ebutius's Dilemma' experience

Some of the users referred to the way the personal element of the storytelling affected their learning: '[It made me] think more about the personal as opposed to the [conventional]/ technical facts of the wall' (user id 43). There were indications of critical reflection, with the statement D4 about having their eyes opened to new ideas receiving 3.7 out of 5, and less so with D3 about feeling challenged and provoked, which received 3.4 out 5. One user mentioned that they became 'more open-minded and receptive to other trains of thought' (user id 35), while another reported that the experience helped them 'appreciate an understanding between Roman soldiers and locals (user id 45). User id 47 identified as a new idea that was opened to him during the experience 'the idea that Romans and locals could easily form relationships and start families. That they worried about the same things we still worry about' indicating the effectiveness of EMOTIVE's approach in integrating universal themes in its experiences. This was further supported with a statement by another statement: 'change and loss and history being relevant today' (user id 41). Another user referred to the main character's dilemma as a way of triggering more reflection: 'whether the decision he made was the right one - wouldn't usually contemplate so much' (user id 44).

Users mostly agreed that they could distinguish which were the archaeological/historical facts behind Ebutius's story (3.9 out of 4). User id 50 appeared to understand what was speculative in the storytelling, stating that 'it's clear how the tangible exhibits in the display are woven into the story from reading the interpretation cards on the displays. However, they were integrated in such a way as to merge smoothly with the speculative story.' User id 43, however, mentioned when identifying as the experience's aim 'personally relating to a potential story behind an object but the archaeological story was not automatically presented so I missed that - probably deliberately for me'. Our observations and interviews showed that some users missed the last section on the facts behind the story. This was added at the end of the experience in order to not negatively affect the immersion in the story, rather than being available throughout the story.

Interestingly, the learning and opening to new ideas that participants self-reported did not refer only to Roman Britain and the past, but also to digital interpretation in museums and the actual process of using the app. '[It helped me] discover a new way of visiting a museum' (user id 40) and 'of presenting information' (user id 35); '[I am now] …much more open to the idea of tech and apps in a museum setting, I'd be more likely to take a virtual audio tour in future, for example' (user id 50). A user eloquently synthesised the reflection on both museum interpretation and Roman past that the Hunterian onsite experience encouraged: 'Ideas about how visitors engage with heritage in a museum setting, about how cultural interaction took place in Roman Britain and about how modern perceptions of Ancient Rome are shaped by our own perceptions of ourselves' (user id 50).

d) Next steps

The feedback on usability and ease of navigation will feed the next iteration of Ebutius's Dilemma. The facts behind the story section of Ebutius's Dilemma will remain unchanged, but the findings from the evaluation will feed into the design of the story of another character of the Hunterian Onsite experience, the slave girl Verecunda, currently being developed by the UGLA, NOHO and ATHENA teams. This will have a more integrated approach of embedding the facts within the story, so this aspect would be interesting to evaluate in comparison with the approach taken in Ebutius's Dilemma.

4.1.2 Hunterian offsite virtual experience

a) Overview

The Hunterian offsite virtual experience took as a starting point the alpha release of the Hunterian onsite experience Ebutius's Dilemma and tested the efficacy of it being transferred into an offsite virtual experience which could be experienced by users online. A large part of the offsite virtual experience was developed and evaluated by Metaxia Adami as part of her University of Glasgow Museum Studies MSc Work Placement with EMOTIVE in June-August 2018 (Adami, 2018) (Figure 16). The Floor Plan Editor tool and the Storyboard Editor were used to create the offsite virtual experience of 'Ebutius's Dilemma'. Rozhen Mohammed, visiting Nahrein and BISI foundation scholar at the Glasgow EMOTIVE team then worked in September-October 2018 to update the 'virtual Ebutius' with the new text and audio that were added to the onsite beta release of Ebutius's Dilemma (See D3.8).

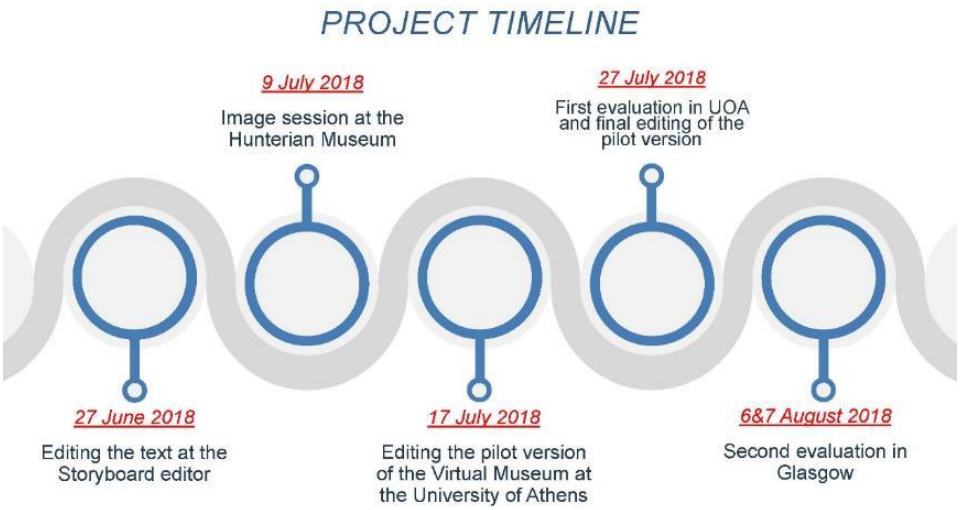

Figure 16: Hunterian Offsite Virtual experience timeline (from Adami 2018).

b) Methodology

Two evaluation sessions were conducted by Adami (guided by the UGLA and ATHENA teams) during the summer of 2018:

I. Prototype testing with 10 adults in Athens (July 2018)
II. Evaluation event with 12 adults, primarily University of Glasgow MSc students (August 2018)

At this stage of the evaluation, the audience testing the pilot version consisted primarily of researchers from the University of Athens in the case of the Athens evaluation, and MUSE guides and fellow students of the MSc Museum Studies at the University of Glasgow (UGLA) (except for one participant who works in the video games industry). Most UGLA participants were familiar with both museology and digital technologies. The Athens participants were more aware of new technologies and to a lesser degree, museology. However, both groups were more aware of these areas of research interest than casual participants.

The evaluation of the Hunterian virtual experience included user observations, semi-structured interviews and self-completion of a post-experience questionnaire. Utilizing three distinct evaluation techniques provided the opportunity to verify the acquired data through triangulation of results. The questionnaire used for the offsite virtual experience was based on the questionnaire designed and utilized by EMOTIVE partners in previous formative evaluation sessions of the onsite experiences (See D9.2). The questionnaire aimed to divide the questions into wide categories such as emotional connection, engagement, learning and understanding, facts versus fiction, usability and technical issues, comparison with the onsite experience (for those who had taken part in that). Since the pilot virtual experience presents a new usability scenario, where the user has to navigate within the virtual museum (VM) 360° interface of the gallery whilst experiencing the story of Ebutius's Dilemma mainly on a separate window (Figure 17), these specific aspects pertinent to this experience had to also be addressed within the evaluation questionnaire. Although for most of the questions the Likert scale was utilized, some questions had the form of open-ended questions intending to obtain further clarification for the interviewer's use, as well as provide users with the flexibility to express personal opinions.

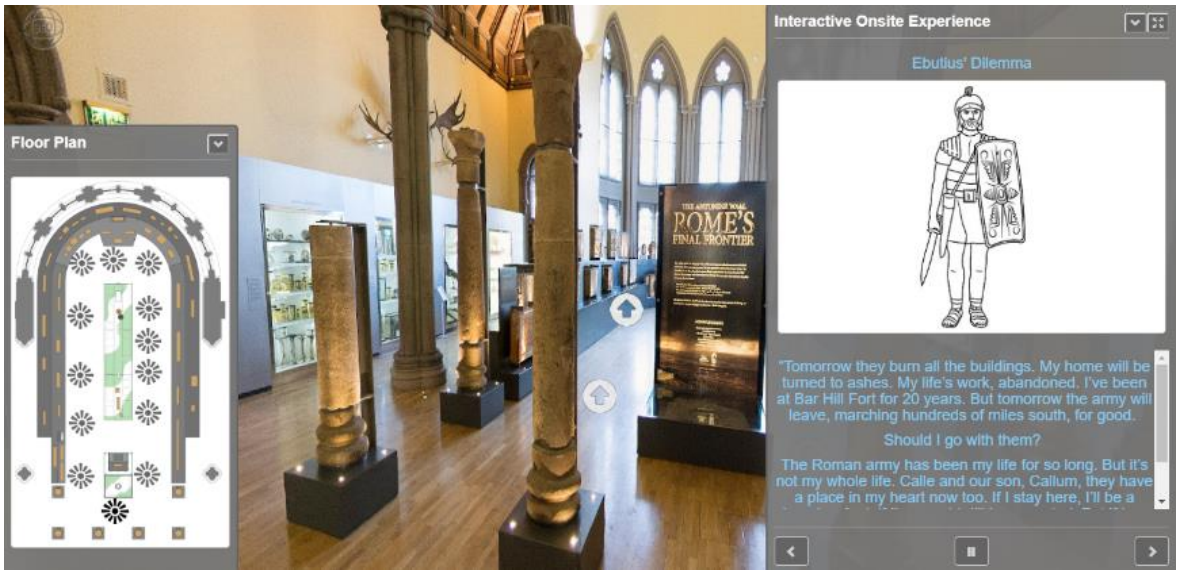

Figure 17: Screenshot of the Hunterian Virtual experience

It is important to point out that the participants at the University of Athens (UoA) tested a different earlier pilot version from those at the UGLA. After the UoA evaluation, some changes needed to be carried out in order to improve the usability of the prototype without changing the content.

c) Findings

The evaluation of the virtual Ebutius prototypes yielded some useful initial findings related to usability, engagement, learning and knowledge and emotional connection.

Usability

In terms of usability, there were several issues identified by the researcher and the evaluation participants in relation to these first prototypes. The users had difficulty navigating within the three different windows of the virtual Hunterian environment, the Floor Plan, the 360° panorama, and the storytelling window (Figure 17). Some of them mentioned getting worried that they would miss something from the story while trying to navigate between the windows, while others actually reported that they lost track of the story due to all the action they needed to perform at the same time in order to move around. The Athens participants seemed to have slightly less problems with the interfaces (3.30 out of 5 agreement that the different interfaces were easy to use, with 2.75 out of 5 among Glasgow participants). There was a stronger agreement that the floor plan assisted effectively their visit (at both Athens and Glasgow sessions this scored 3.7 out of 5), while users at both sessions disagreed that it was easy to find the artefacts/objects within the virtual museum interface (2.8 out of 5 for both). Users generally found that the system responded quickly to their commands (especially in Athens, 4.1 out of 5, while in Glasgow it was 3.3 out of 5).

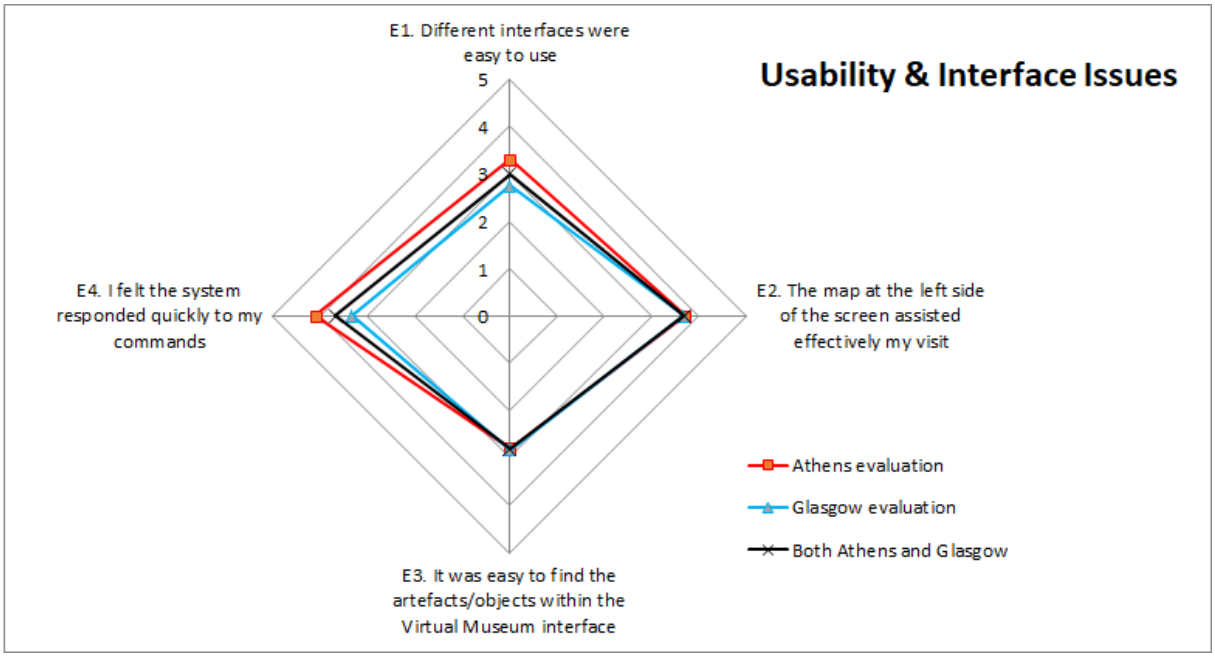

Figure 18: Usability and interface issues with the offsite virtual 'Ebutius's Dilemma' experience

Some users mentioned that they would prefer to start with navigating within the 360° of the museum first and then start the Ebutius's Dilemma story later after they had the chance to familiarise themselves with the virtual environment of the gallery, similarly to how they would behave in the physical museum. Most participants in both the Athens and Glasgow sessions suggested adding an introductory section which would help them understand their task as well as the operation of the virtual museum, i.e. an explanation of the hotspots and overall functionality of the virtual application.

Users had difficulty identifying the hotspots (Figure 19) and some mentioned that they would like the objects to be marked at the floor plan, with the user's place being clearly marked within the 360° of the museum. Participants would also prefer the information related to the objects to be provided hosted in the museum's 360° interface, separated from the Ebutius's Dilemma plot and its window. The inability or difficulty that some users faced to zoom in and out effectively in the virtual museum's 360° interface posed a challenge in their interaction with objects.

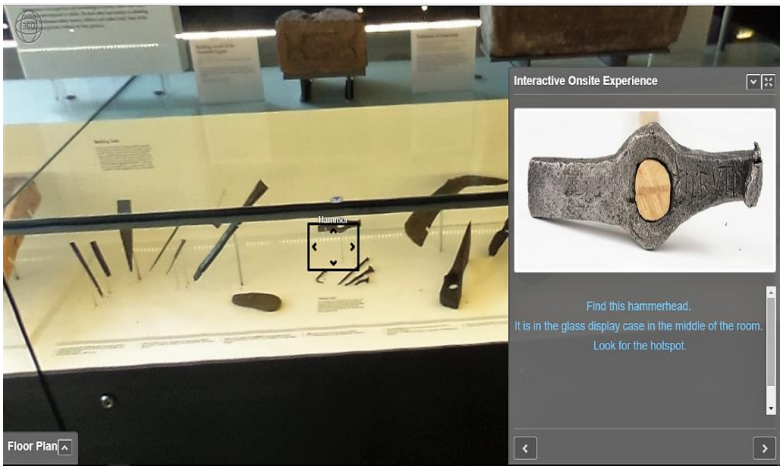

Figure 19: Hotspot (the black rectangular with the arrows on its 4 sides) for Ebutius's hammer

Emotional connection

Most participants in both Athens and Glasgow felt empathy for the characters in the story (4.2 out of 5) and found the experience emotionally engaging (4.1 out of 5) (Figure 20). They had less strong agreement that the experience made them connect with the objects in the display (3.5 out of 5) and that they will be thinking about the experience for some time to come (3.5 out of 5), with the Athens participants giving this a slightly higher score (3.7 out of 5) (Figure 19).

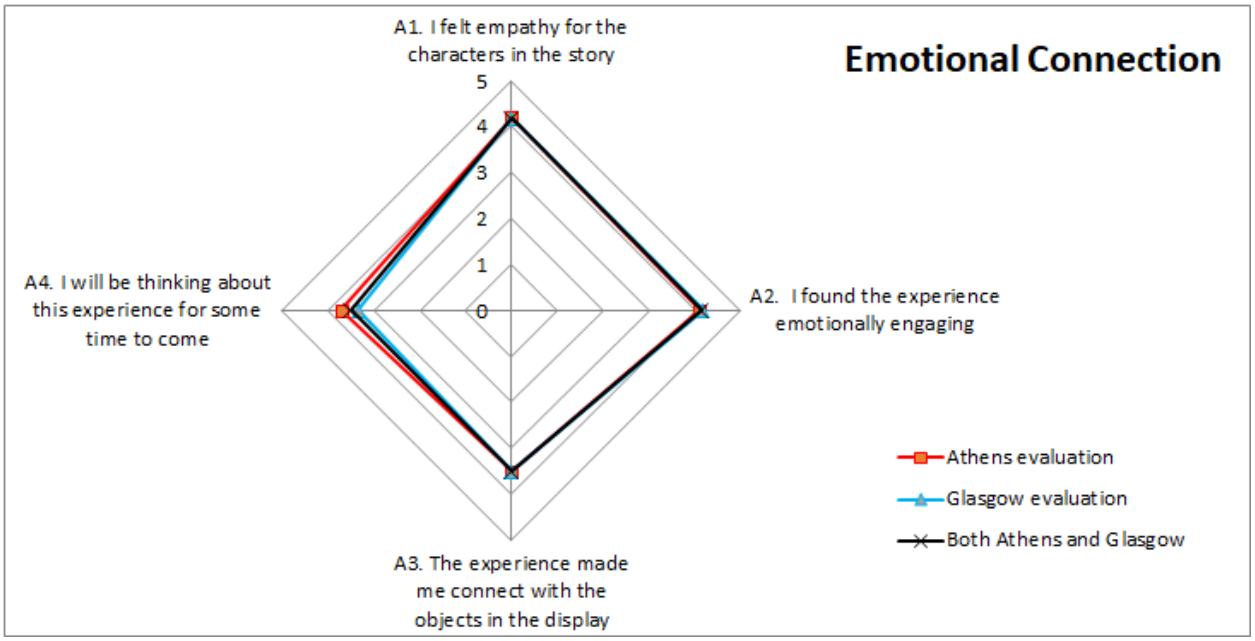

Figure 20: Users' emotional connection with the virtual 'Ebutius's Dilemma' experience

Engagement

When asked to select what they felt during the experience from 11 adjectives describing different types of engagement and an additional open choice for them to complete (Annex C.1, question B1), the most popular choice was clearly "interested" (17), followed by "engaged" (14) (Figure 21). "Satisfied" was the third most popular selected by 8 users, "captivated" by 7, and "excited" by 5. Unlike the evaluation of the onsite Ebutius, in the case of the virtual one, there were more adjectives selected by users denoting their frustration or lack of engagement with "neutral" selected by 4, "frustrated" by another 4, "disappointed" by 2, and "indifferent", "bored" and "uninspired" by 1 each (Figure 20). This is probably because of the early prototype nature of the application, the usability issues and the confusion with the three different windows described above. Another element affecting these results might have to do with remote online nature of the experience with no real objects and gallery environment to engage with and will be

investigated further with a more developed version of the application. However, the observation and interviews suggest that it is more likely to be the former rather than the latter, as there were users who selected simultaneously adjectives like “interested” and “engaged” with negative ones like “frustrated” and “disappointed”, indicating that they found the medium engaging and with a lot of potential, but ended up being frustrated by usability and technical problems. It is interesting that 6 out of the 10 Athens participants, none of which had ever visited The Hunterian, found the experience “captivating”.

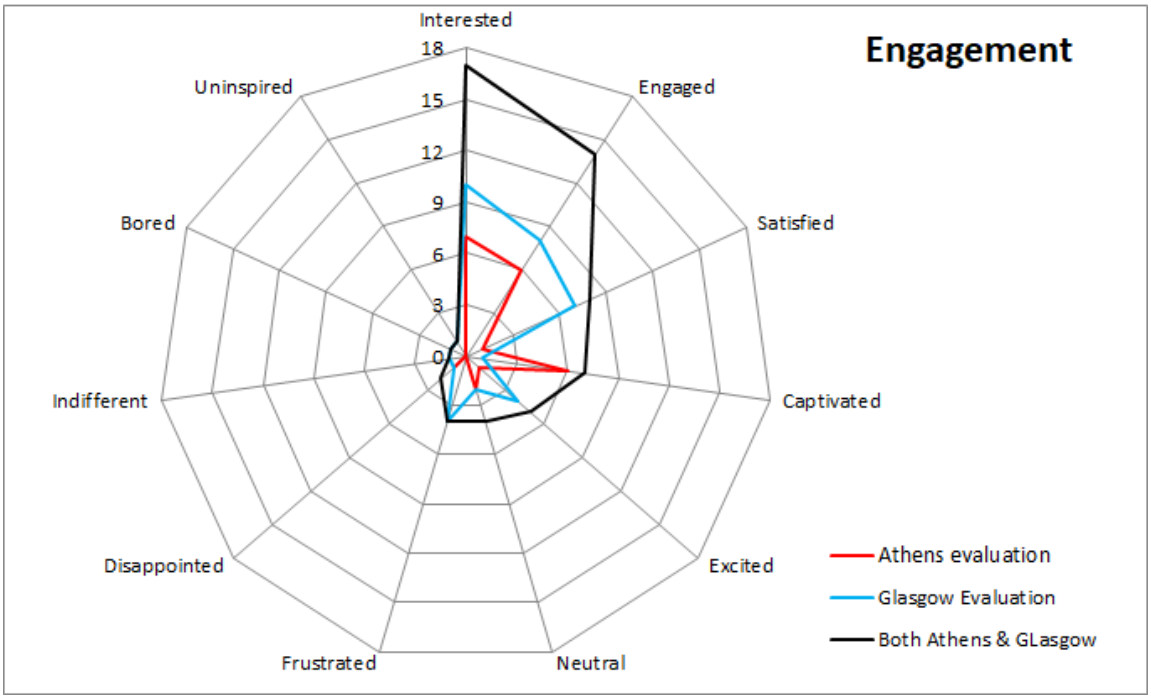

Figure 21: Users’ engagement during the offsite virtual ‘Ebutius’s Dilemma’ experience

Most participants, particularly at Athens (4.6 out of 5) agreed that they would recommend the virtual museum to their friends and family (Glasgow 3.9 out of 5) and that they would like more experiences like this in the future (at Athens 4.5 out of 5 and at Glasgow 4.25 out of 5).

Learning and understanding

All participants, particularly at Glasgow, thought that the experience helped them learn something about the Antonine Wall (at Athens 4 out of 5, at Glasgow 4.7 out of 5). They also agree but not as strongly, that they would like to have more information about the artefacts (at Athens 3.6 out of 5, at Glasgow 4.4 out of 5). It is interesting that despite the usability issues encountered, users were very keen to interact with the objects and wanted to interact with more of them as they mentioned at the interviews. Participants also thought that the virtual museum offered a realistic representation of the Antonine Wall display at the Hunterian Museum, but with less strong agreement (at Athens this was only 3.5 out of 5 as half the participants selected neutral, and at Glasgow 4.1 out of 5).

When asked if the experience opened their eyes to new ideas, three of the Athens participants commented on the novelty of trying a virtual museum as it was their first time, while some of the Glasgow participants commented particularly on the combination of the virtual environment with the narrative (’Adding story to the virtual museum is new and good’ (Glasgow user id 3); ‘Different ways to view the narrative’ (Glasgow user id 4); ’Excited about combining interactive narratives with objects in a museum’ (Glasgow user id 8). Glasgow participant 9 mentioned that they ’don’t often think about Roman soldiers in Scotland and how they would have built lives here’, while Glasgow participant 10 was reflective about the learning process itself while using the virtual museum: ‘You can be engaged and learn without looking at every single object’.

In this section which focused on understanding, it was obvious that the Glasgow participants who were familiar with the city, The Hunterian, the Antonine Wall, and its history were better able to learn new information, while the Athens participants were lacking the general context on which to scaffold new knowledge or make an assessment about the representation of the gallery in the virtual environment.

Fact versus fiction

All users thought that it was clear that the Virtual Museum was a digital representation of the Antonine Wall display (at Athens 4.2 out of 5, at Glasgow 4.5 out of 5). Most of them (less among Glasgow participants) thought also that the distinction between the archaeological/historical information and the Ebutius story was clear (at Athens 4.1 out of 5, at Glasgow 3.75 out of 5). The weakest agreement was to the statement that it was clear what the objects' real dimensions were (at Athens 3.5 out of 5, and at Glasgow 3.1 out of 5) as indeed the experience does not provide any scale or other way to assess the objects' dimensions.

Comparison between onsite and virtual Hunterian experience

As the Glasgow participants had experienced both the onsite as well as the virtual Ebutius, they were asked to compare the two. All of them preferred the onsite (which is also technically more developed than the virtual museum prototype) for the experience of engaging with the objects and moving physically in the space, but could also see the potential of the virtual online museum, especially for increasing access: 'I preferred being on-site because you can see the real objects and find them by walking rather than navigating online but I liked the virtual experience as well and I think it's great if you are unable to visit the museum' (Glasgow user id 2). This confirms the findings from research carried out with school teachers of the wider Glasgow area who had experienced the onsite Ebutius's Dilemma experience and who saw significant potential in the virtual experience to supplement their teaching in the classroom and potentially also act as preparatory activity before or after the visit to the museum (Nicholson, 2018).

Other users explained why they preferred the onsite, partly due to the early stage of development that the virtual is at, but also the greater control that one offers and the embodied experience in space it offers: 'On-site was better, easier to navigate. Also, the image cannot translate the real experience' (Glasgow user id 3). 'I think the virtual experience is on its way, but the physical provides better images and is easier to see the stones' (Participant user id 5). [I prefer the 'on-site experience [as it is] nice to spend time with other objects, read labels and see extra content. Nice to walk and be in space' (Glasgow user id 9). Glasgow participant 11 also made a more general comment about the relationship between the onsite and the virtual, stating 'I believe that a virtual experience is one meant to add, not replace or supplement'. For most of the Athens participants, it seems that the experience made them eager to visit the Hunterian Museum in Glasgow and triggered their interest in having the onsite EMOTIVE Hunterian experience.

d) Next steps

In the next version of the offsite virtual Ebutius's Dilemma story we will be addressing the usability issues and experiment for greater consistency on where to best place the hotspots for the objects in relation to the 360° panorama, and the storytelling window. After that, we plan to extend the evaluation of the virtual Hunterian use case beyond Glasgow and Athens to users interested in the topic, museums, and heritage, as well as carry out more comparisons between the onsite and the virtual experience. This will allow us to explore more systematically how the two experiences compare in terms of emotional engagement, engagement with the objects and the characters, knowledge and understanding, and critical reflection.

4.2 Çatalhöyük experiences

4.2.1 Çatalhöyük schoolkit

a) Overview

A formative evaluation of the *Exploration of Egalitarianism Classroom Kit* was held on July 14th, 2018, led by Sierra McKinney in relation to her MSc dissertation on the topic (McKinney 2018). (Note that subsequent evaluations, held across several weekends in September 2018, will be reported in future deliverables.) The Kit was tested with eleven members, aged nine to fourteen, of the York branch of the Young Archaeologist Club (YAC) (Figure 22). YAC is a not-for-profit organization that hosts monthly archaeologically themed events across the United Kingdom for youth, ages eight to sixteen (Young Archaeologists' Club 2018). The pilot test received ethics approval in advance of the evaluation and all the data collection was completed within the ethical framework of the University of York. The primary aim of the evaluation was to determine the Kit's potential in fostering the three pillars of historical empathy: historical contextualisation, perspective taking, and affective connection. Additionally, the children's use of the Kit was observed to identify potential technical concerns and aspects requiring additional alteration and improvements.

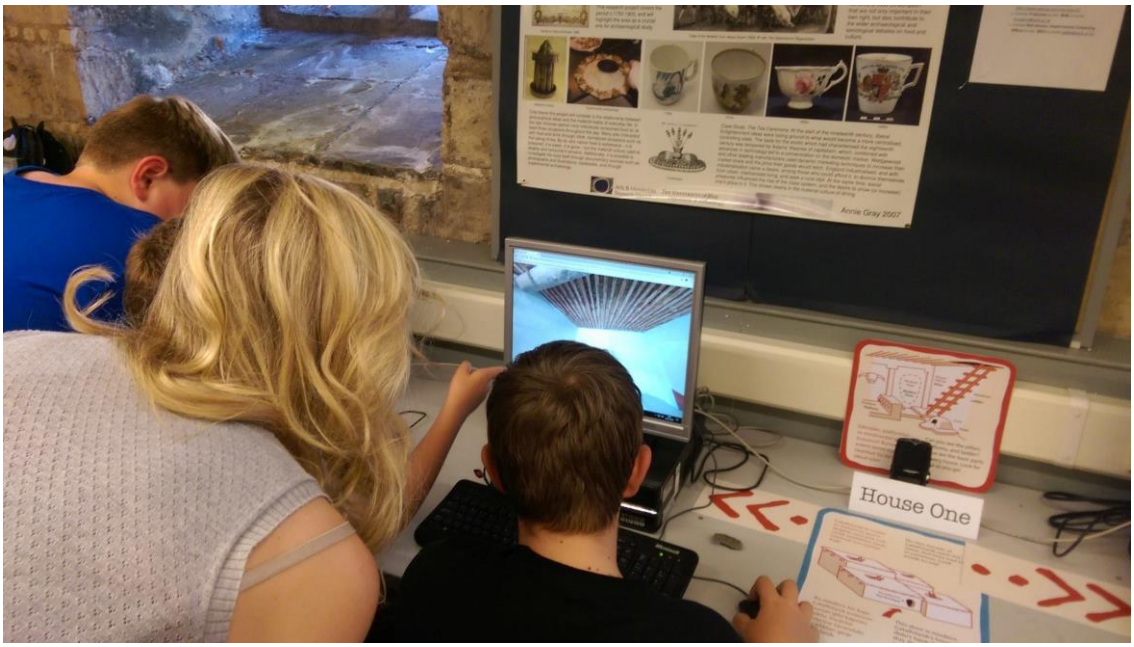

Figure 22: York YAC Members explore the virtual houses (Photo By Sarah Drewell)

b) Methodology

The evaluation, which entailed the children testing the three elements of the Kit, occurred during one of the Club's two-hour sessions. Following a brief introduction, the children were organised in three groups of three and one group of two to complete the first two stages, *Welcome to Çatalhöyük* and the *Egalitarian Experience.* For the final element of the evaluation, the smaller groups were combined into two larger teams to partake in the chatbot discussion. During the conversation with the chatbot one group was facilitated by Dr Sara Perry, while the second group was self-directed and observed by Katrina Gargett. These two distinct methods of facilitation provided an additional element for future analysis, following subsequent trials. A more thorough explanation of the Kit can be found in D3.8 "Pilot Experiences Based on Platform Beta Release".

Observations were recorded for the *Welcome to Çatalhöyük* and *An Egalitarian Trading Experience* phases. While the initial aim was for each observer to follow a group of three participants, due to the high level of interaction between the participants, the observations were made more broadly of the entire

process. The participants were additionally audio-recorded while they engaged in the *Discussion with Bo the Chatbot* component of the exercise. Following their engagement with the Kit, participants were asked about their experiences through a questionnaire (Annex D.1) and within a focus group.

Initial analysis and coding was performed to identify recurring themes and concepts. The coding process followed the responsive interviewing model outlined in Rubin and Rubin's *Qualitative Interviewing: The Art of Hearing Data* (2005, 22). The chatbot sessions and focus groups transcriptions were coded line-by-line for predetermined elements of historical empathy (Figure 23). The coding structure was based on existing studies of historical empathy by Endacott (2010) and Barton and Levstik (2004).

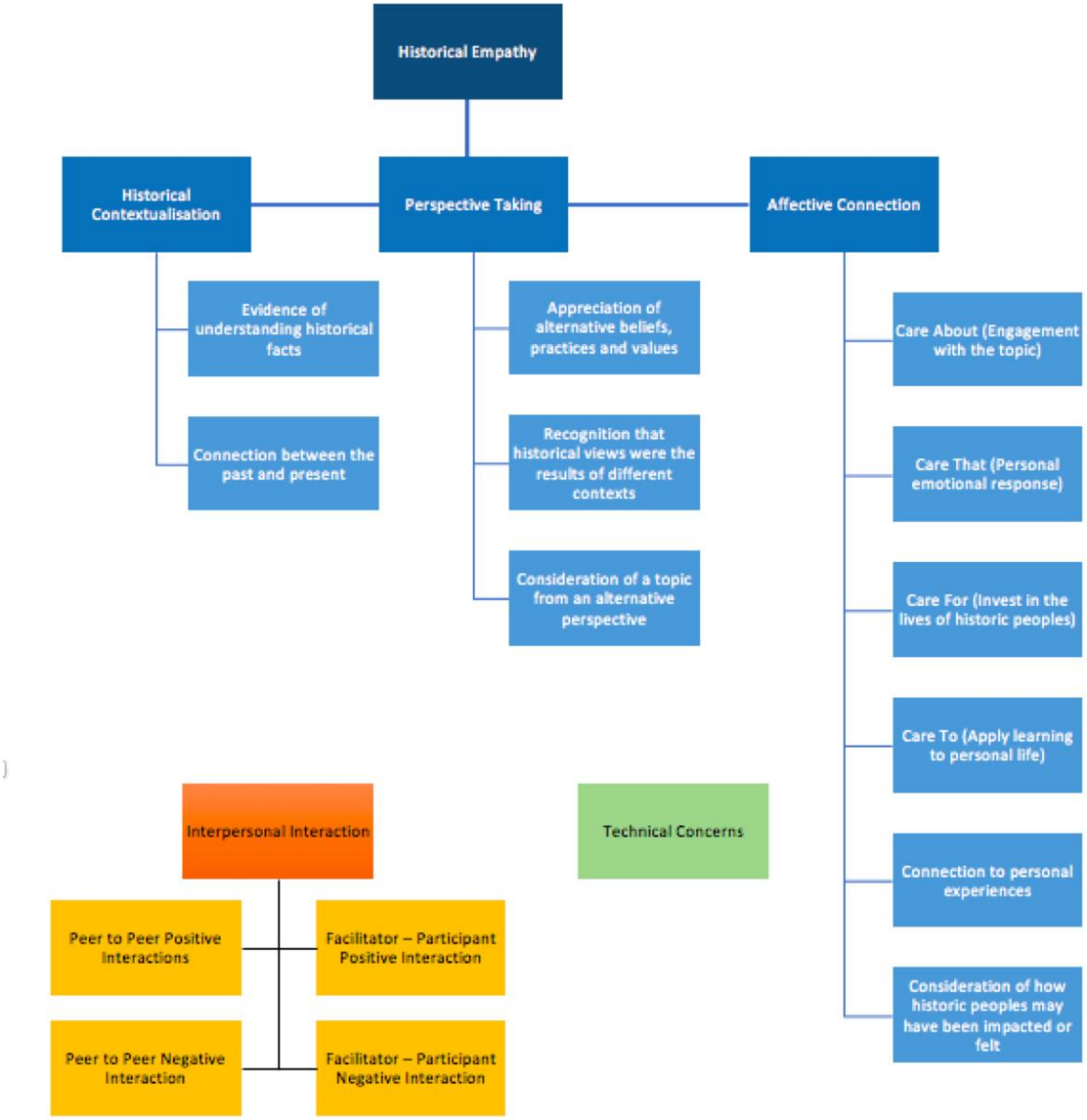

Figure 23: Diagram of the Coding Schema (Image by Sierra McKinney)

c) Findings

A preliminary analysis by McKinney (2018) of the data collected from the July 14th evaluation, demonstrated the potential of the Kit to develop historical empathy while also revealing areas requiring additional development. Participants responded positively to the experience (i.e., "I had a really fun time") and club leaders highlighted the children's high level of engagement. Furthermore, the digital elements

such as the 3D prints, the digital walkthroughs, and the chatbot were of great interest to the children and prompted questions, excitement, and were noted as favourite elements.

Of the three components of historical empathy, the children were most successful in demonstrating historical contextualisation. All of the participants indicated they learnt something new during the experience and demonstrated their learned knowledge throughout the questionnaire and focus groups. Perspective taking was also demonstrated, though to a lesser degree. An example of such perspective taking was seen during the second stage of the experience, when the children repeatedly showed themselves to be considerate of which objects would be the most useful to a person from Çatalhöyük. Finally, according to the questionnaire, the students struggled the most with developing an affective connection. However, the results of the observations and focus groups contradicted the participants' questionnaire responses: many students identified or showed a personal emotional reaction during the experience and in the focus group. As an example, one participant answered "Yes I really did" when asked if they found it difficult to leave behind their object.

Based on this preliminary evaluation, there is evidence for the initial development of historical empathy: throughout the evaluation, participants displayed aspects of historical contextualisation, perspective taking and the development of affective connections.

d) Next Steps

Following the evaluation, specific improvements were noted and implemented for subsequent evaluations. These included technical considerations, such as reducing the speed at which the chatbot's text appeared, and minor content modifications, including simplifying the language used in the various components of the experience. Since the initial trial, the Kit was tested with an additional 16 individuals from two YAC clubs, resulting in a total of 27 user evaluations. The latter results will be published in future deliverable documents.

Having established the potential for the Classroom Kit to foster empathy, upcoming evaluations will work to determine the usability and efficacy of the component tools in order to develop the phases of the Kit into stand-alone modules. Therefore, our next steps are to develop the elements of the Kit to provide a series of modular tools and frameworks, with supporting documentation, that educators can use separately or together to generate emotive experiences for their own content. This Kit will also continue to explore the potential for emotion-based storytelling in informal environments and is currently identifying opportunities for additional evaluation with a range of informal learning environments and audiences.

5 Feedback on EMOTIVE evaluation methods from the 2nd EMOTIVE Users' Workshop, Athens

5.1 Overview

The second EMOTIVE User Workshop was held in Athens (5 - 6 November 2018) with a select group of invited eminent professionals all of whom work directly either in digital cultural heritage, cultural heritage evaluation or cultural heritage academic practice. During this workshop, participants experienced demonstrations of the EMOTIVE use cases, participated in the evaluation process (Figure 24) and were invited to reflect on the EMOTIVE evaluation methodology. (See Deliverable 3.5 for more detail on participant profiles and the agenda for the workshop.)

Figure 24: Participants of the 2nd User Workshop experiencing the EMOTIVE evaluation

5.2 Feedback on EMOTIVE evaluation

The EMOTIVE evaluation methodology which includes a mixture of qualitative and quantitative instruments, was overall received well by the 2nd Users' Workshop participants. We invited them to feedback their comments on what we should keep from the current evaluation instruments and how to improve the evaluation methodology in relation to measuring emotion and affect. They did this in several ways: by writing on colour coded post-it notes green "things I'd keep" and pink "things I'd improve" in the evaluation and posting them on related boards (after the Hunterian onsite session) (Figure 25); by following this up with a recorded focus group discussion (for the Hunterian, Athenian Agora, Schoolkit and Chatbot experiences); by completing the online evaluation form for the chatbot; and by commenting verbally in a large debrief focus group at the end of the workshop.

Instruments and practices the participants liked and encouraged us to keep using included the 'Where In Your Body?' map to ask users where they felt the experience the most. While some participants felt this was a difficult question to start with in the evaluation process, as it did not necessarily set the user at ease, others felt it was well placed and wanted this question to go deeper and ask for more than one body part. One participant wrote "Keep the body sheet. We don't do enough to recognize the embodied nature of these experiences". Several participants encouraged us to be more creative and open to qualitative methods in our evaluation. One expert suggested we invite users to write their own story in response to

the experience, while another participant suggested we invite users to draw their emotional reaction to the experience.

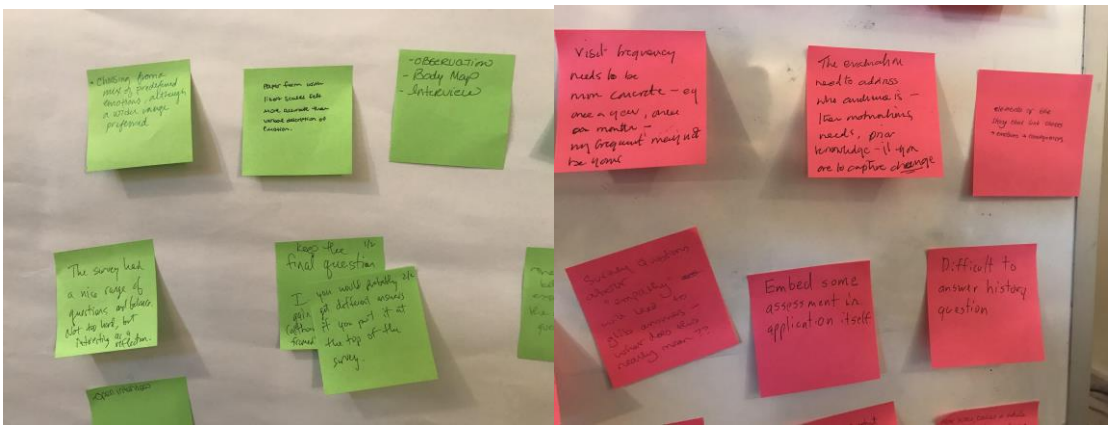

Figure 25: Feedback from the 2nd User Workshop participants on the EMOTIVE evaluation methods

Similarly, several participants encouraged us to continue to do more qualitative as well as long-term evaluation to ensure we capture self-reporting of emotional impact and affect, noting "that it takes time to elicit emotion". This comment was supported further by another participant who appreciated the interviews used as one of our key methods, but found problematic asking users directly about their emotional engagement: "Unpacking the experience with someone was nice. But it could have been more conversational and exploratory instead of explicitly asking for emotions felt." A longitudinal approach or follow-up interview to be completed by the user at a later date was also suggested as a way to explore the long-term impact of the experience.

Triangulating the evaluation process by including a combination of qualitative and quantitative instruments allows us to compare and reflect on different ways people report or respond to the experiences. Although some participants favoured more qualitative and creative methods as described above, one participant highlighted the value of the Likert-scale questions in the Hunterian onsite self-completion questionnaire: "Paper form with Likert scales felt more accurate than verbal description of emotion".

In terms of ways to improve the evaluation process, a number of workshop participants suggested integrating the evaluation into the experience itself to allow users to respond and reflect on emotion and feelings while they occur during the experience with the possible inclusion of visual representation of reactions. Similarly, it was suggested that the format of the evaluation should be digital/tablet based in order to aid analysis and aggregation of results. This would also tie in with the app-based presentation of the experience.

The workshop participants acknowledged the pros and cons of each EMOTIVE evaluation instrument and as with any evaluation instrument and methodology, their feedback reflects this mixed response. There was no outright suggestion to stop using any of the evaluation instruments; instead, participants were able to suggest ways to improve the elicitation of emotional response from users with small adaptations to the current instruments.

5.2.1 Physiometric measurements

In our research into ways of evaluating emotions we have also considered physiometric measurements of emotional response (Deliverable D9.1, section 4.2.5, page 16), as even though the potential of wearable sensor technologies in a museum context has not yet been sufficiently explored, physiological measurements offer the advantage that when it comes to measuring emotional states, physical responses

cannot be controlled by participants and are triggered unconsciously, thus counterbalancing any 'interviewer's effect' of interviewees offering mainly positive responses when face to face.

For this reason and the technology has been improving over the last few years offering a lot of potential, we hosted a special EMOTIVE session on 'Evaluating Emotions in Digital Cultural Heritage' at the 3d International Congress on Digital Heritage 2018 session at San Francisco, 26-30 October 2018 inviting with the open call for papers presentations from researchers working in this area. [1] In addition, two of the participants we invited to the 2nd EMOTIVE Users' Workshop in Athens have been carrying out research in this field: a) Tedi Asher, an expert neuroscientist based at the Peabody Museum who is researching the use of neuroscience data in the design and interpretation of art exhibitions (Mansky, 2018), using bio-feedback, eye-gaze measurements, skin conductance level changes and memory; and b) Jess Hoare, PhD student at Cardiff University who is carrying out research on the use of physiometric measurements using as a case study visitors' reactions from a visit to Tredegar House, a National Trust cultural heritage property (Hoare 2019). During the workshop we discussed the benefits and the issues related to carrying out this type of research within a museum setting, as there are several disadvantages which outweigh the use of physiological measurements for the EMOTIVE evaluation.

Firstly, the main disadvantage of these methods is the fact that measuring tools used during biodata measurements can be intrusive, due to the external measuring instrumentation, so in consequence, these measurements often take place in laboratory conditions. The growth in affordable, portable wearables, however, has prompted studies which investigate physiological response outside of a laboratory setting. As reported by Hoare (2019), across these, a link is confirmed by a sensor's ability to indicate some forms of arousal that can, in some but not all cases, relate to participant-reported changes in feeling (Tröndle et al. 2014; Howell, et al. 2018). However, as Hoare (2019) presented at the EMOTIVE Digital Heritage 2018 session at San Francisco, 'studies have reported issues with signal noise, emotional valence, and determining the value of physiological activation (Conati et al. 2003; Kappeler-Setz, et al. 2013).

Secondly, physiological reactions – despite becoming relatively easy to measure accurately - are very difficult to link to any specific emotions (positive or negative). In addition, any external variables, such as body temperature or heart rate from before starting the experience (Güiza and Beuzekom 2006), can influence the data. When evaluating educational games, Conati et al. (2003) concluded that it is 'not clear how effectively the sensors can detect emotions that may be expressed more subtly' (as is the case for a wide range of the emotions triggered by the EMOTIVE experiences, as our evaluations are showing).

Finally, physiological and neurological evaluations require specialised equipment such as sensors, electronic gloves etc., which can be costly, as well as the assistance of neuroscientists and experts in physiology to be able to plan appropriately the related research and analyse the data.

Asher confirmed at the workshop in Athens all these last points above, as the cost of the equipment she uses at the Peabody is considerable, and she is herself a trained neuroscientist. Hoare and Canning (who also presented a paper at the Digital Heritage 2018 EMOTIVE session (Canning 2019)), both use more affordable arm bands compared to Asher, but both confirmed that they had problems with the unreliability of the devices and of the resulting data. Both Asher and Hoare confirmed in Athens what is reported by existing research (e.g. Tröndle 2014) that physiometric investigations might be relevant in circumstances where they are heavily supplemented by traditional forms of evaluation. This allows the physiometric data to focus on deeper investigation into specific aspects of the experience studied that have already been testified to via typical quantitative and qualitative data, such as for example, dwell times or self-reporting. Ultimately, the evidence suggests that physiometrics might be able to provide more detailed data about behaviour that firstly needs to be known through traditional methods.

[1] The Call for Papers is available at https://emotiveproject.eu/index.php/2018/05/30/call-for-papers-emotions-in-digital-cultural-heritage/ [Accessed 29 November 2018].

There is no evidence to suggest that these methods expose wholly new behavioural patterns or previously unknown effects of exhibits on visitors. In other words, the physiometrics might be able to add depth, but still this depth relates to the individual user experience. Untangling the relationship between the museum space, its exhibits and the social interactions between users through physiometrics is very challenging. In addition, the use of physiometric technologies raises ethical questions of empowerment, privacy, autonomy, and trust (Cowie 2015).

In the EMOTIVE onsite use cases, the users are not only in motion, exploring the artefacts on display and are influenced by the environment, but are also engaged in the story created for the app. Additionally, given the central role that social interaction has in EMOTIVE, users' experience our use cases most of the time in pairs (in the case of the Hunterian onsite) or larger groups (in the case of the onsite Çatalhöyük). This is another aspect which might cause additional interference in measuring the biometric data, as most of the physiometric research is single-user focused. Biometric research undertaken in an uncontrolled environment, currently presents difficulties which undermine its justification in our project.

As devices recording physiometric measurements become more affordable, widespread, and less invasive, there is increasing potential in using physiometric measurements in future museum research. However, as until now research into measurement of emotional states via bodily responses has proven either unreliable or too costly (and sometimes a combination of both) and requires related neuroscientific expertise not available within the consortium, we have decided to not apply these methods in the EMOTIVE evaluation.

5.3 Next Steps

We will continue to refine the evaluation instruments and methods in line with the findings from the 2nd User Workshop. Any modifications to evaluation instruments will be tested initially before being used across the evaluation of EMOTIVE experiences and will be reported on in the next WP9 Deliverable D9.4 Summative Evaluation of Final Release (platform and experiences).

6 Conclusion

The second year of EMOTIVE has seen the consortium consolidate the results of the formative evaluation and address key issues regarding the usability and functionality of authoring tools. The summative evaluation results of EMOTIVE experiences continue to show their capacity to engender visitor engagement with our cultural partner sites, and – most importantly – their potential for emotionally connecting visiting audiences with the distant human past. In the third and final year of EMOTIVE we will refine and hone our tools and experiences further in line with the summative evaluation conducted to date, as well as in response to our continued implementation of the conceptual framework (D5.5).

The combination of methods we used for this phase of the evaluation has provided rich qualitative and quantitative data that have highlighted the importance of adapting the instruments accordingly for each case study. By adapting our existing methods thoughtfully and by retaining common variables across the spectrum of EMOTIVE experiences, we are able to discern users' emotional engagement and reaction. As is always the case with carrying out evaluation work in the cultural sector and the social science research area more broadly, each element of evaluation in digital heritage research requires time, reflection and refinement. This year's intensive and varied evaluation activities did require a lot of our time but led to useful reflection, while feedback from our visitors; conference delegates; and EMOTIVE workshop experts is allowing to carry out refinements in our methods and tools and prepare effectively for the evaluation that will be carried out during the last year of the project.

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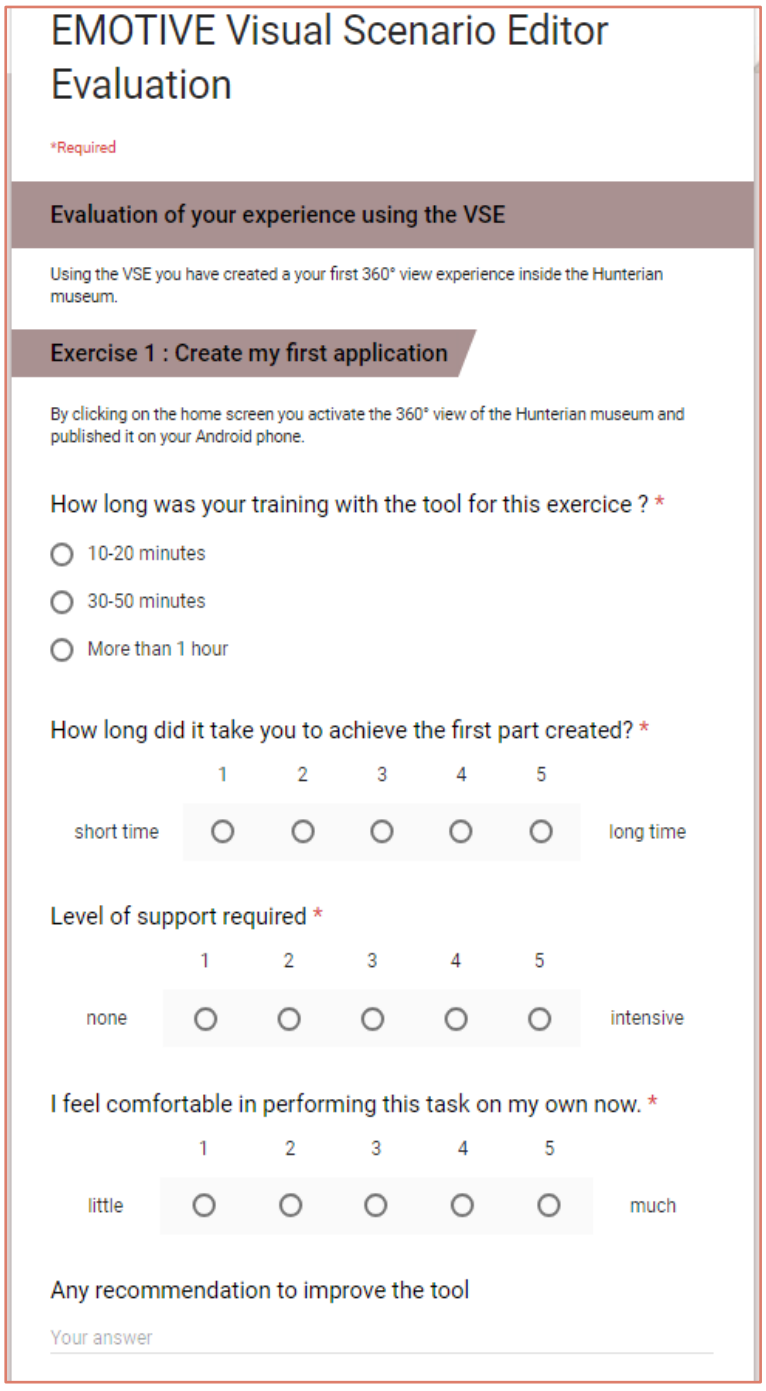
Annex A VSE Online Evaluation Instruments

A.1 Online questionnaire - questions regarding Exercise 1



EMOTIVE Visual Scenario Editor Evaluation

*Required

Evaluation of your experience using the VSE

Using the VSE you have created a your first 360° view experience inside the Hunterian museum.

Exercise 1 : Create my first application

By clicking on the home screen you activate the 360° view of the Hunterian museum and published it on your Android phone.

How long was your training with the tool for this exercice ? *

- 10-20 minutes
- 30-50 minutes
- More than 1 hour

How long did it take you to achieve the first part created? *

	1	2	3	4	5	
short time	○	○	○	○	○	long time

Level of support required *

	1	2	3	4	5	
none	○	○	○	○	○	intensive

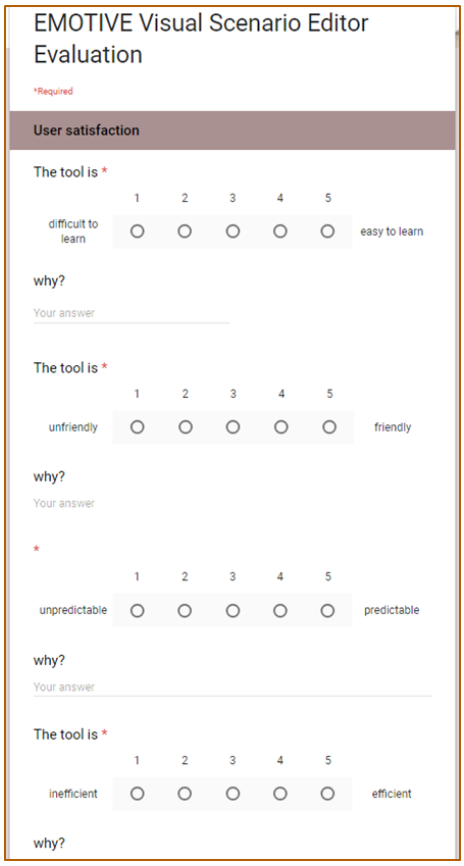
I feel comfortable in performing this task on my own now. *

	1	2	3	4	5	
little	○	○	○	○	○	much

Any recommendation to improve the tool

Your answer

A2. Questions regarding overall experience of authoring a story with the VSE & evaluation of training offered



EMOTIVE Visual Scenario Editor Evaluation

*Required

User satisfaction

The tool is *

	1	2	3	4	5	
difficult to learn	○	○	○	○	○	easy to learn

why?

Your answer

The tool is *

	1	2	3	4	5	
unfriendly	○	○	○	○	○	friendly

why?

Your answer

*

	1	2	3	4	5	
unpredictable	○	○	○	○	○	predictable

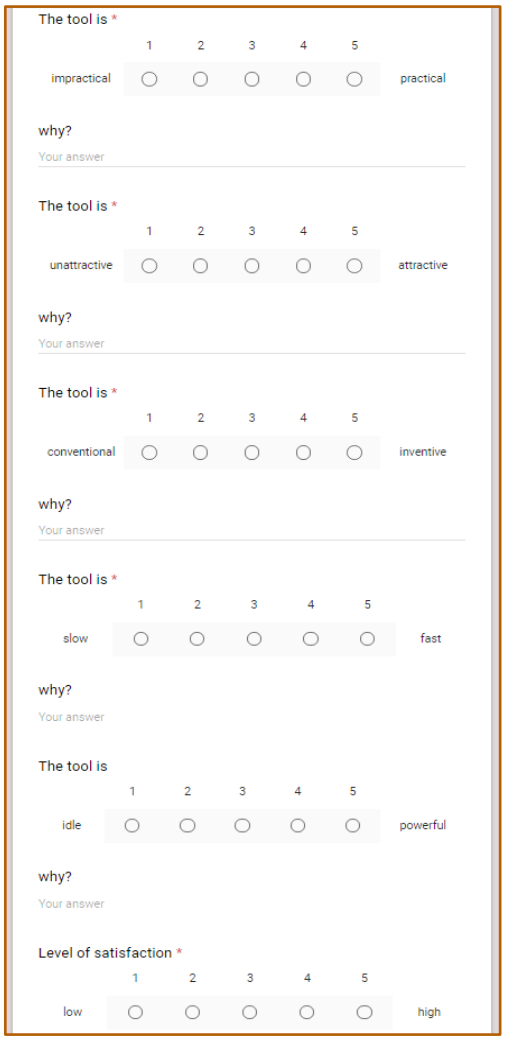
why?

Your answer

The tool is *

	1	2	3	4	5	
inefficient	○	○	○	○	○	efficient

why?



The tool is *

	1	2	3	4	5	
impractical	○	○	○	○	○	practical

why?

Your answer

The tool is *

	1	2	3	4	5	
unattractive	○	○	○	○	○	attractive

why?

Your answer

The tool is *

	1	2	3	4	5	
conventional	○	○	○	○	○	inventive

why?

Your answer

The tool is *

	1	2	3	4	5	
slow	○	○	○	○	○	fast

why?

Your answer

The tool is

	1	2	3	4	5	
idle	○	○	○	○	○	powerful

why?

Your answer

Level of satisfaction *

	1	2	3	4	5	
low	○	○	○	○	○	high

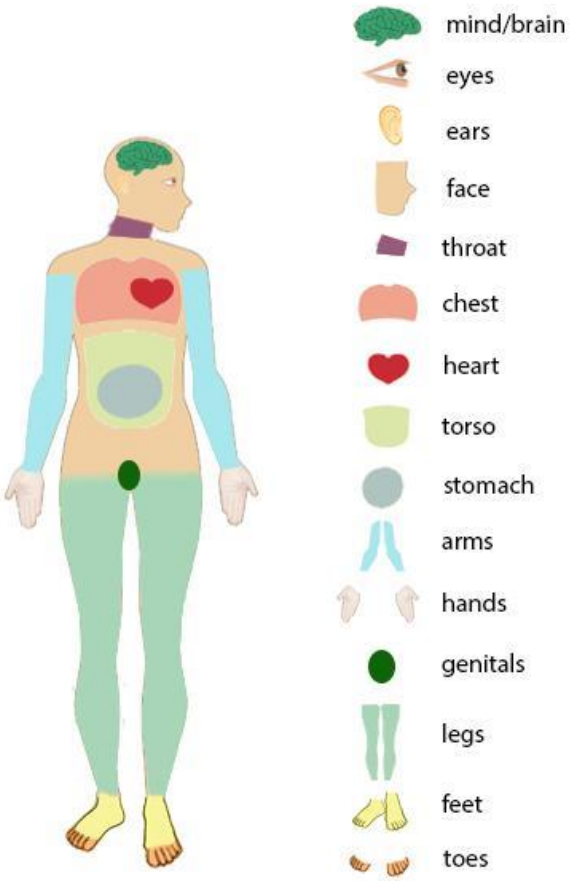
Annex B Hunterian Onsite Evaluation Instruments

B.1 Where in your body? form

Interviewer: Date: Time: Session: User ID#:

Where in your body did you feel this experience the most?

(Please tick <u>only one area</u> on the body below)



(Adapted from Matthew Reason, *Where in your body*? 2015 https://matthewreason.com/portfolio/where-in-your-body/)

Please comment

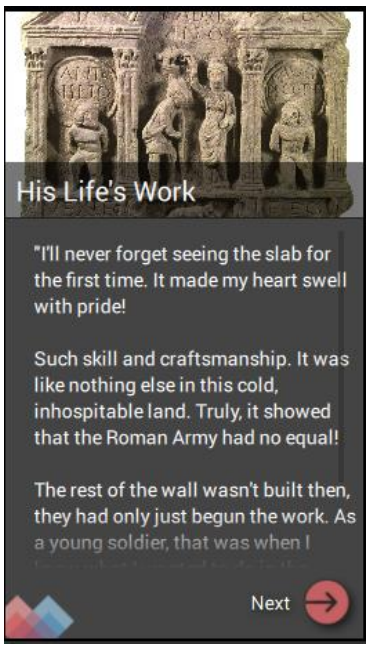
……

……

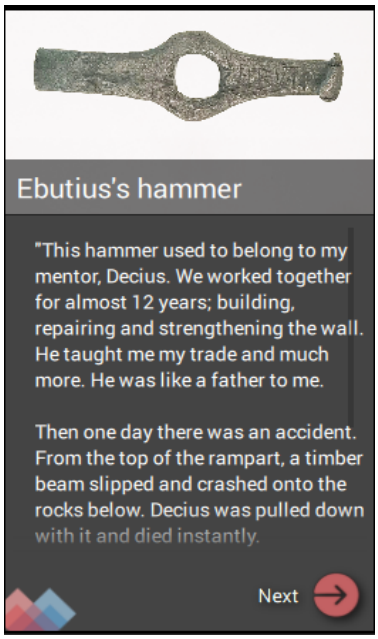
B2. Handout for memory recall at interviews

A3. Which one (if any) of the following stories made you feel most emotionally engaged?

His Life's Work

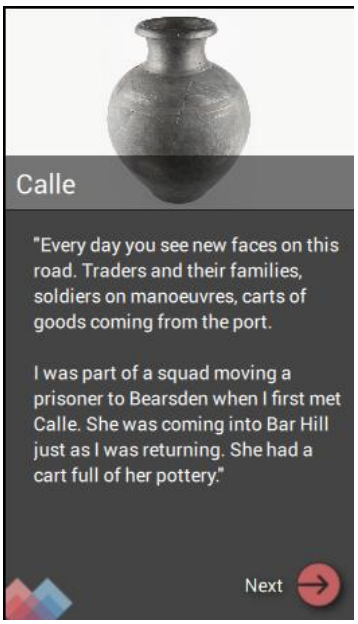


A3.1

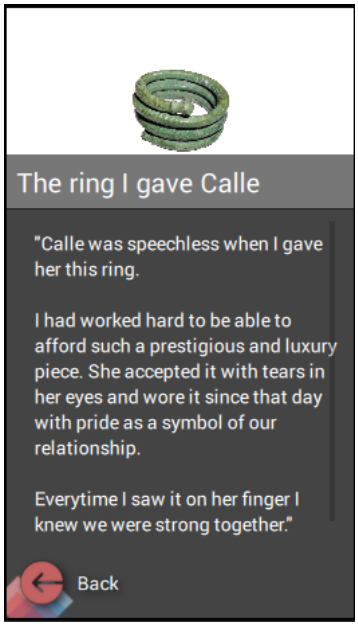


A3.2

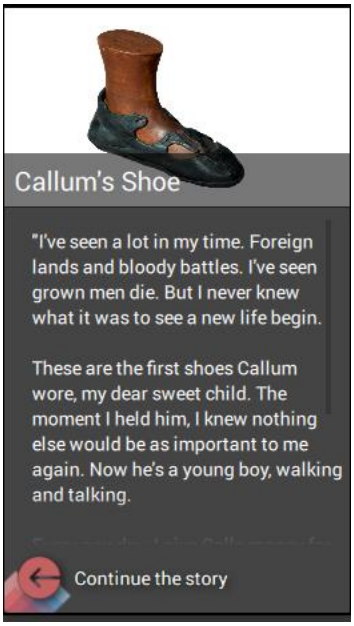
The Love of His Life



A3.3

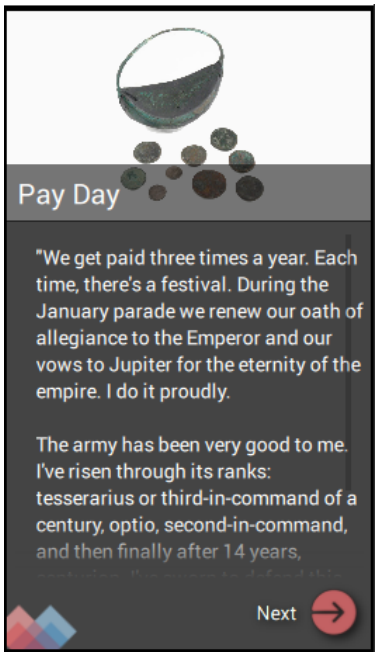


A3.4

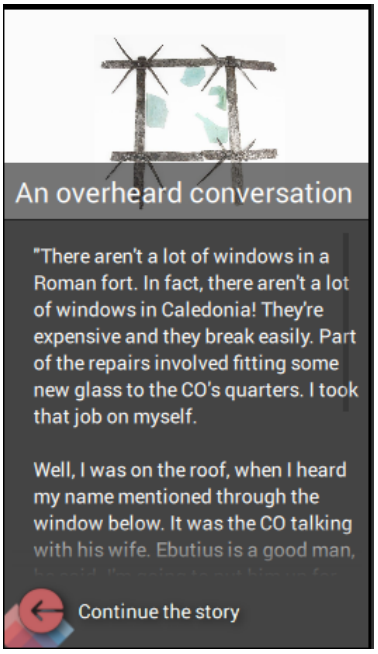


A3.5

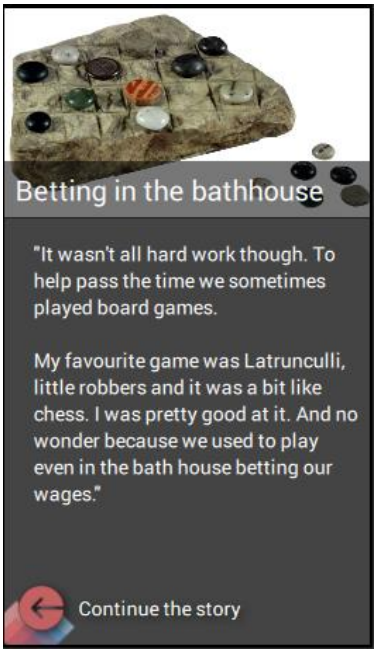
The Oath He Swore



A3.6



A3.7



A3.8

The Final Decision

A3.9

B3. Questions to use during interview

Summative Interview Questions (to be recorded)

State the date and User ID Number at beginning of recording

1. Where in the story did you feel emotionally engaged the most?

To Probe:

- Why?
- What kind of emotions did that part of the story make you feel?

NB: You can probe for other points in the story that they felt emotionally engaged, not just one. But remember to ask what kind of emotion did each of those parts of the story make the user feel.

2. Did you relate to any of Ebutius's life experiences?

NB: Show the user the image below and read out the 3 experience strands if needed

To Probe: If yes, which experience? If not, please explain why not.

3. Which one (if any) of the following parts of the story made you feel the most emotionally engaged? Please mark an X under the screen.

[Interviewer Shows interviewee handout with screens on]

To Probe:

- Which kind of emotion did the part you have chosen make you feel?
- Were there other parts that you were emotionally engaged with?

4.1 IF IN A PAIR: Can you tell me how you found sharing the experience <u>with someone else</u>?

To Probe:

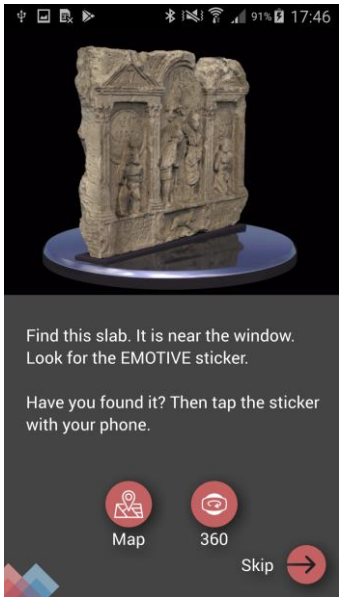
- How did you make decisions about which story or path to follow?
- Did you agree with each other about which path/route of choices to make?

4.2 IF ALONE: Can you tell me how you found doing the experience <u>by yourself</u>?

5. In terms of using the application was there anything you had particular problems with?

To Probe:

- What did you use to locate the objects?
- (Did you use the 360 degree view or the map?)



6. Did you make it to the Facts Behind the Fiction screens?

To Probe:

- Yes/No
- What did you think?

7. What did you choose at the end?

To Probe:

- Why?
- Did you agree or disagree?
- How did you negotiate? (if in a pair)

End

B4. Self-completion questionnaire

A. Demographics and details of visit

A1. Age:

A2. Gender: M / F / Other / Prefer not to say

A3. Did you come to the museum:
a) On your own b) As part of a group
(number of adults: __ / number of under 18s: __)

A4. Have you visited this museum/site before? Yes/No
A4.1 If yes, please specify **all** that apply:
a) As an independent visitor
b) As part of your course
c) As a MUSE guide
d) Other. Please specify: _____

A5. Why did you come you here today?
a) Invited for evaluation b)
Other_____

A6. Did you do the EMOTIVE experience:
a) on your own b) shared a device with someone else c) other, please specify

A7. Are you a resident of Glasgow? Yes/No

A7.1 If not, please specify where you live_____

A8. How often do you visit museums or cultural heritage sites?
a) Often
b) Sometimes
c) Rarely
d) I do not visit them

B. Engagement

B1. Did you enjoy the experience?

Not at all |_____|_____|_____|_____|_____| Very much

B2. During the experience, which of the following did you feel? (Circle **all** that apply)

Indifferent	Interested	Uninspired	Bored
Excited	Captivated	Engaged	Disappointed
Satisfied	Neutral	Frustrated	Other _____

B3. I felt like I was transported to another world and lost track of time

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C. Emotional Connection

C1. I felt empathy for the characters in the story

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C2. I found the experience emotionally engaging

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C3. Some aspects of the experience seemed relevant to my own life

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C4. The experience brought the past to life for me.

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C5. The experience has changed my perception about the interaction between Roman soldiers' and local people

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C6. The experience made me connect with the objects on display

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C7. I will be thinking about the experience for some time to come

Completely disagree |_____|_____|_____|_____|_____| Completely agree

D. Learning and Understanding

D1. The experience helped me better understand the Antonine Wall.

Completely disagree |_____|_____|_____|_____|_____| Completely agree

D2. The experience helped me learn something new about the Antonine Wall.

Completely disagree |_____|_____|_____|_____|_____| Completely agree

D3. During the experience, I felt challenged and provoked

Completely disagree |_____|_____|_____|_____|_____| Completely agree

D4. During the experience, my eyes were opened to new ideas

Completely disagree |_____|_____|_____|_____|_____| Completely agree

D4.1 If you agreed with the previous statement, please explain what these new ideas were

_____

_____

D5. I could tell which were the archaeological/historical facts behind Ebutius's story

Completely disagree |_____|_____|_____|_____|_____| Completely agree

Please explain how:

_____

_____

_____

E. Final Take Away

E1. Please complete the following statement:

The EMOTIVE experience made me…

_____

_____

_____

_____

Thank you for taking part in our EMOTIVE evaluation!

Would you like to participate in future evaluation of EMOTIVE applications? YES/NO

Annex C Hunterian Virtual Evaluation Instruments

C.1 Hunterian Offsite Virtual Evaluation Questionnaire

A. Emotional Connection:

A1) I felt empathy for the characters of the story:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

A2) I find the experience emotionally engaging:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

A3) The experience made me connect with the objects in the display:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

A4) I will be thinking about this experience for some time to come:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

B. Engagement:

B1) Which of the following did you feel during your visit:

Indifferent	Interested	Uninspired	Bored
Excited	Captivated	Engaged	Disappointed
Satisfied	Neutral	Frustrated	Other _____

B2) I felt like I was transported to a whole new world and lost track of time:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

B3) I would recommend the Virtual Museum to my friends/family:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

B4) I would like to have more experiences like this in the future:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C. Learning and Understanding:

C1) The experience helped me learn something about the Antonine Wall:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C2) I would like to have more information about the artefacts:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C3) The Virtual Museum offered a realistic representation of the Antonine Wall display at the Hunterian Museum:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

C4) During the experience my eyes were opened to new ideas, if yes please explain:

_____

_____

D. Fact VS fiction:

D1) It was clear that the Virtual Museum is a digital representation of the Antonine Wall display:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

D2) The distinction between the archaeological/historical information and the Ebutius story was clear:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

D3) It was clear what the objects' real dimensions are:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

E. Technical part:

E1) Different interfaces were easy to use:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

E2) The map at the left side of the screen assisted effectively my visit:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

E3) It was easy to find the artefacts/objects within the Virtual museum interface:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

E4) I felt the system responded quickly to my commands:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

F. Overall experience:

F1) Choose one of the following words that can best describe your overall experience:

Indifferent Interested Uninspired Bored

Excited Captivated Engaged Disappointed

Satisfied Neutral Frustrated Other _____

F2) In terms of using the application was there any particular problem you faced?

_____

_____

_____

Gi. Please answer the following question <u>if you have had the on-site EMOTIVE experience:</u>

G(i) 1) The on-site experience at the Hunterian Museum in Glasgow was better than the virtual:
Completely disagree |_____|_____|_____|_____|_____| Completely agree

G(i) 2) Which of the two experiences you preferred and why:

_____

_____

_____

G(ii). Please answer the following <u>question if you have not visited the Hunterian Museum:</u>

G(ii)1) The Virtual Museum makes me eager to visit the Hunterian Museum in Glasgow:
Completely disagree |_____|_____|_____|_____|_____| Completely agree

G(ii) 2) The Virtual Museum triggered my interest in having the on-site EMOTIVE experience at the Hunterian Museum in Glasgow:

Completely disagree |_____|_____|_____|_____|_____| Completely agree

H. Demographic questions:

H1) Please select your gender from the options below:

Male ☐ Female ☐ Other ☐ Prefer not to say ☐

H2) Please select your age group from the options below:

18-24 ☐

25-34 ☐

35-44 ☐

45-54 ☐

54-75 ☐

H3) Are you familiar with the EMOTIVE project:

Yes ☐ No ☐

H4) Have you visited the Hunterian Museum in Glasgow:

Yes ☐ No ☐

H5) Have you experienced the on-site EMOTIVE experience:

Yes ☐ No ☐

H6) Have you ever had any virtual museum experience before:

Yes ☐ No ☐

Thank you for taking part!!

Annex D Çatalhöyük Schoolkit Evaluation Instruments

D.1 Çatalhöyük Schoolkit Evaluation Questionnaire

Questionnaire

We need your help to make this experience better! This questionnaire will ask how you felt during the experience. There are no right or wrong answers. If you don't understand one of the questions, you can ask the leader or Sierra for help.

1. How old are you? _____

During this experience...			
2. I learnt something new.			
3. I used the facts I learnt when thinking about how a person who lived in Çatalhöyük might act.			
4. I thought about the past from a new perspective.			
5. Talking with my group members helped me understand something new.			
6. I thought about the past from the perspective of a person who lived at Çatalhöyük.			
7. I felt connected to the people of Çatalhöyük.			
8. I became emotional.			
9. I became more interested in the site.			
10. I felt comfortable sharing my ideas in my group.			
11. I was able to connect the experience to my own life.			

12. During this session, I felt … (Circle the ones that you felt)

Interested Bored Happy Excited Disappointed

Sad Frustrated Curious Confused Comfortable

Other: _____

13. One thing I've learnt about Çatalhöyük is …

(if you don't remember anything that's okay!)

14. The part of the experience that made me think about the differences between people in the past and people today is …

Thank you for taking part in our EMOTIVE evaluation!