

# Master Degree Project



UNIVERSITY  
OF SKÖVDE

## **SOUND, SPACE, AND STORYTELLING**

Designing a Location-Based Audio Game for  
Engaging Museum Visitors and Fostering  
Historical Empathy

Master Degree Project in Informatics

Two year Level 30 ECTS

Spring term 2025

Dawn Xiaoqing Li

Supervisor: Per Backlund

Examiner: Rebecca Rouse

# Abstract

This study explores how location-based audio games can foster historical empathy by connecting museum narratives with real-world heritage sites. Developed in collaboration with the Västergötland Museum in Skara, the prototype guides players through the city using GPS-triggered audio, encouraging spatial imagination and emotional engagement. Adopting a mixed-methods approach, the research combines narrative co-design, iterative prototyping, and empirical testing with ten participants. Data were collected through observations, questionnaires, and semi-structured interviews informed by the VALERIE framework (Carneiro, Viana and Darin, 2021) and the Historical Empathy Measurement Tool (HEMT) (Crompton et al., 2023). Results indicate that audio-first design enables immersion without visual distraction and supports affective engagement with historical content. While most participants reached mid-level historical reflection, deeper contextual understanding was less frequent, suggesting further potential for design refinement. This study offers practical insights into the design of non-visual, site-specific games for cultural heritage, and contributes to ongoing discussions on empathy, narrative, and place-based interaction in serious game research.

**Keywords:** serious games, cultural heritage, location-based games, audio games, historical empathy

## ACKNOWLEDGEMENTS

The completion of this study would not have been possible without the contributions of the following individuals.

Xin He implemented all technical features of the game prototype; his support and collaboration made it possible to bring the concept to life.

Participants in the narrative workshop—Pierre-Benjamin Monaco, Lissa Holloway-Attaway, Lars Kristensen, and Patrik Erlandsson—provided valuable perspectives that laid a solid foundation for the game’s narrative design.

Ludvig Lhonneur from the Västergötland Museum offered historical input and guided on-site tours that informed the game settings.

Part of the background research was informed by a literature review on narrative in serious games for cultural heritage, previously co-authored with Hanbing Dong.

I also thank my supervisor, Per Backlund, for his guidance throughout the project.

Finally, I am grateful to all playtesting participants for their time and constructive feedback, which directly supported the evaluation of the prototype.

# CONTENT

<b>1 Introduction</b> .....	<b>1</b>
<b>2 Background</b> .....	<b>2</b>
2.1 Serious Games for Cultural Heritage .....	2
2.2 Historical Empathy .....	3
2.3 Location-based Games Design for Cultural Heritage .....	4
2.4 Soundwalks and Location-based Audio Games .....	5
<b>3 Problem</b> .....	<b>9</b>
3.1 Problem Context .....	9
3.2 Research Questions .....	9
3.3 Method .....	10
3.4 Ethical considerations .....	12
<b>4 Development Process</b> .....	<b>13</b>
4.1 Contextual research .....	13
4.2 Co-design narrative workshop .....	15
4.3 Mechanics and interaction design .....	20
4.4 Pilot Prototype and Testing .....	24
<b>5 Prototype Result</b> .....	<b>27</b>
5.1 Mechanics and storylines .....	27
5.2 Audio and interface .....	29
<b>6 Evaluation Results</b> .....	<b>30</b>
6.1 Playtest Session and Interview .....	30
6.2 Collected Data .....	32
6.3 Data Analysis .....	34
6.4 Results .....	36
6.4.1 Player experience and perception .....	36
6.4.2 Historical empathy levels .....	40
6.4.3 Contributing factors to historical empathy .....	43
6.4.4 Extended Impacts .....	44
<b>7 Conclusions</b> .....	<b>45</b>
7.1 Summary .....	45
7.2 Discussion .....	46
7.3 Future Work .....	48
<b>References</b> .....	<b>49</b>

# 1 Introduction

Games have been considered as promising tools for cultural heritage for years. Many museums now integrate digital games to their exhibition space to immerse visitors in dynamic narratives (Navarrete, 2019; Barkova et al., 2019). Yet, despite their potential, these solutions often fall short in bridging the gap between curated museum exhibitions and the fragmented, dispersed historical sites embedded within urban landscapes. Existing approaches, such as in-exhibition VR simulations or location-based AR apps, either isolating users in virtual environments or overwhelming them with screen-dependent interactions (Chatzidimitris et al., 2016; Mortara et al., 2014).

This study proposes an alternative paradigm: location-based games that prioritize non-visual interaction to integrate digital storytelling with physical exploration. Using 3D spatial audio, and GPS-triggered narratives, such games aim to anchor historical knowledge within its original context, transforming city streets into living museums. For instance, a player might follow the singing of the monks to discover the location of an old monastery, guided solely by soundscapes that blend past and present. This approach not only minimizes screen distraction but also invites users to experience heritage in situ, fostering connections between institutional narratives and the tangible remnants of history.

The research addresses three core questions:

RQ1: How do players perceive the experience of a location-based audio game designed to foster historical empathy?

RQ2: To what extent does the game elicit historical empathy?

RQ3: What factors contribute most to eliciting historical empathy?

To address these goals, the project adopts a mixed-methods approach that combines contextual inquiry, narrative co-design, iterative prototyping, and empirical user testing. A total of 10 participants tested the final prototype in real-world settings. Data were collected through field observation, questionnaires, and semi-structured interviews informed by the VALERIE framework (Carneiro, Viana and Darin, 2021) and the Historical Empathy Measurement Tool (Crompton et al., 2023).

This study contributes both practical and theoretical insights. It demonstrates how audio-first design can support immersive and accessible experiences in cultural heritage games, and offers empirical findings on the emotional and cognitive dimensions of historical empathy in location-based contexts.

The remainder of this paper is structured as follows: Section 2 shows the research background and previous research, Section 3 states the research questions and details the research methods, Sections 4 presents the prototype development process, Section 5 demonstrates the prototype result, Section 6 the data collection and analysis, and Section 7 discusses the conclusion of this study and potential future work.

## 2 Background

This study is situated at the intersection of cultural heritage, games, location-based technologies, and audio storytelling. While very few previous studies have addressed all four aspects together, a considerable amount of research has explored related topics from various perspectives and disciplines.

The Background section is structured in four parts: The first part begins with a discussion of the broader context of using serious games (SGs) in cultural heritage (CH), the focus then narrows to the use of narrative in these SGs; The second part presents studies that focus specifically on location-based games (LBGs) applied within CH settings; Given the project's emphasis on audio as the primary narrative and interactive medium, a review of audio-focused experiences is included in the third part; Lastly, a key theoretical concept of this research is introduced: *historical empathy*.

### 2.1 Serious Games for Cultural Heritage

Serious games (SGs) are games with goals beyond entertainment (Greitzer et al., 2007), and they have long been considered as promising tools for cultural heritage (CH) (Foni et al., 2010). The main objectives of the SGs for CH including cultural awareness, historical reconstruction, and heritage awareness (Mortara et al, 2014).

Existing SGs for CH can be categorized into three main types: prototypes and demonstrators that used for academic or experimental purposes but not widely released; virtual museums that offer interactive experiences or present digital replicas used in museum or remote learning; and commercial historical games that are more entertainment-focused but also provide historically themed gameplay (Anderson et al, 2010).

Technological aspects that are emphasized in cultural heritage serious games (CHSGs) studies include game engine infrastructure, virtual world interfaces (VR, AR, and MR), rendering techniques, and artificial intelligence (Anderson et al, 2010). Some other studies also point out that the most popular approaches of integrating games with museum content involves the use of interactive touchscreens, Augmented Reality (AR) and Virtual Reality (VR) devices within exhibition spaces (Navarrete, 2019) (Barkova et al., 2019).

Regarding practical methodologies, the study of Laiti et al (2020, pp.296-311) incorporate perspectives from CH field, including techniques such as participatory observation, qualitative interviewing, and textual analysis.

While the broader field of cultural heritage serious games (CHSGs) discusses diverse design approaches and technological considerations, the project presented in this thesis adopts narrative storytelling as one of its core design strategies. Therefore, it is necessary to examine how narrative has been employed within CHSGs, what benefits it offers, and what design challenges it presents.

Narrative elements can enhance player engagement by enhancing motivation (Naul and Liu, 2020), and enhance the immersion and fluency of the player experience during gameplay, thereby having a positive effect on player perception and learning (Alexiou et al., 2020). However, based on the review of the literature on narrative in CHSGs, I have identified

several challenges that must be considered when designing narrative strategies, as discussed below.

**Risk of over-instrumentalizing empathy through advanced technologies.** Many studies have shown that cultural heritage serious games are very suitable for the emotional field, that is, empathy for characters and plots can help understand history, culture, and the feelings and behaviors of others (Mortara et al., 2014). In parallel (and in line with broader trends in SGs for cultural heritage), recent research on narrative design has increasingly emphasized the role of new technologies, especially the realms of AR and VR. Giariskanis et al. (2022), Ticala et al. (2020), Nóbrega et al. (2017) provided evidence for that XR can enhance immersion in narrative games.

Together, these developments suggest a growing interest in designing emotionally powerful, technologically enhanced historical narratives. However, this trend also raises critical concerns. While immersive media such as VR and AR appear to offer promising ways to evoke empathy and influence users' attitudes or beliefs around cultural and social issues, it risks simplifying complex realities, preventing true dialogue across communities, and even reinforcing existing power structures (Rouse, 2021).

**Narrative adaptability and contextual constraints.** Mortara et al (2014, pp.318-325) highlighted that the content and themes of the narrative may be influenced depending on various application scenarios. For instance, serious games employed in fixed locations such as museums demand careful consideration of the duration required for the overall experiential content and whether it permits simultaneous engagement by multiple individuals. On the other hand, scenarios using mobile devices for outdoor exploration should prioritize lightweight, interruptible narrative content to ensure that users are not unduly burdened, thereby preserving their capacity to engage in real-world activities (Mortara et al., 2014).

**Challenge of integrating narrative with gameplay mechanics.** DaCosta and Kinsell (2023) pointed out that narrative content should be intricately interwoven with the challenges presented in the game to prevent players from experiencing monotony and boredom. It is essential to validate and reinforce the knowledge acquired by players through appropriate questions and story elements.

**Tension between historical authenticity and narrative freedom.** Palombini (2017) introduce the famous debate about harmonizing narrative freedom and historical truth, and suggests that employing narrative for exposition and presentation may require some fictional elements not grounded in history or reality. The only criterion in such cases is to avoid contradicting factual information, and flexibility in the use of supplementary content can be exercised within this principle. This also points to a deeper question about the intended outcomes of such experiences, which will be discussed in the following section.

## 2.2 Historical Empathy

As discussed in the previous section, narrative strategies in serious games for cultural heritage often involve a careful negotiation between historical truth and creative freedom. This tension raises a broader question: what kind of historical understanding should such experiences aim to foster? Aware of the critiques surrounding the instrumentalization of empathy in digital heritage experiences (Rouse, 2021), I initially considered using the term

meaningful connection as the project's objective, which I defined operationally as "not merely cognitive links with historical facts, but emotional resonances, personal reflections, and subjective interpretations." However, I later adopted the term historical empathy, as it is more established and better supported in educational literature. To avoid the pitfalls previously discussed, I closely examined how this concept is applied in relevant studies.

Historical empathy has been a topic of active discussion in history education over the past three decades (Bartelds et al., 2020). It has evolved into a key concept aimed at addressing the limitations of traditional history teaching, which often emphasizes factual content such as dates, places, and events (Cameron, 1997; Momoki, 2022). This fact-based approach can make history feel disconnected from learners' own lives and hinder their ability to grasp diverse historical perspectives (Barton, 2009).

In response, historical empathy has gained increasing attention. A widely adopted definition is provided by Endacott and Brooks (2018, pp.209), who describe it as "the process of students' **cognitive** and **affective** engagement with historical figures to better understand and contextualize their experiences, decisions, or actions."

In this model, the cognitive dimension refers to understanding historical actors' beliefs and decisions within their temporal, spatial, and social contexts — requiring contextualization, multiperspectivity, and evidence-based reasoning. The affective dimension involves creating a sense of personal connection, which can arise when learners feel emotionally engaged with a task because it resonates with their interests or feels relevant to real-world situations (Endacott and Brooks, 2013; Barton, 2016; Immordino-Yang and Damasio, 2007).

To further operationalize this dual-dimensional process in empirical analysis, this study draws on the Historical Empathy Measurement Tool (HEMT) introduced by Crompton et al. (2023). It is a structured framework for assessing learners' ability to empathy with the past. The tool comprised of three core components: contextualization, perspective-taking, and affective connection. HEMT uses a seven-level rubric to evaluate learners' responses to history related questions: (0) Non-response, (1) Facts, (2) Assumptions and Deficits, (3) General Comparison of the Past and Present, (4) Emotional Comparison of the Past and Present, (5) Understanding Motives, Behaviors, Thoughts, and Emotions in the Past, and (6) Acknowledgement of Differences from those in the Past. Though originally developed for analyzing student essays, the framework has been adapted as a qualitative coding scheme to analyze players' responses to questions related to historical awareness.

In the following two sections, I will focus on the two primary approaches this study intends to adopt in addressing the previously discussed challenges and objectives.

### **2.3 Location-based Games Design for Cultural Heritage**

Location Based Games (LBGs) are games that supported by location technologies to integrate the position of one or more players to its rules as a core component of the game (Carneiro, Darin and Viana, 2019). This sections specifically reviews previous research that provides insights relevant to empirical design and evaluation practices.

While numerous studies explore design methods and processes of cultural heritage-focused LBGs, those adopting audio-first approaches remain relatively uncommon. However, a recent study by Vilar, Rodrigues and Correia (2025) highlight the potential of integrating

historical soundscapes within urban heritage experiences. The study present a location-based AR game project and a platform that is designed to support location-based interactive narrative games. The platform emphasizes using the city's historical soundscapes to evoke users' emotional connection to cultural heritage sites. The project also includes a clearly defined user-centered design and evaluation process, including standard usability testing (SUS), knowledge acquisition assessment (pre/post testing), and emotional response feedback, which provides valuable insights for the current research.

Koutsabasis et al., (2021) demonstrate the full application of the design thinking process in developing a location-based cultural heritage game. The game effectively bridges museum content with urban heritage sites through exploratory missions, AR-enhanced storytelling, and spatially distributed challenges. The study offers particularly valuable insights into game ideation, prototype iteration, and user-centered testing. Their use of co-discovery field playtesting with heritage experts and structured evaluation methods provides a strong methodological reference for similar projects. A further example of narrative-driven location-based game design is Avebury Portal, an AR treasure hunt for an archaeological site in England. The game uses puzzles and spatial narrative triggered by user location to support site-specific exploration (Shakouri and Tian, 2019). Similarly, Vassilakis et al. (2020) present a GPS- and AR-supported location-based game focused on the fortification gates of Heraklion. Designed for historical learning, the game combines physical movement with virtual augmentations to support narrative exploration of real-world urban heritage.

In addition to design methods, it is also essential to consider evaluation methods specifically tailored to LBGs due to their unique characteristics. Carneiro, Darin and Viana (2019) presented the results of a systematic mapping study in LBGs evaluation. They pointed out that LBGs have unique features that differentiate them of other “conventional” games, which make it challenging to assess the quality of user interactions with them. By reviewing 51 selected papers that report the evaluation process of LBGs, they extracted that the most common method combinations were “survey-interview-observation” and “survey-interview-logs recording”, and the five most frequently assessed qualities are player experience, usability, enjoyment, immersion and engagement. They also summarized the common strategies of data analysis. In a later research paper published in 2021 (pp. 1-7), they proposed the VALERIE guide focuses on using interviews to explore LBGs characteristics and relevant PX constructs. This guide is adopted and adapted in the present research, as will be further detailed in Section 3.3.

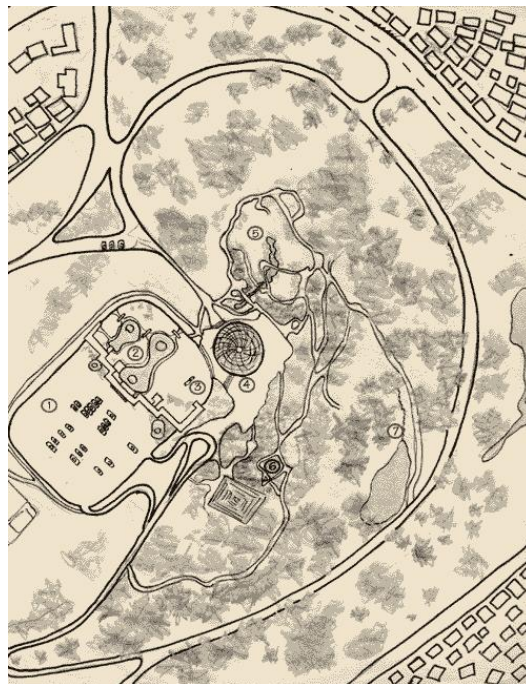
It is noteworthy that, while many location-based applications rely heavily on visual interfaces, which often requires the audience to constantly watch their devices' screen and causes distraction (Chatzidimitris, Gavalas and Michael, 2016), some previous studies already showed that non-visual guides allow users to experience augmented reality while keeping the real-world environment in focus (Szymczak et al., 2012). This points to the need for a closer examination of how sound can play an important role in such practices.

## **2.4 Soundwalks and Location-based Audio Games**

Following the discussions on location-based games for cultural heritage, this section turns to another essential aspect of the present study: the role of sound. Here, I glean insights from two interconnected yet distinct fields of practice: The soundwalks created by artists, and the “audio augmented reality (AAR) games” or “location-based audio games” developed within

the domains of game design and interactive media. These two strands, though developed relatively independently and adopted different vocabularies in their discourses, reflect overlapping concerns in how sound can shape embodied spatial experience. My aim is not to impose a connection between them, but to consider them side by side — to draw on interaction methods from game and media design, and to build on the aesthetic explored in sound-based artistic practice.

Soundwalk is an initiative that emerged in the 70s, when R. Murray Schafer established World Soundscape Project (WSP) (Smolicki, 2023). An early definition proposed by Hildegard Westerkamp, a key member of WSP, describes soundwalking as “any excursion whose main purpose is listening to the environment. It is exposing our ears to every sound around us no matter where we are” (Westerkamp, 2001/1974, n.p.)<sup>1</sup>. Early works centered on attentive listening to the existing soundscape of the real world. They typically provided participants with a paper map with marked walking routes and numbered listening stops (Figure 1), a written guide with instructions on what and how to listen, and a set of reflective questions to prompt deeper engagement. For example: “Close to the fountains you will find a metal sculpture...Explore it visually as well as acoustically. It consists of two pieces both of which have a different structure. Do they also differ in their sounds? What other relationships can you find between its form and its sounds?” (Westerkamp, 2001/1974)



**Figure 1** The map for *A Soundwalk in Queen Elizabeth Park* (Westerkamp, 2001/1974, n.p.)

From these instructions, we can see that early soundwalks, although far from being considered as games, did carry some playful qualities and emphasized active listener participation. Many soundwalking practices were grounded in Careri’s (2017) notion of “walking as a vehicle to re-read and re-write the landscape”. As Radicchi (2017) notes,

---

<sup>1</sup> The original text was published in 1974, the version cited here is a revised edition made available online in 2001.

soundwalking can uncover “the perceptual relationships between the inhabitants and the city itself through its sonic component” (p. 70).

The art form further evolved as incorporating on-site recording and portable audio devices (e.g. Walkman, MP3 player) became increasingly common in the 90s. A representative artist in this period is Janet Cardiff, who created her first audio walk in 1991. Since then, she and George Bures Miller have created several soundwalks that directly inspire the present project. Cardiff and Miller’s works are recorded on-site using binaural technology. Listeners have to put on stereo headphones and follow audio instructions to retrace her original path. The audio content is often guided by Cardiff’s own voice as the narrator, with explicit instructions such as “follow my pace,” “now stop here,” “sit on that bench,” “close your eyes,” or “walk backward”, that intensify embodied experience. As the narration unfolds, thematic sound effects and voice actor’s performance are incorporated to create a complex multi-layers storytelling (Schaub, 2005). Their works provide uninterrupted listening that immerses participants in an interwoven narrative space of present and past, reality and fiction. However, they have acknowledged the practical challenges of calculating the number of steps and the time required to move between locations in her projects. It is difficult to ensure that listeners maintain the same pace she had while recording or that they are in the intended location when the corresponding narratives are played.

In recent years, while soundwalking has been applied to various fields and topics including environmental perception and ecological awareness (Ruiz Arana, 2023; Droumeva, 2023), racialized and postcolonial geographies (Chude-Sokei, 2023; Gutiérrez, 2023; Messina, 2023), memory and trauma studies (Ouzounian, 2023), and technologically mediated artistic practices (Shaw, 2023). There have been relatively few advances in technology or interaction methods within the soundwalking field. However, as mentioned earlier, developments in other areas, particularly within human-computer interaction (HCI) and game design communities, have explored various forms of sound-based walking experiences. Notably, the use of GPS tracking in these contexts offers a potential solution to the challenges Cardiff and Miller faced (i.e. keeping listeners in sync with recorded narration during movement), by enabling automated spatial and temporal alignment and improving the accuracy of both physical navigation and narrative timing, as discussed in Section 2.3.

In addition, Chatzidimitris, Gavalas, and Michael (2016) explored alternative methods of navigation beyond voice-over instructions in a case study of a location-based audio game. Their work examines the effectiveness of relying solely on 3D spatial sound for guiding players. While Rovithis et al. (2019) focused on expanding the ways of player input beyond walking. Their study emphasized additional interactive gestures such as holding, pointing, and waving the device. However, though players are easily adapted to auditory navigation, it is pointed out that the gestural sonic interaction is perceived as difficult.

In summary, the present project is rooted in the aesthetic and philosophical foundations of previous soundwalking practices, while emphasizing specifically the underlying characteristics of establishing connection and relationship in soundwalking projects. A more recent definition of soundwalking reflects this notion:

Soundwalking is a creative and research practice that involves listening and sometimes recording while moving through a place at a walking pace. It is concerned with the relationship between soundwalkers and their surrounding sonic environment.

McCartney (2014, pp.212)

These characteristics also align well with the objectives of historical empathy discussed in Section 2.2, particularly in their emphasis on affective engagement, contextual sensitivity, and personal reflection. Furthermore, the present project aims to appreciate these artistic forms and philosophies to a new application context of cultural heritage. By incorporating new technologies and design thinking, the project reinterprets Careri's (2017) concept of "re-reading" and "re-writing" into real/formal interaction with the system. That said, re-reading refers to the layered outputs generated by the interplay between game systems and real-world space, while re-writing takes place through the player's movements and meaningful choices.

## 3 Problem

### 3.1 Problem Context

As discussed in the Background section, the use of serious games (SGs) in the field of cultural heritage (CH) holds potential but not without research gap. Two aspects that can still be further explored are: **First, the challenges in using narratives to foster historical empathy**, including the harmony between narrative and game mechanics (DaCosta and Kinsell, 2022); the balance of historical authenticity and narrative freedom (Palombini, 2017); and the risk of overusing narrative in ways that instrumentalize empathy (Rouse, 2021). **Second, the lack of exploration regarding audio location-based games**. Current studies on LBGs for CH rely heavily on visual elements, which risk distracting players from real-world settings (Chatzidimitris, Gavalas and Michael, 2016; Szymczak et al., 2012), while artistic practices on soundwalks lack of interactive elements and thus limit user engagement (Schaub, 2005).

To address the challenges outlined above and fill the identified research gap, this study proposes and develops a location-based audio game prototype situated in a real-world setting, in collaboration with Västergötland Museum in Skara. The project aims to foster historical empathy among visitors. As Mortara et al (2014) point out, the narrative design of cultural heritage serious games (CHSGs) must be adapted based on their application contexts. Västergötland museum is a regional historical museums, which serve as central repositories for local knowledge. The historical sites mentioned in its exhibitions are scattered throughout the city, divided by urban streets and facilities, preventing tourists from having a consistent, immersive historical tour. Within this specific context, several practical design questions arise: How to create a consistent narrative structure that fits the mobile, outdoor, and gamified nature of the experience? Can such a design maintain historical authenticity without compromising player engagement? And to what extent can it support the museum's goal of effective cultural communication?

These considerations lead to the formulation of the research questions.

### 3.2 Research Questions

This study explores how location-based technology, audio-first approaches, and interactive game mechanics can be combined to address narrative challenges posed by dispersed historical sites in cultural heritage contexts. The overall research question is: How can a location-based audio game engage museum visitors and foster historical empathy?

The main research question can be further divided into three sub- questions:

RQ1: How do players perceive the experience of a location-based audio game designed to foster historical empathy?

This question explores how players respond to the new format of a non-visual game that requires outdoor physical movement on a general level. On a more specific level, the question draws on the VALERIE framework (Carneiro et al., 2021), which identifies three core dimensions of player experience in location-based games: challenge, immersion, and emotion. These dimensions structure the more detailed evaluation of how players perceive the game.

RQ2: To what extent does the game elicit historical empathy?

For this question, historical empathy is assessed using the levels defined in the Historical Empathy Measurement Tool (HEMT) (Crompton et al., 2023), which offers a structured framework for evaluating participants’ responses. The specific application of this model is detailed in Section 3.3 Method.

RQ3: What factors contribute most to eliciting historical empathy?

To answer this question, empathy levels assessed in RQ2 will be compared with two sets of factors: first, the structural components of location-based games as defined in the VALERIE framework—such as spatiality, mobility, and general aspects, with audio aspects added in this study; and second, the dimensions of player experience explored in RQ1, including challenge, immersion, emotion, and overall acceptance of the format.

### 3.3 Method

This research follows a Design Science Research approach, which focuses on the iterative creation and evaluation of artifacts to address real-world problems and generate theoretical insights (Perjons and Johannesson, 2021). It was conducted as a case study in collaboration with Västergötland museum in Skara, Sweden, which expressed strong interest in the proposed direction. Following an independent site visit and a preliminary meeting with museum staff, it was jointly decided to create a location-based audio game based on one of the museum’s permanent exhibition “Skara in Middle Ages”. The aim is to investigate the broader research problems through the lens of this specific empirical case.

This study adopts a phased, mixed-methods approach that combines contextual inquiry, participatory design, iterative prototyping, qualitative interviews, and quantitative data analysis. As shown in Table 1, different methods were used across three chronological phases: Preparatory, Design & Development, and Testing & Evaluation. These methods collectively contribute to the exploration of the three sub-research questions, either by shaping the design process or by generating empirical data.

**Table 1** Methods and related RQs

Phases	Methods	Participants	Informed RQs
Preparatory Phase (Section 4.1)	Field visit, contextual inquiry, informal interviews, content inventory	Museum staff	RQ3
Design & Development (Section 4.2-4.4)	Narrative co-design workshop	museum staff, narrative experts, game designers, local residents	RQ1 & RQ3
	Iterative prototyping	Development team	RQ1
Testing & Evaluation (Section 6)	Field testing: observation, questionnaires, semi-structured interviews	Target users, game designers, museum staff	RQ1 & RQ2 & RQ3

The preparatory phase primarily involved a field visit focused on contextual inquiry, including informal interviews with museum staff and a content inventory of exhibition materials. This aimed to understand museum needs, identify the target audience, and extract engaging elements to inspire the game design.

During the design & development phase, a narrative co-design workshop was conducted involving five participants: the author (as game designer and facilitator), one media producer from the collaborating museum, two university professors in narrative fields, and one game design student. Reflecting the interdisciplinary nature of the project, this workshop aimed to integrate diverse perspectives from museum professionals, narrative experts, and game designers.

Three main versions of prototypes were created during the design & development phase. The first was a technical prototype, created to test GPS signal accuracy and the branching narrative logic. This version focused on interaction design and core gameplay mechanics, and was tested within the development team. The second was a pilot prototype presenting a vertical slice of the intended gameplay experience. It was tested in the field with two pilot participants, whose feedback led to several refinements in both the game content and the testing procedures. Lastly, a final prototype was produced for the main user testing and evaluation. While minor adjustments were made during the final stage, no major structural changes were introduced.

In the final testing and evaluation session, data collection primarily consisted of observation notes, a short questionnaire, and semi-structured interviews. Each session began with two short pre-play questions assessing the player's familiarity with the museum exhibition and the city of Skara. The player then proceeded to play the game while the researcher followed at a short distance to observe behavior.

After gameplay, participants completed a short questionnaire adapted from the Game Engagement Questionnaire (GEQ) (Brockmyer et al., 2009), a tool to measure the psychological engagement of players during gameplay; as well as the Self-Assessment Manikin (SAM) (Bradley and Lang, 1994), a tool for assessing participants' immediate emotional response to a stimulus. The questionnaire was used to guide the interview. The full questionnaire can be found in Appendix A.

The main interview was structured around four themes: Challenge, Immersion, Emotion, and Historical Awareness. The first three were adapted directly from the VALERIE framework (Carneiro, Viana, and Darin, 2021), while the fourth was inspired by the Historical Empathy Measurement Tool (HEMT) (Crompton et al., 2023). The full interview question bank can be found in Appendix B; however, some follow-up questions were improvised during the interviews.

All interviews were audio-recorded and transcribed. The transcripts were then coded using Delve, a qualitative analysis tool, applying both deductive categories (based on the four PX themes) and inductive coding to capture emergent insights. This thematic analysis allowed for a structured yet nuanced understanding of how different design elements shaped the overall player experience.

### 3.4 Ethical considerations

This study adhered to established ethical standards as outlined by the Swedish Research Council (Vetenskapsrådet, 2025). All user testing and interviews were conducted with respect for participants' autonomy, privacy, and well-being.

During both pilot and final testing sessions, participants used researcher-provided mobile devices to prevent any access to personal data stored on their own phones. In the pilot phase, GPS trajectory data was recorded solely for research purposes and anonymized during analysis. No personally identifiable information was collected or stored. In the final testing, no GPS data was collected on participants' devices, further minimizing privacy risks.

Before each session, participants were clearly informed of the study's purpose, procedures, and data handling methods. Verbal consent was obtained prior to participation. It was emphasized that participation was entirely voluntary, that they could withdraw at any time without consequence, and that any audio recordings or responses used in the thesis or future publications would remain anonymous.

Observation notes and interview recordings were handled confidentially, and only the researcher had access to the raw data. Transcripts were pseudonymized before analysis using qualitative coding software (Delve). To further protect participants' privacy, quotes used in the thesis are presented without any identifying information.

The collaborating museum was also informed in advance about the intended use of selected quotes from its staff, and their verbal agreement was obtained, ensuring institutional transparency.

No participants were minors or individuals in vulnerable situations. The study posed minimal risk and did not involve sensitive personal information. As per institutional practice and Swedish ethical review regulations, no formal ethics board approval was required for this type of minimal-risk, anonymized research. However, all activities were carried out in line with ethical principles of informed consent, non-maleficence, data minimization, and transparency.

All sound assets used in the prototype were sourced from Freesound.org and used under the terms of their respective Creative Commons licenses. No proprietary or copyrighted materials were used without explicit permission.

AI (ChatGPT) was used at several stages of the study, including early-stage brainstorming and idea generation, organizing interview transcripts, Swedish-to-English translation, and conducting final grammar checks.

## 4 Development Process

This chapter outlines the full development process of the project. Section 4.1 describes how insights gathered during field visits and informal interviews informed the initial concept. Section 4.2 details a narrative co-design workshop that explored how storytelling could be used to elicit historical empathy. Section 4.3 explains the design of core mechanics and interaction models tailored to an audio-first LBGs. Finally, Section 4.4 presents a pilot prototype and test run, which helped validate the design and refine the evaluation procedure.

### 4.1 Contextual research

Informed by the study of Laiti et al (2020), a field visit was conducted in Skara during the pre-development phase. The museum coordinator provided a regular visitor tour for the museum's current exhibition *Skara in the Middle Ages, as well as* a special walkthrough in the city space covering most of the key historical sites. During and after the tours, informal conversations were held with museum staff to explore two key aspects: (1) identifying which elements were most intriguing and/or engaging for visitors, these elements should be incorporated into the game design. (2) understanding the museum's priorities, challenges, and expectations for the collaboration.

The exhibition focuses on the city's history in medieval times, particularly between the 11<sup>th</sup> and 14<sup>th</sup> centuries, a period when Skara and the Västergötland region exerted significant influence across Sweden. The walkthrough followed the typical route used for public visitors, offering insights into the museum's interpretive structure and key narrative highlights. Based on insights gained during the tour, the 13th century was identified as a key historical period as well as a promising setting for the game. This decision was informed by the fact that Skara reached its peak during the 13th century, a time when most of the city's major structures—such as churches, monasteries, the castle, and the cathedral (which still stands today)—were either established or significantly renovated. Figure 2 illustrates a 3D city model representing this era. As the overall city layout has remained relatively unchanged, one can easily identify corresponding locations on the model if they are familiar with the city today.



**Figure 2** The city model of Skara in 13th century

In contrast to the regular exhibition tour, the city walkthrough was not part of the standard visitor experience, but rather intended for designers to explore how physical spaces in the urban environment could be meaningfully linked with the exhibition's narrative content. As mentioned, many of Skara's medieval structures significantly influenced the city's layout, and some relics are still visible today. Figure 3 depicts the current site of S:t Nikolaus Church, while the cathedral still stands in the background.



**Figure 3** The relic of S:t Nikolaus Church

However, unlike S:t Nikolaus Church, most historical relics from this period are either buried underground or have been replaced by modern buildings. This creates significant difficulties for visitors attempting to connect the rich historical narratives presented within museum exhibitions to the actual urban landscape they encounter today.

In parallel, available exhibition brochures and catalogues were collected and reviewed to map key historical themes, storytelling elements, and potential connections to physical sites in the city. This process functioned as a content inventory, helping identify materials suitable for adaptation into game narrative.

It is worth noting here that in the preface of the exhibition's accompanying publication (exhibition monograph), it is clearly stated:

The exhibition is, however, only one way to bring the past to life. Another is to make landmarks in the landscape accessible and signposted, so they can be experienced on-site.<sup>2</sup>

Augustsson (1995, p.7)

This statement further supports the idea that the research questions addressed in this study are closely aligned with the specific context of this case.

## 4.2 Co-design narrative workshop

After the field visit, a narrative co-design workshop was conducted to address the second and third research question: To what extent does the game elicit historical empathy, and what factors contribute most to eliciting historical empathy?

Based on this principle, the design process had to navigate several key challenges:

- Time span: The narrative spans approximately 600 years.
- Spatial fragmentation: Relevant historical sites are dispersed throughout the city.
- Chronological-spatial conflict: The chronological order of events often conflicts with the most intuitive or practical spatial routes for navigation.

It is important to note that this workshop focused exclusively on story and narrative development — not on gameplay mechanics, interaction models, or rule systems. These aspects were considered separately to avoid limiting narrative creativity during the ideation process.

During the workshop, participants focused on developing a narrative that aligns with the game's core design principles. That said, rather than aiming for factual memorization (e.g. dates or locations), the game should aim at:

- Evoke emotional connections to history.
- Highlight how historical events have shaped the contemporary city.
- Encourage personal reflection through open-ended storytelling.

The workshop was attended by five participants with diverse backgrounds relevant to the project's interdisciplinary goals. These included:

- The author, acting as both game designer and facilitator;

---

<sup>2</sup> Original text in Swedish: Utställningen är emellertid bara ett sätt att levandegöra det förgångna. Ett annat är att göra sevärdheter i landskapet tillgängliga och skyltade så att man kan uppleva dem på plats. (English translation generated by ChatGPT)

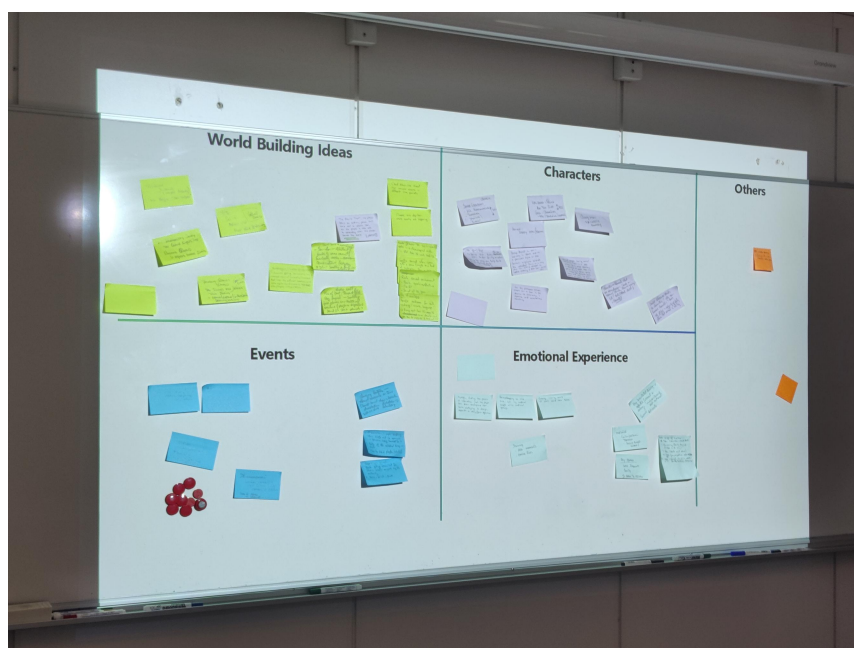
- One media producer from the collaborating museum, responsible for digital content and public communication, and also had some previous experience in game writing;
- Two university professors specializing in narrative fields such as literature, theatre, and film;
- One Business and Marketing student with a specialisation in game industry, who had lived in Skara for a year and contributed local insights.

All participants were informed in advance that anonymized insights from the session might be used in this thesis, and they gave verbal consent to be acknowledged by their professional roles.

The full session lasted approximately 2.5 hours and followed a two-phase structure: an initial round of guided brainstorming, followed by a collaborative storyboard development phase, with a 15-minute coffee break in between.

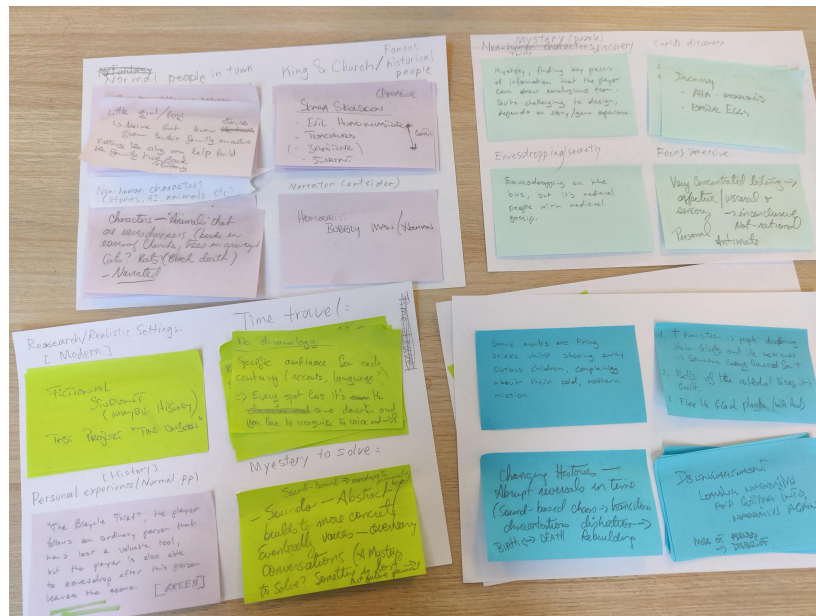
In the first phase, participants engaged in silent individual brainstorming using sticky notes, followed by group discussion. Four guiding questions were posed to structure this ideation process:

- World-building: What defines the game world, and how can players (as themselves) meaningfully connect to this world? What unified narrative or setting could integrate fragmented locations and timelines?
- Characters: Who might players encounter or hear from during their experience? What distinctive traits make these characters memorable or relatable? Participants provided brief character descriptions.
- Events: What significant or intriguing events could players experience? Participants considered both historical and fictional events or anecdotes.
- Emotional Experience: What emotional tone should underpin the game, and how might this evolve as the narrative progresses?



**Figure 4** Ideas generated during brainstorming session

A total of 42 narrative ideas were generated during the brainstorming phase, initially structured around the four guiding prompts. After the workshop, these ideas were regrouped into six narrative themes: *Cross-era framing*, *Micro-histories*, *Key moments of change*, *Contemporary mediation*, *Fantasy*, and *Sci-Fi*. Each thematic group included ideas that spanned across multiple prompt categories. For example, a single theme might contain both character concepts and emotional framing, though not necessarily all four.



**Figure 5** The process of regrouping ideas

Among the six themes, *Key moments of change* and *Micro-histories* were the most comprehensive in scope, containing ideas that addressed all four initial prompts. As such, they were identified as the most promising directions for further narrative development.

**Table 2** Ideas grouped under the “Micro-histories” theme

**Micro-histories**

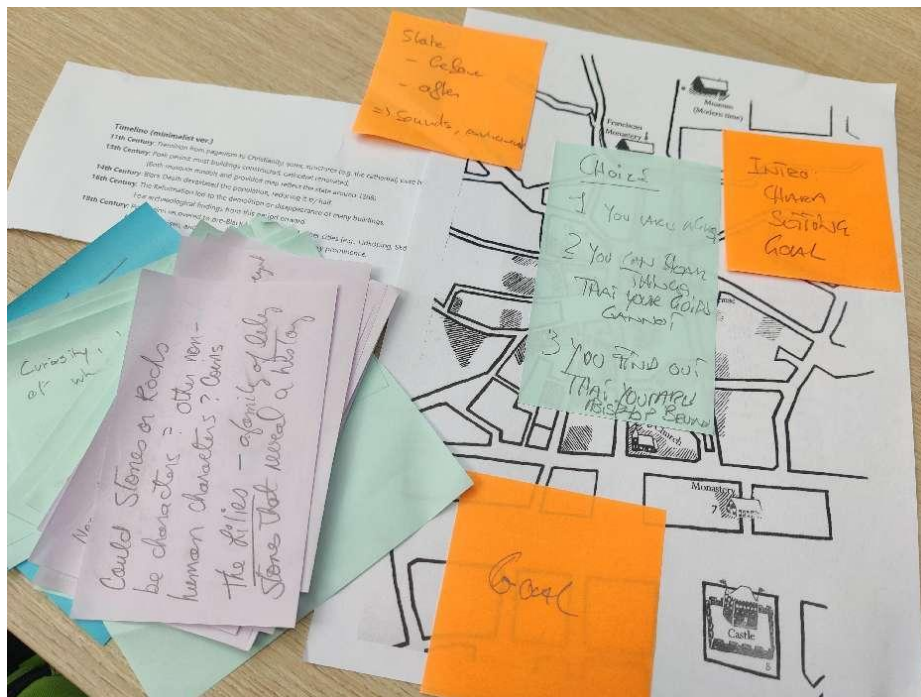
<b>Theme</b>	Let players witness the past through the intimate, human-scale lens of one ordinary life. Personal joys, losses, and small struggles reveal the larger period in miniature.				
<b>World-building</b>	Follow a humble craftsman who has lost his only tool; eavesdrop on what happens after he exits each scene.(Refer to the movie: The Bicycle Thief)	Accompany a naïve girl (or boy) who roams the medieval streets piecing together her family story while searching for her pet.		The Black Plague	A transitional period in which people doubt their old beliefs and question new ones, leading to harassment.
<b>Characters</b>		The child herself (acts as wandering narrator) Parents or elder siblings recalled in flashbacks	Local monks		
<b>Events</b>	Distant carriage wheels, market chatter, church bells, animals	Inspired by a priest’s book describing his parishioners—for example, a farmer applying for a dynamite license in the early 1900s.	Monks grumbling as they chase children away; bricks clatter; cathedral bells toll guilt	Fleeing from the Black Plague while wearing bird-like masks.	People assaulted for their beliefs or punished by authorities.
<b>Emotions</b>	Curiosity, quiet empathy, moments of fear or hope, a sense of “overhearing” real lives				

**Table 3** Ideas grouped under the “Key Moments of Change” theme

**Key moments of change**

<b>Theme</b>	Position players slightly outside the action to observe pivotal events that reshape society, politics, or faith. Focus on comprehension of broad shifts rather than deep identification with a single figure.	
<b>World-building</b>	11th-century transition from paganism to Christianity; motifs echo The Grand Inquisitor—debates on faith, power, and conscience.	13th-century Skara at its zenith: a royal speech, civic pageantry, and the looming Black Death.
<b>Characters</b>	Clergy and inquisitors Heretics, pilgrims, ordinary townsfolk as crowd voices	Monarch or local nobility
<b>Events</b>	Cathedral sermons, anxious murmurs Trials of heretics and villagers during religious reforms; uncover evidence, draw conclusions, witness verdicts.	The king's speech Brynolf returns: initially found limping or being carried through a side street; later seen as a triumphant hero outside the unfinished cathedral.
<b>Emotions</b>	Tension, awe, moral unease, sudden “Aha!” discoveries as hidden motives surface	

In the second phase, participants split into two sub-groups and collaboratively developed story sequences using a provided city map.



**Figure 6** Notes in storyboard creation session

One group decided to keep developing the ideas under the *Micro-Histories* theme. A key takeaway from their design was giving the player a simple, instantly understandable goal—in their case, “feed the cat”—that drives them to wander the city, meet different people, and catch glimpses of their everyday lives.

The second group pursued a different approach. The player takes on the role of a significant historical figure in Skara: Brynolf the bishop. The key feature of this design is that the player doesn’t know their own identity at the start of the game, and must gradually piece it together through conversations and environmental clues. Only later will they discover they’ve been playing an important role in a historical moment. This transforms player motivation into a curiosity-driven quest for self-discovery.

In the final version, I combined the key features from both designs into a unified narrative, where the player is given the simple goal of helping a girl search for her lost cat and gradually realizes that they themselves are also a cat. I further introduced a narrator who, on one hand, provides verbal instructions to guide players through the city and, on the other, offers supplementary information about the city’s history that transcends the main story timeline. This approach was inspired by the multi-layered storytelling in Cardiff and Miller’s works (Schaub, 2005).

### 4.3 Mechanics and interaction design

In parallel with preparing and organizing the narrative workshop, the game’s core mechanic design was under development. To better address the first research question (how do players

perceive the experience of a location-based audio game designed to foster historical empathy?), two essential questions should be considered:

1. How to help players navigate through the physical space?

The most common way in LBGs are using a map interface. But inspired by Szymczak et al. (2012), who suggest that non-visual guides allow users to experience augmented reality while keeping their attention on the real-world environment, this project adopt an audio-first approach and intend to experiment the possibility of not using visual element, to ensure maximum immersion and focus on real world environment. The initial design thinking include: direct voice-over/verbal instruction; 3D sound effect for navigation; in-story indications (puzzle like elements).

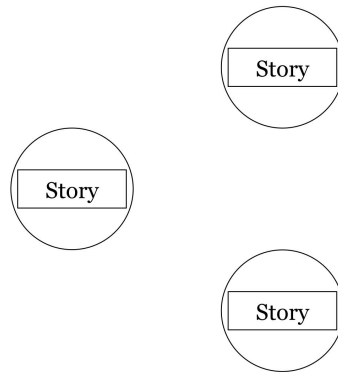
2. In what ways can players provide input to interact with the system?

Without screen-based interaction, the most common and sometimes even the only way to interact with mobile games, what other ways of interaction are possible? The emphasis on non-visual approaches inherently limits how players can interact with the game. Previous studies have shown that while certain unique interaction methods (e.g. gesture-based interaction) show potential in non-visual games and allow for complex inputs, they have proven difficult to learn (Rovithis et al., 2019). Considering that the target users of this project are not typical gamers but rather casual museum visitors, complex interactions should be avoided to ensure accessibility and intuitive learning. Thus, it was decided that the player's physical location and movement trajectory would serve as the sole input method. To fully harness its potential, we can deconstruct it and analyze the different ways people walk, and the different meanings embedded in the walking. More importantly, ensure that the game can detect and interpret these differences. Below are some thoughts: Walking direction (Branching stories); Not walking (stop, stay still, focus) Walking speed.

The design thinking behind the game's foundational structure is constructed through four steps:

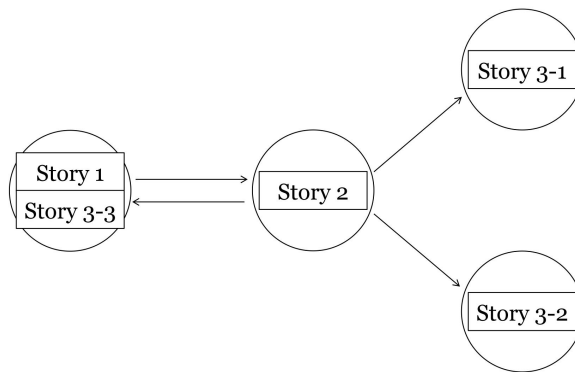
**First, determine the core mechanic and minimalist game loop.** As shown in Figure 7, each story is attached to a circular trigger zone (hereafter referred to as a “location”) defined by a central GPS coordinate and a set radius. Story audio clips require the player to stay within the corresponding location for a few seconds before playing. This design aims at distinguishing between player’s accidental movement and intentional interaction. Standing still in a zone acts like a “click,” while walking past is more like a “hover.” It is a way to allow multiple interaction styles in a game controlled entirely through walking. Once a story is triggered, the audio continues regardless of whether the player leaves the area – unless they enter a new location before it finishes. In that case, the new clip will override the previous one.

A technical prototype incorporating only this mechanic was developed and tested in a non-field setting outside of Skara, serving as an early-stage validation before proceeding to the next phase.



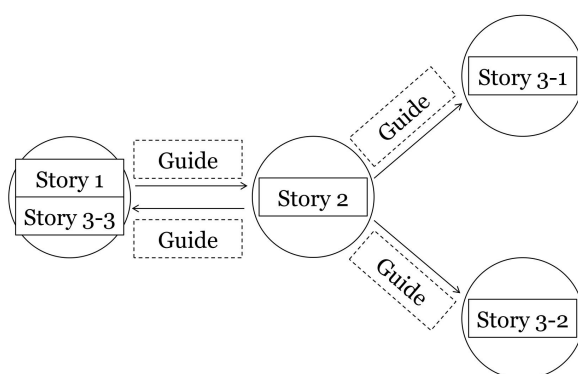
**Figure 7** Circular GPS-triggered story zones

**Second, add narrative logic and branching conditions.** As shown in Figure 8, triggering Story 2 requires that Story 1 has already been played. Similarly, Story 3-1, 3-2, and 3-3 are only accessible after Story 2 is triggered. Once a player activates one of these branches, the others become unavailable. An important point here is that story clips and locations do not follow a strict one-to-one relationship. A single location can be linked to multiple story clips, depending on the player's narrative path. For instance, in this example, Story 1 and Story 3-3 share the same location coordinate, but different conditions determine which one is played.



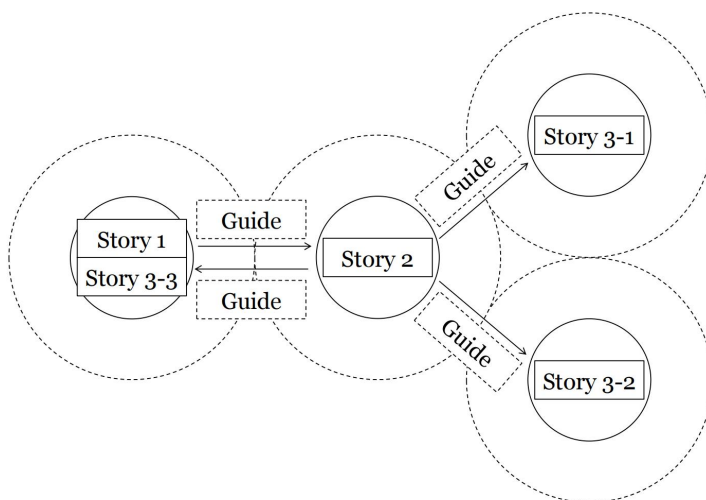
**Figure 8** Narrative branching and story logic

**Third, guiding audio is introduced.** Unlike story audio clips, these guiding clips are triggered instantly as the player passes through an area, allowing them to listen while walking (see Figure 9). They are typically narrated by a third-person narrator who both describes the surroundings and gives directions, while also sharing historical information about the places. In some cases, guidance is woven into the dialogue of in-game characters, blending narrative and navigation. In either case, the formal function of the guiding clip remains the same: to help players find their way without breaking immersion.



**Figure 9** Real-time guiding audio

**Finally, ambient soundscapes are added around the locations.** These share the same central coordinates as the corresponding story location but cover a wider area with a larger radius (see Figure 10). The ambient audio consists of looping background sounds (e.g., birdsong, market chatter, or monk chanting) that signal to players they are approaching an interactive area. While ambient audio is triggered instantly when the player enters the area, the volume is spatially graduated—100% at the center, fading to 20% at the edge. This serves as both an emotional backdrop and a navigational hint.



**Figure 10** Ambient soundscapes

The game was developed using Cocos2D (version 3.8.6), and location tracking was implemented through the browser’s built-in navigator.geolocation API. This is a standard web API supported by most browsers, which typically uses GPS data on mobile devices to provide reasonably accurate positioning. While the technical implementation was carried out by a collaborator with programming expertise, the core design and system logic were jointly defined during the early development phase. To streamline the process, we created a shared spreadsheet to manage all key elements—such as location types, coordinates, trigger radius,

and story priorities. The programmer could then convert this data into JavaScript and integrate it into the game.

This approach was effective for a small-scale prototyping team. It allowed the author to retain full creative control over spatial and narrative structures, and enabled rapid iteration and flexibility during playtesting. Changes to game logic or story structure could be made independently and efficiently, without requiring direct code-level intervention.

#### **4.4 Pilot Prototype and Testing**

After the core mechanic and basic game loop were defined, a pilot version was developed for the on-site testing. The pilot served dual purposes: on one hand, it collected external feedback beyond the development team; on the other hand, it evaluated the effectiveness of data collection and analysis methods to inform the design of the final testing procedure

The pilot version included three story clips tied to three different locations, along with four guiding clips linking them. The test was conducted in Skara with two participants. During gameplay, I followed a few steps behind the testers. A third-party mobile application (Nike Run) was at the same time to track their GPS trajectory.

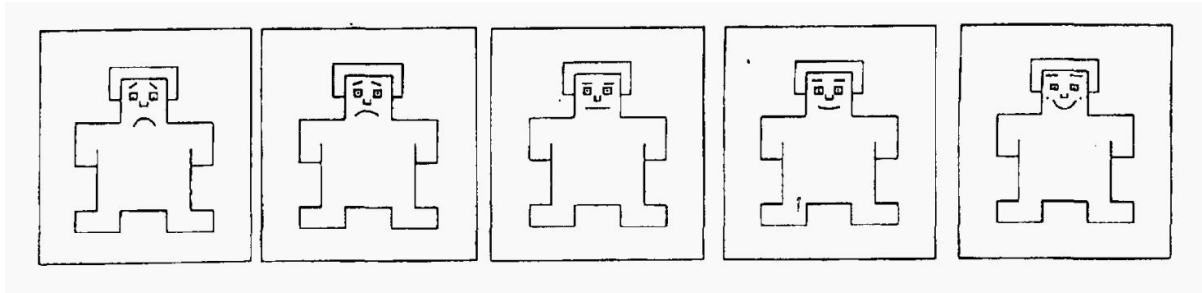
As mentioned earlier in the background section, Carneiro, Darin and Viana (2019) summarize in their systematic review that the most common method combinations for evaluating LBGs are “survey-interview-observation” and “survey-interview-logs recording”. This pilot session employed both observation and logs recording to assess which would better support this study.

After the tests, a short questionnaire was filled by the participants. The first part of it was adapted from Game Engagement Questionnaire (GEQ) (Brockmyer et al., 2009) a tool to measure the psychological engagement of players during gameplay. The full GEQ consists of 19 items, each rated on a three-point scale (No / Sort of / Yes). During the pilot testing, 8 most relevant questions were selected, as listed below:

- 1 - I lose track of time
- 3 - I feel different
- 5 - The game feels real
- 6 - If someone talks to me, I don't hear them
- 14 - I lose track of where I am
- 15 - I play without thinking about how to play
- 18 - I really get into the game
- 19 - I feel like I just can't stop playing

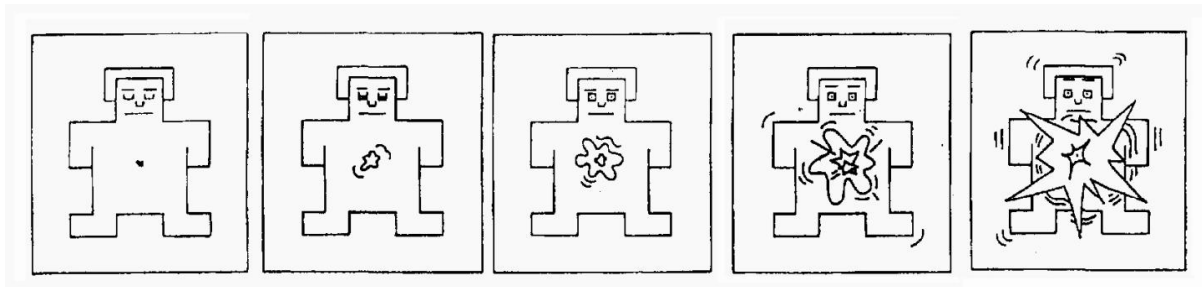
The second part of the questionnaire was informed by Self-Assessment Manikin (SAM) (Bradley and Lang, 1994), a tool for assessing participants' immediate emotional response to a stimulus. It measures emotion along three dimensions: pleasure, arousal, and dominance. In the pilot testing, each item was rated on a 5-point scale.

How pleasant or unpleasant did you feel? (1=very unpleasant, 5= very pleasant)



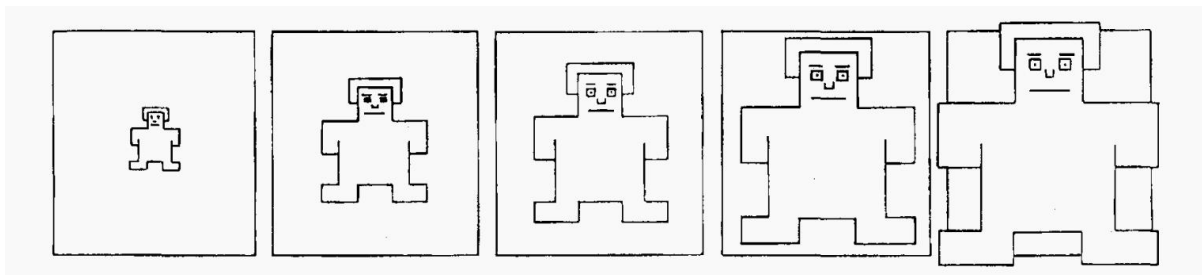
**Figure 11** Illustration for *Pleasure*

How intense or calm was your emotional state? (1=very calm, 5= very excited or intense)



**Figure 12** Illustration for *Arousal*

How much control did you feel you had in the situation? (1=very little control, 5=full control)



**Figure 13** Illustration for *Dominance*

All responses to the survey were used primarily to inform the subsequent interview, rather than for quantitative analysis. For example, if a participant answered “Yes” to an item on the GEQ (e.g., “I lose track of time”), the interviewer would follow up with: “You said that you lost track of time while playing — can you tell me more about that? When and how did it happen?” Similarly, if a participant reported high emotional arousal (e.g., a rating of 4 or 5 on the SAM arousal scale), the interviewer might ask: “You rated the game as very intense. Can you describe what made it feel that way?”

In addition to the questionnaire-based follow-up prompts, the interview included five questions under the theme of “challenges” and two under “historical empathy”

Based on observations and feedback from the pilot test, several adjustments were made for the final testing phase:

- GPS tracking was removed, as it did not provide additional insights beyond direct observation.
- The questionnaire was revised to better align with the game content (further detailed in Section 6.1).
- The interview structure was restructured, with additional questions added under the theme of historical empathy to better emphasize the study's core research focus.

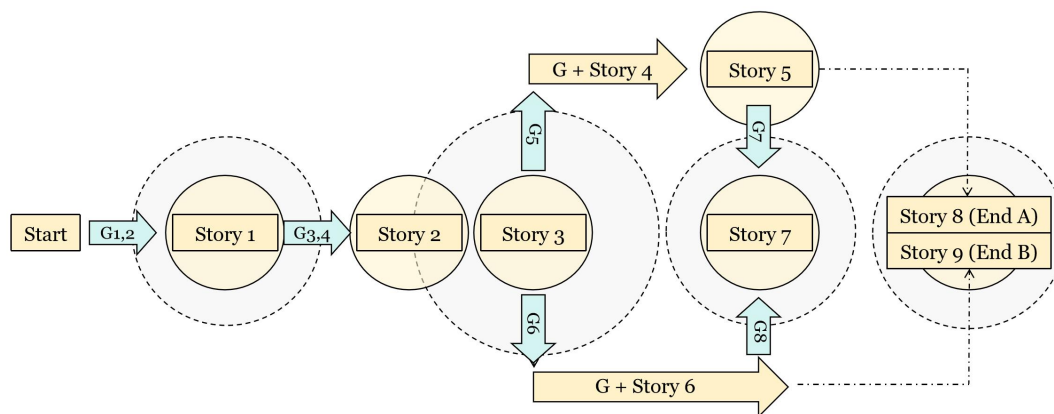
As stated earlier, the pilot test served not only to evaluate testing procedure but also to gather external feedback for development. One significant revision was to the need to clarify an interaction rule: when players hear the clock-ticking sound, they should stand still.

In the final prototype, the game begins "loading" (e.g. playing a clock-ticking sound effect) when the player enters the trigger zone of a story clip. If the player leaves the zone before the loading completes, the story will not be played. This mechanic was introduced to explicitly teach players how to interact with major storytelling locations, distinguishing them from guiding clips, which can be listened to while walking.

## 5 Prototype Result

### 5.1 Mechanics and storylines

The final prototype consisted of nine storytelling clips and eight guiding clips. As illustrated in Figure 14, the game begins with a linear narrative sequence. After completing Story 3, players encounter a branching point that leads to two different storylines, each represented by a different walking route in the city. Although these paths converge later together at Story 7, they ultimately lead to two different ending clips (Story 8 & 9) that share the same physical location.



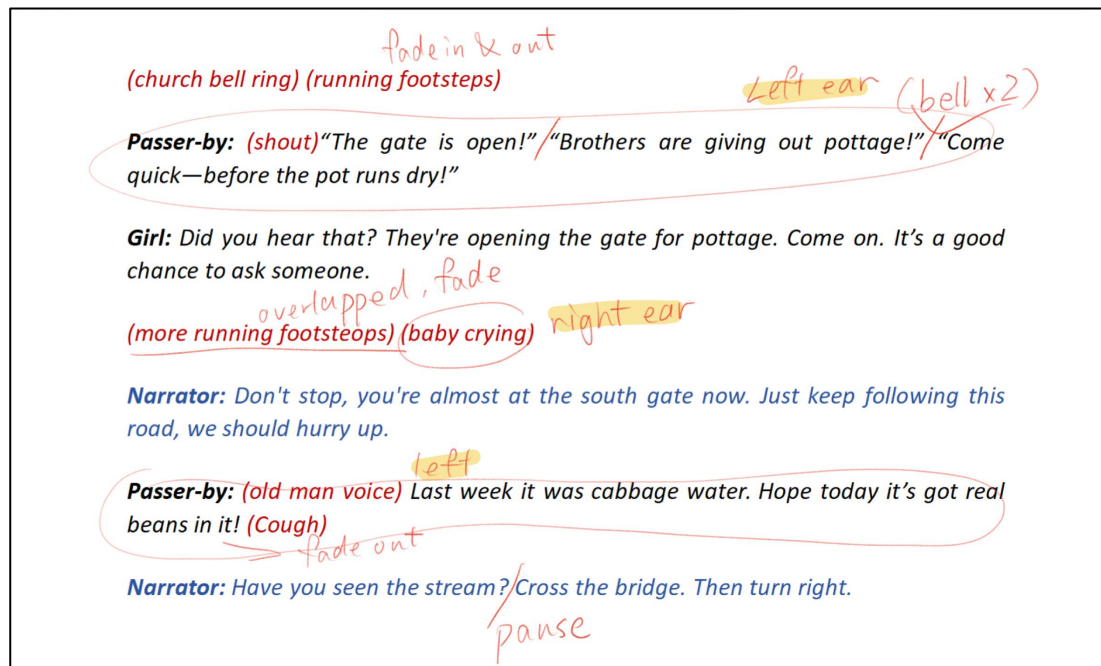
**Figure 14** Game flow

When designing the prototype, several distinct narrative mechanics were developed, each representing a specific mode of triggering and experiencing story content. These are outlined as follows:

**Narrative locus clips:** Seven episodes (Story 1, 2, 3, 5, 7, 8, and 9 in Figure 14) followed the initial design principle in which an audio clip is played only when the player remains within the corresponding trigger zone for a certain duration. At the beginning of the game, it is explained that the player should “focus” and wait for time to reverse when approaching a historical site. An eight-second sound cue of a ticking clock is then played. The sound effect is rendered in stereo, moving gradually from the left to the right ear; it functions as a metaphorical “loading” signal. The story clips typically present a layered theatrical soundscape, combining ambient environmental sounds, voice-acted dialogue (either between characters or directed at the player), and contextual sound effects such as footsteps or clanging tools.

**Guiding clips:** Six guiding clips (G1-G8) were placed between key locations. These clips are typically confined to small areas associated with route turning points. A guiding clip is typically voiced by a third-person narrator who acknowledges the modern environment and refers to visible objects in the player's view. Sometimes these instructions are accompanied with storytelling elements and contextual information that connect present locations with their historical context. For example, “Do you see that small wooden step over the fences? The long brick wall is gone now. You can just enter the monastery. They wouldn't see you.”

**Narrative corridor clips:** Two clips (Story 4 and Story 6) were designed with an interwoven structure that blends theatrical soundscapes with the narrator’s instructions. These clips are technically implemented as guiding clips in the system, which means they require no “focus” to trigger and can be listen while walking, but they serve functionally both narrative and navigational purposes. They are typically placed along a relatively straight path where players are involved in a long walk without encountering specific historical sites, or within a larger historical area that allows a long walk under one consistent historical settings. Figure 15 shows the multi-dimensional content embedded in one of these clips.



**Figure 15** An excerpt of script for Story 6

**Ambient field:** As shown in Figure 14, larger ambient fields were placed around Story 2, 3, 7, and Story 8/9. These fields are circular zones with a typical radius of 20 - 30 meters, where the audio gradually fades from the center outward. They serve as the intro and outro to the Narrative locus clips, and they also signal the center of interactive points.

As part of an experimental design, there are no guiding clips between Story 2 and Story 3. Instead, the ambient field from Story 3 partially overlaps with the trigger zone of Story 2, and navigational hints are embedded within the character dialogue in Story 2. For example, cues like “let’s search along the wall” or “follow the monks’ singing” introduces a riddle-like challenge. However, this approach received mixed feedback from playtesters, which will be discussed in Sections 6.3 and 6.4.

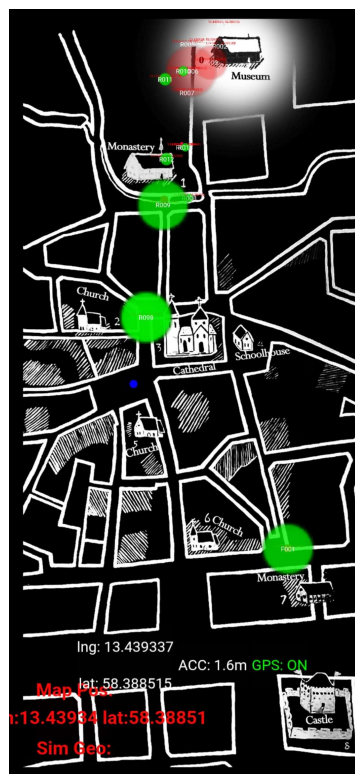
There are no guiding clips from Story 7 to Story 8/9, as the prototype is not complete yet (in the design, there should be more locations between 7 and ending before the story ends). Listening to the ending is only optional in the testing, if they wish to do so the organiser will explain that they’re now skipping the middle parts and lead them to the ending point.

## 5.2 Audio and interface

Most of the soundwalk practices mentioned in Section 2.4 rely on field recordings. In contrast, this project, as a prototype aimed at rapid iteration, uses AI-generated voice-overs and freely available online sound resources. Specifically, 18 voice clips comprising a total of 23,303 characters were generated using Microsoft Azure AI Speech, which allows fine-tuned adjustments to voice quality, speed, pauses, intonation, and more. Ambient sounds and other sound effects were sourced from the SoundFree website and edited using Audacity. The editing process primarily involved trimming, adjusting stereo channels, and modulating volume to suit the narrative flow. In total, 20 minutes and 43 seconds of audio were produced, with some clips reused at multiple points in the game (e.g., the recurring “clock-ticking” sound).

Although the game was designed as an audio-first experience, a map interface was initially created. It was based on a 13th-century city layout featured in the museum exhibition. The original intention was to provide secondary support for players who felt disoriented or unsure about navigating solely through audio.

However, during the pilot test, the interface – though visible on the screen – was not understandable without explanation. Since no participants expressed a need for visual support, nor showed such intent through their behavior, the feature was not further developed for user-facing interaction in the final version. Instead, it remained a developer-only tool to monitor GPS accuracy and trigger status (Figure 16). All activatable zones were marked with green circles, which turned red upon activation. The player’s location appeared as a red dot. Although not accessible to players during the final testing, this interface could be adapted for future visual support if needed.



**Figure 16** A screenshot of the final prototype

## 6 Evaluation Results

### 6.1 Playtest Session and Interview

The final playtesting session included 10 participants. Four were recruited through the museum's official website, while six were invited via purposive sampling by the author, with a focus on individuals interested in museums, history, or urban walking, rather than those from typical gaming communities.

Each playtesting session began with a brief introduction, during which participants were informed that the game was part of a Master's thesis project in Game Development at the University of Skövde, conducted in collaboration with the Västergötland Museum. The game prototype was based on the museum's permanent exhibition, Skara in the Middle Ages.

Before the test, participants were asked two brief questions to assess their familiarity with the exhibition and local history. First, whether they had previously visited the exhibition; second, how they would rate their knowledge of Skara's history on a scale from 1 to 10.

Participants were informed that no personal data (such as name, age, or gender) would be collected, and that the test was entirely voluntary. Each session lasted approximately 50 minutes, including a 25-minute game experience followed by a semi-structured interview of about 25 minutes. Testers were told they could pause or withdraw from the session at any time.

Participants were then given a mobile device and a pair of headphones. They were instructed that the game was designed as a screen-free experience. All game interactions were controlled by GPS location and player movement, but no data would be collected on the provided phone.

Testers were also informed that the organizer (the author) would follow at a short distance during the play session, observing silently unless the participant requested assistance or stepped outside the intended play area.

After listening to Story 7 (see Figure 14), an audio message was automatically played, informing participants that they could either stop at that point and return the device, or follow the organizer directly to the ending location to listen to the final scene (skipping the un-finished middle segments). In either case, the gameplay session concluded once the participant returned the device, and the interview phase began.

The interview session began with an open-ended question such as "How was the experience?" or "What's your general feedback?" to capture the participant's initial, spontaneous impressions. Following this, all questions were organized under four structured categories: Challenge, Immersion, Emotion, and Historical Empathy. As shown in Table 4, the first three were designed to address the first research question, which investigates how players perceive the experience of a location-based audio game. The fourth section targeted the second and third research questions, which focus on the elicitation of historical empathy and the factors that contribute to it.

This structure was primarily informed by the VALERIE semi-structured interview framework, proposed by Carneiro, Viana, and Darin (2021). VALERIE is specifically

designed for evaluating player experience (PX) in location-based games (LBGs), and provides a comprehensive bank of 60 questions. These are organized along two dimensions: (1) game-specific features — including spatiality & mobility, pervasiveness, sociability, and general aspects common to most digital games; and (2) core PX dimensions, including challenge, immersion, and emotion.

In this study, the first three categories—Challenge, Immersion, and Emotion—were directly adapted from VALERIE. The fourth category, Historical Empathy, was added by the author to specifically examine players’ responses to historical and cultural themes. This category was further informed by the Historical Empathy Measurement Tool (HEMT), a framework designed to assess learners’ emotional and contextual engagement with the past.

**Table 4** Structure of interview design

Interview section	Theoretical framework used	Data collection	RQs addressed
1. Challenge	VALERIE (Carneiro et al., 2021)	Semi-structured questions (adapted from VALERIE)	RQ1: Player experience
2. Immersion	VALERIE + GEQ (Brockmyer et al., 2009)	Questionnaire (GEQ) + follow-up questions	RQ1
3. Emotion	VALERIE + SAM (Bradley and Lang, 1994)	Questionnaire (SAM) + follow-up questions	RQ1
4. Historical Empathy	HEMT (Crompton et al., 2023)	Thematic interview questions	RQ2: Historical empathy level RQ3: Which factors contribute most?

The first part of the interview focused on Challenge, aiming to identify moments where players felt confused or frustrated, as well as instances they found positively challenging. Follow-up questions explored the strategies players used to overcome these difficulties.

After this section, participants were presented with a short questionnaire. They could choose whether to fill it out independently before discussing their responses or to have the author read the questions aloud and discuss the answers in real time. The questionnaire comprised two parts: a revised version of the Game Engagement Questionnaire (GEQ) (Brockmyer et al., 2009), used to inform the Immersion section, and a revised Self-Assessment Manikin (SAM) (Bradley and Lang, 1994), which supported the Emotion section.

Several changes were made at this stage compared to the pilot version, including: - Rephrasing some statement in GEQ, to make them clearer and better fit into the game context, for example “The game feels real” to “The game world felt real even though I was

walking through a modern city.”; “I play without thinking about how to play” to “I found myself just following the story and moving without thinking too much.”, the amount of GEQ questions are reduced from 8 to 4.

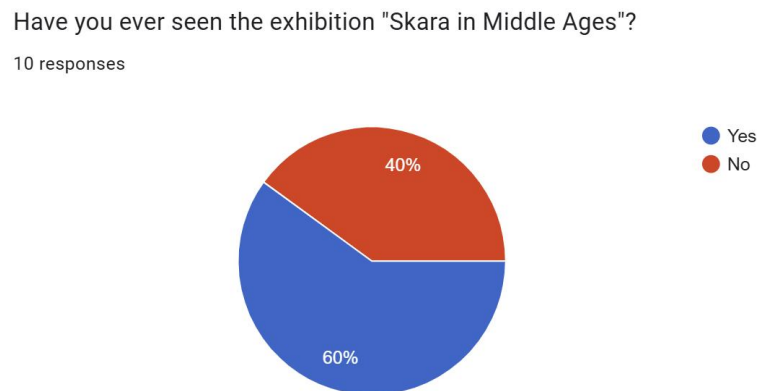
- Changing both GEQ and SAM questionnaire’s answer into a 6 point scale to ensure a either positive or negative answer (not neutral)

- Add more questions under the theme of historical empathy.

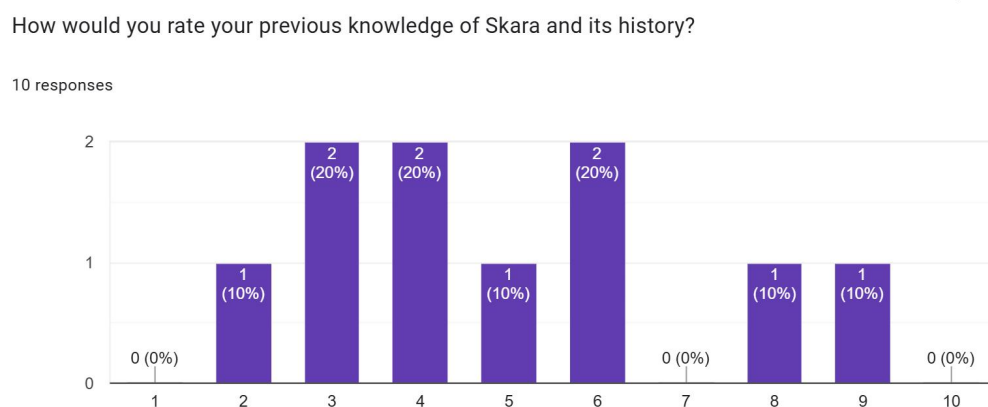
The full questionnaire can be seen in **Appendix A**.

## 6.2 Collected Data

**Basic information:** A total of ten participants took part in the final playtesting session. As shown in Figure 17, 6 of them had previously visited the exhibition *Skara in the Middle Ages*, while 4 had not. In terms of self-rated historical knowledge, participants showed a relatively wide range. As illustrated in Figure 18, ratings ranged from 2 to 9 on a 10-point scale, with most responses clustering between 3 and 6.



**Figure 17** Participant responses to the first question (N=10)



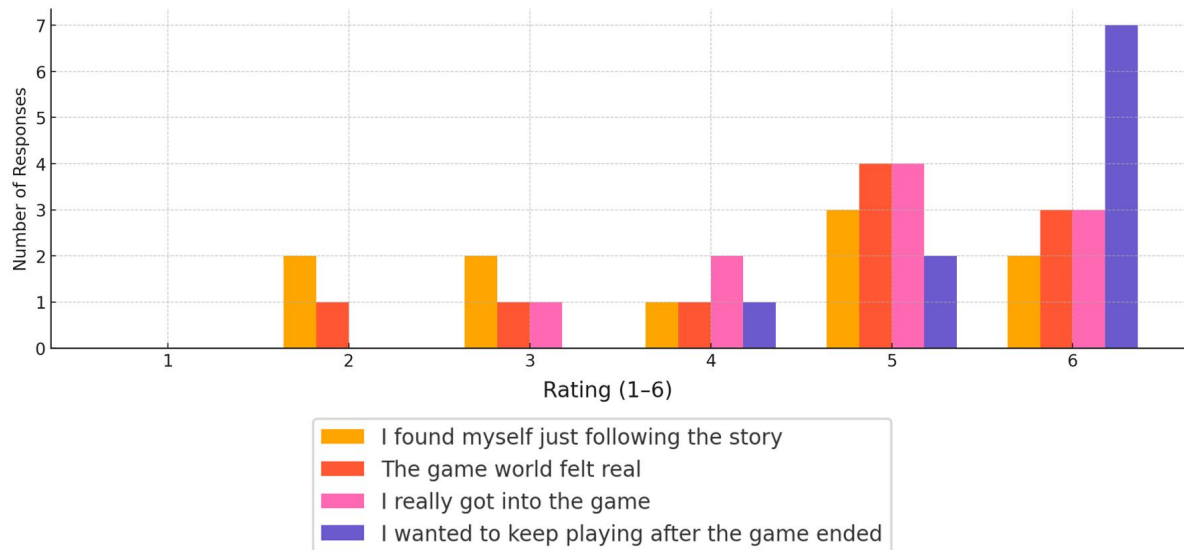
**Figure 18** Participant responses to the second question (N=10)

**Field observation notes:**

- (1) During the playtesting sessions, two participants were observed to have clearly deviated from the intended path, each occurring once;
- (2) Four encountered failed audio triggers due to GPS inaccuracy (3 participants experienced this once, and 1 participant experienced it twice), requiring the organizer to assist by guiding them to the activation point;
- (3) Only one participant attempted to check the map for navigation; all others relied entirely on audio cues;
- (4) At the branching point following Story 3 (see Figure 14), six out of ten participants chose the Story 4 route, while 4 others followed the Story 5 path.

Additional minor observations were recorded to support interview but are not detailed here. For example, if a player lingered at a particular location for an extended period, a follow-up question was asked during the interview to explore what they were thinking or experiencing at that moment.

**Game engagement questionnaire (GEQ) results:** The first part of the questionnaire included four items adapted from the GEQ, measuring different aspects of player engagement. As shown in Figure 19, responses were generally high across all four items, indicating a relatively strong sense of immersion.



**Figure 19** Bar chart of GEQ responses (N = 10)

Among the four questions, the most consistently positive feedback was found in the item “*I wanted to keep playing after the game ended.*” This result also aligned with observed behavior: after listening to Story 7, players were given the option to either stop or continue to the ending. 9 out of 10 participants chose to proceed and listen to the final scene. The only participant who chose to stop mentioned scheduling constraints rather than dissatisfaction with the experience.

In contrast, the item “*I found myself just following the story and moving without thinking too much*” showed more varied responses. Follow-up interview responses suggested that this

variation was partly due to differing interpretations of the word “*thinking*.” Some saw it as actively interpreting or searching for meaning, which may still indicate a high level of immersion. Others, however, described being worried about getting lost, which may reflect a break in immersion. This will be further discussed in the analysis section.

**Self-Assessment Manikin (SAM):** The second part of the questionnaire used the SAM to assess emotional response along three dimensions: pleasure, arousal, and dominance. As shown in Figure 20.



**Figure 20** Bar chart of SAM responses (N = 10)

In addition to questionnaires and field observations, ten semi-structured interviews were conducted immediately after the gameplay sessions. These interviews followed a fixed thematic structure and were fully transcribed. A total of 300 minutes of audio were recorded (an average of 30 minutes per participant) and transcribed via AI into 32,029 words, then manually proofread. The final 61-page transcript serves as the primary material for the qualitative analysis in the following section.

### 6.3 Data Analysis

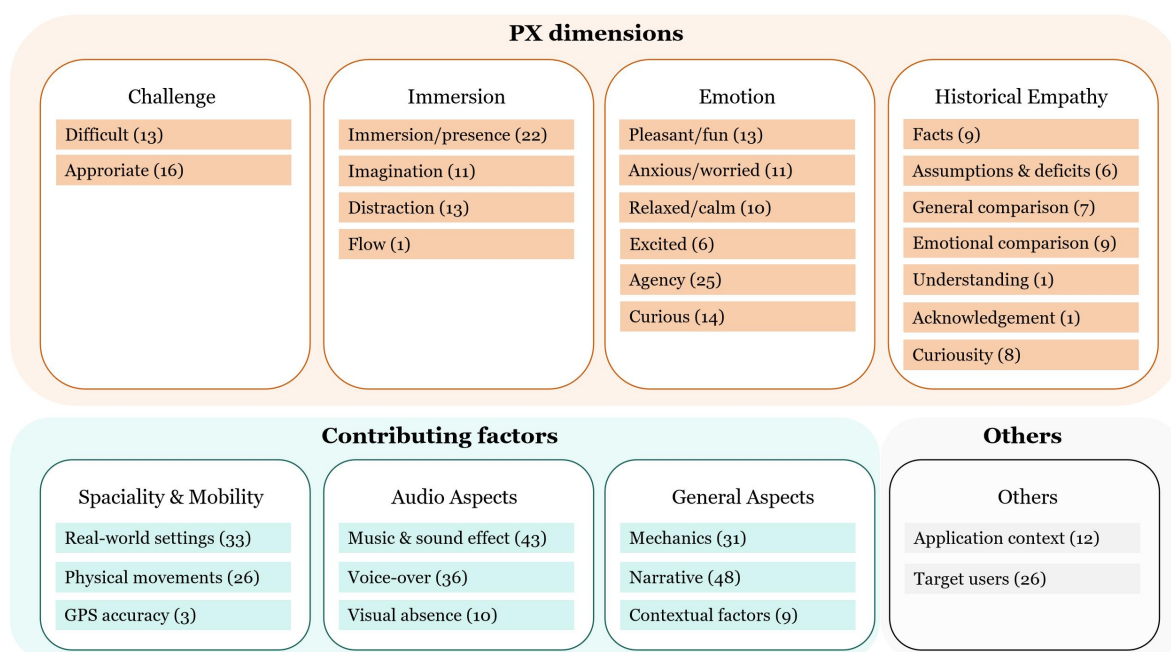
The interview transcripts were imported into the qualitative analysis tool Delve for thematic coding. The coding process followed a three-round procedure. In the first round, a deductive approach was used based on the modified VALERIE framework introduced earlier in this study. This framework helped identify broad thematic categories, which were organized into two primary dimensions.

Under the player experience (PX) dimension, four major codes were used: *Challenge*, *Immersion*, *Emotion*, and *Historical Empathy*.

Under the contributing factors dimension, three codes were applied: *Spatiality & Mobility*, *Audio Aspects*, and *General Aspects*.

Additionally, an "Other" category was included to capture relevant responses that were considered meaningful but did not clearly fall into the predefined codes.

In the second round of coding, each primary code was further refined into subcategories. These subcodes were either theoretically informed based on the frameworks referenced earlier, or inductively derived from recurring keywords and themes observed across the transcripts. This phase followed an iterative approach, in which categories were continuously adjusted, renamed, merged, or split. Figure 21 presents the coding scheme used for analyzing the interview transcripts, along with the number of times each code was applied. These counts reflect how frequently a particular topic was mentioned or emphasized, but they are not intended to indicate significance or priority. A single participant repeating the same idea multiple times may result in repeated tagging. Therefore, the numbers shown here are descriptive of the tagging process, not analytical findings.



**Figure 21** Coding categories and tags

While the overall coding process was primarily inductive, and most tags were developed based on recurring topics and keywords emerging from the transcripts, the tagging of Historical Empathy followed a more prescriptive approach, which outlines seven levels of historical empathy: (0) Non-response, (1) Facts, (2) Assumptions and Deficits, (3) General Comparison of the Past and Present, (4) Emotional Comparison of the Past and Present, (5) Understanding Motives, Behaviors, Thoughts, and Emotions in the Past, and (6) Acknowledgement of Differences from Those in the Past.

The detailed coding criteria will be elaborated in **Section 6.4.4 Historical Empathy**.

The HEMT framework provided a structured basis for assessing the depth and quality of participants' historical reflection, thereby addressing Research Question 2 (to what extent does the game elicit historical empathy?). In addition to the seven levels defined by HEMT, an emergent subtheme, *Historical Curiosity*, was introduced. This was because, although many responses did not demonstrate cognitive reflection that fit any of the HEMT levels,

several participants expressed a strong desire to further explore the historical content after playing. This form of curiosity was considered valuable and thus coded separately.

In order to further address Research Question 3 (what factors contribute most to eliciting historical empathy), the codes under the *Historical Empathy* category were cross-analyzed with those under *Spatiality and Mobility*, *Audio Aspects*, and *General Aspects*. This comparison aimed to identify which factors contributed most to the different levels of historical empathy.

The codes grouped under *Others* (e.g., Application context, Target users) were not directly related to the research questions and were not included in the main analysis. However, they provided insights that informed the discussion section at the end of this study.

## 6.4 Results

This section follows the structure of the three research questions: Section 6.4.1 presents findings related to the overall player experience, including general impressions of the new format, and more detailed feedback on challenge, immersion, and emotion. Section 6.4.2 shows the levels of historical empathy demonstrated by participants. Section 6.4.3 identifies the key factors that contributed to fostering historical empathy.

### 6.4.1 Player experience and perception

**Overall**, all participants responded positively to the new interactive format, as shown in their responses to the very first interview question—“How was the experience? Any general feedback?”—with expressions such as “Amazing, potential, cool, very different from my previous experience” (Tester 1), “I was intrigued and engaged” (Tester 2), “Cool, excited, I can see huge potential” (Tester 3), “Good, but sometimes hard to know what to do” (Tester 4), “It was something new, interesting, and fun” (Tester 5), “It worked well” (Tester 6), “Very interesting, and non-gamer friendly” (Tester 7), “At first nervous, then comfortable” (Tester 8), “Very nice, it took time to get accustomed to it, but after I did, I wished there were more like this in other cities” (Tester 9), and “The sense of immersion was strong” (Tester 10).

When comparing the experience with traditional screen-based games set in visually rich virtual worlds (e.g., a medieval city), participants consistently emphasized the unique strengths of being physically present in a real environment. A typical response was: “I’d definitely prefer walking in the actual city. Seeing the real environment in front of me makes the experience feel more direct and meaningful... If I were just looking at a screen... the place would feel hollow... it wouldn’t connect to my personal experience the same way” (Tester 7).

Some participants (Testers 5 and 8), while expressing a clear personal preference for the audio-based format, also acknowledged that traditional digital games could appeal more to certain groups, particularly gamers looking for greater challenge or interactivity.

When compared to location-based AR games, responses were more mixed. Some participants still favored the audio-only approach, commenting that “scanning QR codes is annoying” (Tester 9), or that this felt like “a fresher approach, considering many museums have already tried those (AR approaches)” (Tester 5). Others, however, saw value in combining formats: “Maybe for kids, using more senses would make it more fun—like seeing a cat run by in AR or spotting clues” (Tester 7), or “maybe the mixture is very beautiful” (Tester 8).

In addition to the overall perception of the experience, participants provided detailed feedback on specific aspects of their player experience. The following parts will present their comments regarding challenge, immersion and emotion.

**First, regarding the dimension of challenge**, participants shared both positive and negative experiences. Positive remarks on difficulty (coded as appropriate challenge) were mentioned in 7 out of 10 transcripts. Negative remarks (coded as difficulties) also appeared in 7 out of 10 transcripts. This overlap occurred because half of the participants (5/10) reported experiencing both smooth and problematic moments; two participants discussed only difficulties, and two reported no difficulties at all, describing the challenge as consistently appropriate.

Among those who gave positive feedback, most attributed it to three main factors:

- (1) Clear verbal instructions delivered by the narrator; “The woman’s directions—especially when she mentioned colours—let me find the spot easily” (Tester 8);
- (2) The GPS-based trigger system, which adapted to each player's walking pace; “if you’re a slow walker, the guide won’t play early before you reach “It’s more adapted; if you’re in a hurry you can ‘fast-forward’ the game” (Tester 6);
- (3) A simple narrative goal: “looking for a missing cat” made the task feel approachable. Though participants didn’t explicitly make the comparison, this may reflect a contrast with typical historical games, which often require players to finish historical puzzles.;

For those who encountered difficulties, the main issues were:

- (1) Missing audio feedback—e.g., “...when the sound stops, I felt a bit lost. I was wondering, When will I hear the voice again? When will I get another interaction?” (Tester 2) This aligns closely with the emotional responses of worry and anxiety, as discussed in Section 6.4.3.
- (2) One-time verbal instructions—participants reported that brief, unrepeated directions like “turn left” were easy to miss: “If you’re unfocused, you miss it... perhaps repeat instructions... you can’t trust people to do exactly as you say.” (Tester 6)
- (3) The experimental, ambient sound-based navigation section between Story 2 and Story 3 (see also Section 4.3). While one participant found it challenging and rewarding — “As I walked north, the sound grew louder, then stopped. That’s when I realized the volume was guiding me... it felt natural, story-driven, and like something I discovered myself” (Tester 7) — three others completely missed the cue: “I didn’t realize I should follow the monks’ voices,” and “It would help to clearly say, “Try to find where the monks’ singing is loudest.” (Tester 5).

**Immersive experience** was discussed by 9 out of 10 participants, though with varying depth and emphasis. According to Brockmyer et al. (2009), immersion ranges from basic *involvement* in the game to more profound states such as *presence* (the sensation of “being there”) and *flow* (a deep absorption in the activity where self-awareness fades and time may distort). By interpreting the 9 participants’ descriptions, most of them fit in the lower to mid-range of the immersion scale, from *involvement* to *presence*. By cross-analyzing the overlapping snippets between *Involvement/presence* and other codes under the

*Contributing Factors* dimension, the factor that contributed most to immersive experiences was ambient sound, with 7 out of 9 participants linking it to their sense of immersion. The second most frequently mentioned factor was narrative, noted by 4 participants. Only one participant described an experience that went beyond light immersion or presence, clearly indicating a temporary state resembling *flow*, as quoted below:

"The sound environment in general drives you into this state where you start to feel yourself in the game. It's not about thinking; it gives you this setup where you let the game drive you. I wasn't thinking about history or anything, it was more like, 'Okay, cool, there is a story, and I have to follow this story.' Because you're wearing headphones, you're already isolated, not really feeling in the real world. The different actors popping up felt real, like they were right next to me... I don't know why, maybe because the voices were good... This simple exercise of imagining you're 100 or 1000 years earlier is really cool...If you compare it with a video game, even if this video game was perfectly made and really looked like a medieval world, I felt more immersed just having sound and small stories here...basically the sound is enough to make you travel through time."

Tester 2

Notably, 7 out of 10 participants also reported moments of distraction or interruption, including the one who briefly reached *flow*<sup>3</sup>. One participant exclusively spoke about distraction without describing any immersive experience. The primary factor causing these interruptions was the real-world setting (4 out of 7), specifically, modern elements that clashed with the game world, such as passing cars or clearly contemporary buildings.

Last but not least, special attention is given to a frequently emerging theme: *Imagination*. Mentioned in 8 of 10 interviews. All 8 participants attributed this effect to the interplay between real-world settings and audio aspects. While some emphasized ambient sound, others focused on voice-over narration, and some described it more abstractly as “the absence of visual elements”, all pointed to the role of audio play under this context.

For example, the player may stand in front of an open, empty lawn while hearing audio narration describing it as the backyard of a former monastery, where monks once worked in the garden and prepared food. These descriptions, combined with sound effects (such as metal tools and light wind), allow the listener to actively construct the historical scene in their minds instead of passively receiving visual input. The absence of visuals here, counterintuitively, enhances the players' sense of immersion.

However, this interplay between visual and audio elements creates a complex duality: on one hand, the physical surroundings anchor the player's imagination within a spatial backdrop, enhancing the sense of presence, like 'I'm standing in the same place where people from the past once were'; on the other hand, the modern world continuously pulls the player out of that imagined space, reminding them they are still in the present. The following quote

---

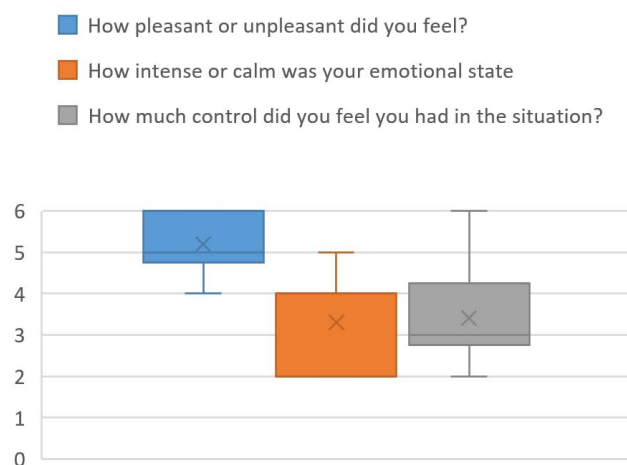
<sup>3</sup> The term “flow” is used loosely here, based on the indirect indicators suggested in Brockmyer et al. (2009). The study did not employ validated instruments specifically designed for measuring flow states.

illustrates this duality, as well as points out a possible solution of referring to old stuff that still exists today as much as possible:

“...as soon as you came to the more modern houses, you’re being pulled out a little bit... but then you’re pulled in again—‘Oh, here you have the monasteries’... That kind of thing happens every now and then. The world that you’re in now always tries to pull you out. So the more you can make people immersed by referencing older stuff... I was looking at this model—the bridge and the road we were following. If you say, ‘Follow the bridge and the dirt road up here,’ you stay immersed, because that road is still here today, so it won’t pull you out.”

Tester 5

In addition to immersion, participants also reflected on their emotional responses. Following the pleasure – arousal – dominance structure from the Self-Assessment Manikin (SAM) framework. As shown before, the results from the SAM questionnaire are presented in Figure 22.



**Figure 22** Box plot of SAM responses (N = 10)

Firstly, ratings for pleasure were generally high and tightly clustered, indicating that participants found the experience enjoyable. The reasons behind this positive affect were relatively diverse. In contrast, the reasons for slightly negative feedback were more consistent. Interview responses revealed that 6 out of 10 participants felt worried or anxious whenever the game went completely silent—typically after a clip ended but before they reached the next trigger zone—as they were unsure whether they were still within the game area or if the game had accidentally stopped.

Another frequently mentioned factor was weather, a somewhat unexpected finding given the game’s design emphasis on audio and narrative. A total of six participants spontaneously referred to the weather when describing what contributed to their emotional state. Among them, five highlighted the warm and sunny conditions as enhancing the experience, making them feel more relaxed and at ease. One participant, however, noted that the cold and rainy

weather made them reluctant to stand still and prefer continuous walking. Given that the game is played entirely outdoors, this might indeed be something worth paying attention to.

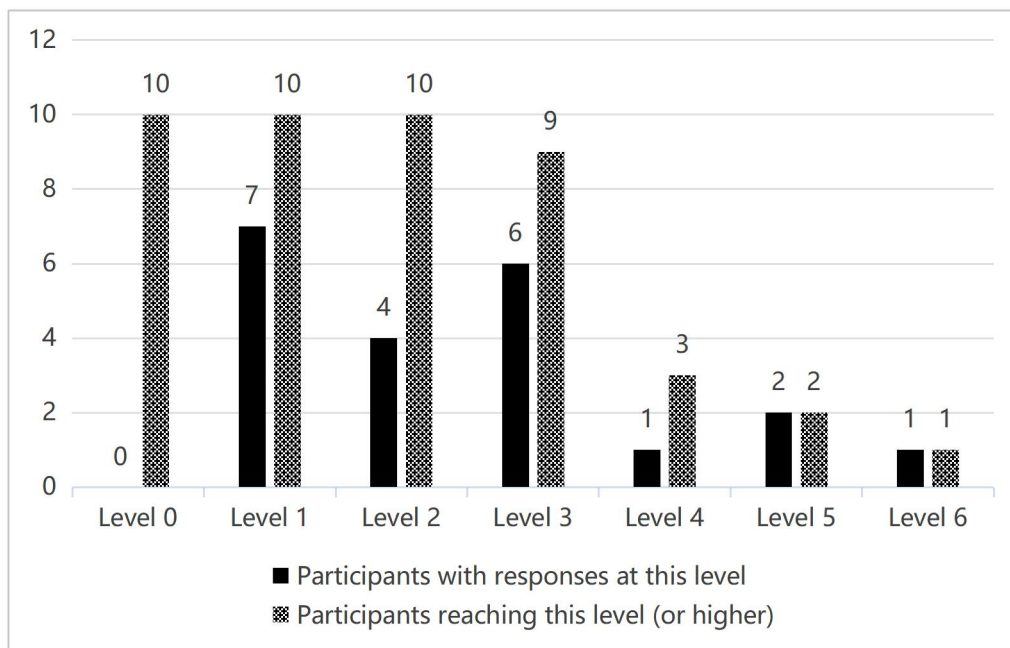
Arousal scores showed some variation but mostly fell in the mid-to-low range, indicating a generally calm experience. Interview responses supported this interpretation: many participants described the game as “peaceful,” “relaxing,” or even “meditative.” Those who reported higher arousal levels did not associate it with stress or urgency, but rather with softer words like “curious” and “motivated.”

When looking across both pleasure and arousal responses, a shared pattern emerged. 7 out of 10 participants said their pleasant or excited feelings came from the novelty of the format itself. An audio-first, location-based narrative game was new and refreshing to them. Instead of pointing to specific features or story moments, they enjoyed the experience as a whole.

Responses regarding perceived control showed the greatest variation. Most participants rated their sense of control as moderate or low. 9 out of 10 discussed this topic during interviews. Three gave positive comments about the decision-making moment in Story 3, while one offered a neutral perspective, stating, “Though it’s mostly linear, I liked it and enjoyed just following the story.” The remaining five expressed a desire for more interactive moments, with comments such as, “I don’t have much control because it’s scripted.”

#### 6.4.2 Historical empathy levels

As mentioned in Section 6.3, the analysis of historical empathy strictly follows the HEMT framework proposed by Crompton et al. (2023). Based on the 7-level categories (including Level 0 as “no response”), As shown in Figure 23, the horizontal axis represents the seven levels defined by the HEMT framework. The solid black bars show how many participants provided at least one response coded as matching that specific level, while the patterned bars indicate how many participants reached this level or beyond. For example, a participant whose highest response was coded at Level 5 is also counted at Levels 1 through 4.



**Figure 23** Distribution of participants across the HEMT levels

The detailed breakdown and examples for each level are presented below

(1) **Facts:** This level reflects recollection or repetition of factual information without interpretation or contextualization. All participants reached at least this level, among which seven gave related responses. A typical example is:

“ You see that this place was formally monastery. It was abandoned in the 1560s or something like that. And then the veterinary school opened here 250 years ago”

Tester 4

As shown, this quote demonstrates knowledge of historical facts without personal reflection or emotional engagement.

(2) **Assumptions and Deficits:** This level includes expressions of historical thinking that rely on personal assumptions, anachronisms, or evident misunderstandings. All participants reached at least this level, although only four gave responses that were specifically coded as such. For example:

“I heard the sound of the brick factory, so I felt like that place is for those physical, hard workers. So I guess Skara is not like a noble city like Stockholm, maybe poorer. Those workers... for it is the imposed labour and the like.”

Tester 9

This response reflects historical reasoning built on speculative assumptions and stereotypes. It does not reflect a historically grounded understanding.

(3) **General Comparison of the Past and Present:** This level involves recognizing that the past was different from the present, typically expressed through broad contrasts or general statements. Most participants reached (9 out of 10) this level, and most of them stopped (6 out of 9) here. A representative quote under this level is:

“...When I was listening to the brick factory sound I also saw those workers working there (at the construction site)... it was good to feel the contrast between Skara’s and its present.”

Tester 9

This response reflects a broad comparison between historical and modern-day Skara by linking the audio scene of the brick factory with the sight of present-day construction workers.

(4) **Emotional Comparison of the Past and Present:** This level involves the use of emotional language to imagine how people might have felt in the past compared to today. Interestingly, although three participants reached this level or above, only one response was explicitly linked to it, and even then, it required some interpretive reading. The quote was:

“ I like the fact that the monks are saying, ‘It's fucking cold here. Why did we go to the stupid place?’ I think that would be, in a way, understanding things differently. ”

Tester 3

Notably, when compared with the original script— “It’s impossible to patch the wall in such cold weather. Why must we be sent to this frozen land?” — it becomes clear that the participant had added personal emotional interpretation to the characters. Their phrase “understanding things differently” possibly suggests a contrast with how people perceive Skara today.

**(5) Understanding Motives, Behaviors, Thoughts, and Emotions in the Past:** This level reflects contextual reasoning and efforts to understand historical figures within the realities of their time. Only two participants reached this level, and each provided a relevant response. One of them shared:

“I got two different impressions. One was that because people were in shortage of food and hard weather, they were very selfish and wanted to have (fight over food)... they didn’t care about other people. But on the other side, I see that there are people also caring and wanting to be nice, even though the situation is very tough.”

Tester 8

This response demonstrates a nuanced understanding of human behavior in historical contexts.

**(6) Acknowledgement of Differences from those in the Past:** Recognition of difference without judgment; awareness that historical perspectives and values may differ fundamentally from our own. Only one participant reached this level, with a single response coded accordingly:

“I'm unsure of when I am, because she prays to Freja—like a Norse god—but then the cathedral is already there, and it's been there for 100 years. I think she said, or maybe 200 years. So she's clinging to an old religion, but I might accept that, because who knows if Christianity took over very quickly, or if it was very gradual. Most people were slow to accept it. Maybe it took generations for them to accept a new kind of religion—it depends on how oppressive society was around them, I think. ”

Tester 1

This response demonstrates a thoughtful consideration of the historical complexity surrounding religious transformation. Rather than judging the character’s actions, the participant speculates on broader societal conditions that may have shaped religious belief and practice over time. Their interpretation closely aligns with the narrative design intention of the prototype.

### 6.4.3 Contributing factors to historical empathy

When examining which aspects of the player experience contributed most to the development of historical empathy, immersion and emotion emerged as the most significant dimensions. These were closely supported by several specific contributing factors: the real-world settings, sound effects, and the narrator's voice-over (descriptive talks). These three elements together formed the conditions that enabled imagination. Consider the act of imagining, which involves actively constructing scenes in one's mind rather than passively receiving information. It strongly engages various areas of the brain and thus is more likely to leave a lasting impression. What's more, this effect was especially pronounced when the narrator explicitly invited players to imagine—for example, in an excerpt:

“Look at the lawn on your right; this might have been the backyard... Take a deep breath... as if the scent of herbs still lingers in the air. Imagine the brothers once lived here, dressed in grey, rising with the bell, working the garden, copying scripture, preparing food, for themselves and for the poor.”

Such direct prompts for imagination proved highly effective and were received with much positive feedback. One participant even described the experience using the word “synesthetic” (Tester 3). I believe this helped establish historical empathy especially between Levels 3 and 4, both of which emphasize forms of comparison. In this case, the juxtaposition between auditory and visual input created a subtle yet conflicted sensation—an embodied tension that draws attention to the difference between past and present.

Another frequently mentioned group of contributing factors included the story content, the character's voice-over, and player mobility (i.e., physical movement). All three are closely tied to the sense of being situated within a fictional narrative world. To be specific, a story provided players with a stage, a role to play, and characters to connect with. This enabled personal connections to form. As one participant put it: “I'm interacting with the character who lost her cat. I still feel like myself, but I also experience what she experiences—it's like a double perspective. People talk to me or to her in a way that blurs the line.” Without a narrative, and with only informative descriptions, such effects would not have been possible.

Physical mobility, meanwhile, enhanced the sense of first-hand experience through embodied engagement. As Cardiff emphasizes in her soundwalks, “The artist works with the understanding that immediate physical experiences make a greater impact and are more memorable than those that are only heard or imagined” (Schaub, 2005, p. 104). These two factors—a story that players can inhabit, and the physical act of walking—go beyond general comparison (level 3) and open up the possibility for emotional comparison (level 4) as well.

Another interesting though somewhat less pronounced combination of contributing factors was the pairing of story and narrator's informative description. On one hand, historical empathy at the lower levels (Level 1 to Level 2)—involving factual recognition and historical thinking that rely on assumptions—often drew from these two sources. On the other hand, higher levels such as Level 5 and Level 6, which involve deeper understanding and acknowledgements of the past, were also more frequently associated with them, rather than with immersion and imagination. One possible explanation is that in order to generate deeper reflection, one must to some extent withdraw from the narrative and immersive environment, and look at the past from a more distanced or reflective perspective.

Contributing factors included the story narration, the emotional tone in the character's voice-over, and the narrator's informative descriptions. However, one factor that may contribute to the differing levels of historical empathy is the player's prior knowledge. The only participant (Tester 1) who reached Level 6 was familiar with the museum exhibition and rated their prior knowledge of Skara's history as 6 (on a 10-point scale). Based on the author's evaluation, their actual familiarity with the period may have been even higher. This likely enabled them to extract deeper historical meaning from the short prototype.

Overall, GPS functionality, game mechanics, and challenge design were not perceived as strong contributors to historical empathy. While essential to gameplay flow and usability, these aspects were rarely mentioned in connection with players' historical reflection or emotional engagement with the past.

#### **6.4.4 Extended Impacts**

While this study primarily focused on historical empathy as the core evaluative framework, two emergent themes arose from the interviews: **historical curiosity** and **lasting impression**.

Though not directly reflected in the HEMT assessment, one notable impact the game had on players is that it sparked their curiosity about the actual history of Skara. Seven out of ten participants expressed either a desire to revisit the museum exhibition or to look up historical information after completing the game. In addition, nine out of ten participants stated that after playing, they would feel differently when walking past those sites again, and believed that the feeling would remain even after a long time—for "it (the experience) is a lot more than just reading or seeing something, it's a first-hand experience" (Tester 5), and "sound is a strong mnemonic device where you get triggered by it" (Tester 3). This powerful residue of memory points to a spatial inscription of experience that extends beyond the moment of gameplay.

# 7 Conclusions

## 7.1 Summary

All in all, this study shows the potential of this format of using an audio-only location-based game to connect museum narratives with real-world historical sites. It not only fostered engagement with history but also, in some cases, generated a synesthetic aesthetic experience. The answers to the research questions can be summarized as follows:

### **RQ1: How do players perceive the experience of a location-based audio game designed to foster historical empathy?**

Overall, players adapted quickly to the interactive model and appreciated the novelty of the format, finding it both accessible and refreshing.

Challenge-wise, though GPS inaccuracy caused some difficulties, most participants managed the challenges without major issues. Some expressed a desire for more narrative branching moments.

Immersion was widely experienced, with the dynamic interplay between the virtual and real worlds playing a key role in activating imagination.

Emotionally, the game was described as peaceful and enjoyable. However, moments of worry and anxiety emerged when the game fell silent, pointing out the importance of continuous audio feedback in a format that lacks visual elements.

### **RQ2: To what extent does the game elicit historical empathy?**

All participants demonstrated at least basic levels of historical engagement, with most reaching Level 3 (General Comparison) on the HEMT scale. Only a few responses reflected deeper levels of empathy. However, the game shows great potential in sparking historical curiosity and forming lasting memories of the historical scenes on a sensory and emotional level.

### **RQ3: What factors contribute most to eliciting historical empathy?**

The design elements that contributed most to eliciting historical empathy were those that supported immersion and emotional engagement.

Real-world settings, sound effects, and the narrator's voice-over are key factors in triggering imagination. Together they laid the foundation for historical empathy at both Level 3 (general comparison) and Level 4 (emotional comparison).

Building on this foundation, narrative content, character voice-over, and player mobility further reinforced the sense of personal involvement. These elements helped transform general comparisons into emotionally reflections, thus enabling the progression from Level 3 to Level 4.

The combination of fictional storyline and informative descriptions supported both lower (Level 1-2) and higher (Level 5-6) levels of empathy, the variable factor that potentially caused this differ might be the player's previous knowledge regarding the topic.

## 7.2 Discussion

As discussed in the background section, there has been very little previous research focusing on location-based games (LBGs) that use a non-visual approach, particularly within the context of cultural heritage (CH). This study fills that research gap and situates itself in an interdisciplinary space, drawing inspiration from diverse fields including serious games, cultural heritage, and the contemporary art form of soundwalking. By detailing the design thinking, development, and evaluation process, this study seeks to inform future research. Some key contributions are discussed below.

This study's findings empirically support Szymczak et al.'s (2012) argument that audio-based interaction can foster situated engagement while keeping users attuned to their real-world surroundings. Notably, Mortara et al. (2014) emphasized that in mobile, outdoor heritage experiences, narrative should remain lightweight and interruptible to avoid interfering with users' perception of the physical environment. However, this study challenges that assumption. Through audio-based storytelling, it was possible to maintain continuous narrative flow without compromising spatial awareness. On the contrary, participants expressed discomfort when the audio stopped, suggesting that uninterrupted guidance not only supported immersion but was actively preferred. This indicates that audio-first design may offer a new model for balancing narrative depth with environmental awareness—rendering narrative “interruptibility” less necessary than previously assumed. This suggests that layering audio over traditional LBG design introduces new affordances for narrative flow and emotional engagement, opening further avenues for exploration.

Drawing on Endacott and Brooks' (2018) definition of historical empathy that emphasize both “cognitive and affective engagement”, the prototype is designed to support the cognitive dimension by situating players within a spatial context through real-world locations, a temporal context through historically anchored narration, and a social context through interactions with and between non-player characters (NPCs). The affective dimension is addressed by assigning players a narrative task and fostering a personal relationship with the main character, encouraging emotional engagement and personal investment.

However, a few critical reflections on the study are worth noting.

The first point of reflection relates to the two primary evaluation models employed in the evaluation: VALERIE (Carneiro et al., 2021) and HEMT (Crompton et al., 2023).

The VALERIE framework provided a concrete foundation for structuring the analysis in this study, particularly thanks to its emphasis on LBG-specific characteristics such as mobility and spatiality. However, this study further narrowed the format to an audio-first game set within a CH context. To accommodate this, I added two new dimensions to the framework: *Audio Aspects* and *Historical Empathy*. These modifications, however, were not systematically validated before being put into use, so certain usability issues emerged. For example, there was overlap between “character's voice-over” under Audio Aspects and “narrative/storytelling” under General Aspects. Such categorization issue led to ambiguity when attributing contributing factors.

Besides structural issues, there were also challenges in using the framework during interviews. The original VALERIE question bank is designed such that each question addresses the intersection of a player experience (PX) dimension and a specific game characteristic. For instance, “Could you tell me about a time when physical displacement prevented you from taking any action in the game?” clearly targets the impact of the spatiality dimension on the PX dimension of challenge. In contrast, this study’s interview questions were organized solely around the PX dimensions. For example, a question like “Have you met any difficulties while playing? Can you describe how it happened and what caused it?” does not directly reference any specific design elements. This was intended to avoid leading the participant and to keep the interviews time-efficient. However, it resulted in some responses being too vague to be analytically useful.

In terms of the HEMT, the issues are more complex. Though it, like the VALERIE framework, offered valuable guidance for this study, after completing the analysis, I began to question whether historical empathy is truly the most appropriate construct to measure in this context.

Originally developed for classroom-based history education, HEMT was intended for a context and set of goals very distinct from those of a historical game. While it offers a clear set of evaluative criteria, applying it to projects like this one may require further revision. In particular, its current focus does not fully account for aspects such as historical curiosity or lasting emotional impressions—both of which emerged as important outcomes in this study. This observation also aligns with a broader understanding within the field: serious games are increasingly recognized not as replacements for traditional learning methods, but as complementary tools that leverage different strengths. This applies to the current project as well: the game may be better understood not as a standalone learning experience, but as one that works in combination with the museum exhibition, either as a pre-visit or post-visit experience. This interpretation is further supported by feedback from museum staff, who saw the prototype’s potential to evoke emotional and personal resonance. Through voice and sound, the narrative felt more “human” and reflective than traditional factual displays.

In addition to the reflections on methods, another area of consideration concerns the research findings themselves.

While the project was developed in collaboration with the museum, most of the scriptwriting was carried out individually by me, based solely on printed materials and the guided tours provided by museum staff. That said, the designer’s level of historical empathy may have limited the depth of that convey to players. Thus, if such projects aim to foster deeper levels of understanding, closer collaboration with archaeologists and historians may be necessary.

Another point of reflection regarding the findings concerns the interpretation of immersion outcomes. While one participant reported entering a flow state, another remained highly distracted throughout the experience. These differences may not necessarily stem from game design alone, but could also reflect individual differences. Overall, the limited sample size and lack of pre-session profiling (e.g., player type questionnaires) may have constrained the analysis. Future studies could benefit from incorporating such tools to better contextualize variations in player response.

### 7.3 Future Work

Several directions can be pursued to build on the findings of this study.

In terms of refining the prototype, an immediate next step is to introduce a constant background audio layer to provide a sense of continuity and reduce player anxiety during silent intervals. Additionally, future iterations would benefit from closer collaboration with historians or archaeologists to ensure historical accuracy and depth in the narrative.

Regarding testing sessions, future testing could involve a more diverse and larger pool of participants, especially across different age groups, to explore its potential within an inclusive design framework. Although the current prototype was primarily developed with short-term tourist engagement in mind, many museums also serve a recurring local audience. Future research could explore how to design for long-term engagement with local residents.

Additionally, if future studies continue to adopt assessment tools such as HEMT, it may be more appropriate to evaluate the combined experience of the game and the exhibition, ideally with the inclusion of a control group or comparative condition.

Finally, on a methodological level, the evaluation process and feedback from this study could inform a revision of the VALERIE framework, adapting it more specifically for location-based audio games. This could provide practical guidance for future research and development in this area.

## References

- Alexiou, A., Schippers, M.C. and Oshri, I. (2020) Positive psychology and digital games: The role of emotions and psychological flow in serious games development. *Psychology of Well-Being*. 10(1), pp. 1–16.
- Anderson, E.F., McLoughlin, L., Liarokapis, F., Peters, C., Petridis, P. and De Freitas, S. (2010) Developing serious games for cultural heritage: a state-of-the-art review. *Virtual reality*. 14, pp. 255-275.
- Arana, U.R., 2023. Soundwalking in the Phonocene: walking, listening, wilding. In *Soundwalking* (pp. 18-33). Focal Press.
- Augustsson, J.-E. (1995) Förord. In: A. Boqvist. (ed.) *Skara i medeltid: staden, stiftet, landskapet*. Skara: Skaraborgs länsmuseum, p. 7.
- Barkova, O., Pysarevska, N., Alienin, O., Hamotsky, S., Gordienko, N., Sarnatskyi, V., Ovcharenko, V., Tkachenko, M., Gordienko, Y., and Stirenko, S. (2019) Gamification for education of the digitally native generation by means of virtual reality, augmented reality, machine learning, and brain-computing interfaces in museums. *Uncommon Culture*. pp. 86, 87-100.
- Bartelds, H., Savenije, G.M. and van Boxtel, C. (2020) Students' and teachers' beliefs about historical empathy in secondary history education. *Theory and Research in Social Education*. 48(4), pp. 529–551.
- Barton, K. C., and Levstik, L. S. (2004) *Teaching history for the common good*. Routledge.
- Bradley, M.M. and Lang, P.J. (1994) Measuring emotion: The Self-Assessment Manikin and the Semantic Differential. *Journal of Behavior Therapy and Experimental Psychiatry*. 25(1), pp. 49–59.
- Brockmyer, J.H., Fox, C.M., Curtiss, K.A., McBroom, E., Burkhart, K.M. and Pidruzny, J.N. (2009) The development of the Game Engagement Questionnaire: A measure of engagement in video game-playing. *Journal of Experimental Social Psychology*. 45(4), pp. 624–634.
- Cameron, F. (1997) Beyond the cult of the replicant: Museums and historical digital objects—Traditional concerns, new discourses. In: K. Jones-Garmil. (ed.) *The Wired Museum: Emerging Technology and Changing Paradigms*. Washington, D.C.: American Association of Museums, pp. 49–75.
- Careri, F. (2017) *Walkscapes: Walking as an Aesthetic Practice*. Ames: Culicidae Press.
- Carneiro, N., Viana, W. and Darin, T. (2021) VALERIE: a guide to qualitative evaluation of player experience in location-based games using interviews. *Proceedings of the XX Brazilian Symposium on Human Factors in Computing Systems* (pp. 1-7).
- Carneiro, N., Darin, T. and Viana, W. (2019) What are we talking about when we talk about location-based games evaluation? a systematic mapping study. *Proceedings of the 18th Brazilian Symposium on Human Factors in Computing Systems* (pp. 1-13).

Chatzidimitris, T., Gavalas, D. and Michael, D. (2016) SoundPacman: Audio augmented reality in location-based games. *Proceedings of 2016 18th Mediterranean Electrotechnical Conference*. MELECON. pp. 1-6).

Chude-Sokei, L., 2023. Walking with sound: race and the prosthetic ear. In *Soundwalking* (pp. 34-44). Focal Press.

Crompton, H., Nako, K. and Burke, D. (2023) The Historical Empathy Measurement Tool (HEMT). *Journal of Social Studies Research*. 47(3-4), pp. 161-172.

DaCosta, B. and Kinsell, C. (2022) Serious games in cultural heritage: A review of practices and considerations in the design of location-based games. *Education Sciences*, 13(1), p.47.

De Leur, T., van Boxtel, C. and Wilschut, A. (2020) 'When I'm drawing, I see pictures in my head': Secondary school students constructing an image of the past by means of a drawing task and writing task. *European Journal of Psychology of Education*. 35(1), pp. 155-175.

Droumeva, M., 2023. Soundwalking extinction: listening on borrowed time. In *Soundwalking* (pp. 78-95). Focal Press.

Endacott, J., and Brooks, S. (2018) Historical empathy: Perspectives and responding to the past. In S. A. Metzger and L. McArthur Harris. (eds.) *The Wiley International Handbook of History Teaching and Learning*. Wiley-Blackwell.

Foni, A.E., Papagiannakis, G. and Magnenat-Thalmann, N. (2010) A taxonomy of visualization strategies for cultural heritage applications. *Journal on Computing and Cultural Heritage (JOCCH)*, 3(1), pp.1-21.

Giariskanis, F., Kritikos, Y., Protopapadaki, E., Papanastasiou, A., Papadopoulou, E. & Mania, K. 2022. The Augmented Museum: A Multimodal, Game-Based, Augmented Reality Narrative for Cultural Heritage. *Proceedings of the 2022 ACM International Conference on Interactive Media Experiences*. Aveiro, JB, Portugal: Association for Computing Machinery.

Greitzer, F.L., Kuchar, O.A. and Huston, K. (2007) Cognitive science implications for enhancing training effectiveness in a serious gaming context. *Journal on Educational Resources in Computing (JERIC)*, 7(3), pp.2-es.

Gutiérrez, A., 2023. Aural border thinking as a decolonial soundwalking methodology. In *Soundwalking* (pp. 96-115). Focal Press.

Koutsabasis, P., Partheniadis, K., Gardeli, A., Vogiatzidakis, P., Nikolakopoulou, V., Chatzigrigoriou, P. and Vosinakis, S. (2021) Location-based games for cultural heritage: applying the design thinking process. *Proceedings of CHI Greece 2021: 1st International Conference of the ACM Greek SIGCHI Chapter* .pp. 1-8.

Laiti, O., Harrer, S., Uusiautti, S. and Kultima, A. (2020) Sustaining intangible heritage through video game storytelling - the case of the Sami Game Jam. *International Journal of Heritage Studies*, 27(3), pp.296-311.

McCartney, A. (2014) Soundwalking: creating moving environmental sound narratives. In: S. Gopinath and J. Stanyek. (eds.) *The Oxford Handbook of Mobile Music Studies, Volume 2*. New York: Oxford University Press, pp. 212-237.

- Messina, P.C., 2023. Soundwalking on the edges: land, safety, and privilege in São Paulo. In *Soundwalking* (pp. 134-147). Focal Press.
- Momoki, S. (2022) Digital storytelling in museums: Enhancing visitor engagement through interactive narratives. *Museum Management and Curatorship*. 37(3), pp. 250–265.
- Mortara, M., Catalano, C.E., Bellotti, F., Fiucci, G., Houry-Panchetti, M. and Petridis, P. (2014) Learning cultural heritage by serious games. *Journal of Cultural Heritage*. 15(3), pp. 318-325.
- Navarrete, T. (2019) Digital heritage tourism: Innovations in museums. *World Leisure Journal*. 61(3), pp. 200-214.
- Naul, E. & Liu, M. (2020) Why Story Matters: A Review of Narrative in Serious Games. *Journal of Educational Computing Research*, 58, 687-707.
- Nóbrega, R., Jacob, J., Coelho, A., Weber, J., Ribeiro, J. and Ferreira, S. (2017) Mobile location-based augmented reality applications for urban tourism storytelling. *2017 24<sup>o</sup> Encontro Português de Computação Gráfica e Interação (EPCGI)* (pp. 1-8). IEEE.
- Ouzounian, G., 2023. ‘Our voices reached the sky’: sonic memories of the Armenian Genocide. In *Soundwalking* (pp. 164-180). Focal Press.
- Palombini, A. (2017) Storytelling and telling history. Towards a grammar of narratives for Cultural Heritage dissemination in the Digital Era. *Journal of Cultural Heritage*, 24, pp. 134-139.
- Perjons, E. and Johannesson, P. (2022) *An Introduction to Design Science*. Springer Nature.
- Rouse, R. (2021) ‘Against the Instrumentalization of Empathy: Immersive Technologies and Social Change’, in Anders, P. and Rouse, R. (eds.) *AR and MR for Communities: Designing Immersive Experiences for Social Impact*. Boca Raton: CRC Press, pp. 3–19.
- Rovithis, E., Moustakas, N., Floros, A., and Vogklis, K. (2019) Audio Legends: Investigating Sonic Interaction in an Augmented Reality Audio Game. *Multimodal Technologies and Interaction*. 3(73), pp. 1-18.
- Schaub, M. (2005) *Janet Cardiff: The walk book*. Vienna: Thyssen-Bornemisza Art Contemporary. Cologne: Verlag der Buchhandlung Walther König.
- Shakouri, F. and Tian, F. (2019) Avebury Portal—A location-based augmented reality treasure hunt for archaeological sites. In *E-Learning and Games: 12th International Conference, Edutainment 2018, Xi'an, China, June 28–30, 2018, Proceedings 12* (pp. 39-49). Springer International Publishing.
- Shaw, T., 2023. Paths of dependence: welcoming the unwelcome. In *Soundwalking* (pp. 116-133). Focal Press.
- Smolicki, J. ed. (2023) *Soundwalking: Through time, space, and technologies*. Focal Press.
- Szymczak, D., Rassmus-Gröhn, K., Magnusson, C., and Hedvall, P.-O. (2012) A Real-World Study of an Audio-Tactile Tourist Guide. *Proceedings of the 14th International Conference on Human-Computer Interaction with Mobile Devices and Services*. pp. 335–344.

Ticala, R., Ciupe, A., Meza, S. and Orza, B. (2020) Augmenting Learning through VR Storytelling. *2020 14th International Symposium on Electronics and Telecommunications (ISETC)* (pp. 1-4). IEEE.

Vassilakis, K., Charalampakos, O., Glykokokalos, G., Kontokalou, P., Kalogiannakis, M., and Vidakis, N. (2017) Learning history through location-based games: The fortification gates of the Venetian Walls of the City of Heraklion. In *International Conference on ArtsIT, Interactivity and Game Creation* (pp. 510-519). Cham: Springer International Publishing.

Vetenskapsrådet (Swedish Research Council). (2025) *Ethics in research*. Available at Internet: <https://www.vr.se/english/mandates/ethics/ethics-in-research.html> [Accessed Jun 4, 2025].

Vilar, J., Rodrigues, A. and Correia, N. (2025) An Extended Reality Platform for Cultural Gaming: Enabling Interactive Narratives in Spatial Contexts. *ACM Journal on Computing and Cultural Heritage*. 17(4), pp. 1-18.

Wang, X. (2021) *The Effect of Mobile Serious Games on Learning Intangible Cultural Heritage*. Doctoral dissertation, University of York.

Westerkamp, H. (2001) *Soundwalking*. Originally published in *Sound Heritage, Volume III Number 4, Victoria B.C., 1974*. Revised ed. Available at Internet: [https://hildegardwesterkamp.ca/writings/writings-by/?post\\_id=13&title=soundwalking](https://hildegardwesterkamp.ca/writings/writings-by/?post_id=13&title=soundwalking) [Accessed May 22, 2025].

Yang, J., Barde, A. and Billingham, M. (2022) Audio augmented reality: A Systematic Review of Technologies, Applications, and Future Research Directions. *Journal of the Audio Engineering Society*. 70(10), pp. 788-809.

# Appendix A - Full Questionnaire

## Part 1 - Basic information

1. Have you ever seen the exhibition “Skara in the Middle Ages”?

- Yes
- No
- Other: \_\_\_\_\_

2. How would you rate your previous knowledge of Skara and its history?  
(1 = I know nothing at all, 10 = I know the city and its history by heart)

- 1    2    3    4    5    6    7    8    9    10

## Part 2 - Revised Game Engagement Questionnaire (GEQ)

Please indicate how much you agree with the following statements.

(1 = Strongly disagree, 6 = Strongly agree)

3. I found myself just following the story and moving without thinking too much.

- 1    2    3    4    5    6

4. The game world felt real even though I was walking through a modern city.

- 1    2    3    4    5    6

5. I really got into the game.

- 1    2    3    4    5    6

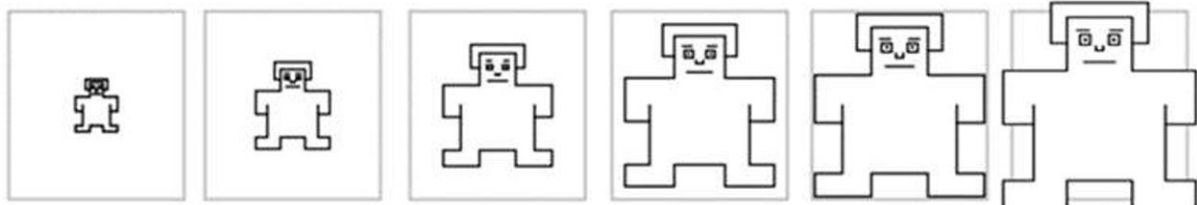
6. I wanted to keep playing after the game ended.

- 1    2    3    4    5    6

## Part 3 - Revised Self-Assessment Manikin (SAM)

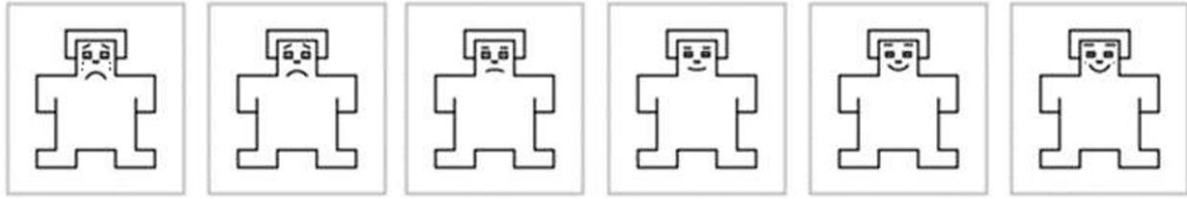
Please rate your emotional responses during the game experience.

7. How pleasant or unpleasant did you feel?



- 1    2    3    4    5    6  
1 = Very unpleasant      6 = Very pleasant

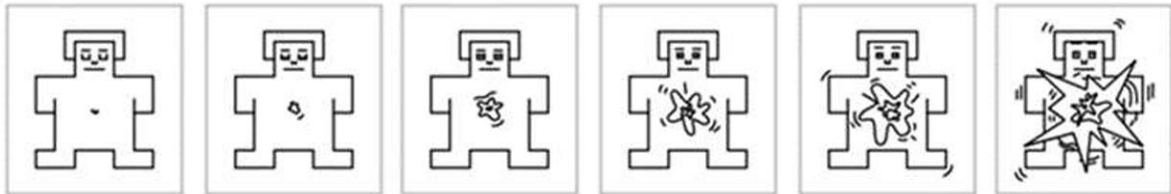
8. How intense or calm was your emotional state?



1    2    3    4    5    6

1 = Very calm      6 = Very excited or intense

9. How much control did you feel you had in the situation?



1    2    3    4    5    6

1 = Very little control      6 = Full control

# Appendix B - Full interview questions

## Part 1: Challenges

Could you describe who are you, what you were doing and where you went in the game?

Have you met any difficulties while playing? Any specific moment where you felt confused or frustrated, if so, when and why?

Do you think the game's story is in harmony with your physical movements in the real world?

Can you describe how did you navigate yourself in the real-world? Like what kind of instructions helped you the most?

## Part 2: GEQ-based follow-ups

If negative: Can you tell me more about that? When and how did it happen? What do you think caused that experience?

If positive: What contributed to that experience? What aspects of the game made it happen? (Was it related to the gameplay, the story, the sound, the music or something in the environment?)

## Part 3: SAM-based follow-ups

You marked the game as unpleasant/pleasure. What caused that feeling?

You rated the game as intense/calm. Can you tell me when did you feel that, and what made it feel that way? What was happening around you? What were you doing?

You felt like you had/didn't have much control. What gave you that sense?

## Part 4: Historical Empathy

Can you tell me about your overall impression about how people lived or thought in the medieval time, as depicted in the game? (Did anything particularly stand out to you?)

Did the game help connect the city's history with the city today, if so, what contribute to that the most?

After playing, would you feel differently walking past the sites again? (In what ways? can you describe what changed in your perception of the place?/Do you think that feeling will stay with you afterward?)

## Part 5: Game format

Imagine this wasn't a location-based game, but a computer or mobile game set in a virtual world, how do you think that would change the experience for you?

Besides audio, would you wish to see more visual elements, like graphics, AR, or text-based content?

Would you prefer the experience to feel more like a game—with challenges, choices, or goals—or more like linear storytelling?