Story Inspiration Station: Deeper Engagement with Museum Objects via Participatory Interpretation

Story Inspiration Station

SIMON J. BOWEN
Open Lab, School of Computing, Newcastle University, simon.bowen@newcastle.ac.uk

HATTIE C. ROWLING
Open Lab, School of Computing, Newcastle University, h.c.rowling2@newcastle.ac.uk

DAVID KIRK
Open Lab, School of Computing, Newcastle University, david.kirk@newcastle.ac.uk

Interactive technologies offer the potential to support new forms of engagement with Cultural Heritage sites and collections, including the possibility of participatory interpretation and the production of polyvocal narratives that might challenge the Authorised Heritage Discourse. To explore this potential, we developed Story Inspiration Station, an interactive museum exhibit using digitised museum objects to prompt reflective engagement amongst visitors. This allowed us to investigate how an interactive exhibit can enable and scaffold deeper engagement with objects and democratises their interpretation through visitors' exploration of their own and other's responses to them. Through content analysis of system use and visitor responses (1,514 submissions) and thematic analysis of visitor interviews (n=8) and survey responses (n=6) we provide insights into strategies for deepening engagement with heritage objects and for challenging dominant discourses and provide design considerations for others seeking to digitally support polyvocal engagement with museum collections.

CCS CONCEPTS • Human-centered computing ~ Interaction design ~ Empirical studies in interaction design • Human-centered computing ~ Human computer interaction (HCI) ~ Empirical studies in HCI • Applied computing ~ Arts and humanities

Additional Keywords and Phrases: Museums, Heritage, Authorised Heritage Discourse, Polyvocality, Interaction Design

1 INTRODUCTION

Cultural heritage (CH) is changing to both address problematic aspects of its past constitution and practice, and in response to opportunities for the application of interactive media and technology. Scholars have drawn attention to heritage as a political act that has historically propagated prejudices such as colonialism, cultural elitism, and Western triumphalism, and sustained power relations that exclude based on expertise, ethnicity, and social class (Association of Critical Heritage Studies, 2012). Smith (2006) characterised these previous CH practices as an Authorised Heritage Discourse (AHD) that, having been left unchallenged, propagates these problematic aspects. In response, new forms of research and practice have sought to address previous prejudices such as post-colonial or post-conflict heritage (Giblin, 2015). A key strategy in CH practices that challenge the AHD is to include multiple voices in the construction and interpretation of heritage to both include those who might otherwise be marginalised or excluded, and to include multiple co-existing stories in interpretations (Mason et al., 2013; Tsenova et al., 2022). This presents an opportunity for the participation of those connected with CH sites and objects (such as local communities and museum visitors) in their interpretation to produce such polyvocality.

Interactive media and technology present opportunities for new forms of engagement with CH sites and objects, and for participation in their interpretation. The digitisation of CH assets, widespread high-speed and mobile internet access, and increasing availability of immersive technologies such as virtual and augmented

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reality, has meant that heritage interactions no longer need to be limited to heritage sites and institutions or static displays. Ways of interacting with heritage objects and sites digitally such as virtual museums have become commonplace and, whilst these present challenges in producing digital representations faithful to original objects (Styliani et al., 2009), they also present opportunities for deeper engagements than are afforded by static interpretations. Here, care is needed to avoid the technology detracting from the heritage object or site itself (Ciolfi, 2018; Harrison, 2012), and – in designing the technology – to avoid unwittingly retaining an AHD -version of CH (Tsenova et al., 2022).

The design, deployment, and evaluation of an interactive museum exhibit titled Story Inspiration Station enabled us to explore these challenges and opportunities. This interactive exhibit was developed in collaboration with the Great North Museum: Hancock and presents a random selection of high-quality videos of objects from the museum's archaeology, natural science (biology and geology), and ethnography collections. The exhibit invites visitors to answer three questions in response to their chosen object, which they can then save for others to read and contribute to a dataset of responses that could support future discovery of objects. Story Inspiration Station allowed us to investigate how an interactive exhibit of this form enables and scaffolds deeper engagement with objects and democratises their interpretation through visitors' exploration of their own and other's responses to them.

In this paper, we present a description of the design and evaluation of Story Inspiration Station, as a case study of a participatory approach to CH interpretation where digitised and visualised CH assets (objects from a museum's displayed and archived collections) were a central resource. From findings on the effectiveness of the interactive exhibit in prompting deeper engagements with museum objects through eliciting visitors' interpretations of them, and an exploration of the features and functionality that enabled such engagement, we go on to propose considerations to support others' design of such interactive technology. Through our paper, we contribute a discussion of Story Inspiration Station as an innovation to cultural heritage research and practice, where it represents a novel way of using an engaging interactive exhibit to subtly challenge the AHD and to scaffold processes of participatory interpretation (and potential future curation) in a non-burdensome way for visitors. We begin with a review of related work on interactive technology in museums, challenging the AHD, and involving people in interpretating CH via interactive technology.

2 BACKGROUND

2.1 Interactive Technology in Museums for Deeper Engagement

Studies of the use of interactive technology in museums have cautioned against it becoming a substitute for or distraction from heritage objects (Roberts et al., 2018; vom Lehn & Heath, 2003) and against designing individualised interactions that ignore the social aspect of museum visits (Eklund, 2020; Heath et al., 2005). Beyond learning, museums offer opportunities for meaningful and social experiences that may be diminished if learning becomes the primary goal of interactive technology (Cosley et al., 2008). Designing interactive technology for deeper engagements with cultural heritage therefore needs to take account of these opportunities.

Several studies have investigated how interactive technology supports social interactions between museum visitors and with heritage objects to enable deeper engagement. From observations of science centre visitors around a tabletop tangible user interface for music performance, Xambó et al. (2017) discuss the importance of facilitating fluid transitions and overlaps between groups of users and how this then enables both synchronous and asynchronous interactions between visitors. Eklund's (2020) ethnographic study of groups of friends visiting a museum identified positive characteristics of their interactions and suggests how the design of interactive technology can better support them including: supporting inter-personal meaning making where visitors make sense of objects together; creating opportunities for playful engagements with exhibits; enabling sharing of information between visitors; and, allowing groups to disperse and coalesce, and disconnect and connect around and with exhibits.

Museum-based studies have shown how encounters with actual heritage objects and including appropriate questions in exhibit labels can afford deeper engagements. Leinhardt & Crowley (2021) distinguish features of objects that make them superior to digital representations for engaging visitors including their scale,

authenticity, value, and having all their details available to be experienced rather than a selection of them. Hohenstein & Tran (2007) observe how including open-ended questions (e.g. "why is this here?") on printed exhibit labels prolonged and deepened visitor engagements. How, then, might interactive technology, alongside objects, use and extend these principles? Roberts et al. (2018) explored different ways of increasing visitors' engagement with a museum's collection via interactive touchscreens alongside objects and observed that provocative questions or interactive visualisations that invite exploration can generate curiosity and engagement. Cosley et al. (2008) investigated the value of eliciting visitors' responses to an object and enabling visitors to explore others' responses. They observed that their system supported social interactions without distracting from the object with visitors discovering connections between their own and others' responses and consequently reflecting on their own responses. Cosley et al.'s study also demonstrated that, at the time of deployment (2007), visitors strongly expected the interactive technology to provide information on the exhibit.

Our design and evaluation of Story Inspiration Station resonates with this work. Like Cosley et al. (2008) it elicits and shares visitor response to museum objects but, in our case, these objects were not present, which raises questions on how the qualities of real objects (Leinhardt & Crowley, 2021) can be made available if they cannot be present. It also affords synchronous and asynchronous interactions between (groups of) visitors (Eklund, 2020; Xambó et al., 2017) although, given the format of the exhibit, this may be confined to smaller groups and pairs. And lastly, it uses questions and aesthetically engaging content to prompt curiosity in visitors (Hohenstein & Tran, 2007; Roberts et al., 2018). Our work extends this previous work in considering how eliciting and sharing visitors' responses (as lay interpretations of museum objects) can challenge the Authorised Heritage Discourse, which we now turn to.

2.2 Challenging the Authorised Heritage Discourse

Traditionally heritage has been thought of as a single narrative concerned primarily with famous historical figures and monumental buildings and places, with this view of heritage being termed the Authorised Heritage Discourse (AHD) by Smith (2006). This results in heritage spaces such as museums showcasing a static collection of objects often viewed in historic isolation with little link to the present (Smith, 2006) where only those objects deemed as important within the narrative of the AHD are deemed worthy of preservation (Logan et al., 2015). More recently, two ideas have helped to break the power of the AHD and made people think differently about what heritage is and how it is presented. Firstly, that heritage objects do not have one fixed meaning as laid down by an expert (Giaccardi, 2011; Smith, 2006). Instead, meaning making is increasingly being seen as a social process through which heritage meanings are created in a more fluid way that considers the links between the past and present (Harrison, 2012; Smith, 2006) and objects' relationship to other objects, to places and to people both in the past and the present (Giaccardi, 2011). While this dialogical turn in heritage advocates for more fluid meaning making around heritage and a breaking down of the barrier between experts and nonexperts (Harrison, 2012), in practical terms this requires changes to traditional methods of museum interpretation and display. Here, visitors need to be supported in thinking about the objects on display and how they relate to them rather than just being presented with a list of facts (Carnall et al., 2013; Silberman, 2013).

Secondly, the AHD is being disrupted is by the widening of heritage narratives to make space for conflicting or alternative heritage narratives (Smith, 2006), particularly those of groups whose experiences are not necessarily reflected in the dominant narrative of the AHD such as ethnic minorities, women, and the working class amongst others (Clark, 2019). In this respect, institutions have been criticised for simply aiming to get a greater variety of people visiting traditional heritage spaces and monuments (Bolick, 2006). However, museums are a long-established part of the heritage landscape and contain vast collections of objects which tell diverse heritage stories so, whilst heritage encompasses more than museums and monuments, these institutions should not be ignored.

Within museums, though, there is a need for a widening of the narratives they tell – often through community outreach with local people giving their views or telling their stories that can then be reflected in museum displays (Carnall et al., 2013) or through co-created exhibitions (Smith & Iversen, 2014). Whilst these projects are not without their merits, they only allow a small subset of the community to be involved rather than allow for participation by any museum visitor and this wider participation opens an important role for technology in museum spaces (Carnall et al., 2013; Ciolfi, 2018).

Sometimes the use of technology in museums is merely a digital means of disseminating information from experts rather than a space for dialogue (Ciolfi, 2018). As museums have become increasingly part of the tourism and leisure economy, they have had to offer visitors greater experiences to compete with other attractions (Harrison, 2012; Kidd, 2018) and technology has increasingly been used to facilitate these experiences (Leoni & Cristofaro, 2022). However, there is a danger here that rather than help to facilitate a meaningful experience with the museum objects, the technology becomes the focus of the experience and thus detracts from the objects on display (Ciolfi, 2018; Kidd, 2018).

2.3 Involving People in Heritage Interpretation via Interactive Technology

Involving visitors in interpretation can make museum collections more accessible and bridge what Trant (2009) has characterised as a semantic gap between how museum professionals and the general public describe objects. In the mid to late 2000s, the steve.museum collaborative project (Chun et al., 2006; Trant, 2009) explored the value of visitors assigning tags (keywords) to works of art from several north American museums. It concluded that people did engage in tagging (often without need for an incentive beyond the activity itself), the resulting keywords were often new in comparison to existing online documentation, and museum professionals found most new keywords useful as relevant search terms (Trant, 2009). steve.museum recognised the value of public tagging in creating dialogues and connections between viewers, artworks, and museums, but also a need to ensure that tagging tools were engaging – prolonging tagging time and encouraging repeated use (Chun et al., 2006). An evaluation of the steve.museum tools observed that users: skipped more objects than they tagged, preferred to tag 2D over 3D objects, assigned more tags when presented with related works rather than random selections, and assigned fewer tags when presented with existing tags for an object (Trant, 2009). Whilst online behaviours have changed since this evaluation (in 2007-2008, when social tagging online was becoming more prevalent), it suggests challenges and opportunities for the design of tools for participatory interpretation of museum collections that Story Inspiration Station seeks to explore. Our work differs in not explicitly requesting public interpretations of objects (e.g. as tags or keywords), instead inviting more open responses. It also considers how, beyond making collections more accessible, visitor responses can represent multiple co-existing interpretations (polyvocality) that can challenge the AHD.

Building on a legacy of Human-Computer Interaction (HCI) work that has sought to understand how to incorporate diverse (often visitor) voices in exhibition design (Ciolfi et al., 2008), recent work in HCI and Interaction Design has specifically sought to explore the ways in which provocative design of interactive exhibits and installations in CH settings can offer opportunities for polyvocality within and around those settings. For example, work by Tsenova et al. (2020) has considered the use of volunteer expertise as genius loci, who can leverage storytelling skills and novel insights around their experiences of place to amplify otherwise un-authorised interpretations of heritage events. The ideas of polyvocality have been stressed to understand the ways in which texturally, temporally and spatially, different voices may be layered to give depth of richness and interpretation around specific CH collections (Claisse et al., 2020; Tsenova et al., 2023). Beyond this however, work has explored how even intangible cultural heritage, such as stories of place, can be utilised to create narratives as boundary objects for supporting CH as a polyvocal practice (Bala et al., 2024) – which is seen as central to inclusively incorporating marginalised communities in heritage experiences and the acknowledgement of pluralistic narratives of the past amongst multicultural communities (Schofield et al., 2019).

2.4 The Great North Museum: Hancock

Story Inspiration Station is part of an ongoing collaboration with the Great North Museum: Hancock in Newcastle upon Tyne, in the North East of the UK, that explores how museum collections and interactive media can increase public engagement with environmental issues such as climate change and biodiversity loss. The museum is part of Tyne & Wear Archives & Museums (TWAM) and displays objects from TWAM's collections over two floors, seven permanent galleries, and a large exhibition space. Many of these objects are from the local area including taxidermy specimens, fossils and mineral samples, and finds from archaeological excavations of Roman forts. The museum receives around 250,000 visitors per year, mostly families with younger children, and including over 22,500 school children as part of organised educational groups.

Figure 1 Story Inspiration Station as installed in the Living Planet gallery with touchscreen interface (bottom left) and display of previous visitor stories (right) – photograph by first author.

3 THE DESIGN OF STORY INSPIRATION STATION

The idea for Story Inspiration Station came from an earlier project where we worked with young people aged 16-19 to explore how museum objects could inspire and be used within short video stories about environmental issues. Whilst our explorations showed that museum objects could inspire stories, young people had difficulty finding objects relating to a particular topic via the museum's online collections search unless they knew precisely what they were looking for (and could describe it using terms used in the database). Furthermore, even if a relevant object was found, database images were rarely of sufficient quality to be used in a video or to illustrate important details of the object. We developed three design proposals for how these challenges might be addressed, including Story Inspiration Station, which was positively received by visitors to an accompanying exhibition and developed into a working interactive exhibit for long-term installation.

Story Inspiration Station is located within the Great North Museum: Hancock's Living Planet gallery, which contains objects from the natural science collection representing animals in different global habitats. The interactive exhibit consists of a smaller touchscreen-based interface through which visitors explore objects and submit responses and a larger non-interactive screen displaying previous visitors' responses (see Figure 1). The touchscreen presents visitors with a random selection of three objects (see Figure 2). Tapping a lever on the interface presents a new selection of objects, akin to operating a 'one-armed bandit' slot machine. Visitors tap an object image to be presented with a high-quality video of the object, a one or two sentence description of it, and the option to *"start your story with this object?"* Once an object is selected, visitors are asked to type answers to three questions about it in turn: *What do you see? What do you notice?* and *What does it make you think or wonder?* These questions were chosen as the museum finds them useful in generating conversations in object handling sessions with members of the public. Videos were chosen to display objects as they would be more visually engaging than static images whilst practically easier to create than digital 3D models with the time and resources available.

The preceding project had focused on object-based storytelling, recognising the potential of stories for public engagement in environmental issues (De Meyer et al., 2020; Ferreira et al., 2021; Veland et al., 2018). Hence, visitors' answers to the three questions were combined into a short 'story' consolidating their responses. The

story structure, and how each answer contributed to it, were hidden until after the third question so as not to give away or influence the result (although this created some usability issues, as we shall describe). Visitors were then asked if they wished to *"save [your story] to inspire other people?"*

If a story is saved, a QR code is presented that directs visitors to a unique web page displaying it along with an image of the object and share links for Facebook, X (formerly Twitter), Pinterest, WhatsApp, and email. Saved stories are then moderated by museum staff using a web interface to block any inappropriate content and selected those to be displayed on the larger screen and on a webpage of featured stories (https://inspire.storyweb.info/). The larger screen is not interactive, instead displaying a random sequence of featured stories, whilst individual stories can be browsed – by object image – on the webpage. The sharing function was developed to enable visitors to share their responses directly after they were completed using their own devices and social media accounts. We discounted either using museum social media accounts for immediate sharing because these unmoderated stories could reflect negatively on the museum, or requiring visitors to log into their personal accounts on the interactive exhibit because we anticipated that visitors would be uncomfortable doing so and the additional time required to do so would discourage sharing. We might have simply saved stories and asked visitors to share them later once they had been moderated but our experience in similar settings is that few visitors will do something later that they cannot accomplish at the time. In our system, visitors could share unmoderated stories, but these would display the disclaimer "This recently posted story has not been reviewed by a moderator yet" to protect the reputation of the museum somewhat.

The visual aesthetics of the touchscreen and story display (Figure 2) were designed to match the materials and colour palette used in the gallery. A visual metaphor of numerous boxes containing objects was chosen to reflect physical object drawers used elsewhere in the gallery, so-called 'cabinets of curiosities' popular in Renaissance Europe, and – through the visual scrolling of seemingly endless drawers – the scale of the museum's collections.

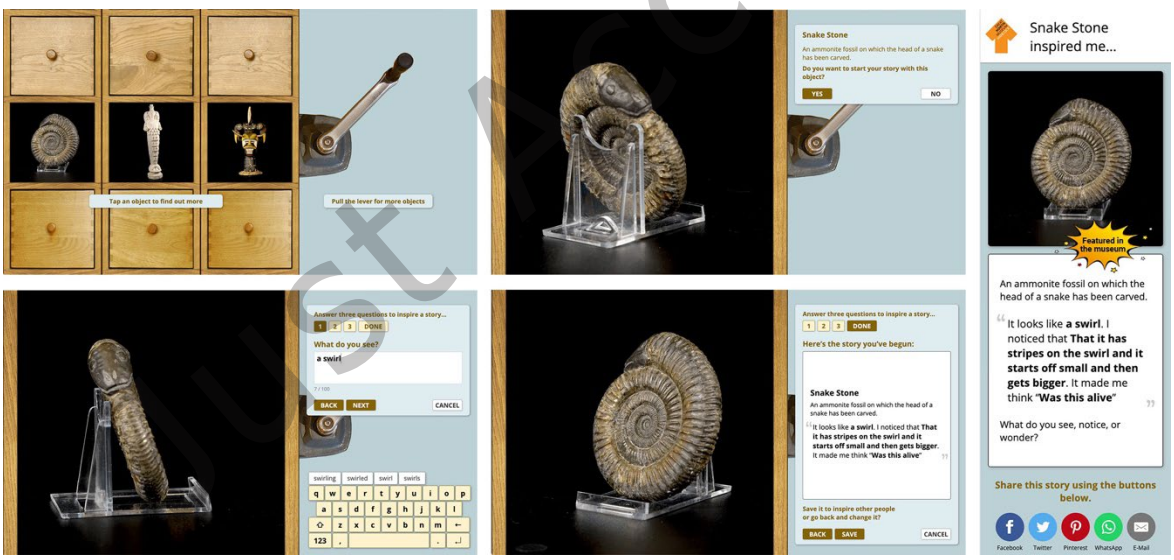

Figure 2 Story Inspiration Station interface: three object view (top left), object details (top middle), question 1 (bottom left), save story (bottom middle), shared story on smartphone (right)

As visitors' interactions with objects would be entirely via digital images of them, they needed to be high quality. It was also important that these images had a consistent visual style that followed the visual aesthetics and metaphor of the interactive exhibit. Existing images in the museum's collections database were of variable quality and style (and were in some cases missing). We therefore produced a new set of images. A forthcoming temporary exhibition ('Mythquest') provided an opportunity to select objects to include in the interactive exhibit. This was convenient in including objects from across the museum's collections and providing a definite

period during which to photograph objects as they were transferred from collection stores to the gallery for installation.

Objects were video recorded against a black background and placed on a slowly rotating turntable with black or transparent object supports as required, and lighting from either side. Videos were post-processed to remove or reduce distracting detail in the black background and trimmed such that one complete rotation was shown to produce short video clips that could be looped and followed a visual metaphor of being 'inside the cabinet'. Where objects were too large or unstable to be placed on the turntable, they were recorded against a black background with slow camera pans or zooms providing movement. Our intention was that slow-moving video showing objects from multiple angles would be more engaging than static images through revealing hidden details and making an object's materials, surface finish, and texture more apparent.

Titles and one or two -sentence descriptions for each object were produced in consultation with the museum's curators. These descriptions were kept deliberately brief to balance providing sufficient detail that visitors knew what they were looking at with sufficient openness to enable visitors to provide their own interpretations without relying upon the curator's 'expert' accounts.

The interactive was constructed as back-end web server application written in Python and a web app running on a PC installed within the gallery. The PC uses Ubuntu Linux in kiosk mode to display the touchscreen interface and larger screen display, and synchronises object images and descriptions, and visitor submissions with the server back-end (also see the software's open-source repository: https://github.com/ashurrafiev/InspirationStation).

The touchscreen interface was designed such that visitors would type answers to questions using an on-screen keyboard. We discounted visitors speaking their answers (either as sound recordings or as speech-to-text input) due to the typically noisy gallery setting. However, a predictive text function that suggested words based on the first few entered characters was added to speed up input. A basic offensive word filter was also included as a first step in discouraging inappropriate content prior to the subsequent manual moderation by museum staff.

4 METHODOLOGY

We adopted a Research through Design (RtD) approach (Archer, 1995; Durrant et al., 2017; Gaver, 2012) to investigate how interactive exhibits enable deeper engagement with museum collections, specifically the value of using high-quality images of objects combined with questions that elicit lay interpretations of them. Here, we designed and evaluated Story Inspiration Station to both determine the form and function of such interactive exhibits and, through the evaluation, derive insights on the value of such interactive exhibits in deepening engagement and democratising interpretation.

Our evaluation of Story Inspiration Station was based upon two sets of data with corresponding analyses: a content analysis of visitors' submissions responses using the interactive; and a thematic analysis of interviews and surveys conducted with visitors following their use of the interactive. Within this evaluation, we sought to answer the following research questions:

RQ1. How effective was Story Inspiration Station at prompting deeper engagements with museum objects?

RQ2. How effective is Story Inspiration Station in arousing visitors' curiosity and prompting their broader reflections?

RQ3. How usable and engaging is Story Inspiration Station for museum visitors?

Analysis of visitor submissions to the interactive were used to answer RQ1 and RQ2, and analysis of interviews and surveys with visitors, after using the interactive, were used to answer all research questions.

4.1 Content Analysis of Visitor Responses

Content analysis (Krippendorff, 2019; Weber, 1990) was performed on the first eight months of visitor submissions (13/7/2023 – 12/3/2024 inclusive). This analysis was of a reduced form because the source data was already well structured (short answers to three questions) – so, content units were readily defined, and sampling was straightforward – and codes could be deduced with respect to our research questions without the need to produce detailed coding instructions.

Content sampling was undertaken as follows. Visitor submissions were downloaded and filtered in MS Excel to remove any submissions flagged as problematic ('block') during moderation and exclude submissions outside the 8-month period. Submissions for each object were then counted. Objects in the interactive came from different museum collections and the number of submissions was likely to be affected by the number of objects from each collection, with average submissions per object being higher for the biology (natural science) collection and lower for the archaeology collection (see Table 1) – i.e. the greater number of objects from the biology collection meant visitors were more likely to see and choose these objects. The number of responses in the filtered data (1514, each consisting of three question answers) made manual coding difficult. So, responses for four objects were analysed reflecting the highest number of submissions across four broadly different types of museum objects (corresponding with their museum collection or sub-collection source): Leopard Head (biology collection, 94 submissions); Snake Stone (geology collection, 51 submissions); Incense Burner (ethnography collection, 34 submissions); and, Griffin Head (archaeology collection, 23 submissions). These four objects (see Figure 3) account for 202 of the total submissions (13.3%) in the 8-month data set.

Table 1 Objects and submissions by museum collection

	Objects	**Submissions**	**Average submissions per object**
Archaeology	3	44	14.67
Biology (part of Natural Science)	27	1003	37.15
Ethnography	10	250	25.00
Geology (part of Natural Science)	10	217	21.70
Total	50	1514	30.28

Visitor responses to each of the three questions in the interactive were coded with reference to our research questions. Codes were assigned where responses provided evidence of some form of deeper engagement with museum objects (RQ1), and visitors' curiosity and reflections (RQ2). Multiple codes were assigned across these three aspects that were refined into a set of 14 codes that sufficiently characterised visitors' responses across 636 coded question answers. The number of codes assigned to each object and question was counted in MS Excel to summarise the character of visitors' responses and guide the narration of findings through highlighting coding density (see Appendix A).

4.2 Thematic Analysis of Interviews and Surveys

An after-hours event at the museum on 8th December 2023 provided an opportunity to conduct interviews and surveys to understand visitors' experiences of using the interactive exhibit. An earlier attempt to do so during normal opening hours was unsuccessful because no visitors spent more than a few moments using the exhibit during the afternoon we visited. After-hours events did provide numerous visitors within a defined period who were open to talking to university researchers. These events, held around six times per year often with live music, food, and drinks, offer a more relaxed setting to daytime visits during which visitors can explore the galleries and talk with subject experts (e.g. at temporary exhibits where they can 'meet the scientist'). Although we recognised that after-hours visitors were different to the typical audience demographic being adults seeking cultural experiences accompanied by older children if at all.

During the event visitors passing the exhibit were asked if they would try the interactive and then provide feedback on it via a short interview or two-page survey. Over the event, eight participants took part in interviews and six participants completed surveys (see Table 2). Informed consent was obtained from all participants, interviews were audio recorded and transcribed, and paper survey responses were transcribed. Transcripts had names and any other personally identifiable information removed prior to analysis. Spelling and grammatical errors in survey responses have been left uncorrected.

Figure 3 Objects used in the content analysis: Leopard Head, Snake Stone, Incense Burner, Griffin Head

The interview and survey included similar questions: *What objects did you find interesting and why? What did Story Inspiration Station make you think about? Has Story Inspiration Station made you think about the museum and its collections differently?* And, *What was good and what needed improving in the interactive exhibit?* The survey also included Likert questions on whether visitors enjoyed using the interactive, were interested in the objects shown, and how it made them think about the museum and its collections differently.

Thematic analysis (Braun & Clarke, 2006, 2021) was conducted on interview and survey transcripts using Nvivo software (https://lumivero.com/products/nvivo/) for assigning and managing codes, and a Mural online whiteboard (https://mural.co/) for organising codes into themes. As the thematic analysis took place following the content analysis of visitor submissions, a deductive approach was used for the initial assignment of codes. Here, visitors' responses were analysed for evidence of: what was engaging about the interactive; why certain objects for were chosen (or not); the interactive's effectiveness at prompting reflection (on the objects, the museum and its collections, and broader issues); and, feedback on the usability of the interactive. A second, inductive, pass was made through the transcripts before codes were organised into themes. Codes and theme names were then refined with reference to the transcripts.

5 STORY INSPIRATION STATION EVALUATION FINDINGS

At the time of writing (May 2024) museum visitors have made approximately 2,500 submissions (each containing three answers) to Story Inspiration Station, although few seem to have been shared beyond the gallery display. A search on X (formerly Twitter) for posts with the hashtag automatically added to shared stories (#StoryInspirationStation) produced no results. The APIs or post formats for the other social media sharing options (Facebook and Pinterest) do not allow the inclusion of hashtags, and it was not possible to track stories shared via WhatsApp or email. Whilst sharing beyond the museum appears limited, the many submissions made offer valuable data for understanding the effectiveness of the interactive exhibit in prompting

deeper engagement. Our findings first consider an analysis of these submissions. Interviews and surveys conducted with visitors following their use of the interactive exhibit extend these insights and offer explanations for visitors' engagement and its effects on them, which we consider in the second part of our findings.

Table 2 Evaluation participant details

Participant IDs	**Details**	**Interview number or survey**
P1	Woman using the interactive on her own.	1
P2, P3, P4	Three women using the interactive together. All took part in the interview.	2
P5	Woman and man using the interactive together. Woman took part in the interview	3
P6	Woman and man using the interactive together. Man took part in interview.	4
P7	Two women using the interactive together. Only one woman took part in the interview.	5
P8	Woman using the interactive on her own.	6
P9	Man under 16, (using interactive with family)	Survey
P10	Man 25-34	Survey
P11	Woman 55-64	Survey
P12	Woman 45-54	Survey
P13	Man 35-44	Survey
P14	Woman under 16, (using interactive with family)	Survey

5.1 Content Analysis of Visitor Submissions

Our content analysis of visitor submissions identified 14 codes that characterised visitors' responses in relation to the depth of their engagement (in relation to RQ1) and whether curiosity or reflection was evident in their answers (in relation to RQ2). 636 of these codes were assigned across the 606 question answers in the sample (202 visitor responses, 3 question answers in each) as summarised in Table 3 with full details in Appendix A.

Table 3 Content Analysis Codes

Code	**Coded answers**	
Name	166	26.1%
Object attributes	212	33.3%
Object history	16	2.5%
Object behaviour	22	3.5%
Object emotion or character	30	4.7%
Viewer emotions	40	6.3%
Viewer opinion	5	0.8%
Viewer future action	3	0.5%
Curious name	1	0.2%
Curious attributes	25	3.9%
Curious behaviour	27	4.2%
Curious history	46	7.2%
Related concepts and objects	38	6.0%
Unrelated concept	5	0.8%
Total	636	100.0%

More than half of the coded question responses (378/636, 59.4%) were of the form of naming the object or describing its attributes (e.g. material, colour, texture, pattern) – *"a big mouth and long ears and patterns"* (Griffin Head, Q1), *"small in shape curled up"* (Snake Stone, Q2) – with most responses of this form being in response to Q1 (193) or Q2 (160). Whilst these codes (Name, Object attribute) suggest a shallower engagement

for most visitors, other codes show deeper engagement to varying degrees as we now describe. 16 responses (coded as Object history) state aspects of an object's history – *"probably from the cretaceous"* (Snake Stone, Q2). In 22 question responses (coded as Object behaviour), visitors described the (imagined) behaviour or actions of objects – *"i see a leopard hunting"* (Leopard Head, Q1) *"its slithers"* (Snake Stone, Q2). Incense Burner was notable in having no responses of this form, perhaps unsurprising given that the other objects represent living things in some form (leopard, griffin, snake).

30 question responses suggest visitors have projected emotions or character onto the object (coded Object emotion or character) – *"it looks mad"* (Griffin Head, Q1). This was particularly evident for the Leopard Head (27 responses) – *"big teeth aggressive animal"* (Leopard Head, Q2), *"he is scared"* (Leopard Head, Q3) – which may lend itself to such anthropomorphising more than the other three objects. Such responses were also more frequent for Q2 answers (13/30).

5 question responses were coded as Visitor opinion – *"interesting shine"* (Incense Burner, Q2), *"Its got lots of lines on it. The head is carved very well with the nostrils of a snake."* (Snake Stone, Q2)

The Leopard Head, and to a lesser degree the Snake Stone and Incense Burner, also prompted 40 question responses that suggest some form of emotional reaction from visitors (coded as Visitor emotion). Such responses tended to be in answer to Q3 (20/40) – *"A funny looking face on a poor stuffed creature"* (Leopard Head, Q1), *"it has a creepy face"* (Incense Burner, Q2), *"the face is cute"* (Snake Stone, Q3).

Questions 2 and (largely) 3 also prompted visitors to express curiosity about certain aspects of objects. 26 question responses demonstrated curiosity about the name or other attributes of the object (coded Curious name or Curious attributes). Deeper engagement with the objects was suggested by 27 responses that expressed curiosity about the behaviour or emotions or character of the objects (coded Curious behaviour). Apart from the Griffin Head, these responses were all in response to Q3 – *"who angered it"* (Leopard Head, Q3), *"why is it growling"* (Incense Burner, Q3).

46 question responses demonstrated curiosity about the history (story) of the objects (coded Curious history), which, with one exception, were all in response to Q3 – *"how it was made"* (Incense Burner, Q3), *"If the person who found it didnt know what it was and thought it was a snake, so he carved the head"* (Snake Stone, Q3).

27 question responses demonstrated curiosity about the behaviour of the objects (coded Curious behaviour), apart from one all in response to Q3 – *"why is its beak open"* (Griffin Head, Q2), *"I wonder what it was like when it was alive and how fast it could run"* (Leopard Head, Q3).

38 question responses suggested even deeper engagement through describing related concepts or objects (coded Related concepts and objects) (another 5 responses described unrelated concepts or abstract terms). Most of these responses were in relation to Q3 however, the Incense Burner also had such responses to Q1 and Q2 as well as the highest number of such responses overall (20/38) - *"gold ingraved face of shrek"* (Incense Burner, Q1), *"it makes me think of the Egyptians"* (Griffin Head, Q3), *"tinga tinga tales [UK TV children's animation featuring African animals]"* (Leopard Head, Q3), *"of the beach when i first saw a fossil"* (Snake Stone, Q3).

Lastly, 3 question responses suggested actions the visitor might take (coded Visitor future action). These were all in response to Q3 and the Leopard Head – *"about playing with my cat"* (Leopard Head, Q3), *"to never go in the wild"* (Leopard Head, Q3).

To visualise how these codes were distributed between objects and questions, code counts were normalised as the percentage of coded answers per object/question then plotted as column charts in Figure 4. From these charts it is clear that Q1 is likely to prompt Name responses, Q2 is more likely to prompt Object attribute responses, and Q3 tends to prompt the deeper responses such as Curious history. It is also notable that, of the four objects, Leopard Head prompted the most responses for Object emotion or Viewer emotions, which we shall discuss later.

Whilst our content analysis offers insights on *what* visitors submitted in their question responses it does not explain *how* the interactive encouraged them to do so or *why* they wrote what they did. Our interviews and surveys with visitors offer insights here, which our analysis now turns to.

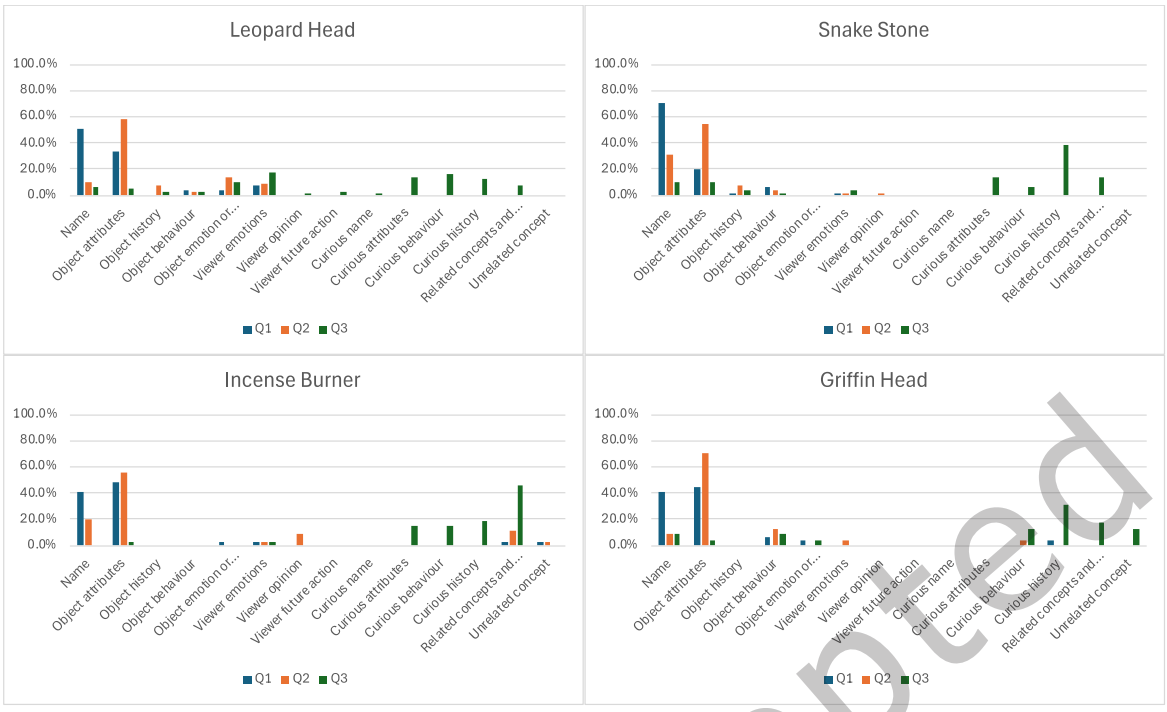

Figure 4 Coded answers by object and question

5.2 Thematic Analysis Findings

It was clear from interview and survey responses that, in general, visitors found Story Inspiration Station enjoyable and interesting to use – 4/6 agreed and 2/6 strongly agreed with "I enjoyed using Story Inspiration Station", and 5/6 agreed and 1/6 strongly agreed with "I was interested in the objects shown in Story Inspiration Station". From our analysis, visitors' responses also provide insights across four themes that offer explanations for how visitors chose objects (described in 5.2.2), why the interactive was engaging (described in 5.2.3), and the impacts of using the interactive (described in 5.2.4 and 5.2.5). A specific question on what could be improved in the interactive exhibit also provided usability insights that will be taken account of in developing it in future, which we describe first.

5.2.1 Usability Insights

Respondents provided feedback on the usability of the exhibit's physical installation, content, and functionality. Three participants assumed that the larger display was an interactive touchscreen – "*[…] initially we were looking at the bigger screen and didn't understand that you couldn't actually press that […] So then we turned to the other one. But it would have been nice if that bigger display was also interactive*" (P4). This was compounded by the larger display being prominent when entering the gallery, with the interactive touchscreen hidden behind a pillar and only visible once closer to the exhibit (see Figure 1) – *"it would be better on the big screen that you first see, that would be a bit more attractive"* (P2). Another participant admitted not understanding that the lever on the touchscreen interface could be interacted with.

Respondents also described difficulties understanding how answering the three questions would be used – *"I did not understand quite how my words were going to be fitting into the story"* (P3). Reading and answering each question in isolation without knowing how answers would be used produced 'stories' that contained grammatical errors or made little sense – *"it would be useful maybe to have an example of what the output looks like. Because the first time I wrote one I was like, "Oh, that doesn't make any sense at all"* (P1). For one participant, this discouraged them from sharing their story *"because I felt like it wasn't very good, (Laughter) which is why I didn't save it"* (P2).

5.2.2 Interactive Exhibits Increase Access to Broader Audiences and Collections

Respondents commented on the value of active interactions with dynamic exhibits compared to passive interactions with static exhibits – *"how interactive it was, I guess, rather than just standing around looking at stuff"* (P2). Two participants described how this made interactives more appealing to children – *"It was fun. And I automatically thought, 'Oh, kids would love this.'"* (P8) – and one participant observed how this made collections accessible to broader audiences:

> "I just think it makes it more accessible to a wider variety of people. If you're […] physically doing something to engage with it and kids like computers anyway, so the fact that it's on a screen will draw a certain demographic, my son's sort of age." (P6)

Accessibility was mentioned by two participants in terms of the interactive revealing some of the museum's larger collection that is not on display – "*by having something like that you can show your stuff they have that maybe isn't available to the public, because it can't all be on display at once"* (P2).

5.2.3 High Quality Images and Accessible Variety Support Choice

Unsurprisingly, several participants chose objects to answer questions upon because of an interest in or a liking for the subject matter – *"[Eider ducks are] just such beautiful birds I just wanted to see what was written about it"* (P1), *"I just like skulls, and I like hyenas"* (P8). One of these participants was drawn to an Artemis Statue due to the craft involved in its making that *"made me think about […] beautiful objects that are made by hand, and how […] craftsmanship and handywork is not so much a thing in everyday life anymore"* (P5).

However, the perceived high quality of images used to illustrate objects in the interactive also encouraged participants to choose objects – *"it was just the image that, yeah, I felt most drawn to […] It was partly the photos, that they were very striking, I think, like the colour contrast"* (P1). The visual metaphors of the interactive also engaged one participant who was *"more drawn in by the animation of it closing and going back in the drawer than the actual image of itself"* (P4).

Respondents also commented on how object videos engaged their interest – *"I liked how the items rotated, so that you could see them all. I really enjoyed that."* (P5). Videos also enabled visitors to notice object attributes such as their textures and materials – *"The ibis, […] it's got leathery feet"* (P5), *"It was interesting because it's very intricately carved"* (P5), *"I noticed the inscriptions, there were marks on it"* (P6).

Respondents chose a variety of objects from across the collections: archaeology, natural sciences (biology and geology), and ethnography. The variety of objects that were displayed within the interactive was a positive aspect for one participant as it enabled them to be selective about what to explore further, rather than feeling the need to 'look at everything' in a static exhibition:

> "[…] having the choice as to which exhibits to look at […] say I didn't want to look at whatever was on screen right now, I didn't have to. I didn't feel this obligation to, because it's in the museum right in front of me. […] I was raised by parents who make you go around to look at every single thing." (P3)

Here, the ease with which the displayed objects could be changed (by pulling the lever) meant that visitors could quickly move on if they were not interested by a set of three objects – *"some of the rocks. I didn't feel anything for them […] And some of the- […] just regular animals […] They didn't, you know, speak to me"* (P8).

5.2.4 Objects with Questions Make you Want to Write and Imagine

Interview and survey responses suggest that another way in which the interactive exhibit engaged visitors was through encouraging them to undertake creative tasks and engaging their imagination – *"feeling like you're involved in doing something, thinking rather than just reading what's already written"* (P2). The objects inspired writing - *"Great creative inspiration > I want to write a story!"* (P12), *"It made me think creatively, on a level that was literary, not just visual"* (P8).

Respondents specifically mentioned stories and descriptive writing as valuable activities prompted by the interactive, describing it as "*a picture-based tool to look at different exhibits and write a story about them, and it was fun*" (P1) and "*A visual, interactive, descriptive writing challenge*" (P6).

For two respondents, using the interactive exhibit engaged their imagination. One described how, in answering questions about the Kingfisher with her friend, *"we went with wings and flight, and it made us wonder what its next catch will be [...] I just imagined it in flight and sitting by the river and maybe with a fish dangling out of its mouth"* (P7). Another described her answers in response to the Hyena Skull were because she was put in mind of computer games, with the skull as the main character – *"a ghostly character, the actual skull itself. And then the silence was [...] a kind of sombre mood. And then how to get out of the woods was, maybe this ghost was trying to figure out how to get out of this particular area that he wasn't supposed to be in"* (P8).

5.2.5 Multiple Interpretations and Potential Connections Prompt Reflection

As with similar findings from the content analysis, interview and survey responses show that the interactive made visitors curious about objects' attributes and history. Here, details visitors noticed in the high-quality images often prompted curiosity – *"I wonder about the symbols that were in* [the Artemis Statue's] *outfit and stuff, what the people at the time would have known just by looking at that"* (P2) – and further questions *"I noticed the helmet. It had feathers and it made me wonder who wears it"* (P7*), "the Artemis statue, because it just looked like a lamp base to me. And the questions I had, like, 'Where are your hands?'[...] 'What is that on your head?' 'Were you a fitting for something?'"* (P5).

Respondents described how the interactive exhibit's use of images with associated questions encouraged greater attention to the objects and prompted them to reflect – *"I think that asking the questions makes you properly look at it. Whereas sometimes when you're in a museum you just walk around not really fully engaging. So actually thinking about the questions first, made you look."* (P2).

Writing their own interpretations of objects prompted visitors' own reflections (c.f. 5.2.4) but sharing and reading others' stories also had value – *"I liked the fact that you see what other people wrote about the things"* (P6), *"it's nice to think that you can create a story out of museum objects and that they can mean different things to different people"* (P1). Respondents noted that lay (non-expert) interpretations were rare – *"you rarely also get to give your own insight into things"* (P4) – and that others' interpretations prompt consideration of how people attribute different meanings to objects and thereby reflection on your own interpretation - *"It makes you think about what other people looking at them are thinking, rather than just what the curator has written or what you're thinking, and how different people would see it in different ways"* (P2).

Such multiple, dynamic interpretation was seen as valuable – *"[museums] can be a bit more dynamic, and you can interpret objects or exhibits in different ways"* (P1). Connections between objects, as well as between individual interpretations were also mentioned – P7 made a visual connection between feathers on the Roman Helmet Cheekpiece and the Kingfisher, and P8 made a conceptual connection between the Hyena Skull and various masks*: "one is inside of the face, and one is on the face."* Noticing potential connections was another useful prompt to reflection and suggested ways in which the interactive might be developed – "[Q: Is there anything else you would like to add?"] *References to rest of collections."* (P10), *"Can a story connect multiple objects? So choosing an object sets a path to the next object?"* (P13).

Lastly, using Story Inspiration Station made some visitors want to discover more objects – *"It made me want to look at more masks. Because the ones that I saw, I was, like, 'Ooh, I really want to go and look at those, you know, now'"* (P8).

5.3 Findings Summary

We now return to our research questions to synthesise findings from our analyses of visitor submissions, interviews and surveys. Our content analysis of submissions shows that the interactive had moderate success in prompting deeper engagements with museum objects (RQ1). To summarise the depth of engagement, we organised codes into three groups relating to shallower, moderate, and deeper engagement, and calculated the percentage of all 606 question answers in the sample that were coded with codes in these groups. The five responses coded as Unrelated concept were excluded as it was difficult to infer depth of engagement from their

content – e.g. *"riches consumed in sand"* (Q1, Incense Burner), *"money"* (Q3, Griffin Head). The results are shown in Figure 5 with full details in Appendix A.

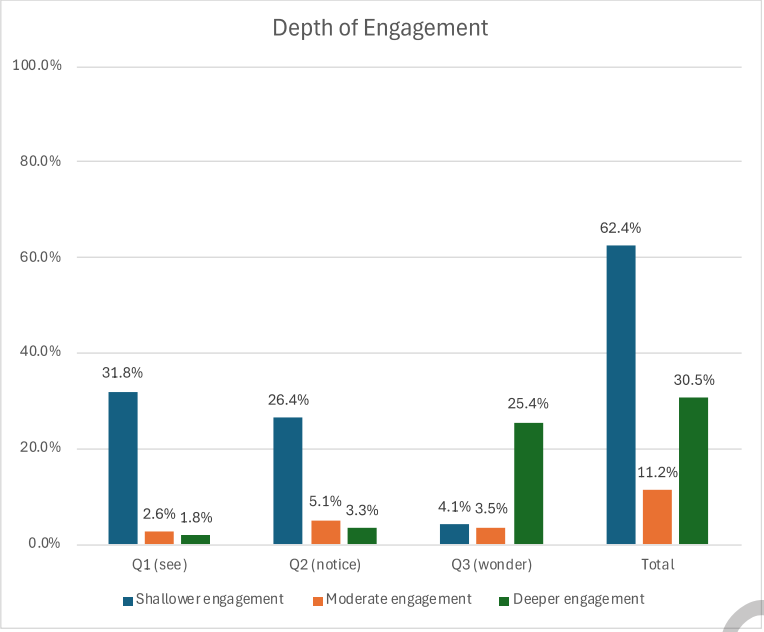

Figure 5 Depth of engagement as a proportion of all question responses

Whilst 'engagement' is well discussed in pedagogy, where conceptual frameworks have been proposed to increase student engagement and improve learning outcomes (e.g. Brown et al., 2022), in museums, beyond recognising it as a valuable goal, conceptualisations of visitor engagement are less well defined. Recognising this and drawing on relevant thinking, museum interactive experience designer and strategist Ed Rodley characterises visitor engagement as "an *intrinsically motivated* process where a person directs their conscious, *focused attention* to an experience which triggers an *emotional response*, leads to the creation or reinforcement of a *memory*, and influences their *behavior* afterward" (Rodley, 2019, emphasis in original). Our identification of deeper forms of engagement follows similar thinking, notably in identifying curiosity (focused attention), emotional responses, and intentions for action (behaviour).

Most question responses (62.4%) demonstrated a shallower engagement with museum objects in having the character of either naming objects or their parts or describing object attributes. Deeper engagements – such as visitors describing opinions, emotional responses, curiosity about the objects, and connections with related concepts – were fewer but still significant (30.5%). Here, the interactive appeared effective in arousing visitor's curiosity and prompting connections with related concepts, albeit the latter to a limited degree (6.3%). Other question responses demonstrated a moderate level of engagement, where question response show that visitors attended to the history, attributes, and behaviour associated with objects and – in some cases – attributed emotions or character traits to objects (11.2%).

Our thematic analysis of interviews and surveys also demonstrate that Story Inspiration Station enabled deeper engagement but also suggest how the interactive exhibit did so. Here, high-quality images and a variety of readily explored objects attracted visitors' interest and prompted their submissions (c.f. 5.2.3). Furthermore, the details revealed in images and the three questions encouraged visitors to write stories and pay more attention to the subject matter (c.f. 5.2.4).

The deeper engagements evident in submissions and described in interviews and surveys also demonstrate that Story Inspiration Station was effective in arousing visitors' curiosity and prompting their broader reflections (RQ2) to some degree. Whilst the quantity of such of responses was **significantError! Reference source not found.**, individual responses within them often showed a limited degree of engagement. For example, whilst some responses made links to related concepts these were to TV programmes and movies

(*"Tinga Tinga Tales", "Shrek"*), and whilst some responses suggested visitors might take subsequent action, these actions had little potential broader impact (*"playing with my cat"*). The limited depth evident in question responses is unsurprising given the typical visitor demographics of the museum (families with younger children and school groups), and the short time usually spent using the interactive. Nevertheless, in a few cases, question responses demonstrated visitors' engagement with broader concerns. The Leopard Head was notable in this respect, prompting responses from visitors that demonstrate engagement with environmental issues associated with trophy hunting – *"Why someone has killed and stuffed this amazing animal","he is geting murdered"* (Leopard Head, Q3).

It was also evident in interviews and surveys that visitors were made curious and reflective, and our analysis again suggests why this was so. The creative activity of composing answers prompted visitors to reflect on objects and their history, and their connection to broader concerns (c.f. 5.2.4). Furthermore, the ability to create their own interpretations and to see others' interpretations, prompted visitors to reflect and make connections with the rest of the collection and wider issues (c.f. 5.2.5).

The interviews and surveys provided a useful evaluation of how usable and engaging Story Inspiration Station was for visitors (RQ3). In addition to confirming that the interactive exhibit was enjoyable and interesting to use and suggesting aspects that might improve its usability (c.f. 5.2.1), our analysis suggests opportunities beyond the exhibit itself. Firstly, the exhibit's interactivity attracts a broader audience (in particular, children and younger people) and, in doing so, increases access to the museum's collections for this audience. Secondly, the interactive exhibit has the potential to increase access to a larger proportion of museum collections (often not on display) (c.f. 5.2.1). And, thirdly, the manner of engagement (eliciting and sharing lay interpretations) offers a means of challenging the Authorised Heritage Discourse, which our discussion now turns to.

6 DISCUSSION

Our evaluation of Story Inspiration Station had some minor limitations: we were only able to analyse responses to a limited range of objects (52); because of our recruitment process (event based) our interview and survey participants may have been unrepresentative of a broader sampling of more typical visitors; and, only a subset of visitor submissions to the interactive exhibit was analysed. Nevertheless, as a case study, it points toward how interactive exhibits of this form enable deeper engagement with heritage objects and how, in the manner of engagement it enables, this can subtly challenge the Authorised Heritage Discourse (AHD). We now discuss these two aspects in turn before describing how Story Inspiration Station might be improved and offering design considerations for others seeking to develop interactive installations that work with museum archives to support visitors' participatory interpretation, and polyvocal engagement with collections.

6.1 Deepening Engagement

Our evaluation of Story Inspiration Station suggests how interactive exhibits can encourage deeper engagements with heritage objects and museum collections in the form of arousing visitors' curiosity and prompting their broader reflection on related concepts and concerns. High-quality images of objects attract visitors' interest and draw attention to details that might otherwise be overlooked, moving towards the value of actual objects (Leinhardt & Crowley, 2021) in situations when those objects cannot be present. Enabling easy exploration of numerous objects supports more serendipitous discovery of what is interesting to visitors and, through this, encourages broader exploration and removes any expectations visitors might have to 'look at everything', corresponding with Trant's (2009) findings on public tagging of artworks. A creative activity (writing), balancing sufficient structure (an object image and brief description) and openness (free text answers), prompts attention and encourages reflection, reinforcing the value of open-ended questions (Hohenstein & Tran, 2007) and interactions that invite exploration (Roberts et al., 2018). Exploring others' interpretations and making connections between objects and concerns prompts deeper reflection and curiosity (and facilitates inter-personal meaning making (Eklund, 2020)), echoing similar findings from (Cosley et al., 2008).

Our Story Inspiration Station evaluation also suggests how, beyond deeper engagements with museum objects, interactive exhibits can support more nuanced connections between visitors and heritage organisations.

This connection is supported by two sorts of data produced in visitors' use of the interactive exhibit. Firstly, data on which objects produce the most visitor responses indicates (in a lightweight manner) which objects most inspire or engage visitors (although we note the influence of certain object categories being more likely to appear in a random selection, if they represent a higher proportion of objects in the interactive exhibit). Secondly, visitors' responses themselves offer a dataset of lay interpretations of objects that indicate the attributes, concepts, and concerns which visitors associate with them. Both forms of data can be used by museums in programming future exhibitions and activities, and in producing interpretation materials that resonate with visitors' interests.

The lay interpretation of heritage objects elicited by interactive exhibits such as Story Inspiration Station also has the potential to support others' discovery of museum objects. Datasets of numerous visitor interpretations offer the potential to use machine learning algorithms to identify patterns within interpretations of individual objects and across several objects. These patterns could then be used to support other visitors' discovery of objects. For example, using patterns (as additional metadata in collections databases) such that objects can be found using lay descriptions of them or through searching for the emotions or concepts the objects evoke – imagine a visitor searching for 'fierce' or 'scary' and having the Leopard Head returned in the results. One can also imagine dynamic or personalised 'curatorial programming' which produces novel pathways through collections for visiting groups based on commonly connected objects creating shareable visiting trajectories. Although care should be taken here to avoid converging to reductive or problematic interpretations and connections that, akin to the 'filter bubbles' created by social media algorithms (Bozdag & van den Hoven, 2015), resist engagement with other perspectives.

6.2 Challenging the Authorised Heritage Discourse

At a higher level, Story Inspiration Station suggests how interactive exhibits of this form can be used to challenge the Authorised Heritage Discourse and support cultural heritage that is both dynamic and broadens heritage narratives to include other voices. Firstly, the interactive challenged single, static interpretations of museum objects (from the museum's curators) and invited a more fluid and dialogic interpretation where visitors' responses contributed to a growing set of stories connecting the objects. Whilst, in its current form, Story Inspiration Station does not include conversations with heritage professionals (museum curators) or volunteers directly (such as in the work of Tsenova et al. (2022)), the growing set of responses produced have the potential to support a more dialogic approach to curation and interpretation as discussed above. Secondly, in eliciting multiple interpretations of museum objects using questions with sufficient openness to allow a range of responses, the interactive widened the heritage narrative to include perspectives beyond that of the museum curators (and thus, countered the 'fetishisation of experts' (Association of Critical Heritage Studies, 2012)). This process was not without limitations – having museum professionals select ('star') visitor stories for display on the larger screen inevitably introduced bias. This bias might be reduced via supporting museum staff in being more reflective of what they 'star' or through exploring other ways of removing problematic content and selecting stories for display such as using AI-based moderation or public voting on featured stories.

To summarise, Story Inspiration Station, and interactive exhibits of this form, offer vehicles for sourcing polyvocal heritage narratives that can then be drawn upon to find ways of curating and presenting artefacts in ways which seek to break the AHD. The extent to which Story Inspiration Station produces diverse and detailed lay interpretations is limited, which is unsurprising given the time visitors typically spend using the interactive exhibit. However, it does do so in a manner that readily engages visitors and encourages them to contribute. Story Inspiration Station therefore represents a novel way of using an engaging interactive exhibit to subtly challenge the AHD and to scaffold processes of participatory interpretation (and potential future curation) in a non-burdensome way for visitors.

6.3 Improving Story Inspiration Station

Our experiences developing and evaluating Story Inspiration Station highlights practical challenges in creating and maintaining such interactive exhibits. Whilst we streamlined our process of generating images for the interactive as far as possible, it was nevertheless resource-intensive, requiring several days for recording and post-processing images. Similarly, the generation of titles and descriptions for objects was time-consuming,

requiring multiple correspondences with a busy curatorial team. Generating content alongside the installation of a temporary exhibition simplified this process somewhat and suggests that future exhibitions might include time for adding objects to the interactive exhibit in their plans.

The usability insights from visitor interviews and surveys also suggest that the interactive exhibit needs to both be more noticeable in the gallery and have clearer cues as to how it is used. Making the larger screen interactive and refining the instructions and questions presented in the 'story' interface may address this. The affordances of user interface elements might also be refined. Whilst we used a photograph of a real lever and text cues to indicate its use in the interface, some respondents did not immediately appreciate its function. Tangible interfaces such as a physical lever could make functions clearer and encourage visitor engagement.

We were only able to track visitor stories shared on X (formerly Twitter) via appending a #StoryInspirationStation hashtag. Whilst the lack of sharing on X indicates a need to make sharing more attractive for visitors, the difficulty in tracking sharing on other platforms points to a need to design systems such as this in ways that allow for measurement of the 'data footprint' beyond the museum. (Tracking HTTP GET requests for visitor story unique URIs could be a way to do this.) This is important for evaluating the wider impact of the exhibit (a pressing concern for most museums) but also to support the further development of such interactive systems. One of our starting points in developing Story Inspiration Station was to explore how museum objects can encourage conversations about environmental issues. Being able to see how conversations (stories) begun on an interactive exhibit in the museum extend and develop beyond the museum online, provides insights into how these conversations might be better supported.

We are discussing these aspects with the museum in considering how Story Inspiration Station can be further developed.

6.4 Design Considerations

Our case study of Story Inspiration Station suggests considerations for the design of interactive media and technology for deeper engagement with heritage objects and sites that also subtly challenge the AHD through eliciting polyvocal narratives:

- Use high quality visuals to attract interest and reveal details.
- Provide a variety of heritage objects that can be easily and quickly explored visually to support choice.
- Use creative tasks to prompt engagement and reflection. Ensure tasks have sufficient openness to enable visitors' voices to be heard and structure to support relevant contributions.
- Share lay interpretations to prompt visitors' further reflection and elicit new contributions.
- Use lay interpretations as resources (meta-data) for curation and interpretation.
- Enable where and how visitor submissions are used beyond the museum and online (their 'data footprint') to be tracked to support evaluation of impact and the further development of interactive systems to support conversations on wider concerns.

6.5 Future Work

Story Inspiration Station offers an example of how interactive installations can enable and scaffold deeper engagement with objects through visitors' exploration of their own and other's interpretations of them. It also points the way towards how computing technology can support more dynamic and dialogic forms of cultural heritage that tackle the prejudices and exclusivity of the Authorised Heritage Discourse. In addition to developing Story Inspiration Station to better encourage visitor interactions, in our future work, we will investigate how such interactive exhibits, and the polyvocal narratives they produce, can be used to help other visitors discover museum collections. We will also explore the usefulness of visitors' interpretations, beyond their direct display, as a growing dataset that can help museums to invigorate their curation and programming.

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7 APPENDIX A: CONTENT ANALYSIS CODE ASSIGNMENTS

	Leopard Head						Snake Stone						Incense Burner						Griffin Head							Total		As proportion of all 606 question responses							
Code	Q1		Q2		Q3		Q1		Q2		Q3		Q1		Q2		Q3		Q1		Q2		Q3			(codes)		Q1	Q2	Q3	Total			Q1	Q2	Q3	Total
Name	46	50.5%	10	10.3%	6	6.3%	42	70.0%	17	30.9%	5	9.6%	17	41.5%	7	19.4%	0	0.0%	12	41.4%	2	8.3%	2	8.7%	166	26.1%	19.3%	5.9%	2.1%	27.4%						
Object attributes	31	34.1%	57	58.8%	5	5.3%	12	20.0%	30	54.5%	5	9.6%	20	48.8%	20	55.6%	1	3.0%	13	44.8%	17	70.8%	1	4.3%	212	33.3%	12.5%	20.5%	2.0%	35.0%	Shallower engagement	31.8%	26.4%	4.1%	62.4%
Object history	0	0.0%	7	7.2%	2	2.1%	1	1.7%	4	7.3%	2	3.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	16	2.5%	0.2%	1.8%	0.7%	2.6%					
Object behaviour	3	3.3%	2	2.1%	3	3.2%	4	6.7%	2	3.6%	1	1.9%	0	0.0%	0	0.0%	0	0.0%	2	6.9%	3	12.5%	2	8.7%	22	3.5%	1.5%	1.2%	1.0%	3.6%	Moderate engagement	2.6%	5.1%	3.5%	11.2%
Object emotion or character	4	4.4%	13	13.4%	10	10.5%	0	0.0%	0	0.0%	0	0.0%	1	2.4%	0	0.0%	0	0.0%	1	3.4%	0	0.0%	1	4.3%	30	4.7%	1.0%	2.1%	1.8%	5.0%					
Viewer emotions	7	7.7%	8	8.2%	17	17.9%	1	1.7%	1	1.8%	2	3.8%	1	2.4%	1	2.8%	1	3.0%	0	0.0%	1	4.2%	0	0.0%	40	6.3%	1.5%	1.8%	3.3%	6.6%					
Viewer opinion	0	0.0%	0	0.0%	1	1.1%	0	0.0%	1	1.8%	0	0.0%	0	0.0%	3	8.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	0.8%	0.0%	0.7%	0.2%	0.8%					
Viewer future action	0	0.0%	0	0.0%	3	3.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.5%	0.0%	0.0%	0.5%	0.5%					
Curious name	0	0.0%	0	0.0%	1	1.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.2%	0.0%	0.0%	0.2%	0.2%	Deeper engagement	1.8%	3.3%	25.4%	30.5%
Curious attributes	0	0.0%	0	0.0%	13	13.7%	0	0.0%	0	0.0%	7	13.5%	0	0.0%	0	0.0%	5	15.2%	0	0.0%	0	0.0%	0	0.0%	25	3.9%	0.0%	0.0%	4.1%	4.1%					
Curious behaviour	0	0.0%	0	0.0%	15	15.8%	0	0.0%	0	0.0%	3	5.8%	0	0.0%	0	0.0%	5	15.2%	0	0.0%	1	4.2%	3	13.0%	27	4.2%	0.0%	0.2%	4.3%	4.5%					
Curious history	0	0.0%	0	0.0%	12	12.6%	0	0.0%	0	0.0%	20	38.5%	0	0.0%	0	0.0%	6	18.2%	1	3.4%	0	0.0%	7	30.4%	46	7.2%	0.2%	0.0%	7.4%	7.6%					
Related concepts and objects	0	0.0%	0	0.0%	7	7.4%	0	0.0%	0	0.0%	7	13.5%	1	2.4%	4	11.1%	15	45.5%	0	0.0%	0	0.0%	4	17.4%	38	6.0%	0.2%	0.7%	5.4%	6.3%					
Unrelated concept	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	2.4%	1	2.8%	0	0.0%	0	0.0%	0	0.0%	3	13.0%	5	0.8%	0.2%	0.2%	0.5%	0.8%	Unrelated concept	0.2%	0.2%	0.5%	0.8%
Total (question)	91	100.0%	97	1	95	1	60	1	55	1	52	1	41	1	36	1	33	1	29	1	24	1	23	100.0%	636	100.0%								