

Usability Analysis of Interactive Museum Exhibits (3500 words)

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Usability Analysis of Interactive Museum Exhibits

Usability Engineering

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1. Introduction

This report will include usability reviews on two museum exhibit displays: one which is considered an effective design and one which is less effective. A recommended interface evaluation strategy for new interactive exhibits and evaluation of interactive exhibits with an evaluation timeline will also be provided. The application of usability and accessibility guidelines of museum exhibits will also be analysed. The background of virtual reality (VR) systems will be discussed and a new augmented reality (AR) exhibit will be proposed to aid in the understanding of Welsh heritage.

2. Usability Review of Two Displays

2.1 Exhibit with effective design

The first display which is an effective design is an interactive digital exhibit found at EPIC The Irish Emigration Museum called the 'Notorious Irish' which gives facts on criminals in Irish history [1].

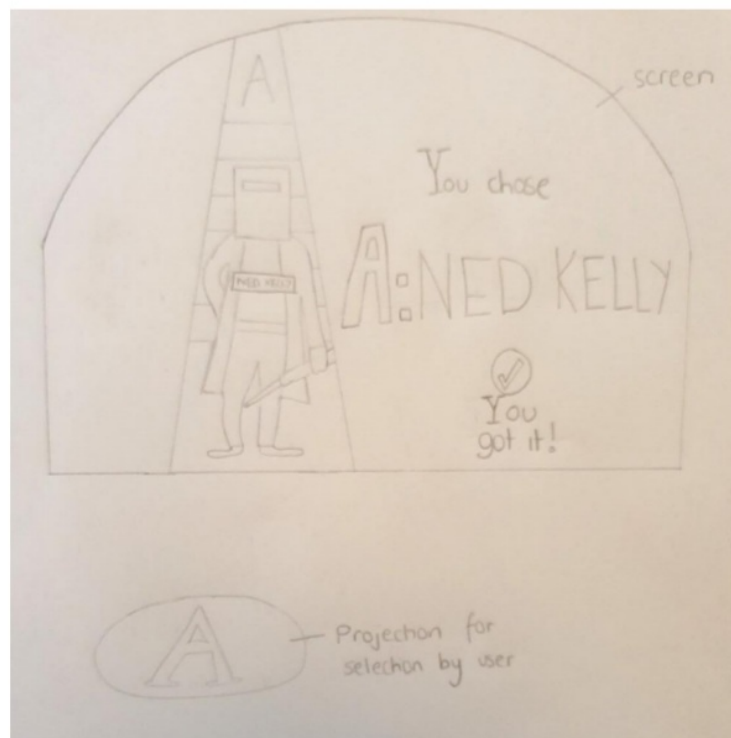


Figure 1 - The Notorious Irish Exhibit

It uses infrared cameras to track the user's body and projections on the floor and wall to help them interact with a group of characters in a line-up and solve famous crimes and mysteries using clues and suspect profiles [1]. Constructivist theory, that says people actively create their own data of an environment using prior knowledge [2], aids in the use of the exhibit when users approach the characters in the line-up that originally stand idle and the characters react when they are in close proximity.

The assumption is made that they would know they need to do this from knowledge on police line-ups. The element of human touch in this exhibit is the user's body itself which they use to walk along the line-up and select characters to look at clues and deduct who is guilty and make their final choice. The videos on the characters are read out to the users which can help those who are blind or find it difficult to read the text on the screen.

Metaphor use in GUI is where one object or idea is used to represent another to help set users' expectations [3]. Effective use of metaphor is used in this exhibit with the mock police line-up setting which is familiar to users from the real world version of a police line-up i.e. the characters against a wall with height lines. Both real affordance, which is the physical characteristics of an interface or object that help its operation [4] and perceived affordance, which is the characteristics in an interface or object which gives clues on how it operates [5], are both present in the exhibit. The real affordance is the arrows in front of the exhibit which points towards the characters and shows how to start the interactivity. The perceived affordance goes back to the police line-up setup which the user can walk along and choose which suspects to learn more about.

2.2 Exhibit with less effective design

The second exhibit which has a less effective design is the Dylan Thomas poetry exhibit at the Dylan Thomas Centre.

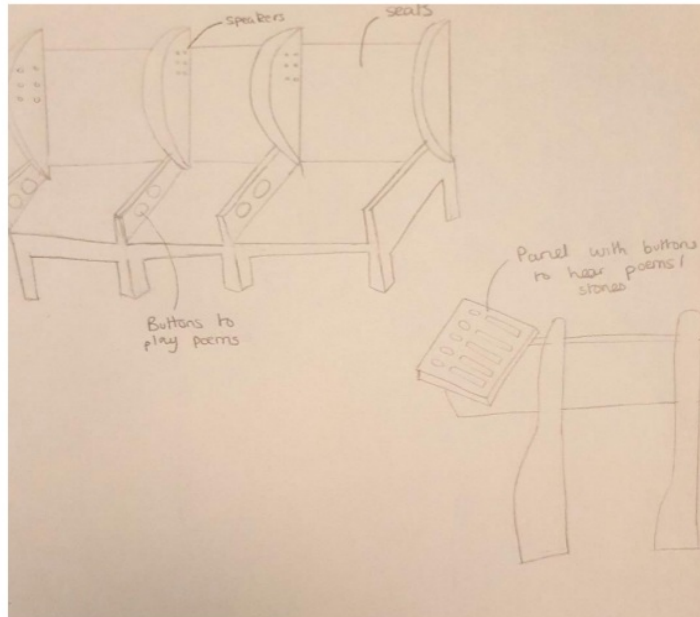


Figure 2 - Dylan Thomas Poetry Exhibit

It is a simple exhibit where there is a row of chairs where you can sit and listen to poetry by Dylan Thomas read by himself and people who knew him. The touch element involves buttons which you press to listen to the poetry where audio comes out of the top portion of the chair close to users' ears which is the best position for optimal hearing. There are also headphones available to help block out possible background noise which can affect users' concentration [6].

There is no obvious metaphor in the exhibit, although the positioning of the speakers could be emulating a person reading the poetry to you from the next chair and trying to create an immersive experience in that way. Affordance is not as effective in this exhibit as the buttons are not clearly visible to the user straight away which makes them easy to push accidentally. The user may be less likely to sit and listen to this exhibit without better affordance. To improve this the buttons could be placed in a more obvious position i.e. the tops of the arms of the chairs rather than the sides. This will make the purpose of the exhibit clearer and give a better chance for user engagement.

3. Interface Evaluation

An interface evaluation is an assessment of an interface's appearance or object's performance [7] which can happen at all stages of the project life cycle. The first proposed step in evaluating an interactive museum exhibit is a Project Initiation Document (PID). Like most other software development projects, a PID for this project would include the scope of the project, deliverables, budget, project team members and their roles and responsibilities [8].

The next stage is a feasibility study which determines the viability of the project based on factors such as economic feasibility and operational feasibility [9]. At this stage, a cost-benefit analysis [10] would be suitable to determine whether the value of the exhibit at the end of the project will be worth any costs. A new interactive exhibit may greatly increase footfall to the museum which could be worth the costs.

The next stage is the requirements analysis. In order to acquire the user requirements, user interviews could be carried out. Flexible interviews would work at this stage to get user opinions on the current exhibit that is going to be updated and what they want in the new exhibit. A study from Chorianopolos and Spinellis [11] on user interface evaluation of interactive TV, showed that user interviews were useful during the requirements collection. Metaphor and affordance need to be analysed on the existing exhibit to see how these can be improved and/or added on for the new exhibit.

To see which tasks are frequently carried out by users, task analysis could be done at this stage. Hierarchical task analysis represents the high priority goals and subtasks in a strict structure and provides thorough information on each task [12]. This can help to identify the resources and skills required for each process and improve the current processes in place when designing the new exhibit [13]. An ethnographic evaluation would also work here to understand the existing design and see how everything, including the user, works in their environment [14].

Once this has been done, the design stage can start. Usability principles should be chosen for the new design e.g. learnability, flexibility and robustness as brought forth by Dix [15]. When designing a new interactive exhibit, predictability, consistency and familiarity should be considered so the user is not overwhelmed by the new system. A paper prototype can be made before a software prototype as it allows for rapid

iteration without wasting time as all you need is more paper to create multiple versions of the prototype [16].

Before implementing the exhibit, a prototype should be released to be tested with a sample of visitors, as suggested by Bitgood [17] in his suggested guidelines for designing interactive exhibits. McNamara [17] also found that only 10% or less of users found most exhibits at the Virginia Science Museum initially effective. This increased dramatically with the use of prototype testing and modification.

Indirect evaluation can be done at this stage with eye tracking to see which elements of the exhibit interface the users are looking at and for how long and the pattern of eye movements can indicate if the users are having problems with completing tasks [18]. Çinar [19] carried out a study where users performed search tasks on two versions of a website, the old one and the new, proposed one, and found that there were fewer eye movements needed to perform the tasks on the new website. The fewer eye movements showed the new website allowed tasks to be done in a more practical, efficient manner [19]. Therefore, eye tracking can help to evaluate on any changes that need to be made to make tasks simpler.

As this is the prototype stage, informal direct observation can be used to observe users interacting with the prototype and see what engages them and how they carry out tasks [20]. While this method of observation is useful because you can see the user interacting with the exhibit in its natural setting [21], there is also the possibility of the Hawthorne effect where observation affects the users' behaviour [22]. Despite this, useful information on usability problems can help the design team to build on the prototype before implementation. This stage can be iterated until the exhibit is ready for implementation.

At the implementation stage, usability ethics and customisability need to be considered so the user can control how they interact with the exhibit [23] e.g. audio instead of text. A structured expert review can work here to evaluate if there are any remaining usability problems. Experts on usability, museums and interactive museum exhibits can be gathered to give their input on what is working and what is not working and find any usability problems. Baauw, Bekker and Barendregt [24] in their study of a structured expert evaluation method for evaluating children's

computer games, also used a variety of experts from different fields e.g. children, computer games and/or usability to evaluate two Dutch computer games.

The next stage is testing. A usability survey would be useful at this stage to gauge the usability of the exhibit e.g. the System Usability Scale [25]. This can be followed up with semi-structured interviews, asking the users set questions on usability about the exhibit and more open-ended questions to allow more of a discussion with the user [26]. A study from Walji et al. [27] found that survey and interview methods alone were not sufficient in evaluating Electronic Health Records (EHRs), but using them alongside user testing provided a comprehensive evaluation. Indirect observation with video recording and interaction logging can be used to help observe user tests of the exhibit, with set tasks given to them to complete so the results can be recorded. Once these tests are completed, and the exhibit is at its optimal performance, the changeover from the old to the new exhibit can happen.

The final stage is maintenance. Cooperative evaluation can be done here where the user is given specific tasks and observed and then encouraged to think aloud about what they think is happening, why they are doing something and what they are trying to do [28]. This is a good indication of whether the exhibit is meeting users' requirements [29] and if any changes need to be made.

4. Guidelines and Accessibility

General guidelines for good usability of electronic systems have existed for many years although it can be difficult to apply them appropriately and there can be situations where the guidelines conflict [30]. Accessibility refers to how a disabled person benefits or accesses an application or system and needs to be well thought-out throughout the development lifecycle [31]. The introduction of the Disability Discrimination Act in 1995 has meant disabled people have been given more rights including access to services, so museums and galleries needed to amend procedures, practices and policies that make their services impossible or unreasonably hard for the use of disabled people [32].

4.1 Guidelines for museum exhibits

Dix has a set of three key usability principles which are learnability, robustness and flexibility [33]. Familiarity is part of learnability and is when the user's prior world

experience is used in the interface [34]. There are many good examples of this in museum exhibits using metaphor such as the storytelling exhibit in EPIC the Irish Emigration Museum which looks like a stack of books and has a non-touch interface so users can make their selections of Irish writers in thin air [1].



Figure 3 - Storytelling Exhibit at EPIC the Irish Emigration Museum [1]

Also, part of learnability in interface design, is predictability where the user can predict what will happen in an interaction [35]. Metaphors are also helpful in encouraging predictions about system actions [36] which improves the usability of museum exhibits. Another example of good use of metaphor in museum exhibits is the 'Hotspot' exhibit at Rhondda Heritage Park which talks about immigration to Wales thanks to the mining industry and displays a map with pinpoints that you can touch and get more information from [37].

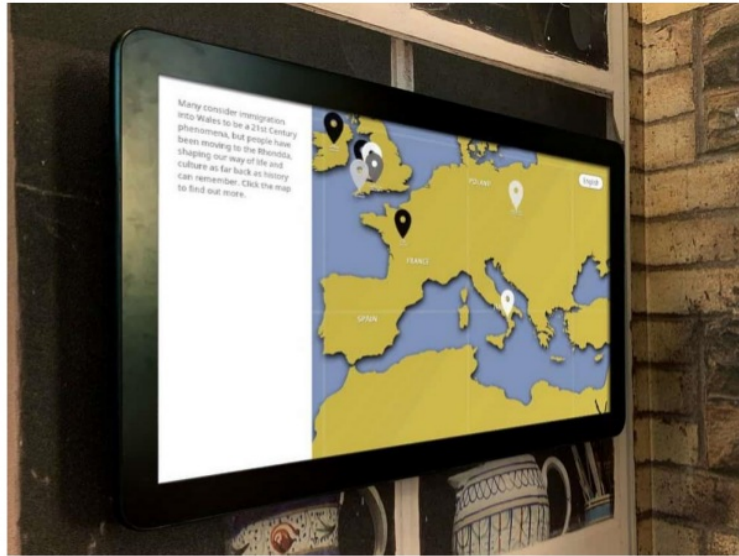


Figure 4 - Hotspot Exhibit at Rhondda Heritage Park [37]

Most users will have used online maps before, and so they can make the prediction that clicking the map points will provide them with more information.

Consistency in interface design is when similar elements have a similar function and consistent look [38]. Many museum exhibits take advantage of this guideline to remove confusion and reduce learning of the software [39]. This can be shown here with the currency exhibit for the royal mint where the same button is used to close the screen you are on [40].

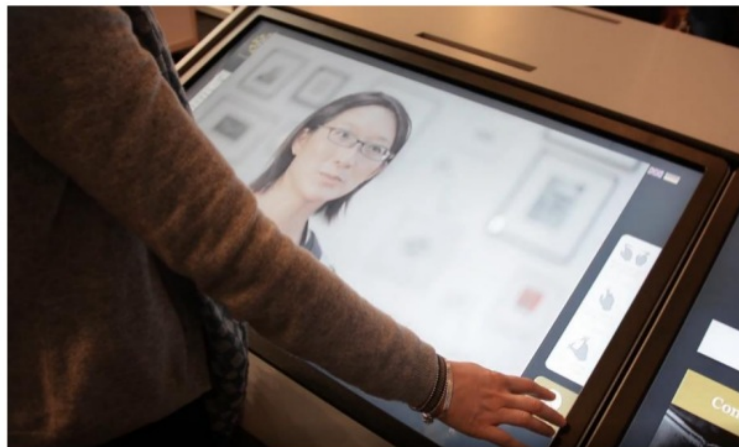


Figure 5 - Currency Exhibit for Royal Mint [40]



Figure 6 - Close button for Currency Exhibit [40]

The same gestures are also used for the same actions e.g. zooming in and out of the item you are viewing and scrolling to the next item.

Responsiveness, which is the time that the system takes to communicate with the user [41] is another guideline applicable to museum exhibits. The user should receive feedback that is appropriate for each task i.e. immediate feedback from a selection and progress indicators for longer tasks [42]. An example of good responsiveness is the Royal Fortress of Suceva exhibit where the magnifying glass gives an immediate response to the interface by zooming into the family tree [43].

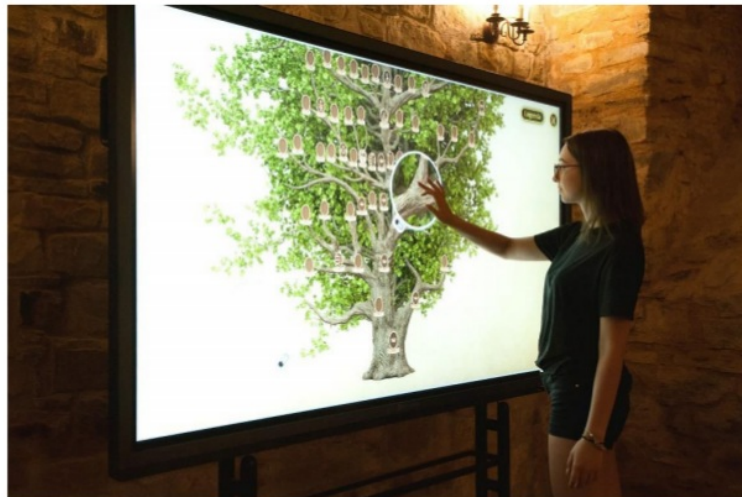


Figure 7 - The Royal Fortress of Suceva Exhibit [43]

Another good example of responsiveness is the Salt Worldwide exhibit at the German Salt Museum which has 34 touch sensitive salt crystals over a world map

that glow when touched and pour salt grains over the table which merge into a window of information [44].



Figure 8 - Salt Worldwide Exhibit [44]



Figure 9 - Salt Worldwide Exhibit part ii [44]



Figure 10 - Salt Worldwide Exhibit part iii [44]

Task conformance can also be applied to museum exhibits. Task conformance is to what extent the system supports all the user's tasks in an order they understand [45]. An example of this is the Style Me exhibit at the National Museum of Scotland that allows users to design their own period clothing that they can view on a 3D avatar, adjusting the pattern, colour and cut of a female or male garment [46]. Users are given a simple interface with clear buttons to complete their tasks. They can see a preview of their design on a mannequin. There is no set order for their tasks so they can choose the order that they feel most comfortable with.

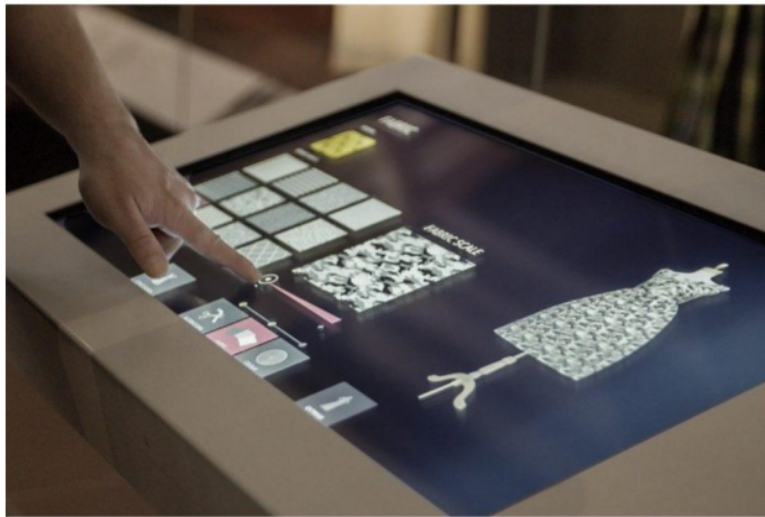


Figure 11 - Style Me Exhibit [46]

A guideline that does not apply to museum exhibits is synthesizability which is the user being able to assess how past operations affected the current state of the system [47]. Museum exhibits tend to focus more on predictability so the average user can “guess” what their actions will do. Multi-threading also does not apply to most museum exhibits as they usually focus on one task at a time and not multiple tasks at a time like multithreading allows [48].

4.2 Accessibility for museum exhibits

The Web Content Accessibility Guidelines from W3C describe how you can make Web content accessible to people with a wide variety of disabilities e.g. auditory and visual [49]. The first one applicable to museum exhibits is to provide a text alternative for non-text content [50]. Online galleries such as the Print and Drawings gallery from the British Museum use text to caption the images and describe them [51].

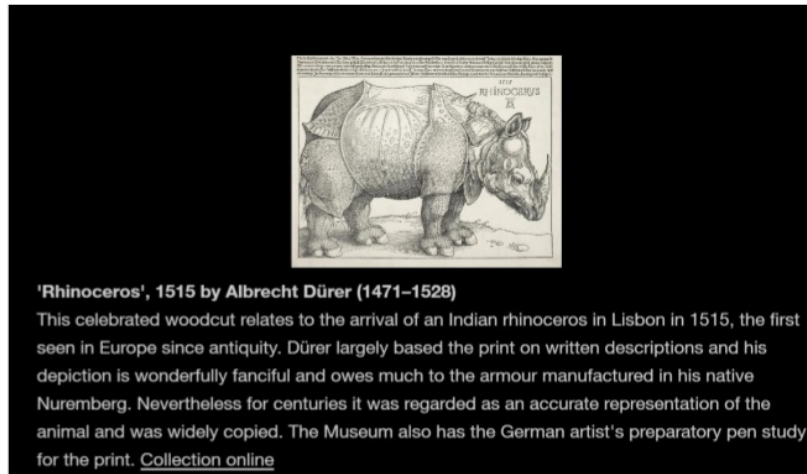


Figure 12 - Print and Drawings Gallery [51]

However, many of these online galleries fail to provide further support for people with visual and auditory disabilities, such as an option to have the text read aloud or enlarging the text [50]. The British Museum does provide the options of an audio descriptive guide, British Sign Language (BSL) guide and a large print guide to help make all real-life exhibits accessible to any user who needs it [52].

Another guideline is to provide captions for pre-recorded audio [50]. The National Museum of Scotland has a video exhibit about the Speak:Unique Voicebank Research project which has captioning throughout and is a good height for people who use wheelchairs [53].



Figure 13 - Speak:Unique Voicebank Research Project Exhibit [53]

This has also been applied to The Met's online video tours [54], as well as the audio control guideline that specifies to provide a mechanism to stop or pause the audio or a mechanism to control volume that is independent of the system volume level [50].



Figure 14 - The Met's Online Virtual Tours [55]

Where the meaning of content is affected by its sequence, a correct reading sequence should be able to be programmatically determined i.e. presented so that assistive technologies can provide it to users in different modalities [56]. This can be found with online exhibits such as the Van Gogh museum which has a clear sequence with images, headings and subheadings [57].

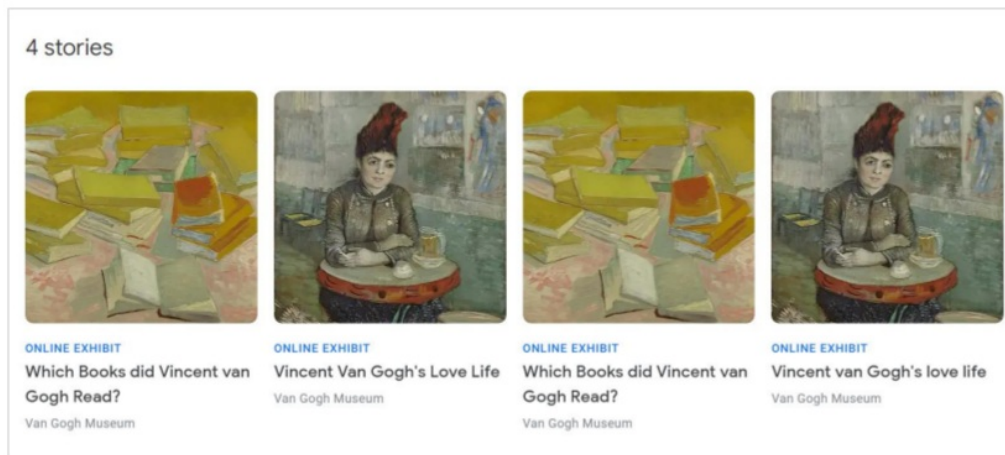


Figure 15 - Van Gogh Museum Online Exhibits [57]

While many museum exhibits may follow this guideline, where there is information in a clear sequence, they often lack the option for the text to be read aloud or made bigger which is the entire purpose of the guideline.

Consistent navigation and identification [50] are also applicable for both online and real-life exhibits. Navigation on each web page should be in the same order every time they appear, e.g. the Mesopotamia and Assyria online exhibits at the J. Paul Getty Museum [58] and the Rainbow Revolution exhibit at the National Museum of Ireland [59].

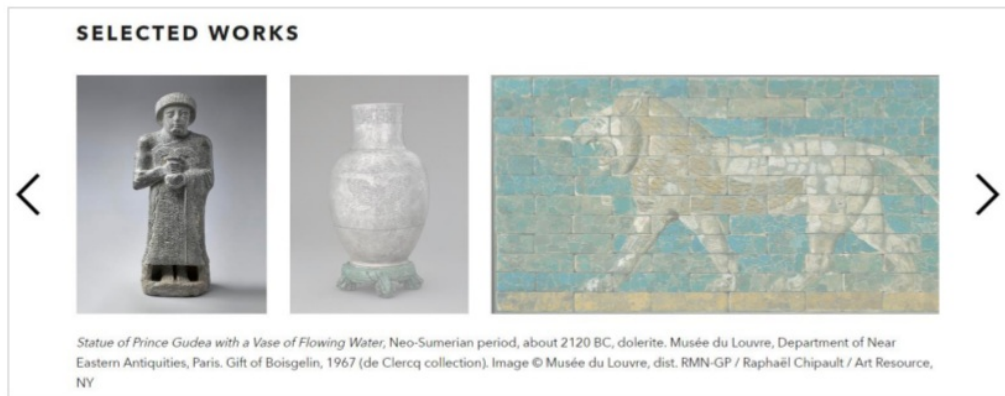


Figure 16 - Mesopotamia Civilization Begins Exhibit [60]

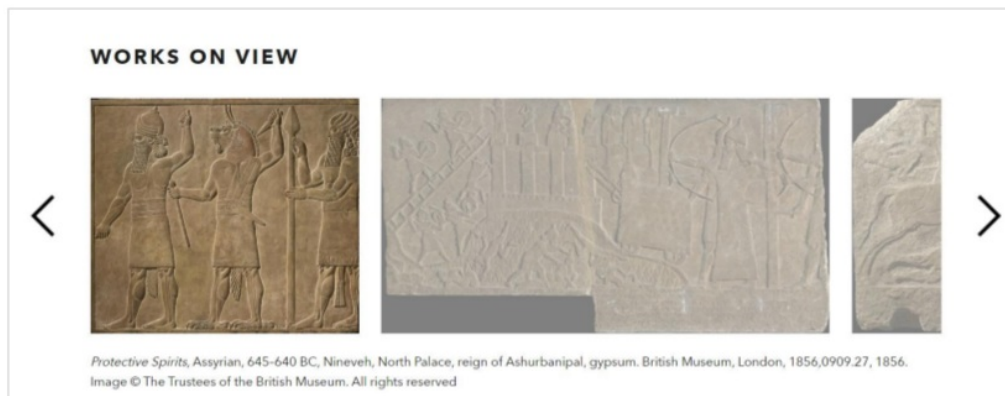


Figure 17 - Assyria Palace Art of Ancient Iraq Exhibit [61]

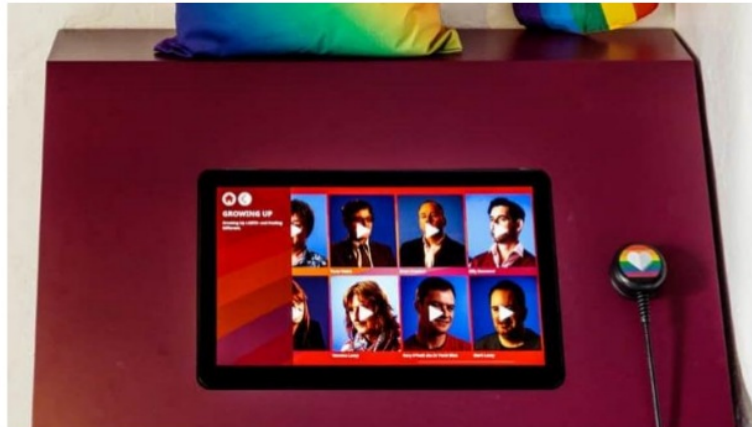


Figure 18 - Rainbow Revolution Exhibit [59]



Figure 19 - Rainbow Revolution Exhibit part ii [59]

This guideline helps those who have low vision, cognitive limitations, intellectual disabilities and who are blind as the user can predict where the navigation will be on the page [62].

Consistent identification i.e. functional components with the same function being “consistently identified” [63] throughout the exhibit helps people to learn the system. People who struggle reading text can interact if non-text content such as icons are used consistently for the same functionality and people who rely on alternative texts will have increased predictability [63]. For example, the WWII Heritage exhibit at the Chelmsford museum using the same quit button on each screen [64].



Figure 20 - WWII Heritage Exhibit [64]



Figure 21 - WWII Heritage Exhibit part ii [64]

The magic of the British Library online exhibit which explores all the treasures of the British library uses the same buttons for zoom in/zoom out, hide details and close viewer [65] as the Thai, Lao and Cambodian collection [66].

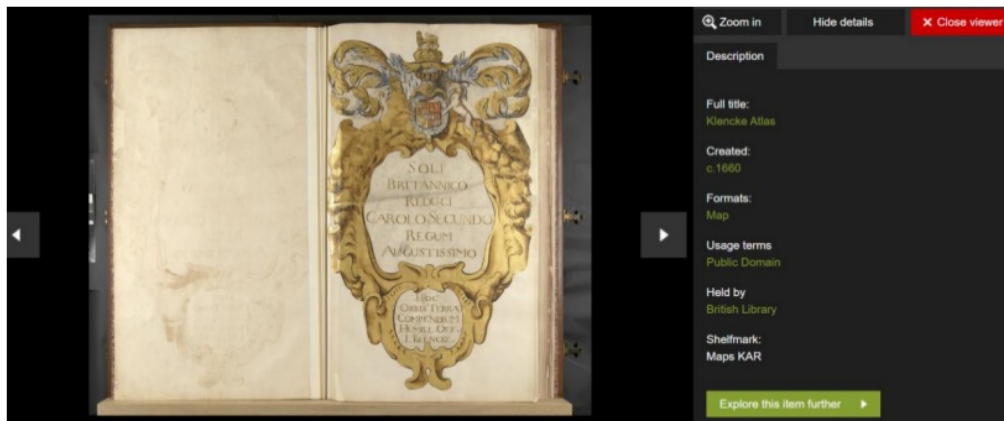


Figure 22 - The magic of the British Library Exhibit [65]

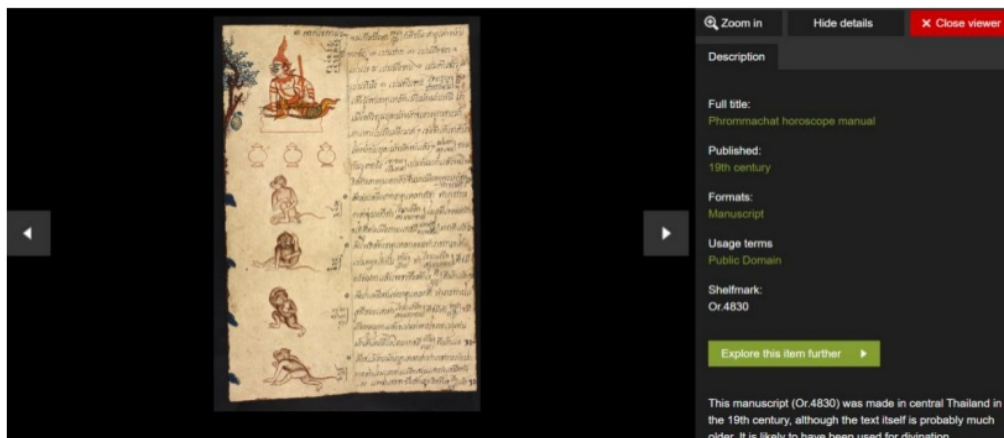


Figure 23 - Thai, Lao and Cambodian collection [66]

It is important for museum exhibit designers to consider these guidelines so every exhibit can be accessible as possible and not discriminate. While it may be easier to apply them to online exhibits, for actual exhibits with an interactive interface, these examples have shown it is possible to do. Even for exhibits with no digital aspect, alternative guides should be provided for text e.g. BSL and audio description.

5. Virtual and Augmented Reality

In the early stages of Virtual Reality (VR), Sutherland [67] described 'The Ultimate Display' which involved audio, interactive graphics and devices with force feedback capability. He explained that the challenge is for that world to act real, look real, feel real and sound real [68]. His 3 characteristics of VR which are immersion, interaction and real-time are shared with Augmented Reality (AR) where interactive digital

elements are placed in the real world [69]. Museum exhibits use VR to immerse users into an experience e.g. into a painting such as “R. W. Ekman’s painting ‘The Opening of the Diet 1863 by Alexander II’” [70] at the National Museum of Finland where users wear a VR headset to “step back in time” [70].



Figure 24 - The Opening of the Diet 1863 by Alexander II [70]

The users can interact with representatives of various social classes and the emperor by speaking, which has been made to feel real through working with history professionals on what they might say [70].

Museums also use AR to modernise existing exhibits e.g. the Bone Hall at the Smithsonian Museum which uses an app called ‘Skin and Bones’ to see how the animals look and move when they are alive [71].



Figure 25 - Skin and Bones App [72]

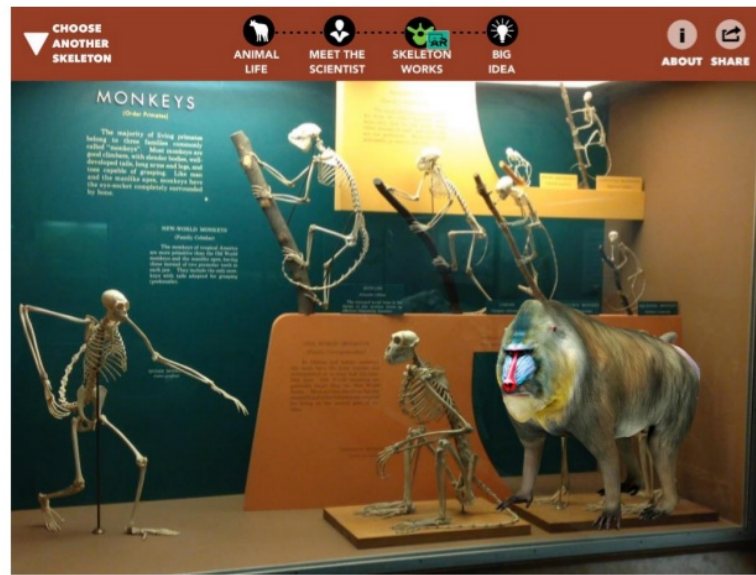


Figure 26 – Mandrill at Bone Hall [73]

Sutherland's vision is still relevant when designing interactive museum exhibits as the user is immersed into another environment with VR, and AR in the real world can "feel" even more real as you are experiencing something in real time right in front of you. The interaction aspect is also applicable in different ways e.g. through the screen with AR and touch/voice interaction with VR.

My proposed exhibit incorporates AR to get a deeper look at several historical castles in Wales. Like other AR exhibits such as ReBlink at AGO's Canadian and Europeans collection [74], it will only require a smartphone/tablet and an app which you point towards the exhibit. You can point at the castle of your choice and get a 3D view of the castle on your screen which you can move around and explore what it looks like in real life. You can also click on different parts of the castle to see more facts.

Wizards Unite also uses AR to immerse the user and meets Sutherland's vision as it allows you to interact and change the space in front of you in real time with activities like battling enemies by casting spells which you trace on the screen, and depending on your success the enemy either resists the spell, escapes or surrenders to the magic. When there are portals in the game, you physically have to step through them in the real world in order to go through. The experience is made to feel as real as possible and the user can feel transported into the wizarding world.



Figure 27 - ReBlink Exhibit [74]



Figure 28 - Wizards Unite [75]

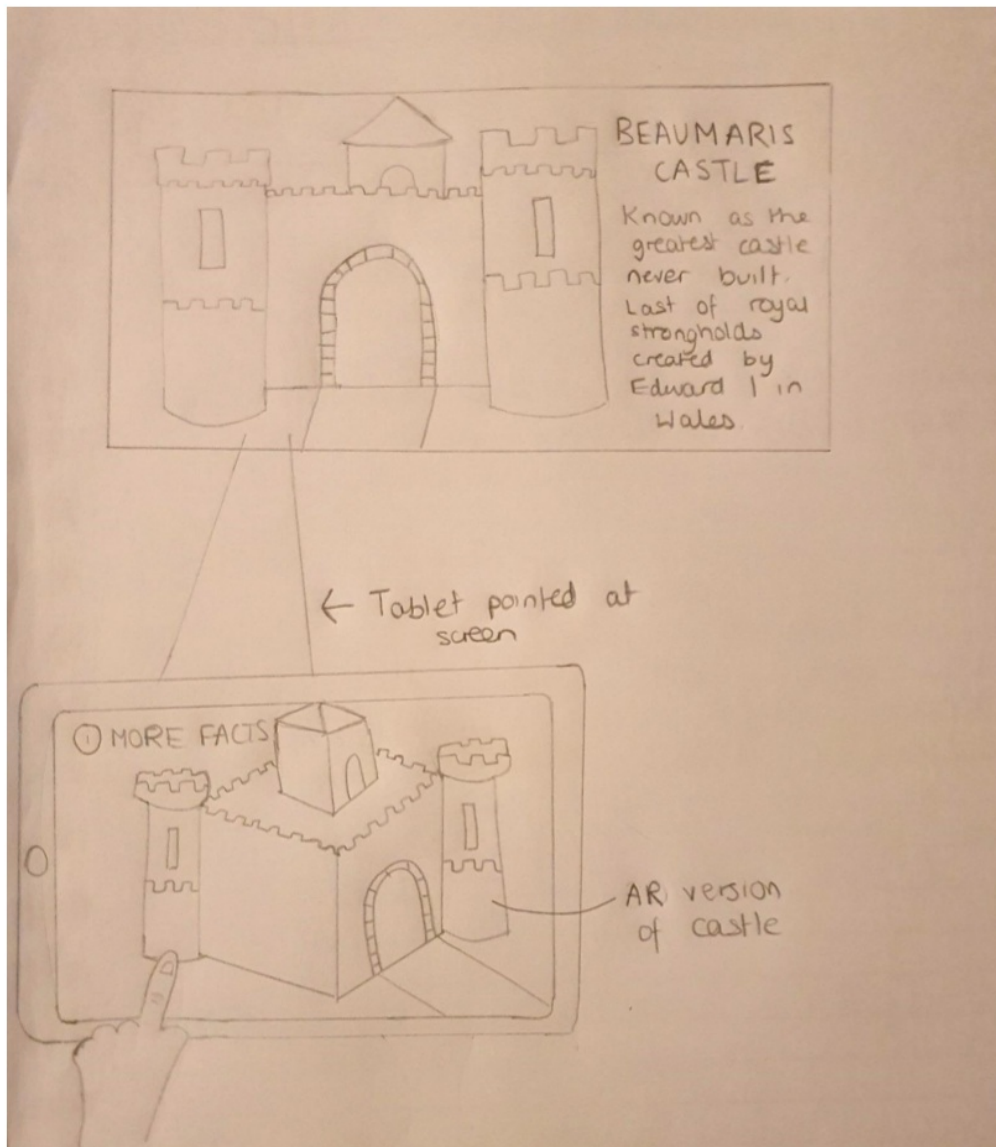


Figure 29 - Welsh Castles Exhibit

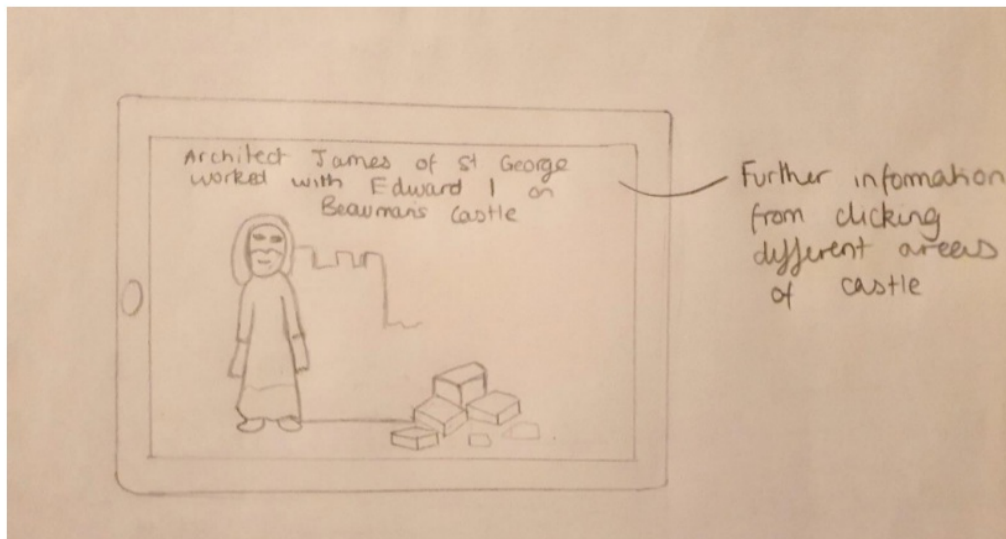


Figure 30 - Welsh Castles Exhibit part ii

6. Conclusion

Interactive museum exhibits help museums to feel more modernised and relevant today. To increase visitors to your museum it is important to keep updated and make these exhibits as accessible as possible for everyone, including those with disabilities. With all the technology available and the introduction of the Disability Discrimination Act, there is no reason for exhibits to be completely inaccessible. Using VR or AR can help to immerse visitors and revive old existing exhibits which can make them more approachable for younger people.

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Usability Analysis of Interactive Museum Exhibits (3500 words)

GRADEMARK REPORT

FINAL GRADE

75/100

GENERAL COMMENTS

Instructor

A great effort in completing your work in difficult circumstances. Good choices of online exhibits worked well with additional research skills demonstrated in selecting appropriate examples. And you were able to use some local examples as well.

Usability Review of Two Exhibits

An effective comparison of an online display and one from the Dylan Thomas exhibition on our campus. Good application of theory here, especially in highlighting the features on the online exhibit. I was relieved that you did identify a metaphor in the Dylan Thomas exhibit after saying none were obvious! Good use of sketches to illustrate the write up.

Usability Evaluation

A range of suitable evaluation techniques is presented and the timeline is explained. An improvement would have been to sketch the recommended timeline. A workable evaluation plan is clearly outlined.

Guidelines and Accessibility

Good work in using a range of diverse examples to illustrate and apply Dix's guidelines and accessibility guidelines. You addressed how well guidelines apply in this context with some excellent points made.

Augmented and Virtual Reality

Again a range of interesting museum case studies are presented to good effect. A good design around Welsh castles

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