Digital leaderboard prototype for guest engagement in Enigmas' Arcadeum

Bachelor project BDDIT, ITU

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Abstract

Dette bachelorprojekt undersøger, hvordan interaktionsdesign og digitale teknologier kan anvendes i museumsformidling, fokuseret på gæste-engagement i Arcadeum-udstillingen hos Enigma Museum.

I samarbejde med Enigma blev en prototype af et digital leaderboard udviklet og testet med det formål at introducere high-score kultur som en legende og social formidlingsform på tværs af spil og gæste-grupper i Arcadeum.
Projektet benyttede en refleksiv "research-through-design" tilgang sammen med interviews, online Maze-tests og spørgeskemaundersøgelser for at informere versioner af prototypen.

Resultaterne peger på, at selvom prototypen i sig selv var funktionel og forståelig, var kontekst og facilitering afgørende for at opnå situeret brug af prototypen. Gæsternes motivation til at bruge et digitalt leaderboard er tæt knyttet med fysisk placering, personalets rolle og den visuelle tydelighed i kommunikation af produktet.
Projektet konkluderer, at et digitalt leaderboard-system har potentiale som støttende formidlingsværktøj i museumsudstillinger, til formidling af arkade-kultur, forudsat at de understøttes af menneskelig facilitering og er kontekstualiseret i udstillingens fysiske og sociale rum.

Acknowledgements

I would like to express gratitude to my supervisor, Mogens Jacobsen, for his constructive guidance and input throughout the development of this project.

I would also like to thank Nanna Nordestgaard from Enigma Museum for her continuous engagement, trust, and insights during the design and testing phases of this project.

Lastly, thank you to all who anonymously participated in testing, gave feedback, and supported me throughout this process.

Contents

Introduction

Project topic, context and aim

Video games are among the most influential cultural products of our contemporary zeitgeist. Games have, historically, struggled to achieve the same recognition as legitimate cultural artifacts as literature, film, or art (Nylund, 2020)

However, museums have increasingly begun to collect, exhibit, and preserve video games as important elements of contemporary heritage. In this context, Enigma Museum's Arcadeum exhibition stands out as a playable archive that both celebrates and preserves the social and technological practices of the golden age of video games.

Arcadeum is not only a nostalgic attraction. The exhibition offers guests tangible, playable experiences of historic gaming technologies such as the Atari, Commodore 64, Amiga, and NES, presenting games within their original hardware (Enigma, 2023).
This follows the belief that video games deserve serious curatorial attention because they reflect historical shifts in technology, culture, and interaction (Nylund, 2020).
Arcadeum embodies this as Enigma evokes the sensory and social atmosphere of Danish arcades in the late twentieth century, a setting where *"the smell of popcorn and the taste of Jolly Cola"* remain evocative references in the marketing material on their website (Enigma, 2023).

However, engaging contemporary audiences with historical gaming practices pose unique challenges, as modern museum guests often expect seamless digital interactions and may not automatically understand or feel motivated to participate in retro gaming environments (Waern & Løvlie, 2022).

As such, Inspired by the notion that interactive technologies can enhance museums' communicative potential, this project explores how a digital leaderboard prototype, accessible via QR-code scanning, can foster playful guest engagement within Arcadeum.
In this report, "meaningful guest engagement" refers to guests' interactions with the exhibit not only functionally, but also emotionally or socially, provoking reflection within the guests via meaningful engagement as such, as it leaves them with a lasting impression, or supports shared experience among guests.
"Prototype" refers to the iterative, interactive systems developed in Figma for testing user interaction, theoretically derived from design theory as a higher-fidelity

instantiation of a design concept, first sketched, then prototyped to be tested (Buxton, 2007).

By emphasizing competitive high-score culture with a leaderboard, a hallmark of arcade experiences, this project hereby seeks to bridge nostalgic play with contemporary modes of digital interaction and engagement via its' product.

Problem statement

During the work of this project insights and design guidelines need to be generated to inform how such a digital interactive installation can be employed to support Enigmas' efforts to highlight and contextualize Arcadeum reliquaries and thereby encourage meaningful engagement among their guests.
The following problem statement has hereby driven the project:

"How can interaction design principles and interactive technologies be integrated into Arcadeum to foster meaningful guest engagement?"

This problem statement carries some assumptions and presuppositions that need to be addressed during the project work, as research questions:

1. How does interaction design encourage engagement with Arcadeum?
2. How does the Arcadeum context influence user motivation?
3. What design choices and contextual elements support or hinder meaningful guest engagement?

This project addresses these questions through a research-through-design approach that integrates stakeholder collaboration, iterative prototyping, and reflective analysis.

How these research questions were addressed can be read in later section:
Discussion

Background

Elaborated context and positioning of project with challenges

Historical context of videogames in Arcades

The golden age of arcade video games, spanning from the late 1970s into the early 1980s, marked a significant period of technological and cultural development. Games like Space Invaders and others introduced key interaction design patterns, including progressive difficulty, multiple lives, and *high-score* systems (Wolf, 2008) (DeWyze, 1982) (Symond, 2010).
These patterns have since become foundational elements in the broader field of digital game design and remain relevant today.

Arcade gaming culture in Denmark followed similar trends, initially flourishing through pinball and electromechanical games during the 1950s and 60s before embracing the arrival of video game cabinets in the late 70s (Stegelmann & Englev, 2012).
Local adaptations, such as the Danish-modified DanPac version of Pac-Man, reflect how gaming practices were localized and culturally embedded (Datamuseum, 2024) (Play Right Forum, 2009).
Despite the subsequent decline of arcades in the early 1980s, these gaming spaces left a lasting impact on Denmarks' social play culture, technological innovation, and popular memory.

Contemporary games in museums

In contemporary and globalized times, competitive play has expanded through digital technologies, where global leaderboards and online matchmaking systems echo the arcade high-score traditions while adapting them to networked environments. The act of competing for recognition through gameplay, once localized in physical arcade spaces, has become a persistent social dynamic in online gaming ecosystems.
Nowadays, museums have increasingly recognized video games as culturally significant artifacts worthy of preservation and exhibition, not only as nostalgic artifacts, but as subjects of critical reflection, education, and public engagement.

Early initiatives to incorporate games into museums are often focused on passive display, but more recent approaches seek to engage guests through interactivity and experiential learning. The value of integrating game-based interaction to support historical interpretation and participatory learning in museum settings is

acknowledged in existing research on the subject (Paliokas & Sylaiou, 2016) (Naskali, Suominen, & Saarikoski, 2013).
These developments illustrate a broader institutional shift toward playful formats that reflect contemporary media habits and guest expectations. And as argued before, games should hereby be seen as historical expressions of technological, social, and cultural change (Nylund, 2020).
Exhibitions like Arcadeum align with this view by not only displaying historical objects but also curating playable experiences that communicate the embodied practices of gaming across generations.

At Enigma Museum, they frame the Arcadeum exhibition as an active, sensory recreation of the arcade experience.
Through playable arcade machines such as Pac-Man, along with home systems such as the Atari 2600, guests are invited to engage with classic video-game titles in their original technological form. As established earlier, Arcadeum seeks to recreate the sensory and social experience of arcade play, embedding games in their original hardware and cultural context (Enigma, 2023).

For a visual overview of the breadth of video game machines present in Arcadeum, also presented in their marketing material, see **APPENDIX A**.

Known design challenges

The attempt at evoking nostalgia provides an important affective entry point, as engaging modern guests with historical gaming experiences also presents various challenges:
Today's museum guests often expect seamless digital interactions and may not automatically feel invested in retro gaming interfaces (Waern & Løvlie, 2022). Arcadeum, like many other museums, hereby need to navigate the tension between historical authenticity and contemporary expectations for interactivity, usability, and social engagement.

Recent literature on interaction design in museums emphasizes the shift from monological exhibition practices toward more playful, participatory formats (Naskali, Suominen, & Saarikoski, 2013) (Paliokas & Sylaiou, 2016).
And, theory such as Falk and Dierking's Contextual Model of Learning further highlights how guest experiences are shaped by the interplay of personal, social, and physical contexts. In this light, interactive technologies can be seen in museum exhibition contexts serving as tools for fostering new social dynamics and enhancing learning opportunities within the museum space (Falk & Dierking, 2016).

The use of hybrid digital-physical interaction formats, such as QR codes, mobile interfaces, and digital gamification, has become increasingly common in museum practice (Waern & Løvlie, 2022).
Yet, the success of these integrations depend heavily on design factors like clear onboarding processes, motivation framing, and user-centered interaction patterns. Here, "onboarding" refers to the initial steps that introduce users to a system and help them begin using it effectively. Poor onboarding generally results in digital interventions being ignored or misunderstood, while effective onboarding can embed them seamlessly into the museum experience, enhancing both engagement and learning outcomes (Hammady, Ma, & Temple, 2016).

In this context, this project explores how a digital leaderboard, accessible via QR code scanning, may foster meaningful guest engagement at Arcadeum by reintroducing digitally mediated social competition as a playful and meaningful layer of interaction. The project also investigates how such a prototype must be framed, designed, and facilitated to align with both the historical character of Arcadeum and contemporary guest expectations for digital interaction.

The potential value of a digital leaderboard lies in its' ability to extend the social layer of arcade play in Arcadeum, possibly increasing dwell time, repeat interaction, or peer recognition among guests.
For the designer, it serves as a lens to investigate how contemporary interaction design can enrich retro gaming exhibitions through playful, low-barrier interfaces.

Methodology and methods

Epistemological stance and projects' chronological process

To explore and develop how a digital leaderboard might foster guest engagement at Arcadeum, this project adopts a mixed-methods design research approach embedded in a pragmatist and user-centered epistemology. Rather than verifying predefined hypotheses, the project investigated how a digital leaderboard might enhance guest engagement at the Arcadeum exhibition through iterative cycles of design, prototyping, and user feedback.
The project didn't start with the idea of a digital leaderboard as a proposed solution, as will be described in following sub-sections.

The overall logic of inquiry aligns with "abduction", where theoretical insights and empirical patterns are brought into mutual resonance during the design process. Knowledge production, here, is approached as situated and emergent, reflecting the logic of "research through design", as described by Koskinen et al., who explain that design artefacts serve as epistemic vehicles to explore social and experiential phenomena within real-world contexts (Koskinen, Binder, Zimmerman, & Redström, 2011), such as how a digital leaderboard may affect and serve to reinforce the Arcadeum experience, and how prototypes as design artefacts provide the means to explore the user-experienced phenomenon of an Arcadeum digital leaderboard.

This view is complemented by Schön's notion of the reflective practitioner, where design becomes a dialogue with a given situation, shaped by experimentation, surprise, and reframing in action in "reflection-in-action" and "reflection-on-action" (Schön, 1983):
"Reflection-in-action" was primarily had during development of the prototypes' iterative versions, either as immediate decision-making based informed by theoretical UX (User Experience) design heuristics, or as a response to feedback from testing. Immediate application of gathered knowledge hereby adapted the design during development, with every new version effectively experimenting with hypotheses of how early UX issues could be addressed. "Reflection-on-action", in gathering feedback from design iterations, in turn informed future reflections-in-actions that'd inform development of future design iterations seeking to address UX issues identified in reflection-on-action, reflecting on the design decisions made during development of then tested design versions.

Acknowledging this general approach to knowledge production across phases of the project, the following sub-sections will describe how knowledge-gathering methods were employed during the span of this project, in chronological order:

Project planning and time management

The project began as a broad exploration of digital play in cultural institutions but gradually narrowed into a focused investigation of QR-activated leaderboard systems. This shift emerged through dialogue with Enigma, feedback from users, and project scoping with the supervisor.

APPENDIX C presents the project on an introductory level, which helped initiate dialogue about shared interests and institutional needs, including a preliminary timeline of milestones. **APPENDIX D** presents the subsequential design solution proposal, as it was pitched to Nanna, outlining design rationale, technical considerations, intended guest experience and an initial project plan of milestones starting from February.
In practice, the plan had to be revised as milestones proved more time-consuming than initially anticipated. During a mid-project workshop in March, facilitated by project supervisor Mogens, priorities were reassessed:

Plans for secondary testing "prototyping" phases were narrowed in scope, and efforts were reallocated to ensure timely data collection during the Easter period in April. This flexibility was essential for maintaining progress despite uncertainties in coordination, test recruitment, and feedback synthesis. **APPENDIX J** presented the project in the status of development it was back then, intended for presentation to peer students and supervisor Mogens, including a revised project plan of milestones. While the plan changed, it served as a flexible scaffold for organizing deliverables and adjusting to institutional and temporal constraints. A month-by-month summary follows:

January: Background research, stakeholder alignment, framing

February: Early wireframes, QR-onboarding trials, stakeholder feedback

March: Iteration, workshop, Maze preparation

April: Online tests, QR poster testing, survey, interview

May: Thematic analysis, synthesis, final reporting

Project planning hereby served not only as a practical scaffold but also as a tool for reflection, guiding design decisions in relation to institutional constraints and emerging user insights.

Co-design collaboration

The project was conducted in close collaboration with Enigma Museum, particularly through ongoing dialogue with Nanna, who served as the primary institutional contact. Early meetings, email correspondence, and presentation materials helped establish the design problem in relation to Enigma's mission of communicating cultural memory through digital media.

These interactions served as a form of contextual inquiry, grounding the prototype in the museum's spatial layout, target demographics, and practical challenges of guest onboarding. Meeting notes and presentation slides document the evolving design rationale and the shared understanding that emerged over time.

Slides used during collaboration with Enigma Museum are included as aforementioned Appendices: **APPENDIX C** contains the initial presentation that introduced the project and helped initiate dialogue around shared interests and institutional needs. And **APPENDIX D** presents the prototype solution as it was pitched to Nanna, outlining design rationale, technical considerations, and the intended guest experience:

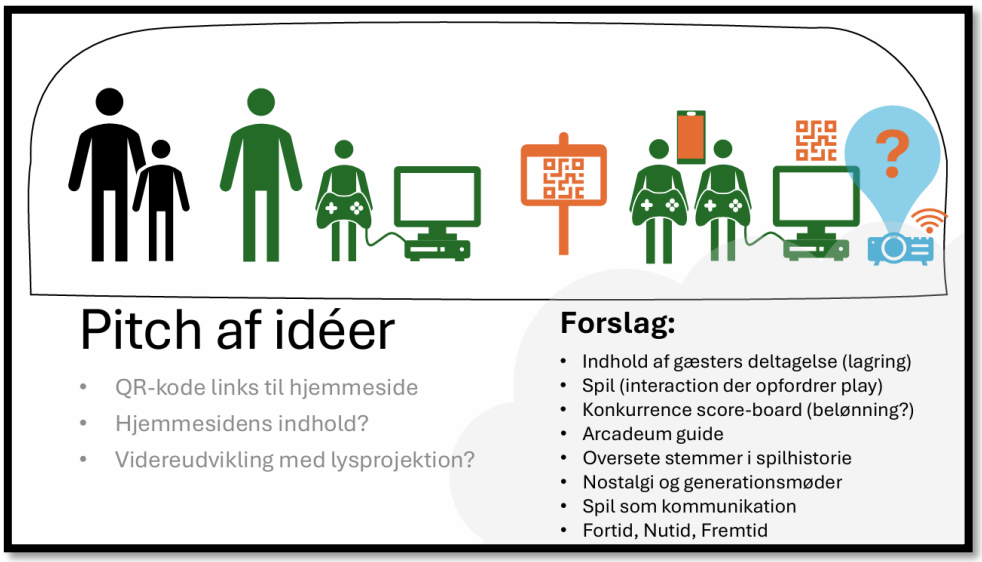

Figure 1: Slide 4 of Appendix D, visualizing design proposals for Arcadeum

These materials illustrate how project direction and stakeholder alignment were shaped through ongoing communication and co-design practices, but also served to evaluate potential directions of the project.

Informed by these dialogues, a decision matrix was developed, comparing alternative concepts across criteria such as engagement potential, technical

feasibility, alignment with Enigma's curatorial visions, and potential data-gathering capacity (Straker & Tomisch, 2021).
This process helped clarify the rationale for selecting a digital leaderboard as the core design intervention, as it offered a high degree of feasibility, institutional alignment, and visitor engagement potential without the legal or technical complexities of more hardware-dependent alternatives.
To read the decision matrix, see **APPENDIX E**.

This collaborative approach follows participatory design traditions, in which stakeholders are co-creators of meaning and direction (Bannon & Ehn, 2012) (Binder, et al., 2011).

And as such, the design hypothesis, that a digital leaderboard could extend arcade-style social play if properly integrated, hereby emerged directly from this co-operative process.
Although drawn later in the process (during development of V0.4, these two user journey storyboards represent conceptual thinking and representation of the concept in guest interaction flows, used retroactively to clarify onboarding logic:

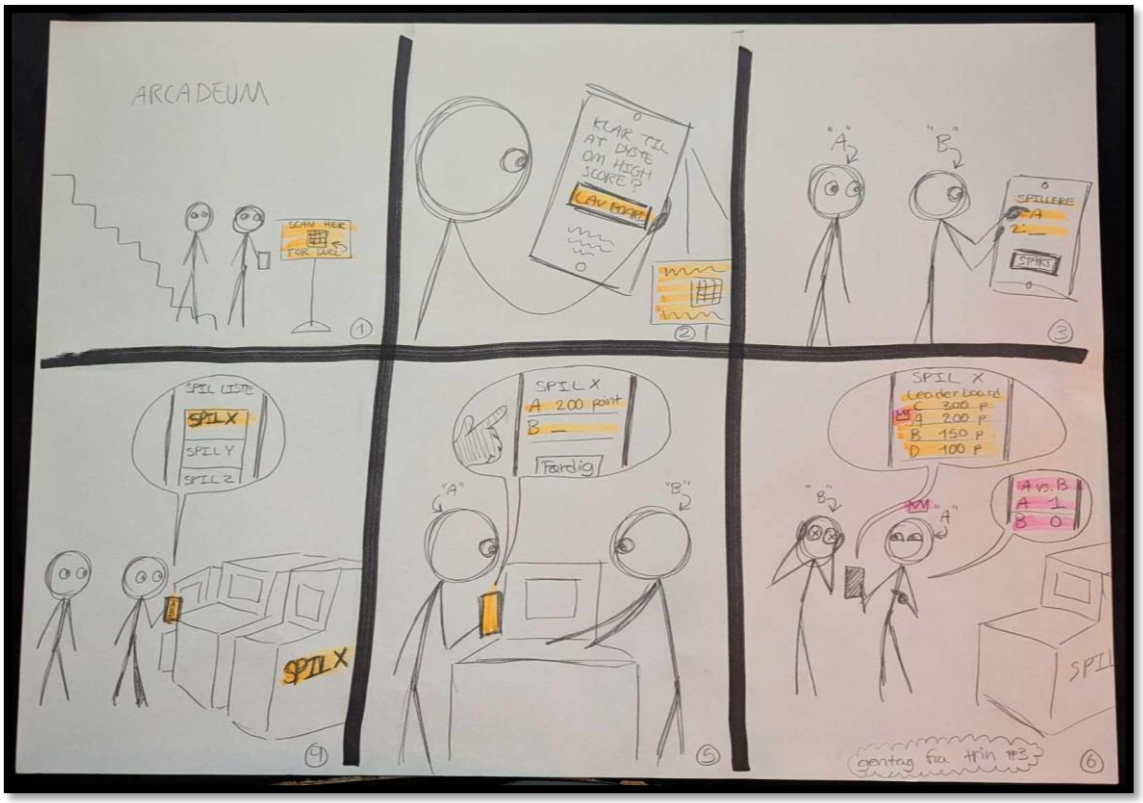

Figure 2: User journey storyboard for prototype variant; QR code by entrance

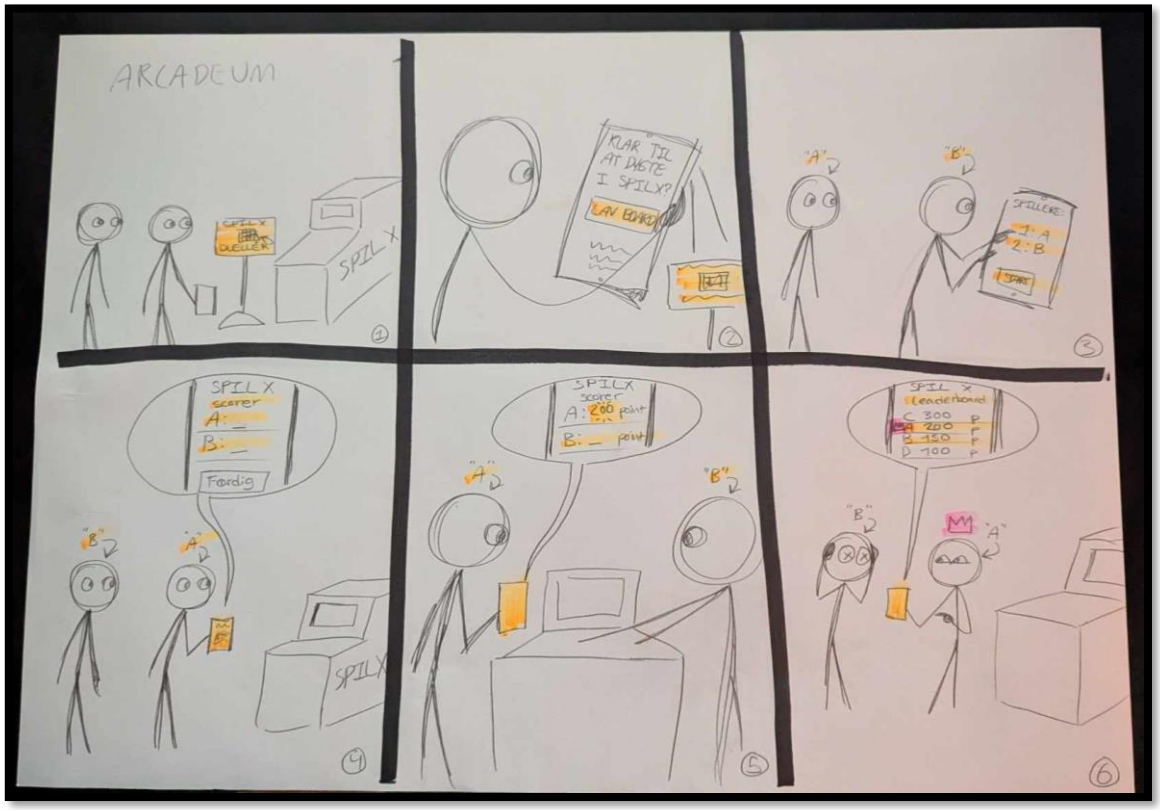

Figure 3: User journey storyboard for prototype variant; QR code by a game

The process of storyboarding supported reflective design decisions about how the onboarding process influenced user comprehension and interaction with the prototype. Although the two storyboards may appear visually similar, the act of drawing them clarified important distinctions between the prototype variants. Elaboration on the storyboarding process can be read in the later section: Developing V0.4 for deployment through user journey storyboarding.

Pilot- usability-testing and prototyping

Initial knowledge-gathering explorations were conducted as low-fidelity wireframes, developed in Figma, to test interaction concepts and behaviors. Convenience-sampled users responded to early versions of the QR-based prototype, exposing early frictions in QR-code prototyping, which led to design changes such as removing in-website scanning and instead developing two variants of QR-code onboarding for "V0.2".

For a visual overview of the early versions of the Interactive prototype, see **APPENDIX B**. The first version "V0.1" focused on the primary steps of interaction necessary to facilitate and construct a digital leaderboard informed by user input on an external device, such as an users' smartphone:

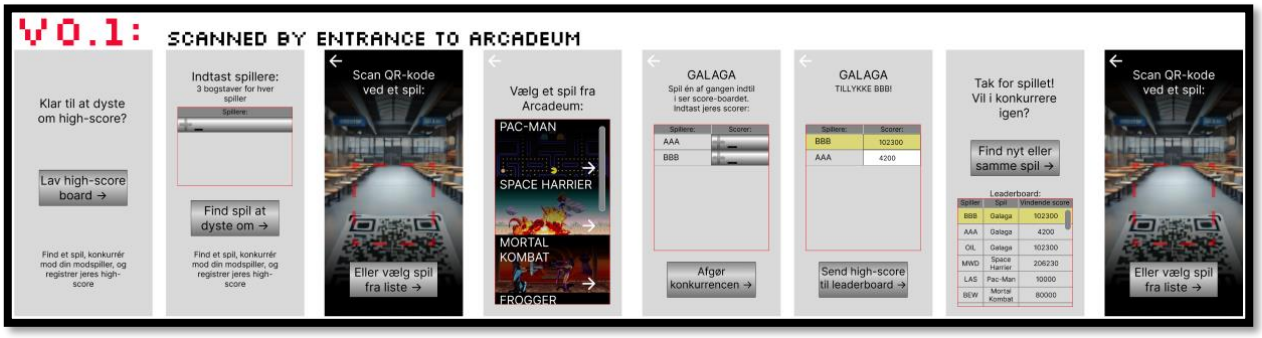

Figure 4: Interactive prototype V0.1 from Appendix B, read from left to right

The steps required by the user, in the conceptualization of this design proposal, were as follows:

1. Scan a QR-code by the entrance of the exhibition to access this website
2. Insert players, represented by their names
3. Scan a QR-code by a game, or pick a game from a list of Arcadeum games
4. Have users manually Insert scores read off the final scoreboard after finishing the game
5. View the digital leaderboard of other scores, and begin a new game

These wireframes were influenced by visual design heuristics, particularly those outlined in Jesse James Garrett's "Elements of User Experience", focusing on the "Skeleton" and "Surface" planes, informing interaction navigation, layout clarity, and visual hierarchy. The UX-planes that Garret introduce are "Strategy", "Scope", "Structure", "Skeleton" and "Surface" (Garrett, 2011), addressed in section Prototype.
These decisions, emphasizing buttons via a "shiny" gradient texture, using red outlines for emphasizing scrollable, interactable or animated elements, and yellow to highlight top scores, were all to try an emphasize functional transitions of internal states, not to enhance aesthetic congruence with Arcadeum.
Frame #3 and #8 in Figure 5 have images of QR-codes situated in an exhibition environment. These were initially intended to simulate in-website QR-scanning frames, where the website would access the device's camera to scan an in-exhibition QR-code to access a game to enter a score for.

Iterative prototyping informed by online user-flow testing and surveys

After reaching a higher-fidelity prototype, user-flow testing was conducted using Maze, an unmoderated online testing platform.
Participants were asked to complete a set of predefined tasks in navigating either of two versions of the interactive prototype: creating a scoreboard, selecting a task-specific game, submitting high scores. Metrics like mis-click rates, task completion success, and time-on-task were logged by Maze's automatic tracking system.

As mentioned, two versions of the Maze test were deployed, for two variants of the interactive prototype, each addressing different evaluation goals and situated in different contexts:
One version was accessed via a physical QR code poster placed next to the Battle Squadron machine within Arcadeum. This iteration focused solely on unmoderated user-flow testing, capturing interaction metrics in a near-authentic exhibition setting.
The second version was distributed online through Facebook. This version included both the user-flow test, and a follow-up survey designed to gather participants' reflections on clarity, motivation, and engagement. The survey responses analyzed in this report therefore stem exclusively from the online version.

Screenshot of the recruitment post on Facebook can be found in **APPENDIX F**, and "V0.2" of the interactive prototype can be seen in **APPENDIX B**, as follows:

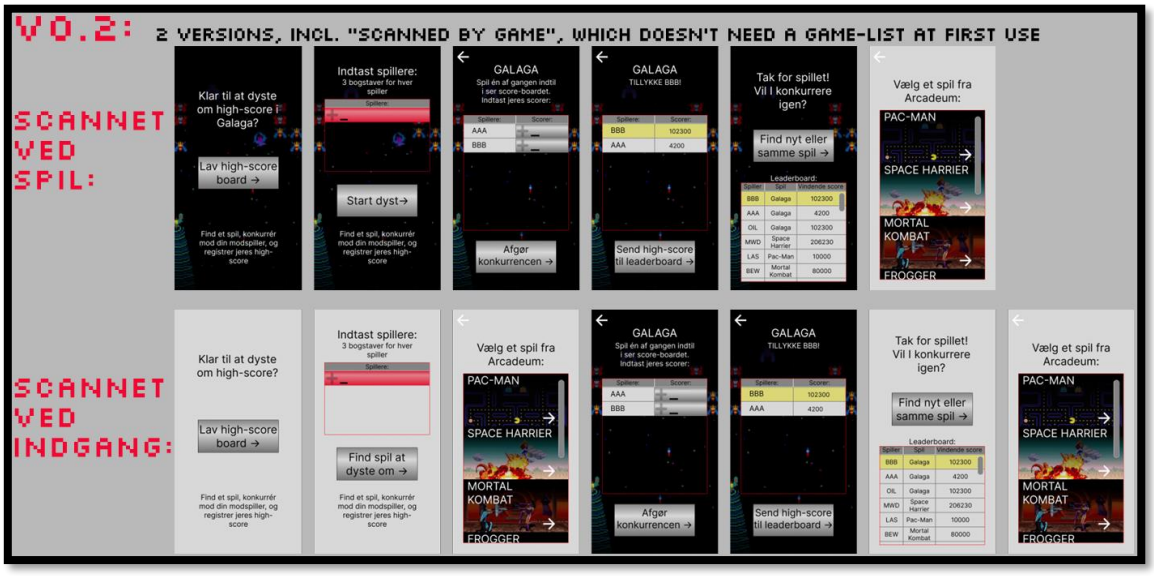

Figure 5: Interactive prototype V0.2 from Appendix B, showing two variants

Based on feedback, the prototype was refined through successive pilot-iterations. Design decisions were guided by practice-based reasoning: streamlining score input order to reduce cognitive load, adjusting button affordances, and aligning aesthetics with Enigma's visual identity.
For example, feedback from Maze-testing V0.2 indicated that many users expected to scroll when partial content was visible but were unsure of how. This insight informed the removal of scrollbars in V0.3, restructuring the interface into discrete steps to reduce interpretative ambiguity:

Figure 6: Interactive prototype V0.2, cropped to show example of scrollable list

Figure 7: Interactive prototype V0.3, cropped to show example of scrollable list

Links to the live Maze prototype tests, as well as screenshots of the test results, can be found in **APPENDIX G**.

Developing V0.4 for deployment through user journey storyboarding

During development of final iterations of the interactive prototype "V0.4", two user-flow storyboards were generated to visualize and re-evaluate guest interactions with the prototype variants, as seen earlier in section Co-design collaboration. These flows helped explore potential interaction frictions and opportunities, such as leaderboard confusion and score-input interruptions.

The storyboarding process informed the decision to implement leaderboard filtering, ensuring that users would first see their own comparative scores, followed by those of other players who engaged in the same game, and only then be presented with access to a broader range of games and scores:

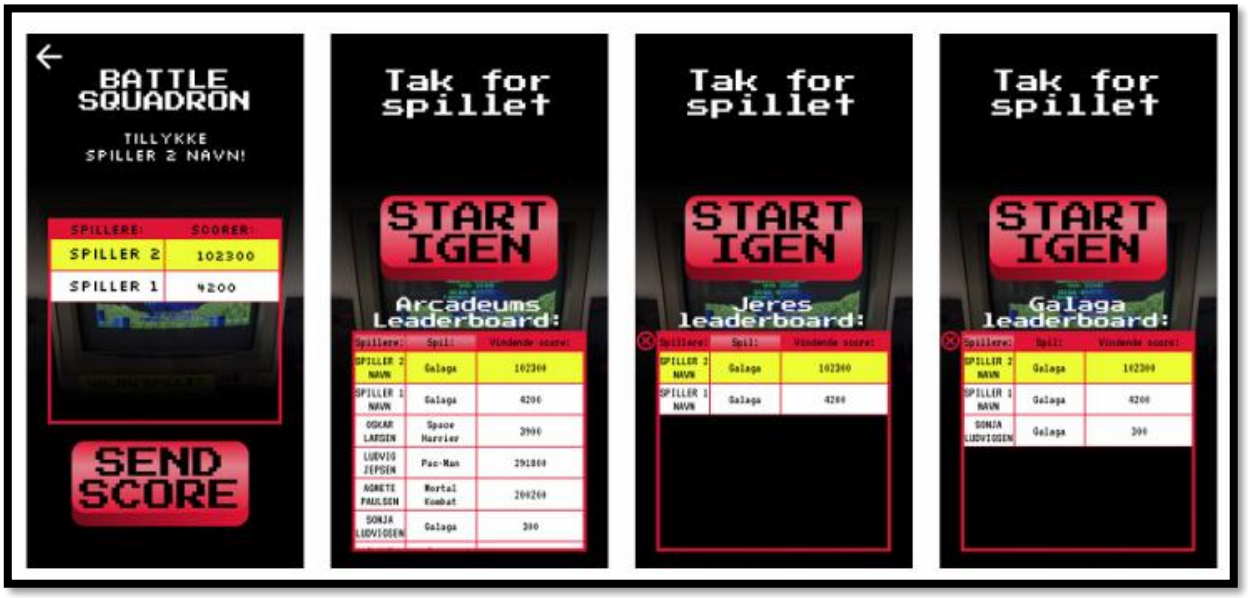

Figure 8: Appendix H, cropped to show V0.4's scrollable, filterable leaderboard

The act of storyboarding prototype interactions, such as comparing user flows between entrance-scanned and machine-scanned QR codes, serves to function as an example of "reflection-on-action", reflecting on previous design decisions made retrospectively (Schön, 1983).
However, by externalizing imagined guest behavior through sketching, design ideas emerged immediately "in-action". For instance, the storyboards made visible how the onboarding context shaped the need for different leaderboard filtering priorities, also considering single players.

These insights did not arise from fixed requirements but from the "reflective conversation with the situation" of this project, where problems and solutions are co-shaped through making, in "conversation with the material" and reflection "in-actions" and "on-actions" of design decision making (Schön, 1983).
And while Garrett emphasizes a sequential, not necessarily linear, layering of UX-planes for development (Garrett, 2011), the design process here was recursive, causing a top-down adjustments from "Surface"-level feedback to re-inform the "Scope" of necessary features , such as removing the scroll-bar, or introducing leaderboard filtering.

V0.4 also took further steps into visual design of the user interface, as will be elaborated on in section Prototype.

A visual overview with images of the onboarding-poster in Arcadeum and how the two deployed Maze tests of V0.4 were deployed can be found in **APPENDIX H**.

Semi-structured interviewing

Toward the end of the development process, a semi-structured interview was conducted with Nanna to contextualize the prototype within the museum's curatorial goals and operational realities.
Drawing from Bernard, the open format allowed insights to emerge organically, enabling nuanced discussions about facilitation, onboarding, and the institutional alignment of the digital intervention (Bernard, 2012).

Analysis and discussion of insights gathered from the interview with Nanna will be described in their respective sections.

Prototype

Documentation of design rationale across iterations

The final prototype, "V0.4", was iteratively developed in Figma and represents the culmination of design insights gathered through iterative pilot user testing and institutional collaboration. It aims to explore how interaction design can support Enigma's curatorial goals by introducing arcade-style social play in a contemporary, digital museum context via a digital leaderboard.

The design was an exercise in interface construction and strategic intervention, to scaffold playful motivation, ease of use, and social interaction within the Arcadeum exhibition. The prototype aims to engage guests as an extension of physical space, distributed via posters with scannable QR codes placed either at the entrance or next to specific machines.
The use of QR codes was hereby central to the prototype's tested onboarding process. Each prototype variant was accessed either by scanning a QR code at the exhibition entrance or directly next to a game.
Prior literature shows that such codes can onboard playful engagement in museums, from treasure hunts to AR overlays, when integrated successfully (Hammady, Ma, & Temple, 2016).

A key design decision was the division of the prototype into two versions for testing purposes: one version for guests scanning QR codes placed by a specific game machine, Battle Squadron, and another more general-access version accessed at the exhibition's entrance. These decisions sought to address different modes of onboarding, reducing friction for casual users while still offering comprehensive access.

A visual overview with images of the poster in Arcadeum and the two deployed Maze tests can be found in **APPENDIX H**.

The prototype's function, as per user-journey steps described in Pilot- usability-testing and prototyping was to try and engage guests in record and view high-scores, reinforcing social comparison and recognition. Secondly, for the purposes of informing this project, the prototype was intended for use in evaluating how onboarding, interface clarity, and context-specific framing affected user motivation and understanding.
Evaluation criteria were defined to guide the design process and frame success metrics for each goal:

Criteria	Design focus	Evaluation metod(s)	Success metric
Social interaction	Facilitating comparison and recognition through visible scores	Maze Survey reflections. & Interview reflections.	Users express understanding in that leaderboard scores are shared amongst users online
Ease of use	Minimizing cognitive load and interface friction	Maze Usability testing.	Smooth task completion: (name, game and score entry). Measured by user paths & mis-click rates.
Playful engagement	Leveraging familiar game tropes like leaderboards and score entry.	Maze Survey reflections.	Users reports of fun or engagement.

Figure 9: Table of design criteria with associated methods and success metrics

Whether these criteria were met will be evaluated in later section: Evaluation.

These criteria align with Jesse James Garrett's model of the five planes of user experience (UX): from "strategic" institutional goals of guest engagement to "scope" features like filtering, to "skeleton" and "surface" layers in visual layout and styling (Garrett, 2011): (next page)

<table>
<tr><th>UX Plane</th><th>Design focus</th><th>Application in prototype</th></tr>
<tr><td>Strategy</td><td>User needs and business/institutional goals</td><td colspan="2">Product objectives: Guests should easily understand and engage with scores, feel motivated by recognition, and experience the leaderboard as part of the playful arcade context.
User needs: Reinforce Enigma's goal to foster social interaction, nostalgia, and playful digital experiences in cultural learning.</td></tr>
<tr><td>Scope</td><td>Functional and content requirements</td><td>Functional specifications
Score submission, leaderboard display, name entry form, game filter buttons, QR-based access flow.</td><td>Content requirements
Arcadeum branding, leaderboard names/scores, game titles, text prompts.</td></tr>
<tr><td>Structure</td><td>Interaction design and information architecture</td><td>Interaction design
Linear flow with minimal branches, confirmation prompts, responsive button states.</td><td>Information architecture
Customizable views. e.g.: filtering own score, same game scores, or all scores. Logical hierarchy of elements, consistent feedback, and progressive disclosure.</td></tr>
<tr><td>Skeleton</td><td>Interface layout, navigation design, information design</td><td colspan="2">Information design: Field labels, e.g. names and games, are placed close to interactable elements. Leaderboard hierarchy visually reflects data relevance, e.g. highest score at top and highlighting user scores.
Interface design
Vertical layout for readability, visual hierarchy via font sizing, mobile-friendly touch targets.
Navigation design
Prominent "Submit" and "Back" buttons, iconography to reduce cognitive load, QR scan entry point.</td></tr>
<tr><td>Surface</td><td>Visual design: typography, colors, imagery</td><td colspan="2">Sensory design: Deep red color from Enigma branding, pixelated fonts evoking arcade aesthetics, and imagery from Arcadeum.</td></tr>
</table>

Figure 10: Table of Garret's UX Planes, relating to prototype

To elaborate, at the "Strategy" level, primary user needs and our project's objectives were identified, providing a clear purpose and direction for the design. This strategic foundation guided the "Scope" of the project, as necessary features and content were defined to meet those goals, herein prioritizing certain ideas over others in co-operative idea generation whilst attempting to avoid scope creep.
Once the scope was set, the "Structure" of the interface was then developed by organizing content and tasks into a logical interactive flow, considering information architecture, so that each user action fits into a coherent journey. Building on that structure, the "Skeleton", consisting of wireframes detailing layout and navigation, was developed to ensure that on each screen, elements are placed intuitively and would support the user's goals, such as positioning the primary call-to-action buttons prominently based on the content hierarchy. Finally, the "Surface" layer was refined with a consistent visual design of colors, typography, and imagery that not only makes the product aesthetically pleasing but also reinforces usability, e.g.: using color cues to highlight interactive elements (Garrett, 2011).

Surface iteration overview

The interface was designed to reflect the exhibition's aesthetic tone, which will be elaborated on in later section Interaction and UX design principles. Each iteration of the prototype sought to address friction points observed in testing. Previous sub-sections of Methedology and Methods covered these iterations. Here's an overview showing the leaderboard frame prototype across prototype iterations:

Figure 11: V0.1 leaderboard end frame

V0.1 presented a linear score-entry journey with dropdown-based game selection. Pilot-Testers found in-prototype QR-scanning unintuitive and cognitively demanding, leading to development of the two variants of the interactive prototype.

Figure 12: V0.2 leaderboard end frame

V0.2 introduced two prototype variants based on QR-onboarding context (QR-code by entrance vs. by specific game).

Figure 13: V0.3 leaderboard end frame

V0.3 removed scrollbars after user confusion in Maze testing suggested that visible but ambiguous affordances caused confusion.

Figure 14: V0.4 leaderboard end frame

V0.4 implemented a filtered leaderboard system, influenced by storyboard-based evaluations of interaction flow. These filters prioritized showing either the user's own scores, other guests who played the same game, or broader game scores across the exhibition.

Figure 15: Overview of leaderboard end frame across iterations

Visual examples of this progression, including interface screenshots and physical posters, are also presented in **APPENDIX B**, **APPENDIX H**, and **APPENDIX I**.

Interaction and UX Design Principles

Visual layout and navigational structure were initially defined by wireframing, emphasizing the UX principles outlined in Garrett's five planes, particularly the layers of "skeleton", as in interface structure, and "surface", as in visual design (Garrett, 2011).

Building on the wireframed user flow described earlier, this section explores the visual and interaction-design level rationales behind design choices made in developing the prototype iterations:

Figure 16: Interactive prototype V0.1 from Appendix B, read from left to right

Figure 17: All frames of interactive prototype V0.4 (QR-by-game variant)

In the "surface" plane of the user experience of the intended design, Visual decisions such as color, font, and imagery are elaborated on in the Interaction and UX Design Principles section.
These visual choices served both aesthetic and strategic functions, aiming to anchor the prototype within the visual language of the institution to increase perceived relevance and trust.

Based on these initial visual design decisions, testing of content layouts, done by the testing of V0.1, V0.2 and V0.3, V0.4 would apply these visually aesthetic qualities for greater visual appeal, to be tested, utilizing applied UI design principles and test evaluations:

Visual Identity and Consistency

The prototype uses a red-on-black color scheme sampled from Enigma's institutional branding.
This color palette is applied consistently across screens and components, drawing on Mullet and Sano's principle of interface integrity, which helped justify early stylization choices in the prototype, e.g., red-highlighted elements to reinforce thematic unity (Mullet & Sano, 2013).

The repetition of visual elements, especially in action buttons like "START", "SEND SCORE" and "START IGEN", supports user recognition and reduces cognitive load.

Effective consistency in color, shape, and placement contribute to interface learnability and trust (Schlatter & Levinson, 2013).

Figure 18: Screenshot of Enigmas' Arcadeum website

Figure 19: V0.4 leaderboard end frame

Typography and Visual Hierarchy

A clear typographic hierarchy was established through size, weight, and casing. Titles such as "INDTAST SPILLERE" and "TAK FOR SPILLET" use large, bold, all-caps lettering to foreground screen purpose. Supporting elements like table headers and input fields are sized and styled to denote their subordinate role:

Figure 20: Typefaces of V0.4, in order of visual hierarchy in use

As can be seen above, typeface "Press Start 2P" is primary in the visual hierarchy of typefaces used, used for text in headers of frames, or button text. "Silkscreen" is used for more secondary information content of the prototype, such as context text or instructions. "VT323" is used solely for leaderboard text, as it's a highly compact typeface that can write more information on lesser space.

These decisions reflect Garrett's "surface plane" principles along with broader goals of visual clarity: users must be able to identify key information immediately.

Layout and Vertical Information Structure

The vertical stacking of interface elements was iteratively refined to guide attention and gesture behavior. Primary buttons are positioned near the bottom of the screen to support more ergonomic thumb access.

The "START IGEN" button, however, was deliberately moved to the top of the result screen, above the leaderboard, to encourage leaderboard interaction before restarting and effectively ending the prototype testing.

These decisions were informed by ergonomic UI guidelines that prioritize lower-screen touch zones on smartphones. By relocating the "START AGAIN" button to the top of the result screen, the layout shifted focus toward leaderboard exploration. This reflects Marcus' notion of interfaces as "visible language", where positioning cues structure behavior (Marcus, 1992).

Figure 21: V0.4 leaderboard end frame

Linear Navigation Flow

The prototype maintains a single-directional, step-by-step flow. Each screen contains a single primary action, such as "VÆLG SPIL" or "SEND SCORE", that advances the experience without requiring backward navigation or decision-making:

Figure 22: All frames of interactive prototype V0.4 (QR-by-game variant)

This structure sought to consider Aaron Marcus' concept of interfaces as "visible language", and Garrett's "skeleton plane" in ensuring that users remain oriented and unconfused throughout their structured interaction with the interface (Schlatter & Levinson, 2013) (Garrett, 2011).

Interface Personality and Thematic Cohesion

The interface deliberately evokes arcade nostalgia, attempting to establish a coherent "interface personality" (Schlatter & Levinson, 2013), that ought to be congruent with the Arcadeum retro aesthetic.

Background visuals were sourced from Arcadeum's physical environment or marketing materials, reinforcing a sense of place and thematic continuity.

Figure 23: Front frame of V0.4, Battle Squadron picture as background

Affordances and Feedback

Interactive elements are designed with clear visual boundaries and contrast, seeking to apply Norman's concepts of "affordances" and "signifiers" (Norman, 2013).

Buttons, here, are made highly visible and boxed, inviting touch interaction.
Input fields and leaderboard rows are grouped visually using horizontal lines and padding to suggest relationship and structure.
Visual feedback mechanisms, such as button state changes and subtle animations, were implemented to signal, "signify", system responses to user input. These signifiers support user interpretation of interaction possibilities (Norman, 2013) (Schlatter & Levinson, 2013).
While Schlatter & Levinson echo these ideas through their visual design heuristics, it is Norman who offers the conceptual foundation for these terms, explaining how the usability of interactive systems depend on users perceiving both what actions are possible as signaled by intentional "signifiers", and receiving feedback that confirms their actions have had an effect.

"Affordances" in this context refer to the perceivable affordances and possibilities for action, such as tappable buttons or scrollable content areas.
Visual feedback seeks to ensure that the user can perceive that their action has had an effect, in this case signified by animated transitions in color, shadow effects and blurring.
Design decisions hereby sought to emphasize clarity in touch-based interaction:

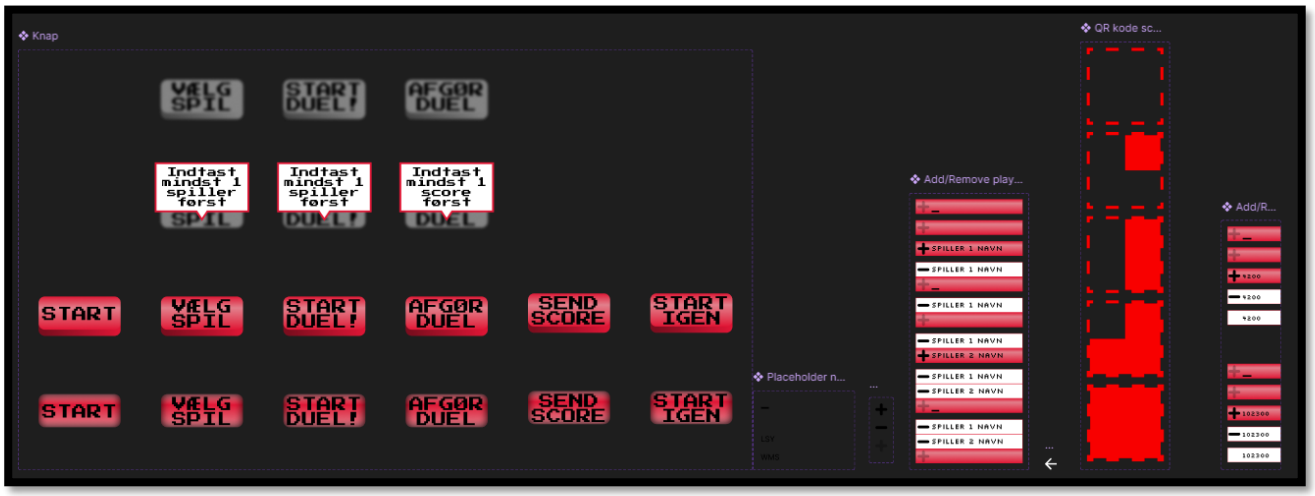

Figure 24: Screenshot of Figma interactable components w. variants and states

Grid-Based Alignment and Predictability

Consistent positioning was applied to input screens and result displays, ensuring alignment of text, icons, and tables since V0.1.
This contributes to a predictable visual as a key to usability, particularly in transient, attention-scarce contexts like museum exhibitions. Spacing between elements was kept uniform to maintain order and avoid misaligned clusters, which could distract or confuse users (Schlatter & Levinson, 2013).

Prototype Library and Documentation

The final versions of the prototypes, as well as the Figma component library used during development and other visual resources such as screenshots, pictures taken and other visual communication, are included in **APPENDIX I**, as a view-access link. This design document, serving additionally as a resource library, contains reusable components such as input fields, buttons, and leaderboard list items, built to ensure consistency and allow for future scalability.

A selection of poster iterations and screen mockups are also included in **APPENDIX I**, to document how the digital interface was envisioned as part of a broader physical-digital guest journey. These elements were designed with attention to placement and framing within the exhibition environment, with the intention of encouraging interaction through visual cues and thematic alignment.

The Figma prototype was published using Maze for online testing, but the final version includes improvements based on both Maze feedback and the semi-structured interview with Enigma.

The prototype is not implemented in code, but its structure and interactions are detailed and documented with handoff-ready frames for future implementation if needed.

Analysis

User testing and stakeholder feedback, evaluated

The following analysis integrates Maze testing data with open survey responses (**APPENDIX G**) of the test distributed online via Facebook posts, and a semi-structured interview with Nanna from Enigma (**APPENDIX K**).
This aims to identify patterns in user behavior, evaluate the effectiveness of the prototype across design goals, and inform conclusions about the contextual viability of a digital leaderboard in Arcadeum.

Qualitative data from the semi-structured interview with Nanna was analyzed using "thematic analysis", to provide a generalized overview of the interviews' contents. This involved inductive coding of open-ended responses and interview excerpts to identify emergent patterns in user behavior, preferences, and barriers to engagement (Braun & Clarke, 2008).
The interview with Nanna, however, was conducted in Danish. In this report, her responses are paraphrased in English where necessary, translated into illustrative quotes. These translations are not verbatim but are interpretive renderings that seek to preserve the intended meaning of her statements.
I acknowledge that, as the translator, I have shaped these expressions through both linguistic choices and contextual interpretation.

Due to the limited number of participants (n=5), the findings presented here should be interpreted as indicative rather than generalizable. Nonetheless, qualitative insights from testing and interviews provided rich input for iterative refinement and offer transferable lessons for similar institutional contexts.
The decision to focus on the Maze test distributed online is due to an insufficient quantity of responses (n=2) for the test distributed by the poster in Arcadeum.

Usability and success rate

All five test participants successfully completed the assigned task in creating a scoreboard, selecting Battle Squadron, and submitting scores. This demonstrates basic usability of the prototype.
However, user completion times ranged widely, from 19 to 213 seconds (mean: 88.2s), suggesting cognitive friction for some users. After removing the outlier, durations still ranged from 19 to 73 seconds:

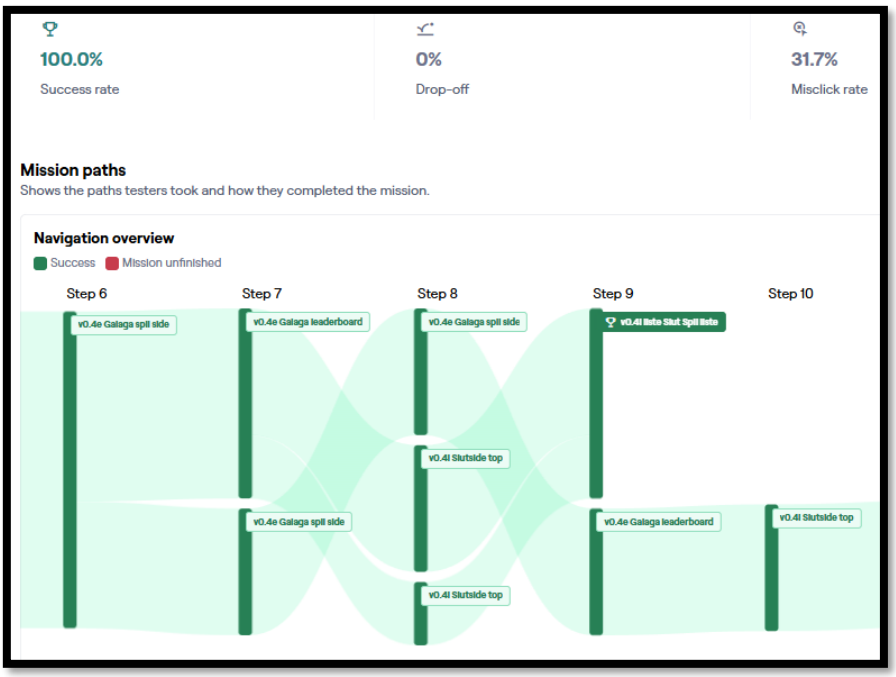

Figure 25: Screenshot of Maze user-test results and user path diagram

As shown above, the user-path diagram reveals that most users finished their assigned task at "step 9", or rather user-interaction #9, ended by having pressed the "START AGAIN" button at the end of the prototype flow. 2 out of 5 users lingered on the leaderboard, interacting with the filter before ending their task at step 13 or 21.

The mis-click rate of 31.7% indicates that while the interface was navigable, certain interactive elements, such as dropdown menus or scrollable areas, were not always intuitively understood.
Combined with written feedback, this suggests the need for further affordance refinements and clearer onboarding cues.

Navigation frictions and task flow

Despite a 100% success rate, user responses revealed moments of hesitation, particularly around game selection and score input. One participant noted difficulty starting a game and receiving feedback from clickable elements. Another offered a deeper critique, suggesting the order of interactions should be reversed: gameplay first, then score input, as a form of "investment behavior", referencing Nir Eyal's "Hooked", 2014, as will be discussed in later section Discussion.

Multiple-choice responses confirmed that locating Battle Squadron and inputting scores were the most common friction points:

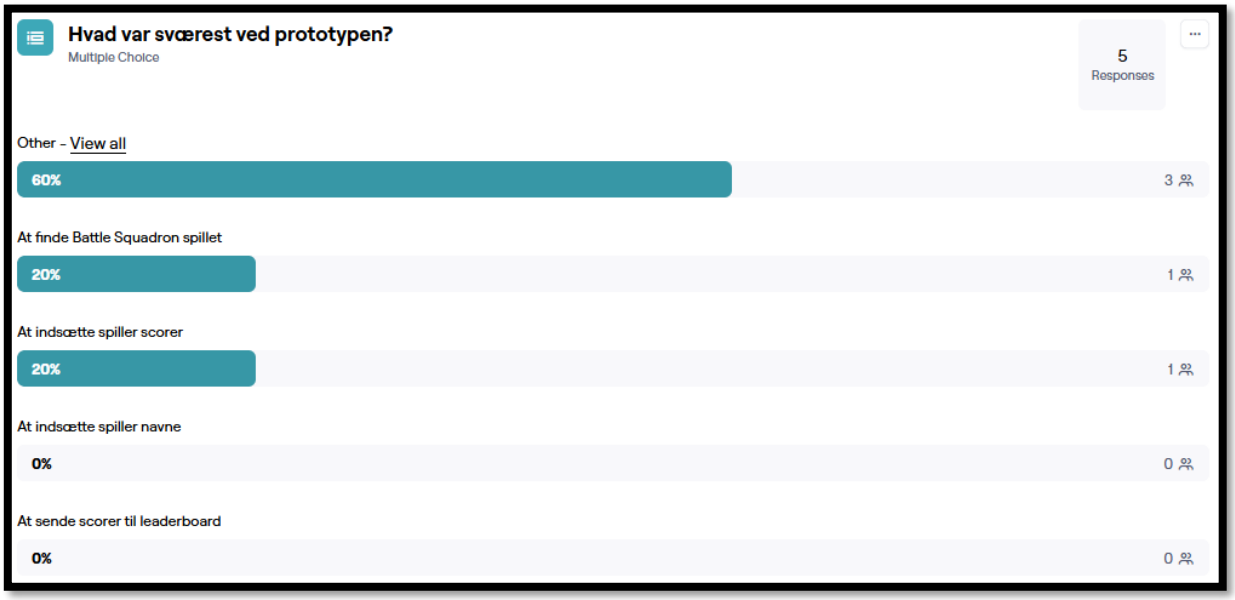

Figure 26: Screenshot of Maze survey multiple choice results

This echoes issues observed during earlier prototype iterations which V0.4's implementation of leaderboard filtering and revised content stacking sought to address.

Engagement and motivation

Participants rated the prototype's ease of use at an average of 3.4 out of 5, reflecting a generally positive, though varied, experience. Two users found the interface very easy (score: 5), while one rated it as difficult (score: 1):

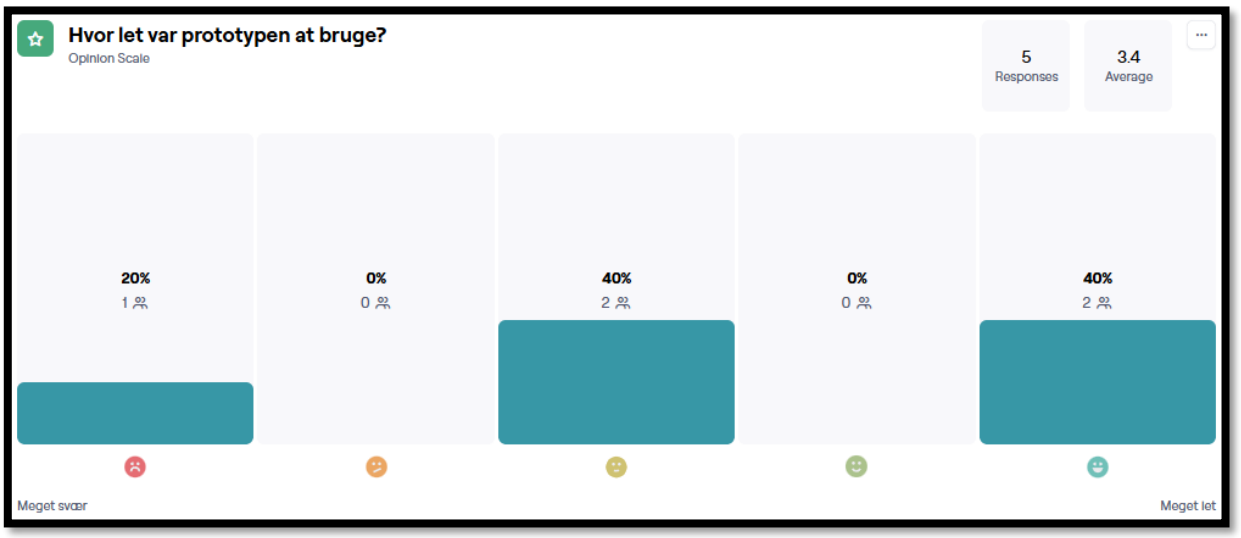

Figure 27: Screenshot of Maze survey Likert-scale results

Qualitative responses ranged from "meget enkel at forstå" to thoughtful critiques of interaction flow.

QR codes and onboarding preferences

Survey responses revealed a surprising ambivalence toward QR-code onboarding. Two participants explicitly stated they would not use either onboarding method, while two expressed indifference.
Only one respondent preferred scanning QR codes placed next to each arcade machine, no one favored the entrance QR scenario.
This distribution supports observations made during the interview with Nanna, who emphasized that QR codes are rarely used without strong facilitation or a clear, contextualized purpose. She highlighted that such digital interventions require introduction through host engagement or clear motivational framing:

> *"It requires some form of facilitation, that someone pointing and saying: over here, you can also do something fun"*
> -Nanna, **APPENDIX K**.

This insight was reflected in participant feedback and Maze observations: when the QR code lacks context, the interaction feels unnecessary or is entirely overlooked.

Evaluation

Evaluation criteria "social interaction", declared in earlier section Prototype, assumed that guests would perceive leaderboard scores as shared amongst other users, the collected data did not provide clear confirmation of this understanding. Survey reflections did not explicitly address user awareness of score visibility or online connectivity. This limits verification of the leaderboard's social communicative function and highlights a gap between intended affordance and user perception. And while Maze-testers described the interface as *"meget enkel at forstå"*, only a few mentioned the experience as "fun" or "engaging" explicitly. This leaves playful engagement under-verified and may reflect the limitations of short-form, remote testing in capturing affective responses to interaction

However, the need for facilitation emerged as a key theme across both user data and stakeholder insights. Nanna emphasized that successful guest engagement often relies on staff prompting, especially in a museum context where visitors are distracted or unfamiliar with digital interventions:

> *"one can put up as many signs as they'd like, but that doesn't necessarily mean people will understand what they're supposed to do"*
> -Nanna, **APPENDIX K**.

This is particularly relevant to Arcadeum's setting, where visual and auditory stimuli can overwhelm subtle cues like signage or QR codes.
These insights support the notion that any leaderboard-based interaction must be presented and supported through staff onboarding or physical material (e.g., "scan to compete" flyers). The strongest justification for the prototype lies in its potential to extend social play through competitive comparison. Nanna emphasized the value of seeing one's name on a leaderboard. Anecdotes from the museum, including a student proudly pointing out their high score, underscore the role of recognition and memory in shaping meaningful engagement:

> *"The ability to compare scores and gain recognition is particularly engaging for children. That's why it works, they see their own performance and feel acknowledged"*
> -Nanna, **APPENDIX K**.

While QR codes alone did not prove sufficient, the leaderboard concept itself was well-received. The ability to compare scores, revisit previous play sessions, or show others one's accomplishments all supports the idea that digital extensions of arcade culture can contribute meaningfully to guest experience, if integrated properly.

Discussion

Theory and gathered knowledge to address research questions

Throughout the project, theory actively informed design decisions. For example: Garrett's UX planes informed interface layout decisions, Norman's concepts shaped visual communication use in user-interface design, and Osterwalder's value proposition design logic directly influenced the sequencing of collaboration with Enigma.
This iterative interplay of theory and practice guided both visual expression and experiential framing, as described in Methodology and methods.

The following table provides an overview of how research questions were addressed throughout the report in summary:

Research question	Key findings
1: How does interaction design encourage engagement with Arcadeum?	Interaction design supports engagement by leveraging clear affordances (e.g., visual signifiers), nostalgic theming, and social motivators like high score recognition. A linear, low-friction flow and responsive feedback made the interaction approachable for users, assumably for a 100% success rate in testing.
2: How does the Arcadeum context influence user motivation?	Guest motivation was shaped heavily by spatial placement, staff presence, and the perceived relevance of the leaderboard to the surrounding arcade environment. Without facilitation or strong signage, even a well-designed interface would struggle to attract use, exemplifying that physical and social context is essential for onboarding.
3: What design choices and contextual elements support or hinder meaningful guest engagement?	Supporting factors included UX design heuristics such as consistent UI layout (Garrett), affordances and signifiers (Norman), and context-sensitive onboarding-visibility. Hindrances, as sourced from user testing feedback, included unclear dropdown interactions, lack of immediate feedback, and generic onboarding posters. Facilitated onboarding by further QR-code-by-machine integration occurs as potential supportive factors in retrospective.

Figure 28: Table of how research questions were addressed throughout project

Application of how research questions were addressed during design, within the development of the prototype, follow Schön's concept of engaging in a "conversation with materials", as major iterations followed "reflection-on-action", drawing from testing insights and user data. the moment-to-moment layout decisions, iconography adjustments, and text clarity choices during design revision,

then, often emerged as "reflection-in-action". Here, 'conversation with materials' occurred both digitally (within Figma) and socially (with stakeholders and testers), producing design responses (Schön, 1983).

Postphenomenological lens

Postphenomenology, as defined by Olesen et al., explores how technologies mediate and co-constitute human experience and engagement with the world, as in their "life-world" (Olesen, Bille, & Riis, 2021).
In this context, the leaderboard becomes part of the visitor's life-world, as in their subjective everyday experience as shaped by cultural and technological environments, modulating behavior by introducing playful, goal-oriented structures into the museum visit environment.
This context reframes what "visitor engagement" entails in of itself, challenging conventional educational UX models often oriented around informational clarity or slow exploration (Clari, Bounia, & Economou, 2012).
To elaborate, the ways by which a digital leaderboard within Arcadeum **could** relate to human guests could be by a variety of human-world relations mediated by technology (Olesen, Bille, & Riis, 2021):
"hermeneutic" relations, as scores are interpreted as representations of quality of ones gameplay experience, or unfortunately as "background" relations in how an onboarding poster becomes "invisible" within the exhibition, perhaps to be made visible by museum hosts as facilitators of onboarding instead of relying on the poster alone.
However, in successful integration, there's an arguable case that engaging use of a digital leaderboard would involve an "Alterity" relation, as guests would experience the leaderboard, as a website on smartphone in their hand, separate from the Arcadeum exhibition environment despite being a technological and aesthetic co-constituent of the exhibition.

A digital leaderboard hereby operates not only as an extension of gameplay, but as a new interface layer within a hybrid physical-digital space.
The leaderboard, in case of successful integration, can hereby be viewed as shaping and being shaped by visitor experience. It becomes a mediating artifact that reconfigures attention, social relations, and orientation in space, especially when linked to QR onboarding and mobile interaction which root it in the physicality of the exhibition.
From a "post-phenomenological" perspective, this hereby implies a mutually shaping relationship of mediation (Olesen, Bille, & Riis, 2021).
The visitor's subjective museum experience is restructured by the affordances of

the leaderboard interface, while the use of the leaderboard is itself co-constructed through situational, bodily, and social factors in Arcadeum.

Onboarding via QR-codes and test limitations

Test results and interviews revealed that the success of QR onboarding depends on more than just technical functionality. Placement, framing, and the visibility of interaction pathways are critical.

While Maze testing produced useful insights, the testing environment, primarily online, digital, and brief, did not fully replicate the social dynamics of Arcadeum. Responders to the Maze usability test and survey were isolated and not necessarily aware of the museum context despite the context preface of the test.
As such, aspects of interaction, e.g. co-located decision-making or social signaling through public score sharing are underrepresented.

Furthermore, existing literature on museum gaming suggests that age, familiarity with digital media, and dynamics of intergenerational play all influence user motivation to onboard onto new experiences (Paliokas & Sylaiou, 2016).
Given Arcadeum's mixed-age audiences, further testing should explore how to accommodate both older visitors with limited digital familiarity and younger audiences expecting seamless smartphone UX.
The limited number of respondents (n=5) further constrains the generalizability of findings. Nevertheless, thematic analysis of open-ended responses reveals several key concerns: visibility of the task path, clarity of action feedback, and the sequence of interaction.
This furtherly reinforces notions of how museum technologies must integrate with the social organization of visitor attention and interaction (Lehn, Heath, & Hindmarsh, 2001).
In Arcadeum, this means that QR codes must be spatially positioned within the visual and motivational flow of gameplay, ideally near the machines themselves rather than in the periphery.

Considering the placement of the poster by the Battle Squadron game, when testing V0.4, the line-of-sight angle made it arguably easy to miss. Findings in museum UX literature emphasize that onboarding interfaces must be embedded in the perceptual ecology of space. This explains how new digital interfaces can't solely rely on onboarding new users via a physical poster placed in the museum exhibition; the human facilitation of museum hosts provides a necessary, guest-adaptive support.

Additionally, in-situ observations and/or interviews at Enigma could've provided necessary situated, embodied, and socially co-located aspects of guest-behavior. This absence was particularly noticeable when trying to answer how shared decision-making, co-engagement between children and parents, and informal facilitation by staff could affect user behavior. See section Conclusions and reflections for further consideration of potential additional methods.

Additional design and technological considerations

Insightful feedback from one participant directly referenced the "Hook" Model, as described by Eyal, suggesting that user motivation might improve if score submission happens after gameplay rather than before.
This logic model reigns from the field of behavioral design: the "investment" phase, where the user performs an effort to gain future value, should ideally follow a rewarding experience (Eyal, 2014).

From a Value Proposition Design perspective, the leaderboard's success hinges on aligning what it offers with what visitors truly value during a museum visit, such as recognition, light competition, or shared memory.
Value proposition design, as described by Osterwalder & Pigneur, focuses on aligning what a system offers with the real-world needs and motivations of its users (Osterwalder & Pigneur, 2010).
The value is not merely in function, recording a score, but emotional and social: seeing one's name on the screen, comparing with friends, and being part of a collective arcade narrative. However, this value only emerges if the interaction is well-timed, minimally effortful, and meaningfully contextualized. In this case, the leaderboard is not a product to be "used," but an experience that reflects the visitor's presence and participation back to them, supporting Enigma's curatorial goal of connecting retro gaming practices to contemporary guest participation.

Beyond usability testing and interface design, future iterations could benefit from client-side data persistence and session tracking. User input (e.g., scores or player names) could be preserved across page views or museum sessions. While such client-side storage is limited in scope (5MB, string-only), it would allow for more dynamic interactions, such as personalized game summaries or returning guest recognition, without requiring backend infrastructure.

As technical opportunities expand, it's also worth considering how augmented reality and gamification frameworks might further support guest engagement. Hammady et al. propose a communication model for AR-enhanced museum visits, emphasizing the importance of feedback loops, embedded narratives, and

layered interpretation (Hammady, Ma, & Temple, 2016).
While this project did not implement AR, their call for interaction that is "visual, game-informed, and emotionally engaging" aligns well with the design intentions of the prototype. Their emphasis on "noise" in user experience, caused by device friction, UI complexity, or spatial mismatch, parallels the issues observed in QR onboarding and static poster placement.

Next steps towards a V0.5

These insights could inform the future development of a V0.5.

Throughout the project, Enigma employees, especially Nanna, played a key role not just as collaborators but as co-facilitators of the guest experience.
This underscores the importance of viewing museums not only as spaces of interaction, but as institutions that mediate experience through human presence. Future development would rely more on participatory design workshops involving front-of-house staff, to further refine the onboarding logic and integration strategy.

And, in designing for "engagement", Yates & Løvlie emphasize how digital intervention ought not dominate the exhibition visually or conceptually, seeking to strike a balance within the "experience blend" (Yates & Løvlie, 2023).
The leaderboard's design must avoid dominating the exhibition visually or conceptually. Instead, it should complement the aesthetic tone of Arcadeum without disrupting immersion. Anticipating disruption in guests' focus of attention could serve to mitigate potential issues in future development.

Conclusion and reflections

Project's contribution and future directions of development

This project explored how interaction design principles and digital technologies can be applied within a museum context to support meaningful guest engagement, using a digital leaderboard prototype for the Arcadeum exhibition at Enigma Museum to abductively generate knowledge.

The main research question, *"How can interaction design principles and interactive technologies be integrated into Arcadeum to foster meaningful guest engagement?"*, was addressed through a research-through-design process combining stakeholder collaboration, iterative prototyping, and user testing.

Key findings include, that Interaction design choices, such as clear signifiers, linear navigation, and nostalgic theming, significantly influenced users' ability to submit scores and explore rankings with minimal friction.
Also, Guest engagement was strongly shaped by context, particularly physical placement, onboarding signage, and social factors such as recognition from peers or staff.
And a digital leaderboard's success depends not only on usability, but on its situatedness within Arcadeum's spatial, institutional, and cultural environment. As such, facilitation by museum staff, thematic alignment, and visibility of digital elements emerged as crucial mediators of engagement.

Methodologically, the project used qualitative interviews, Maze-based usability testing, and design storyboarding. Though the user testing was limited to five participants, the consistency of results, combined with stakeholder insights and theory from existing knowledge in the field, supports credibility of findings.
Future research could seek to validate these conclusions with in-situ testing and a wider participant pool.

Reflecting on the process, constraints such as limited physical access and testing time prompted agile adjustments. Applying Schön's reflective practitioner model, mid-project, the project's approach was shifted toward remote testing and prioritized actionable feedback over generalizability, strengthening pragmatic design decision-making in the prototype.

In applying theory to practice, Norman's affordance theory shaped interactive elements, Marcus and Garrett informed layout and visual language, and Ihde's Postphenomenology sharpened my awareness of the prototype's mediating role.

These theoretical lenses helped bridge speculative and applied perspectives on interaction design.

With a deepened understanding of how playful technologies intersect with public engagement, and how design can foster socially situated experiences, future work could explore richer game-linked experiences (e.g., AR overlays, persistent scoreboards) through co-design workshop sessions with staff and families, or leaderboard integration into broader museum journeys.
The works of this project offer methodological lessons for others seeking to enhance visitor engagement through playful, contextual interaction design.

Considering how successfully integrated technology mediates guest behavior, the leaderboard's design does not neutrally reflect guest behavior, as it subtly encourages competitive behavior and prioritizes certain interaction patterns over others within it's enscribed "script".
Designers, intentionally or not, enscribe their intentions of use, and thereby politics within design, as they design. This underlines the designer's ethical responsibility to critically reflect on what is being made visible, hidden, or valued (Verbeek, 2006).

It's worth considering contemporary critique from scholars such as Trammell, who problematize how Eurocentric play theory, including Huizinga and Caillois, can marginalize non-voluntary or culturally distinct play forms (Trammell, 2023).
While this prototype leans on competitive play, "Agôn", in accordance with Caillois' taxonomy of play (Ham, 2016),
future iterations could explore "paidia", as in more unstructured play associated with improvisation, creativity and carefree fun (Caillois, 2001).
Arguably, this is already integrated for children in Engima's "Teleportalen", an indoors playground situated on the ground floor of the museum (Enigma, 2013).

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List of figures in order of occurrence

Numbering of used figures is not in ascending order, and some numbers are missing due to revision of included figures, while some are used multiple times during the report:

Appendices

material serving to substantiate report arguments

Every appendix listed should be located in the "Appendices" folder neighbouring this report pdf.

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J. Mini-workshop slides
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