Exploring Colour Compositions Like Van Gogh:

Designing an Interactive Learning Experience at the Van Gogh Museum

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2025 August

Van Gogh Museum Amsterdam

TUDelft

Colophon

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22 February 2025 - 28 August 2025

Master Thesis

Integrated Product Design
Faculty of Industrial Design Engineering
Delft University of Technology

In collaboration with Museum Future Lab & The Van Gogh Museum

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Preface

This graduation project was carried out in collaboration with the Van Gogh Museum as the final assignment of the MSc Integrated Product Design programme at TU Delft. It explores how interactive design can help museum visitors experience and reflect on Van Gogh's use of colour, combining tangible and digital elements into a meaningful learning journey. For me, this project has always felt like, as I often say, a "dream coming true." I have long had a passion for museums and museum visits, and it was both a valuable professional experience and a very new type of challenge as a design student.

Throughout the project I was able to apply a wide range of skills and knowledge gained during two years of study at TU Delft, which made it a fitting culmination of my education. It also deepened my understanding of design as a discipline: even though our programme tracks differ, design knowledge is interconnected and ultimately converges into integrated outcomes. Working at the museum itself was an inspiring and formative experience—being in such a creative and culturally rich environment, surrounded by colleagues whose passion for art and the humanities was evident, made this journey not only educational but also profoundly motivating.

I would like to express my sincere gratitude to many people who made this project possible. First, to my academic mentors Jeff and Arnold, for their guidance, their advice on design methods, and for giving me confidence at crucial moments. To Harma and Lisa at the Van Gogh Museum, who not only accepted my initial proposal but also created the conditions for this project to take place—organising logistics, providing workspace, and even granting me the opportunity to test with real museum visitors, which was truly remarkable. Their critical perspectives and professional expertise, balanced with encouraging and inspirational feedback, have been a constant source of insight. I am also grateful to the colleagues in at VGM, for their warm conversations and for generously sharing their expertise, which has enriched my understanding and inspired me greatly. I also thank all the participants, whose contributions were indispensable. Finally, my heartfelt thanks go to my friends and family for their continuous support throughout this project and my entire Master's journey, especially my grandfather and my parents: as I wrote during my Bachelor's thesis, I am deeply grateful for your unconditional support of my choices. I could not have become who I am today without you.

Please enjoy reading!

Terminology

VGM (The Van Gogh Museum)
The museum in Amsterdam collaborating on this project.

TUD (Delft University of Technology)
The university where this graduation project was conducted.

IDE (Faculty of Industrial Design Engineering)
The faculty at TU Delft offering three Master's programmes in design.

IPD (Integrated Product Design)
MSc programme at TU Delft focusing on designing innovative and user-centred products.

DFI (Design for Interaction)
MSc programme at TU Delft focusing on interaction and experience design.

SPD (Strategic Product Design)
MSc programme at TU Delft focusing on product strategy and business-oriented design.

RtD (Research-through-Design)
A research approach where knowledge is generated through iterative cycles of designing and evaluating artefacts.

Colour strategies
Van Gogh's ways of using and combining colours, including contrast colourss, variations within one single hue, mixing paints to create dull colour and using colour combinitions to express feelings.

Wool story
Van Gogh's practice of experimenting with coloured wool threads to explore and test colour combinations before using real expensive paints.

Executive Summary

This graduation project, conducted in collaboration with the Van Gogh Museum, explored how interactive design can make Vincent van Gogh's colour strategies more tangible and accessible. Van Gogh's vibrant use of colour often leaves a strong impression, yet the principles behind it remain abstract to many visitors. The museum sought an installation that could inspire, surprise, and encourage reflection, while relying on hands-on rather than text-heavy explanation.

The project began with a basic goal: to design an interactive prototype that allows visitors to experience, understand, and utilise Van Gogh's colour theories and stories. Through literature review, contextmapping, and user research, this was later reframed into a guiding design goal: to create an inviting and easy interaction, where visitors can quickly experiment with colours, feel engaged and curious, and take away reflective insights into Van Gogh's choices without pressure or complexity.

Following a Research-through-Design framework structured by the Double Diamond, the process moved from exploration to ideation and prototyping. In the Discover and Define phases, user studies with multiple prototypes revealed preferences for intuitive, multisensory interactions. In the Develop phase, individual ideation and a co-creation workshop produced a broad set of ideas, later narrowed with museum staff into three concepts. The concept Choosing Colours like Van Gogh, based on Van Gogh's wool-thread experiments with colour combinations, was selected for final development.

The Deliver phase translated this into a high-fidelity prototype: a physical colour wheel with tokens linked to a digital wool ball and painting projection. Visitors moved tokens to test palettes and pressed a button to reveal the updated painting, echoing Van Gogh's experimental process. User testing at the museum confirmed strong engagement, surprise, and intuitiveness, though educational clarity was mixed and interaction times suggested possible congestion.

Evaluated against six criteria—engaging, surprising, intuitive, educational, thought-provoking, and practical—the design performed strongly on the first three and partially on the others. From a design-thinking perspective, it demonstrated desirability, feasibility, and viability.

In conclusion, the project delivers both a feasible exhibition concept and insights into how tangible–digital interaction can communicate artistic strategies. Recommendations for future development include optimising placement within the visitor journey, extending to more paintings, adding guiding prompts, and conducting larger-scale gallery testing.

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Chapter 1

Introduction

1.1 Project Brief

1.1.1 Assignment from VGM

One of the ambitions of the Van Gogh Museum is to inspire a diverse audience with the life and work of Vincent van Gogh, and colour is one way to achieve this — an approach that also forms part of a broader initiative to enrich the permanent collection through interactive installations. While Van Gogh's vibrant colours often leave a strong impression, the strategies behind his way of using colours remain abstract to most visitors.

The project assignment from the Van Gogh Museum is to translate Van Gogh's colour usage strategies into a hands-on, interactive experience that allows visitors to experiment with colours themselves. The installation should be multi-sensory and curiosity-driven, fostering surprise, inspiration, and reflection, while relying minimally on text to encourage learning through doing rather than reading or watching. It must also operate independently, without requiring staff guidance or causing congestion in the exhibition space.

1.1.2 Design Goal Defined

After initial discussion and reflection, my interpretation of the design assignment wwas defined:

[Design an interactive prototype to experience, understand and utillise the theories and stories of colours reflected in Van Gogh's works for visitors in the Van Gogh Museum.]

This project presents the opportunity to explore how digital and tactile interactions can make abstract artistic principles more tangible. By allowing visitors to experiment with colours, the design can foster inspiration, surprise, and reflection—key experiential goals defined by the museum.

However, the installation must also respond to practical constraints within the museum environment, including high visitor traffic, minimal supervision, and the need to avoid queues or congestion. The challenge lies in designing an interaction that is both educational and fluid, encouraging meaningful engagement without slowing the overall visitor flow.

1.2 Project Approach

To address the assignment, Research-through-Design (RtD) is applied as the overall process framework, starting from contextual exploration to iterative prototyping and user evaluation. As defined by Frayling (1993) and expanded by Koskinen et al. (2011), RtD integrates inquiry and creation in an iterative cycle, using design activities as a means to generate and refine knowledge in context.

Key methods include:

1.2.1 Double Diamond

Figure 1: Illustration of the Double Diamond method
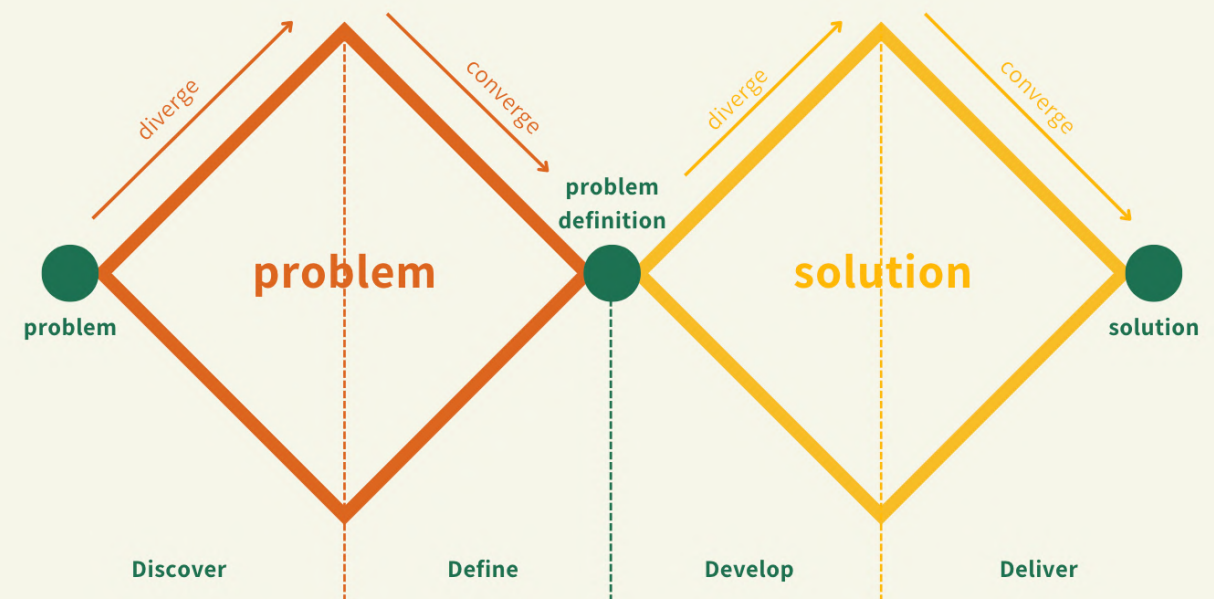
To structure the design process in a manageable and iterative way, the Double Diamond model (Design Council, 2005) provided a clear framework for diverging and converging phases. It guided the overall flow of the project from exploration (Discover, Define) to development (Develop, Deliver), helping identify opportunities before moving toward solutions.

1.2.2 Literature Review

To support the design process, literature was reviewed across several relevant areas. These included multisensory design, exhibitions and experience design; colour education and interactive systems involving colour; the psychological and physiological effects of colour; and museum experience and exhibition design. In addition, materials on Van Gogh's work, especially his use of colour, and museum visitor behaviour were consulted to contextualise the project within both artistic and experiential frameworks.

1.2.3 Contextmapping Research Method

To uncover latent user needs and emotional associations around colour, contextmapping offered access to users' unspoken experiences (Sleeswijk Visser et al., 2005). In this project, participants were sensitised and engaged in reflective exercises to gather qualitative insights, which helped define interaction directions that felt intuitive and personally meaningful.

1.2.4 Co-creation and Ideation

This phase combined individual ideation with a co-creation workshop to generate diverse concepts. The workshop drew on generative design techniques described in Convivial Toolbox (Sanders & Stappers, 2012), encouraging participants to collaboratively reinterpret Van Gogh's colour strategies into design concepts. Together, these approaches expanded the solution space while grounding ideas in user perspectives.

1.2.5 Prototyping and User Testing

The final concept was translated into a high-fidelity prototype, integrating both physical and digital components. Prototyping and testing are central to RtD (Zimmerman et al., 2007), serving not only as a way to validate the design but also as a means of generating knowledge. The prototype was evaluated through on-site user testing with museum visitors, combining qualitative insights with quantitative ratings to assess engagement, clarity, and educational value in the museum context.

Figure 2 (right): Picture of Uset testing setup at the museum

Chapter 2

Discover

2.1 Vincent van Gogh & Van Gogh Museum

Vincent van Gogh (1853–1890) is widely regarded as one of the most influential figures in Western art history. His bold use of colour, emotive brushwork, and deeply expressive subjects have had a lasting impact on modern art (Department of European Paintings, 2010). Today, Van Gogh is celebrated not only for his artistic innovations but also for his intense personal vision and turbulent life story, which continues to resonate with audiences around the world.

The Van Gogh Museum in Amsterdam, opened in 1973, holds the world's largest collection of his works, including over 200 paintings, more than 500 drawings, and around 700 letters. The museum is dedicated to presenting Van Gogh's artistic development and making his life and work accessible to a broad audience through exhibitions, research, and education (Van Gogh Museum, 2024).

2.2 VGM Context and Design Implications

The Van Gogh Museum's mission, vision, and core values form a key framework for this project. As stated in its Strategic Plan 2025–2028, the museum's mission is "to inspire a diverse audience with the life and work of Vincent van Gogh and his time". Its vision emphasises openness, innovation, and connection, seeing the museum as a meeting place where dialogue happens and the collection gains new meaning. For this project, they inform the intended design tone and positioning, ensuring alignment with the museum's identity and commitment to meaningful, human-centred experiences.

What's more, discussions with museum employees indicated that a current objective is to strengthen the on-site emotional impact on visitors, with an emphasis on creating moments of surprise, inspiration, and reflection. The museum aims to achieve this through deeper engagement with Van Gogh's personal story, multi-sensory interactions, and opportunities for self-expression. These ambitions have informed and inspired the project's design direction.

2.3 Main Target User Group

Before any research or design process begins, it is essential to identify the main target user group to ensure the project addresses their specific needs, expectations, and engagement patterns.

2.3.1 Target Visitor Groups of VGM

The Van Gogh Museum already identifies six target groups among all of their visitors, based on cultural behaviour and lifestyle segmentation. Following discussions with the museum, this project primarily targets one of the 6 visitor groups: *Urban Omnivores*. This segment was chosen due to their high long-term potential and cultural influence—they represent the future core of museum engagement.

2.3.2 "Urban Omnivores"

According to the museum's internal definitions, Urban Omnivores are young, active city dwellers (aging 25–44) who lead fast-paced lives and seek emotionally engaging, novel experiences. They have broad cultural interests—attending concerts, exhibitions, and festivals. This group appreciates visual richness, social interaction, and creativity. Experiences that connect with feelings, imagination, and self-expression are particularly appealing. Their museum behaviour suggests high potential but also high expectations—experiences must feel original, surprising, and worth their time.

This project decides to directly adopt the VGM-defined target groups, as they better reflect the museum's context and allow the design process to proceed efficiently without investing additional effort in audience redefinition.

Figure 3: Persona illustration of the visitor group "Urban Omnivores" (Van Gogh Museum, 2022)

2.4 Desk Research: Vincent's Colours

Understanding how Van Gogh used colours is a crucial step in translating his artistic approach into the design, therefore a thorough research on his colour strategies was conducted.

Van Gogh learned to use colours gradually: first through classical techniques, then by studying the works of Delacroix, Japanese prints, and the Impressionists. Over time, colour became central to how he expressed mood and meaning in his work (Van Gogh Museum, n.d.).

Eventually, Van Gogh's use of colours was not bound to one fixed system, but rather grounded in colour wheel principles which he applied in multiple expressive ways. His colour strategies served emotional and narrative purposes, and can be summarised as:

1. Contrasting colours: To intensify both emotional tension and visual vibrancy
2. Variations within a single hue: To create subtle harmony and depth
3. Mixing paints for dull colours: To direct focus and control emotional tone
4. Using colour deliberately to evoke specific emotions or atmosphere (e.g., comfort, unease, warmth)

These different strategies helped him guide how viewers feel and interpret each scene of painting.

Figure 4 (left): Vincent van Gogh, Irises (1889), Van Gogh Museum – example of using contrast colours.

Figure 5 (right): Vincent van Gogh, Sunflowers (1889), Van Gogh Museum – example of using variations within one single colour hue.

Figure 6 (left): Vincent van Gogh, The Bedroom (1888), Van Gogh Museum – example of using colours to express calm emotions.

Figure 7 (right): Vincent van Gogh, The Potato Eaters (1885), Van Gogh Museum – example of mixing paints to create dull colours.

2.5 Literature Review Insights

As mentioned in Section 1.2.1, the literature review began naturally with sources on museum and exhibition design. Many of the papers and case studies encountered in this phase addressed topics such as exhibition circulation design, visitor experience design, or experiences built around specific technologies like AR/VR. While informative, these topics were considered too high level, yielding insights similar to those in Sections 2.2 and 2.3, and offering limited direct applicability for the next stages of this project. To arrive at more actionable, low-level insights, the scope was refined by selecting two areas for deeper analysis. First, multisensory experience design, which appears frequently in existing museum cases and is also an explicit requirement in the VGM assignment. Second, literature on colour perception and interaction, which is essential for developing targeted, interactive design strategies for this project. These two themes are discussed in more detail below.

2.5.1 Multisensory Experience Design

Combining colour (visual) with other sensory modalities shows strong potential in museum experiences. Studies suggest that multisensory cues can deepen emotional engagement, aid memory, and enhance immersion (Obrist et al., 2017; Guo et al., 2023). Scent, sound, and touch have been successfully used to personalise or contextualise artworks (Not & Petrelli, 2018; Bérubé, 2022).

However, vision—being the dominant and easily processed modality—is often used to explain or represent less accessible senses. For example, colours can help visualise fragrances, but this is mediated largely by shared emotional associations rather than literal translation (Schifferstein & Tanudjaja, 2004). Using other senses to interpret or explain visual elements like colour may be less intuitive, presenting a design challenge when reversing the usual sensory hierarchy.

2.5.2 Understand Colour Perception and Interaction

Research shows that interacting with colour involves both emotional associations and cognitive processing. The "Emotional Colour in Visualisation" theory suggests colour is a subconscious entry point into interaction, influencing mood and guiding perception in UX contexts (Ouyang, 2021). Ucelli et al. (2005) demonstrate that interactive colour-based tools—such as AR-enabled books—support exploratory, reflective learning in children by enhancing attention and engagement.

Meanwhile, broader studies show universal tendencies in colour-emotion links (e.g., blue as calming, red as arousing), while also noting variations shaped by context and culture (Zhang, 2021). Crossmodal research further indicates that people associate certain colours with tactile features (e.g., red = intense/warm,
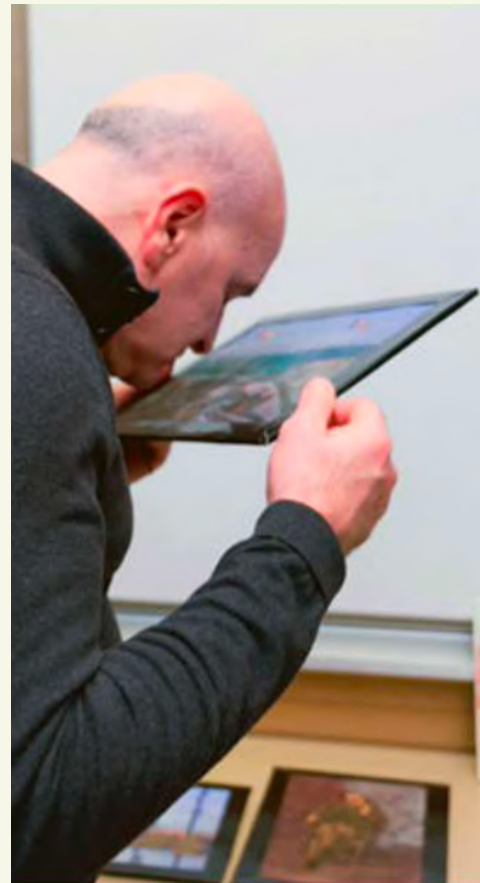
blue = cold), highlighting embodied mechanisms of colour understanding (Lin et al., 2021).

These insights highlight the potential of using colour not only as a visual design element, but also as a multisensory and emotionally resonant tool to deepen visitor engagement and support reflective interaction.

2.6 Benchmarking

To further explore diverse approaches to interaction in cultural spaces, several references were reviewed.

To begin with, at the Van Gogh Museum, a small corner invites visitors to interact with a textured replica of Sunflowers, smell a floral scent, and touch a real vase. This add to the multisensory experience of visitors.

The MET (The Metropolitan Museum of Art) 's Multisensory Met explores inclusive interaction by pairing selected artworks with scent diffusers, soundscapes,

and raised-line drawings, intended to support blind or low-vision visitors (The Metropolitan Museum of Art, 2015). While the sensory elements are rich, the experiences function more as individual prompts than a cohesive narrative.

Museo Tiflológico in Madrid focuses entirely on tactile interaction for blind visitors, including scale models of monuments, embossed paintings, and 3D objects, offering a fully touch-based experience (Museo Tiflológico, n.d.).

Ultraviolet by Paul Pairet choreographs each course of a meal with full-room projections, scent, sound, and table lighting, turning dining into a tightly timed, immersive narrative—demonstrating how sensory alignment can create emotional impact (Pairet, n.d.).

All these examples broaden the understanding of how interaction can be designed in spaces, extending beyond conventional touchscreens to include tactile objects, immersive lighting and soundscapes, scent-painting combinations, and other sensory integrations. This variety of approaches has provided valuable inspiration for the next stage of the project's Define phase, particularly in designing the explorative research to test diverse interaction possibilities.

2.7 Conclusions – Discover

2.7.1 Insights & Implications

The Discover phase broadened the perspective on how interaction with colours can be designed in museum contexts, highlighting possibilities beyond conventional touchscreens. Insights from literature and benchmarking pointed to the potential of integrating *playful tangible elements, emotional experience, and multisensory combinitions* to enhance engagement. These findings set the focus for the next phase on exploring how different interaction types can shape visitors' experiences of colour, and on identifying which approaches align best with the museum's experiential goals.

2.7.2 Project Limitations

As a graduation project, the scope and scale of implementation are inherently constrained by time, resources, and the capacity of a single designer. While the Discover phase identified a wide range of interaction possibilities—including complex multisensory installations and large-scale spatial interventions—many of these exceed what can feasibly be developed and tested within this context. Subsequent phases will therefore prioritise approaches that can be prototyped at a smaller scale while still offering meaningful insights for the museum's future initiatives.

Figure 12 (right): Full setup of the multisensory corner at VGM

Chapter 3

Define

3.1 User Research Protocol

3.1.1 Research Background

Following the insights and implications from Discover phase, this project narrowed its research focus to the interaction process itself—specifically, *how users experience and engage with colours across different mediums at museum*.

Rather than immediately introducing colour theories and stories, this study begins with a focus on interaction preferences in order to isolate and understand the influence of different formats on user engagement. Involving colour narratives at this stage could bias responses towards content familiarity or personal associations, making it harder to assess the intrinsic qualities of each interaction type.

The identified research gap lies in the limited exploration of how different interaction formats—such as tactile tools, digital media, or other sensory pairings—affect users' direct experience of colour. Most existing studies focus on single modalities, like AR-based colour learning (Ucelli et al., 2005), without comparing alternatives. Therefore, this study addresses this gap through a qualitative, exploratory approach. By examining user preferences and perceptions across multiple interaction types, aiming to generate insights that can inform future strategies for colour-based interactive experiences.

3.1.2 Research Goals & Questions

This study seeks to:

- Explore how users perceive and engage with different colour interaction methods in a museum context.
- Identify the needs and expectations of the target group for colour-based interactions.
- Determine design characteristics that are most promising for further development, and identify potential usability challenges to refine future interaction methods.

The research questions are:

1. How do users perceive and engage with colours across the different prototypes?

2. In what ways do different colour interaction formats influence the overall user experience?

3. Which design features are perceived as most effective and promising for future colour-based interactive experiences?

3.1.3 Research Methodology

Study Design

- Exploratory User Study: This research adopts an exploratory approach using multiple interactive prototypes.
- Mixed Methods Approach: A combination of qualitative methods (interviews, observations) and quantitative analysis (Likert survey ratings) will be employed to gather comprehensive insights.
- Within-Subject Design: Each participant will interact with all prototypes and compare their experiences to identify preferences and usability differences.

Materials & Prototypes

To design the prototype set, a broad range of concepts was first generated based on insights from Section 2.7.1, ranging from plain textual tools to contextual multisensory setups and generative sessions (see Figure 13). This collection was gradually narrowed by applying practical criteria such as portability, clarity, and ease of mock-up; for example, concepts requiring large-scale installations or intensive facilitation were excluded.
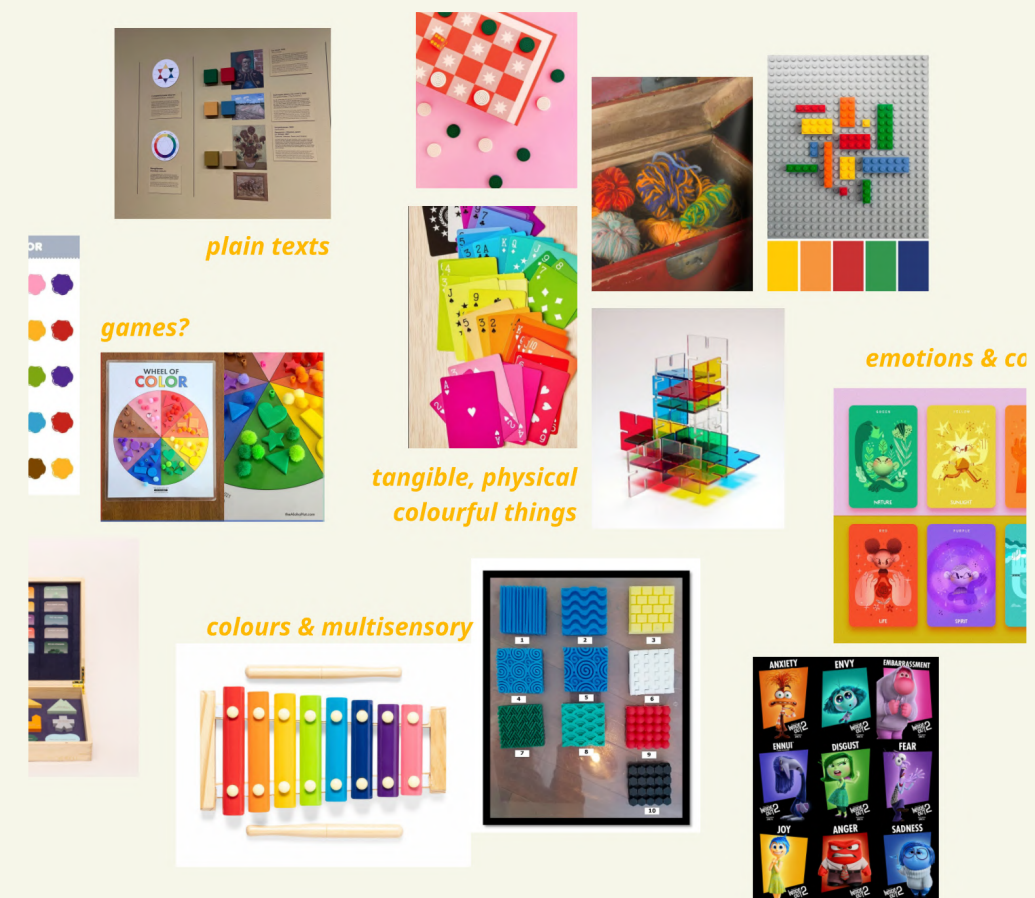

Figure 13: Overview of the broad range of possible concepts involving colours

plain texts

games?

emotions & co

tangible, physical colourful things

colours & multisensory

The remaining ideas were developed into six prototypes covering four key themes in colour interaction. A preliminary pilot study (see Appendix B for details) tested these prototypes for feasibility and user response. Based on the findings, the set was refined to four final prototypes for the main study, focusing on only three themes:

- Digital vs. tangible interaction
- Multisensory engagement vs. visual-only perception
- The desirability of freedom and creativity in user engagement

Prototype 1: Paper and Colour Pens

Addressing the theme of freedom and creativity, participants are given a double-sided sheet: one side is blank for free drawing, while the other contains a Sunflower-inspired outline that can be filled with colour. This prototype is designed to explore the desirability of freedom and creativity in user engagement with colours.

Prototype 2: Digital Painting-Based Colour–Sound Blocks

Focusing on multisensory engagement, a painting is presented alongside a deconstructed musical score that reflects its colour composition. Participants can click on colour blocks to play corresponding instrument tracks, allowing them to recompose the painting as a layered sound experience. This prototype explores how colour can be interpreted through multisensory translation and contextual meaning, while also serving as a digital counterpart in the digital vs. tangible comparison.

Prototype 3: Tactile Textures

Exploring tangible interaction, each colour is represented by a distinct 3D-printed texture, allowing users to explore colours purely through touch. This prototype tests whether colour impressions can be meaningfully conveyed through non-visual, tactile interaction.

Prototype 4: Tangible Colour Objects

Linked to the theme of freedom and creativity in tangible interaction, participants interact with various physical colour elements—including LEGO bricks, puzzle blocks, and wool balls—by building, arranging, and combining them. This prototype aims to explore how hands-on, playful construction supports user creativity and freedom and engagement in colour interaction.

Figure 14: Overview of all four prototypes

Prototype 4
Prototype 3
Prototype 1
Prototype 2

Location & Participants

This formal study involved 12 participants recruited on-site at the Van Gogh Museum's café area.

Recruitment primarily targeted visitors aged 25–44 who broadly align with the Urban Omnivore profile—culturally curious, socially active individuals open to interactive experiences. The researcher approached visitors who appeared to fit this description while they were taking a break, briefly introducing the study and inviting them to participate. After consent, participants were asked to answer short background questions to identify their visitor group. Diversity in age, gender, nationality and professional background was considered to capture a broad range of user perspectives.

Ethics

The study has been submitted for ethical approval from the Human Research Ethics Committee (HREC) of Delft University of Technology. All participants provided informed consent prior to participation, and all data collected were anonymised and used exclusively for research purposes.

Procedures

The study was conducted in one-on-one sessions of approximately 15–20 minutes per participant. Several modifications were made following the pilot study (see Appendix B for details). The final procedure comprised the following steps:

Step 1. Introduction & Consent:
Each session began with a brief explanation of the study's purpose and structure. Participants were then asked to read and sign an informed consent form, in line with ethical research practices.

Step 2. Background Questions:
To identify the participant's visitor group, a brief set of background questions was asked (e.g., hobbies and typical leisure activities). Participants were asked to reflect on their previous museum experiences and to share memorable impressions to contextualise the following tasks. They were asked to select adjectives from a vocabulary list—including positive, neutral, and negative terms—to describe each participant's ideal interactive museum experience (see Appendix C for materials).

Step 3. Interaction with Prototypes:
Participants were given the task of reinterpreting or recreating a Van Gogh painting using a selected prototype, and they were asked to interact with all prototypes in an order of their choice, verbalising their thoughts, feelings, and reactions throughout at the same time.

The researcher provided minimal guidance when necessary to avoid confusion while observing natural responses, such as mentioning the task again or suggesting the use certain approaches. This stage aimed to sensitise participants to different interaction mock-ups and uncover deeper preferences and needs.

Step 4. Survey & Interview:
After interacting, participants revisited the same vocabulary list - this time circling adjectives for each prototype separately - to help them articulate their impressions and reflect on differences across experiences.

They are then asked to complete a Likert-scale questionnaire rating each prototype across four dimensions: element of surprise, engagement, intuitiveness, and ease of use. These four criteria were selected to align with the design goals defined in Section 1.1.2 and with commonly recognised qualities of effective interactive design, while also serving to prompt participants to verbalise their experiences. (See Appendix C for details).

A short semi-structured interview followed to explore reasons behind their choices, any challenges encountered, and moments they found particularly meaningful or enjoyable.

Limitations

There are a couple of unavoidable limitations in the research design:

– Risk of participants not being "urban omnivores":
Due to the design and contextual constraints of the museum setting, it was difficult to fully confirm a visitor's type before inviting them to participate. This issue was left to be addressed during data processing, for example by placing more emphasis on responses from the target group where relevant.

– Language barriers:
These could not be fully avoided and may have affected participants' ability to fully express their thoughts.

– Environmental distractions:
Conducting the study in the museum café area introduced background noise and movement, which may have influenced participants' focus and engagement.

3.2 Data Analysis Plan

3.2.1 Data Categories

The study generated both qualitative and quantitative data, which were categorised as follows:

Qualitative data:
- Keywords selected by participants to describe a memorable museum experience
- Keywords selected to describe each prototype after testing
- Observed interaction sequences (order in which prototypes were used)
- Think-aloud comments and transcripts from interviews and observations

Quantitative data:
- Likert-scale ratings for each prototype on four dimensions: engagement, intuitiveness, ease of use, and element of surprise

3.2.2 Data Processing Methods

The following methods were used to process and interpret the data collected:

Statement Cards Analysis

The primary method of qualitative analysis was based on the "statement card" approach, a commonly used technique in user research for extracting and clustering user insights from open-ended responses (Sanders & Stappers, 2012). It involves breaking down user expressions into discrete statements that reflect observations, preferences, needs, or frustrations.

In this study, the think-aloud recordings and interview transcripts from each participant were examined line by line. Statements that revealed distinct attitudes, concerns, or preferences toward colour interaction were extracted.

This method was crucial not only for evaluating prototype-specific feedback but also for uncovering deeper insights into how users perceive and engage with colour through interaction.

> **The statement concluded from quotes.**
>
> " quotes from the participant
>
> Participant X

> **Tangible objects are definitely more intuitive than screens.**
>
> " definitely feel like the objects or things are more intuitive than screens too.
>
> P2

Figure 16: An example of a statement card

Word Cloud

A word cloud is a graphical representation of word frequency in text data, with more frequent words shown larger (Kirk, 2021).

Two sets of word clouds were generated to visualise vocabulary patterns: one based on participants' keywords describing their ideal museum experience, and another capturing adjectives selected for each prototype after testing. These visualisations offered an accessible overview of common descriptors and emotional tones associated with each prototype.

Although word clouds are limited to surface-level sentiment and lack contextual depth, they serve as a complementary tool to support and triangulate the findings derived from the statement card analysis.

Radar Charts

A radar chart displays multivariate data using multiple quantitative variables arranged as axes radiating from a central point (Porter & Niksiar, 2018). For each prototype, a radar chart was created to represent aggregated participant ratings across four evaluation dimensions: engagement, intuitiveness, ease of use, and element of surprise. These visualisations enabled quick horizontal comparisons between prototypes.

However, as these dimensions were predefined and focused only on surface-level usability and affective response, the radar charts are more limited in depth than the qualitative methods. They served primarily as a supplementary tool to contextualise and validate patterns observed in qualitative insights.

3.3 Results

3.3.1 Final Recruitments & Data Merging

Data were collected from a total of 20 participants, including 12 recruited on-site at the Van Gogh Museum and 8 from the pilot study conducted at TU Delft. Among the on-site participants, 7 matched the "urban omnivore" target profile, while the remaining 5 belonged to other visitor groups (not specified here due to museum confidentiality regulations). These 5 participants exhibited key similarities to the "urban omnivore" group, such as frequent museum visits, openness to interactive experiences, and interest in exploring diverse cultural content. Given these overlapping characteristics—and to ensure sufficient sample size for trend analysis—they were included in the same dataset as the target group.

Although the pilot study at TU Delft was originally conducted to refine the prototypes, the main procedures, materials, and task instructions were kept identical to those in the formal study at the Van Gogh Museum. Given the comparable testing conditions and the lack of notable differences in participant behaviour or feedback between the two settings (See Appendix D for raw data from both studies), the datasets were merged for analysis. This approach also ensured a sufficient sample size for identifying trends among the target visitor profile.

Following this approach, the final combined sample consisted of 14 participants classified as "urban omnivores" and 6 participants from other visitor segments. While merging datasets from different settings may introduce minor variation due to contextual differences, these were considered unlikely to meaningfully influence the overall findings.

3.3.2 General Museum Experience Overview

As shown in Figure 17, participants most frequently described ideal museum experiences as *interesting*, *immersive*, *surprising*, *intuitive*, and *informative*, shown by their larger word sizes. Less frequent terms like *slow* or *moderate* indicate minority views. This visual contrast suggests strong consensus toward emotionally engaging, cognitively accessible museum interactions.

The colour differences in the word cloud are for visual distinction only and do not represent any particular meaning.

3.3.3 Prototype-Level Analysis

Word Clouds & Radar Charts

By combining word cloud visualisations with radar chart ratings, participants' impressions of the four prototypes were analysed across both qualitative descriptors and quantitative evaluation dimensions.

The colour differences in all visuals in this chapter are for visual distinction only and do not represent any particular meaning.

Figure 18:
Word clouds
& radar chart
describing
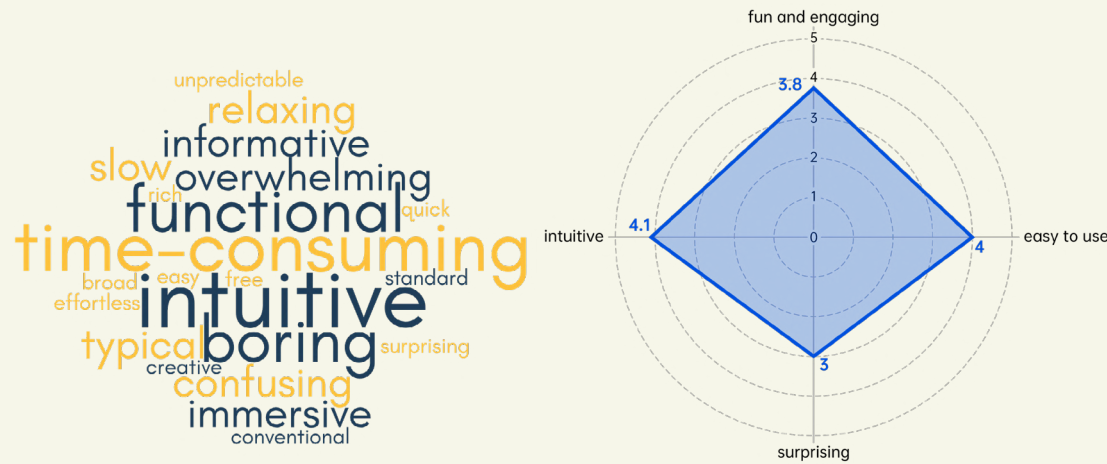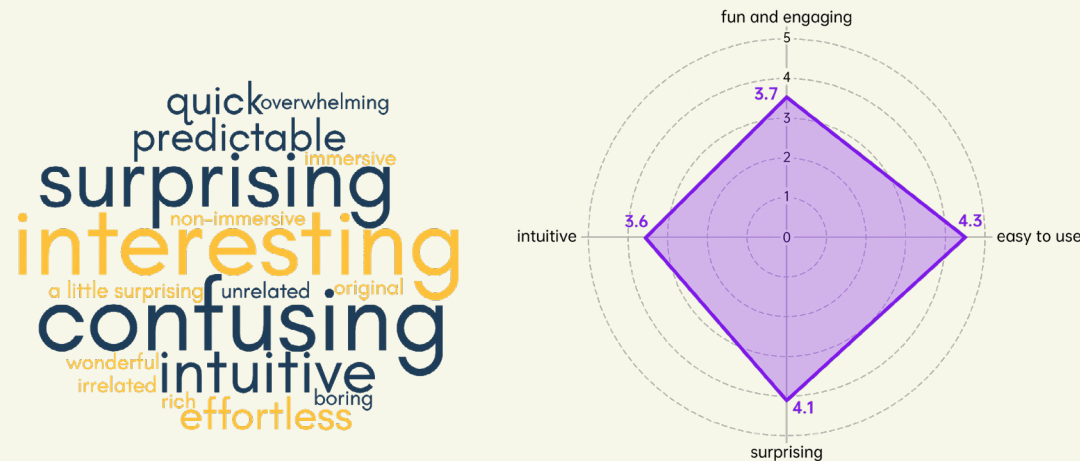Prototype
1 (Pen and
Colour Pens)

Figure 20:
Word clouds
& radar chart
describing
Prototype
3 (Tactile
Textures)

Figure 19:
Word clouds
& radar chart
describing
Prototype
2 (Digital
Painting-
Based
Colour–Sound
Blocks)
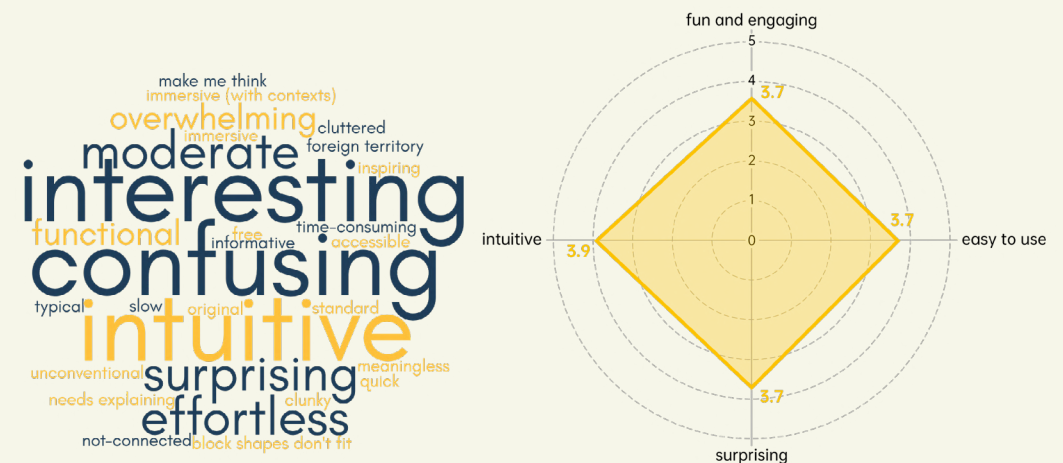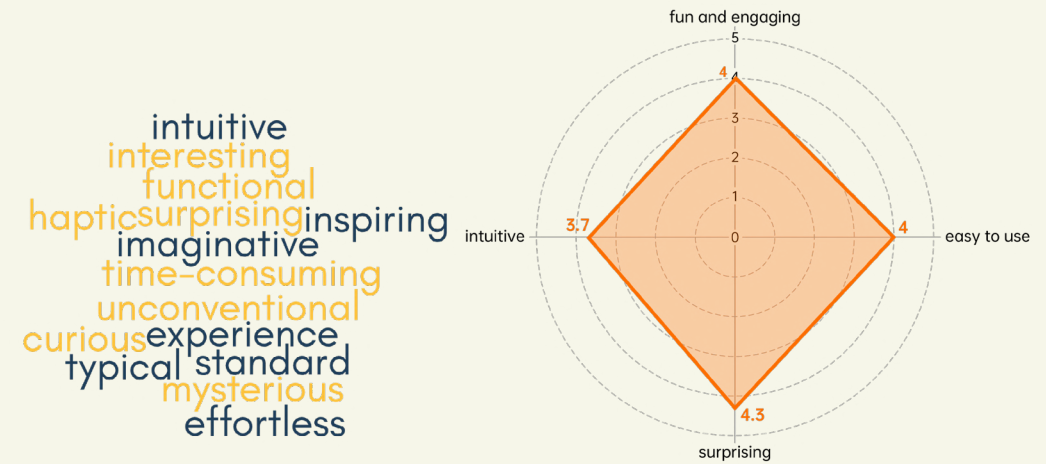
Figure 21:
Word clouds
& radar chart
describing
Prototype
4 (Tangible
Colour
Objects)

Prototype 1 (Paper and Colour Pens) showed mixed impressions. While *intuitive* and *immersive* were mentioned, *time-consuming*, *boring*, and *confusing* dominated. This suggests that although users valued the creative freedom of drawing, the open-ended format lacked clarity and efficiency, making it less suitable for quick, intuitive engagement. The radar chart confirmed this: intuitiveness was rated relatively high (3.7), but fun and engaging (3.8) was moderate, and ease of use was lower compared to other prototypes.

Prototype 2 (Digital Painting-Based Colour–Sound Blocks) elicited strongly positive responses such as *surprising*, *interesting*, and *intuitive*, though *confusing* also appeared. The strong engagement outweighed its initial complexity, making it valuable for further exploration. This was reinforced by the highest ease-of-use score (4.3), suggesting clarity and accessibility once users understood the logic.

Prototype 3 (Tactile Textures) generated widely varied impressions, with terms like *intuitive*, *inspiring*, *haptic*, *curious*, and *imaginative* pointing to strong sensory appeal, while *time-consuming*, *standard*, and *typical* raised concerns about practicality. The radar chart highlighted its strengths: it scored highest for surprising (4.3) and fun and engaging (4.0), showing clear experiential advantages despite mixed practicality.

Prototype 4 (Tangible Colour Objects) received highly polarised feedback. Words such as *interesting*, *confusing*, *intuitive*, and *overwhelming* reflected divided opinions: many were intrigued, but unclear layout and mismatched objects limited usability. Ratings showed intuitiveness slightly leading (3.6), but other dimensions lagging, reflecting the ambivalence seen in the qualitative responses.

Observations on Interaction Order

The interaction order was recorded primarily through direct observation, capturing which prototypes participants approached first and in subsequent choices. Prototype 1 (chosen first by 7 participants) and Prototype 2 (first by 5 participants) showed the highest initial appeal. Prototype 3 gained prominence as a second choice with 8 participants. Prototype 4 appeared more often in later choices, with 5 participants selecting it as their third choice and 7 people as their fourth choice, while Prototype 1 was the fourth choice for 5 participants.

These sequential patterns may reflect factors such as clarity, playfulness, or familiarity that shaped user engagement—potential causes explored further in the following section - 3.3.4 statement analysis.

Conclusions

The table summarises each prototype's relative performance across word associations, user ratings, and interaction order. These patterns may relate to factors such as clarity of interaction, sensory richness, and perceived playfulness, etc. A deeper analysis of the underlying reasons will be conducted later.

Prototype No.	Word Cloud Summary	Radar Chart Highlights	Interaction Order
1 Paper and Colour Pens	Mixed: intuitive, immersive vs. boring, time-consuming	High in fun and engaging (3.8); second in intuitiveness	Frequently chosen first; sustained early appeal
2 Digital Painting-Based Colour–Sound	Surprising, interesting, intuitive, some confusion	Highest in ease of use (4.3), high in surprising (4.1)	Frequently chosen first; strong early appeal
3 Tactile Textures	Diverse and balanced; intuitive, haptic, curious	Highest in surprising (4.3); high overall	Gained attention mid-sequence
4 Tangible Colour Objects	Mixed: interesting, confusing, overwhelming	Balanced in all dimensions (3.7–3.9)	Gained attention late-sequence; playful appeal

3.3.4 Statement Cards Analysis

Method and Process

After analysing the interview transcripts from 20 participants, over 250 individual statements were extracted. These were grouped by 7 thematic topics and then further broken down into sub-opinions within each topic.

Each opinion was tagged with the number of supporting participants. Opinions that were widely supported, or those with fewer supporters but strong significance or insight, were prioritised. These selected statements were later translated into either design requirements or inspiration materials. The full list of detailed statements can be found in the Appendix E.

Thematic Findings

A total of 7 thematic topics were identified from the statement card analysis. Each topic groups together recurring reflections based on direct participant quotes. The blue statement cards come from participants recruited at the museum in the formal study while the orange ones come from the pilot study.

1. Colour Impressions and Preferences
Participants expressed strong preferences for vibrant colours and aversion to dark tones. Colour choices were often intuitive or based on real-world references. Many associated colours with personal memories, objects, or emotions, indicating colour perception is deeply experiential and contextually rich.

These insights suggest that bright palettes may attract visitors more strongly, while dull tones (e.g., The Potato Eaters) might be less appealing. Comparing visitors' colour choices with Van Gogh's could also provide valuable contrast.

I prefer to paint with colours instead of black colour.

❝

I usually wouldn't choose black because I prefer to paint with more colourful options.

P6

I like the contrast colours in the painting so I try to find a light colour to create this montage.

❝

(So basically you're picking the colors and matching these paintings and compose them together.) Yeah, because I just like the contrast of it stands out the most. So trying to find light colors to kind of do a montage of what it looks like.

P9
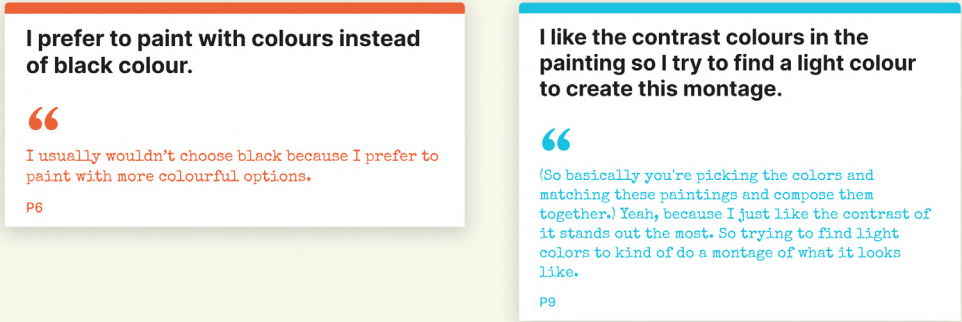
2. General Interactive Experience

Users valued interactions that felt guided, meaningful, and occasionally surprising. They preferred experiences that offered cues, narrative framing, or clear goals, highlighting that ambiguity often led to confusion or disengagement. Elements of uncertainty and variation were appreciated when balanced with intuitive access.

These insights are fundamental: although not colour-specific, they highlight core interaction needs that can be directly translated into design requirements.

People prefer having a specific goal or task to accomplish.

"

I don't feel as comfortable just making things without any aim or something.

P2

Instant feedback and randomness made the iPad interaction engaging and encouraged continued exploration.

"

The iPad interaction was really nice. When you tap it, it responds instantly. And since what it plays is random, I felt more drawn to keep interacting with it. It offers a lot of freedom.
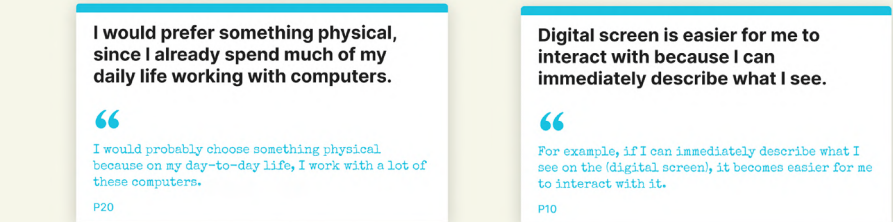
P19
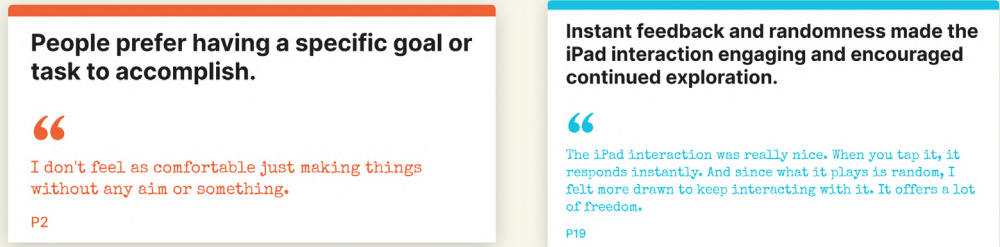
3. Interacting with Different Mediums

Tactile textures, sound, and visual feedback each shaped how users perceived and responded to colours. Clicking on screens was seen as effortless, while textures prompted associations with objects(e.g., curved lines evoking blue waves). Musical mappings were considered imaginative but occasionally hard to interpret. Participants were drawn to interactions that stimulated multiple senses clearly.

This suggests digital screens are the most accessible and intuitive medium, though their ubiquity may limit novelty. Exploring alternative media remains important for innovation.

I would prefer something physical, since I already spend much of my daily life working with computers.

"

I would probably choose something physical because on my day-to-day life, I work with a lot of these computers.

P20

Digital screen is easier for me to interact with because I can immediately describe what I see.

"

For example, if I can immediately describe what I see on the (digital screen), it becomes easier for me to interact with it.
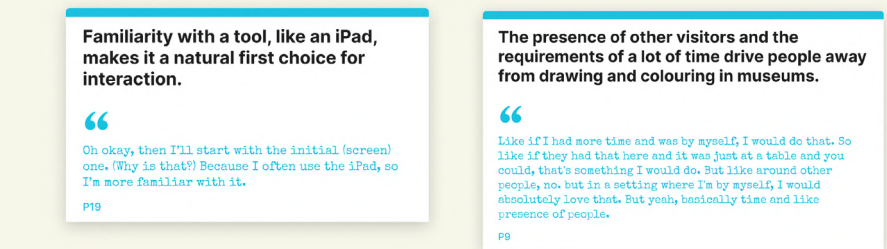
P10

4. Interaction Behaviour in Museum Contexts

Visitors often felt constrained by time and social setting. Overly open-ended tasks made them hesitant or overwhelmed. Familiar, low-effort interactions were preferred, especially when tools were visually clear or required minimal interpretation, like digital screens. Freedom within limits was appreciated, while performance pressure discouraged participation.

These insights, closely related to those on general interaction, emphasise museum-specific constraints and can be translated into concrete design requirements.

Familiarity with a tool, like an iPad, makes it a natural first choice for interaction.

"

Oh okay, then I'll start with the initial (screen) one. (Why is that?) Because I often use the iPad, so I'm more familiar with it.

P19

The presence of other visitors and the requirements of a lot of time drive people away from drawing and colouring in museums.

"

Like if I had more time and was by myself, I would do that. So like if they had that here and it was just at a table and you could, that's something I would do. But like around other people, no, but in a setting where I'm by myself, I would absolutely love that. But yeah, basically time and like presence of people.

P9

5. Paintings and Contextual Influence

Van Gogh's paintings served as powerful anchors for colour understanding. Participants reported being influenced by context, composition, and emotional tone in their interpretation. Visual references helped ground abstract interaction in recognisable content, supporting more intuitive engagement.

This suggests that interactions should always be tied to Van Gogh's artworks and context, rather than presenting colour in isolation.
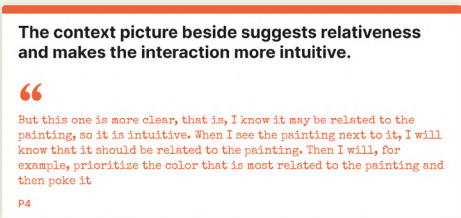
The context picture beside suggests relativeness and makes the interaction more intuitive.

"

But this one is more clear, that is, I know it may be related to the painting, so it is intuitive. When I see the painting next to it, I will know that it should be related to the painting. Then I will, for example, prioritize the color that is most related to the painting and then poke it

P4

Seeing the Sunflowers inspired my choice—it was fresh in my mind.

"

(Are you kind of inspired by the Sunflowers?) Yes. We've just seen it.

P16

6. Creating with Van Gogh

Users responded positively to interactions that allowed them to "create with Van Gogh" rather than passively observe. "Co-creation", whether through colour play, layering, or tactile input, was linked to enjoyment and self-expression. Freedom and output visibility were key to enhancing this sense of agency.

Future concepts should therefore include opportunities for creation, while carefully calibrating task difficulty.
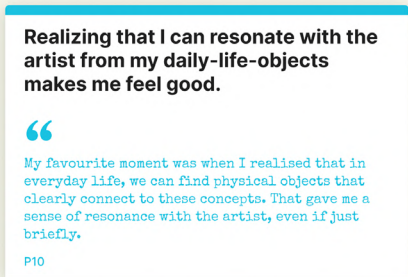
Realizing that I can resonate with the artist from my daily-life-objects makes me feel good.

"

My favourite moment was when I realised that in everyday life, we can find physical objects that clearly connect to these concepts. That gave me a sense of resonance with the artist, even if just briefly.

P10

The experience of using wool makes me want to try it like an artist, just like Van Gogh used to do.

"

But this (experience) gave a kind of prompt—it might motivate you. It makes you want to play the artist's role, to imagine how he used wool to feel colour.

P8

7. Subjective Understanding Paintings & Stories

Though less frequently discussed, some participants reflected on their personal interpretations of artworks versus the intended meaning. There was recognition that both artist narratives and visitor emotions shape the museum experience. These insights suggest potential for layered storytelling or perspective-sharing features, though such approaches may risk being overly abstract or complex.
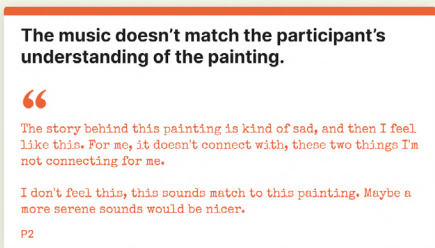
The music doesn't match the participant's understanding of the painting.

"

The story behind this painting is kind of sad, and then I feel like this. For me, it doesn't connect with, these two things I'm not connecting for me.

I don't feel this, this sounds match to this painting. Maybe a more serene sounds would be nicer.

P2

It was sometimes confusing when I couldn't understand the picture's message or recognise its motif.

"

Sometimes it was confusing. Which part was confusing? Sometimes I didn't understand what the picture was going to say, or what the message of the picture was. Sometimes I just don't recognise the motive of the picture.

P18(Social Zoomer)

3.4 Conclusions - Define

3.4.1 Design Requirements & Evaluation Criteria

Based on an integrated review of the project brief, user research findings, and the Van Gogh Museum's core values and vision, a set of design requirements was established. These are structured into 6 high-level requirements that serve as overarching evaluation criteria. Under each criterion, the more detailed low-level design suggestions (16 in total) specify how it can be practically achieved.

1. **Attractive and engaging** – *The interaction should be enjoyable and motivate visitors to spend time exploring it.*
- Calibrate the level of freedom—moderate level to spark creativity while maintaining clarity.
Encourage elements that feel open, approachable, "not complete and perfect", and
- inviting for user interaction.
- Ensure feedback is immediate, clear, and engaging.
- Foster an atmosphere where users feel comfortable, supported, and encouraged to interact without hesitation.

2. **Surprising** – *The design should offer unexpected elements or novel experiences for users.*
- Incorporate varied, unexpected, or uncertain elements to sustain engagement.

3. **Intuitive and easy to use** – *The interaction should be clear from the start, with visitors quickly understanding what to do without extra explanation.*
- Provide clear cues and hints to guide user interaction.
- Make both the task and the outcome of interaction clear and visible.
- Minimise reliance on explanatory texts.
- Embed narrative context or background stories to minimise confusion.
- Prioritise low-effort, quick-start interactions, and introduce more demanding tasks gradually.
- Enable users to feel capable and confident by providing tasks that are clear and achievable.

4. **Informative and educational** – *The interaction should help visitors notice or learn something new about Van Gogh.*
- Integrate Van Gogh's colour usage knowledge and stories directly into the interaction process.
- Encourage learning through doing.

5. **Inspiring and thought-provoking** – *The design should encourage reflection during and after use.*
- Reflect the museum's values of authenticity, connectedness, and peculiarity.

6. **Practical in the museum context** – *The interaction should comply with specific onsite requirements for interaction installations at VGM.*
- Prevent congestion or operational complexity in the busy exhibition space.
- Ensure the installation functions independently, without staff guidance.

3.4.2 Inspirations for Future Ideation

Based on the seven thematic findings from qualitative statements, each theme was further broken down into sub-opinions, with the number of supporting participants noted. Opinions supported by more than two participants were marked as high priority, with remaining opinions categorised as low priority. In total, 38 design inspirations were extracted and grouped as raw materials for further ideation. The full list of inspirations can be found in Appendix F. Six key themes include (each followed by 2 examples of sub-opinions):

1. Colour Impressions & Preferences:
- (High Priority) People don't like dark colours. They prefer vibrant colours, which can attract attention and emotional engagement.
- (High Priority) People tend to select their favourite colours first.

2. Interacting with Different Mediums:
- (High Priority) Clicking is intuitive and effortless—it immediately tells users what they can do with it.
- (High Priority) Linking music to colours is new and surprising, and sparks curiosity.

3. Interaction Behaviour in Museum Contexts:
- (High Priority) People tend to choose familiar tools first to save time.
- (High Priority) People go for easier tools or those with clearer tasks first.

4. Paintings and Contextual Cues:
- (High Priority) Context paintings influence people's colour choices.
- (High Priority) Paintings provide inspiration and intuitive entry points for interaction.

5. Creating with Van Gogh:
- (High Priority) The idea of co-creating with Van Gogh is intriguing.
- (High Priority) The process and result of creating feels emotionally satisfying.

6. Understanding Paintings & Stories:
- (Low Priority) People have their own interpretations of paintings.
- (Low Priority) Paintings may trigger similar emotions in different viewers.

3.4.3 Answers to Research Questions

The research questions are:

1. How do users perceive and engage with colours across the different prototypes?
Findings from prototype evaluations (Section 3.3.3) and the subsequent requirements and inspirations (Section 3.4.1 & 3.4.2) highlight that users perceive colour interactions as engaging when they are attractive, intuitive, and surprising. The diversity of impressions, ranging from curiosity and immersion to confusion and overload, shows that perceptions are shaped not only by the visual qualities of colours but also by the clarity of interaction cues and the context provided. These insights establish that engagement with colours is strongest when freedom is balanced with guidance, and when interactions encourage both immediacy and reflection.

2. In what ways do different colour interaction formats influence the overall user experience?
The comparison of prototypes (Section 3.3) and design criteria (Section 3.4.1) indicate that the format of interaction—whether tangible, digital, or multisensory—has a direct influence on the perceived experience. Digital formats (Prototype 2) were rated highest in ease of use, while tangible and haptic approaches (Prototype 3 and 4) offered surprise and sensory richness, though sometimes at the cost of clarity. These findings confirm that different formats emphasise different experiential qualities, suggesting that hybrid approaches combining clarity, playfulness, and sensory appeal may offer the most balanced user experience.

3. Which design features are perceived as most effective and promising for future colour-based interactive experiences?
The distilled requirements (Section 3.4.1) and future ideation inspirations (Section 3.4.2) point to several promising design features. Users consistently valued surprising, engaging, and intuitive interactions that are practical in the museum context and informative about Van Gogh's work. High-priority inspirations included allowing visitors to select preferred colours, embedding contextual paintings, and co-creating with Van Gogh. Together, these suggest that the most effective features are those that combine clarity and guidance with emotional resonance and multisensory depth, while aligning with the museum's experiential values.

3.4.4 Translational Outcome: Ideation Cards

All 16 low-level requirements and 38 inspirations were translated into three categories of ideation cards and rephrased into concise prompts. Organised as Requirement Cards, Core Sparks Cards, and Edge Sparks Cards, the set serves as an assistive tool to effectively support both individual and group ideation in the next design phase (Section 4.3.2) (see Appendix G for the complete set).

*Figure 29:
Overview
of printed
physical
ideation cards*

Chapter 4

Develop

4.1 Concept Development Process Overview

The overall concept development process can be summarised in the following illustration:

Section 2.4
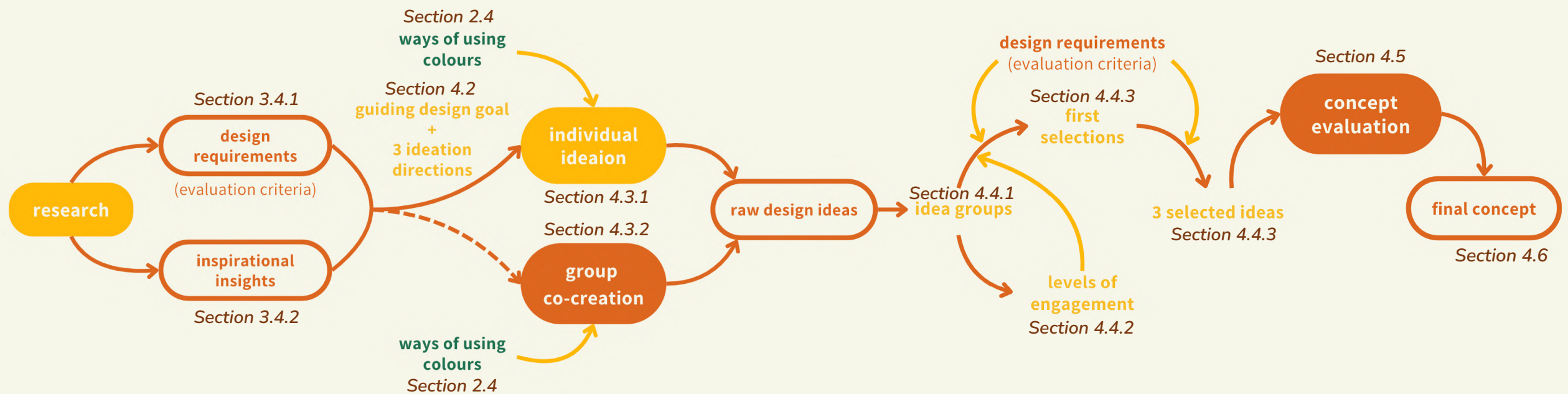**ways of using colours**

Section 4.2
guiding design goal + 3 ideation directions

Section 3.4.1
design requirements
(evaluation criteria)

research

inspirational insights
Section 3.4.2

individual ideaion
Section 4.3.1
Section 4.3.2

group co-creation

ways of using colours
Section 2.4

raw design ideas

Section 4.4.1
idea groups

design requirements
(evaluation criteria)

Section 4.4.3
first selections

levels of engagement
Section 4.4.2

3 selected ideas
Section 4.4.3

Section 4.5
concept evaluation

final concept
Section 4.6

Building on the design requirements and inspirational insights (Section 3.4) gained from the research phase, the process began with the formulation of a guiding design goal (Section 4.2) and three initial ideation directions, followed by individual ideation (Section 4.3.1).

A group co-creation workshop (Section 4.3.2) was then conducted to broaden the solution space. Together, the raw ideas were organised into thematic groups (Section 4.4.1) and mapped on different levels of user engagement (Section 4.4.2).

Guided by the predefined evaluation criteria, a two-stage selection process (Section 4.4.3) was applied to filter and refine the most promising concepts for evaluation with VGM staff (Section 4.5), leading to the identification of the final concept for further development (Section 4.6).

4.2 Guiding Design Goal

Based on prior research findings, detailed requirements, collected inspirations, and the six evaluation criteria, a clear design goal was iterated from the design foal in Section1.1.2 and formulated to guide the following development phase:

[An inviting and easy experience where visitors feel engaged, attracted, and curious—wanting to touch and try—without pressure, fear, or boredom. Through quick, hands-on interaction, they learn about Van Gogh's colour theories in a way that is enlightening and reflective, even without fully understanding, while not having to think too much.]

4.3 Ideation Process

4.3.1 Individual Ideation on Three Directions

Built on research insights and testing results, three exploratory directions guided the individual ideation phase. Each represented a distinct approach to interaction and interpretation, aiming to embody the design vision in a unique way.

Direction A:
An intuitive and expressive experience which invites visitors to co-create with Van Gogh (and other visitors) by transforming colour into personal interpretations—altering, rather than only admiring, the painting, within a structured and focused interaction that guides creativity without overwhelming freedom.

Direction B:
An accessible and seamlessly integrated multisensory interaction where touch, shapes and form, and sounds support the visual experience—all modalities intuitively converging to tell one coherent colour story, without need for explanation.

Direction C:
An immersive installation that gently shields users from social pressure—enabling fluid, low-effort exploration of colour meanings through advanced modalities, without fear of doing it wrong.

Figure 31: Overview of ideas generated in individual ideation phase of the 3 directions (Blue table: Direction A; Yellow table: Direction B; Red table: Direction C)

Different numbers of ideas were generated across the three directions. See for a full overview.

To keep the ideation process systematic yet approachable—and to enable fast-paced brainstorming—a text-based method was used. All ideas were documented in plain text, without visuals, and structured according to the following segments: user actions, system feedback, user feelings & takeaways, and optional notes. This allowed for quick formulation of simple user interaction flows. While these ideas were still rough and not yet fully defined, this format helped outline core concepts and encouraged further associations during the process.

For example, under the direction of "co-creating with Vincent," one idea was "AI Vincent." In this concept, as the visitor paints or creates, an AI mimicking Van Gogh offers live colour advice—suggesting what Vincent might have said in response.

user actions	feedback	user feelings/ meaning	notes
select colours from palette ->decide how to use colours (mixing, not mixing) like in real world	see the results directly, comparing with similar Van Gogh works	understand mixing contrast colours make muddy tones v.s. vibrant colourful ones	digital (screen); tangible (brush with screen)
AI vincent: users performing simple colour tasks	AI vincent: "I would do this" or change the users' choice directly	the idea of communicate with Van Gogh	digital screen?

Table 2: Example ideas from Direction A (Graphics reworked for clarity)

The second direction explores the integration of multisensory experience. For example: Van Gogh himself once experimented with threads of wool to try out colour combinations before applying them to his canvases, saving costs on expensive paints. Inspired by this story, I wanted users to see the original colour combinations of the wool ball used in the painting, and to allow them to change the colours both in the wool and in the painting itself. Tangible materials, such as wool, can be incorporated to enhance the multisensory experience.

user actions	feedback	user feelings/ meaning	notes
see the original wool used in a painting ->change the colours of the wool	see the wool of new colours intertwining, see the new painting	understand how vangogh chose colours, different colour combinitions	wool fun digital (to avoid mess) and tangible (to feel the material)
provided with pieces in different colours, user "rebuild" the painting in 3D	see a different, personalized version of the painting	understand different colour combinations	tangible + screen

Table 3: Example ideas from Direction B (Graphics reworked for clarity)

The third direction focuses on creating an immersive interactive experience. This direction includes bolder ideas. For example, one idea involves creating an immersive space based on a replica of a painting (e.g., The Bedroom), where users can change the colours of certain objects in the space and experience the impact of those changes by themselves.

user actions	feedback	user feelings/ meaning	notes
walk into an immersive area of a replica of a painting (e.g. bedroom, sunflower field) –› touch and change the colours of certain objects	see the difference in colours they make		fun
decide on a colour palette first –› walk through an immersive area of replica painting	reveal: a customized realistic painting with different colours		

A total of 10 ideas were generated for Direction A, 4 for Direction B, and 2 for Direction C. I personally found Direction A easier to ideate around and more thought-provoking, while B and C felt more limiting—possibly due to my own background and mindset.

However, these 3 directions mainly served as initial triggers for indiviual ideation. I eventually decided to adopt a more open-ended approach to explore a wider range of ideas specifically focused on how to communicate Van Gogh's colour strategies and stories through design.

4.3.2 Co-creation Workshop: Group Brainstorm

To overcome the limitations of individual ideation and expand the design solution space, a group co-creation workshop was organised. The aim was to generate diverse interpretations and unconventional ideas for communicating Van Gogh's colour strategies through design.

Workshop Setup

The session took place at TU Delft and involved five design students. Over the course of 80 minutes, participants collaboratively explored different ways of translating Van Gogh's colour strategies into interactive concepts, supported by a the set of ideation cards from previous chapter. Further details of the setup and procedure can be found in Appendix I.
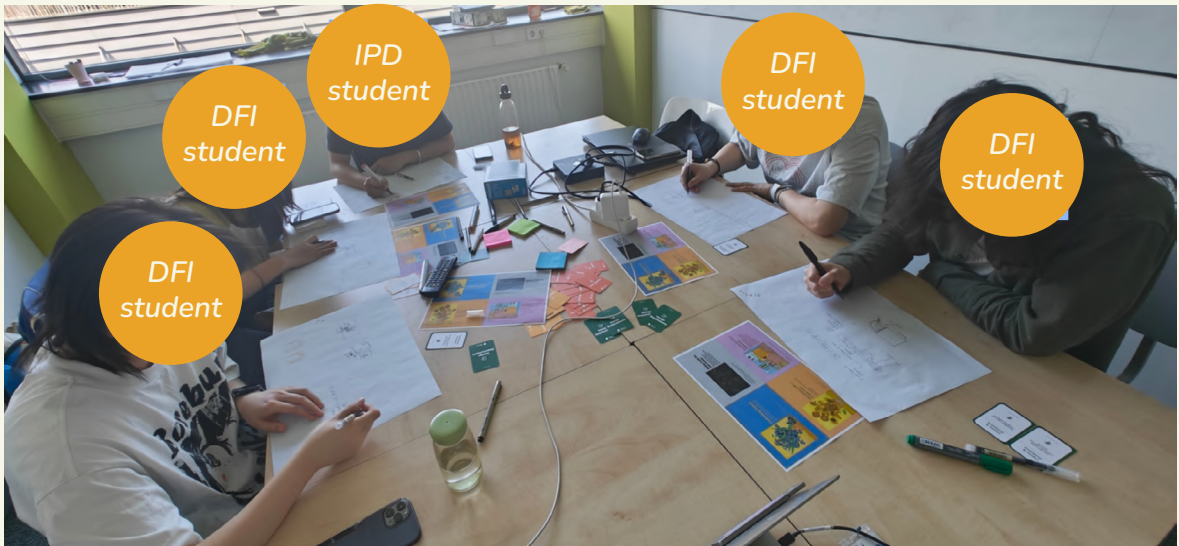
Results & Outcomes

A total of 10 pages of concepts were generated across the two rounds. While not all ideas were fully developed, many proved thought-provoking and inspired further exploration. (See Appendix J for details of all ideas.)

The author conducted an initial categorisation of the results, distinguishing between entirely new concepts that had not emerged in the individual ideation phase and those that overlapped with ideas previously developed by the author.

One example of the entirely new concepts is an idea proposing the creation of a dish inspired by The Bedroom, where the colours of the furniture are reinterpreted through food ingredients (e.g., red bed = red tomatoes), offering a multisensory reinterpretation of colour.
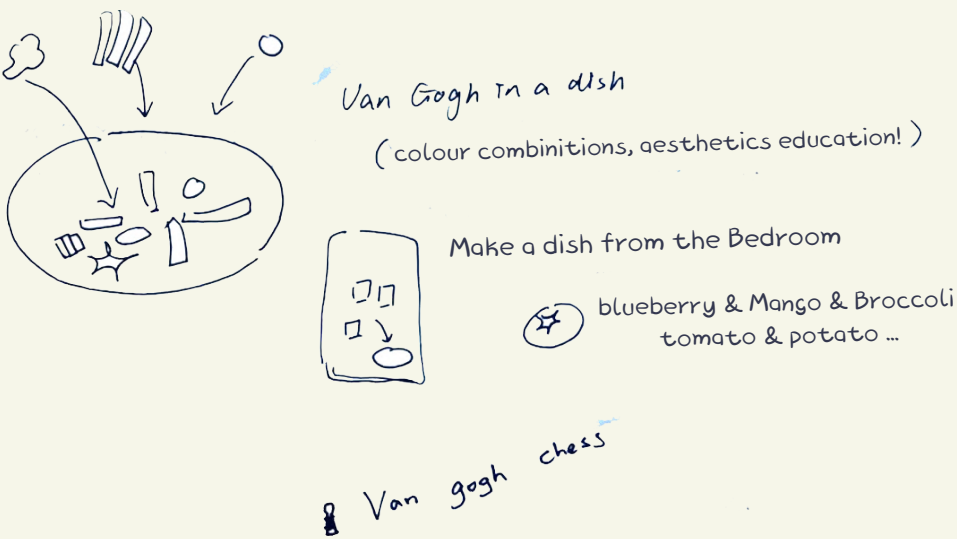
One example of recurring ideas is an interactive wool-based installation, inspired by Van Gogh's own method of using wool to test colour schemes. Users could freely combine coloured threads to explore visual effects, reinforcing a pressure-free, experimental process.
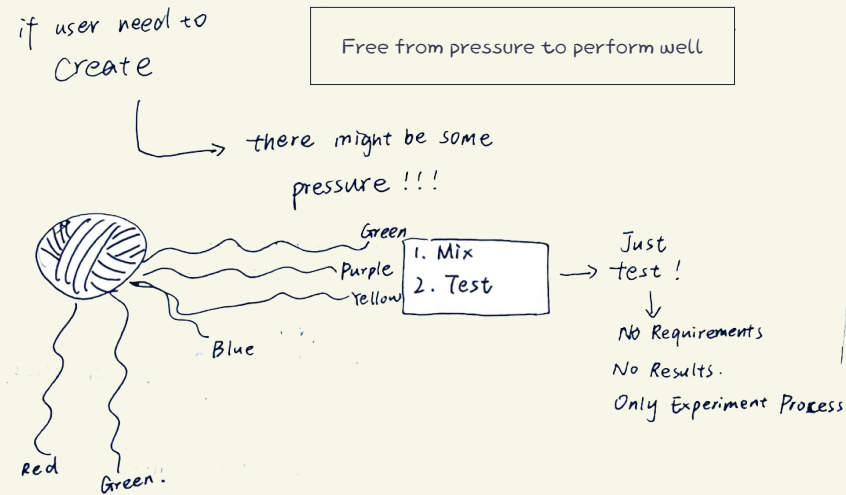
Among all proposals, three ideas were most positively received during group discussions:

1. The Wool Interaction
As mentioned before, this idea comes directly from Van Gogh's colour pairing method, allowing users to experiment with thread colour combinations. It was valued for its historical grounding and experiential quality.

2. Sunflower Arrangement
A physical vase containing sunflowers of various colours was proposed. Visitors could choose a flower and place it in the vase, which would dynamically update a digital representation of the Sunflowers painting. The simplicity and tangible interaction were widely appreciated.
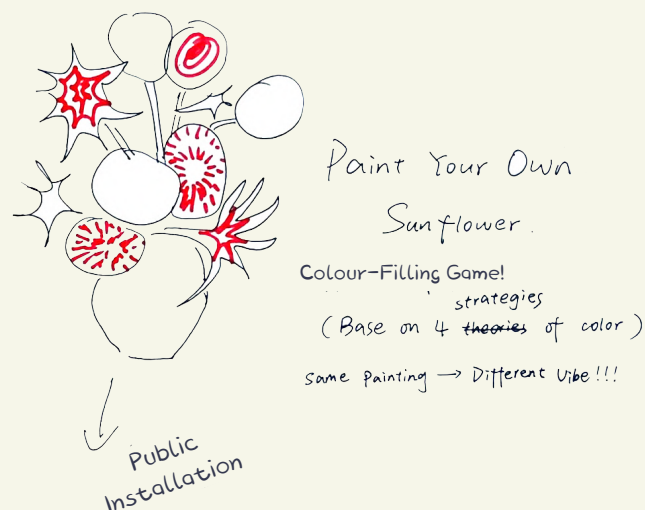
3. Customised Bracelet Based on Van Gogh's Palette
This concept allowed visitors to select beads representing colours from Van Gogh's paintings to create personalised bracelets. The opportunity for free expression and the take-home physical artefact were considered highly engaging.
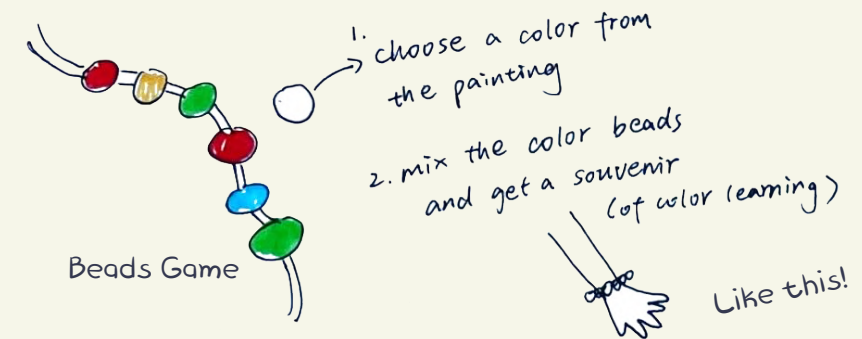
4.3.3 Discussion

The co-creation workshop significantly expanded the ideation space beyond the limits of individual exploration. It introduced diverse perspectives and brought forth unexpected interpretations of colour-related storytelling in the context of Van Gogh's work. While not every idea was viable, many offered valuable conceptual directions worth deeper investigation.

Combined with the initial individual ideation, the session resulted in a rich pool of ideas. A filtering and evaluation process was required in the next phase.

It is essential to keep in mind the overarching goal of this project: to educate visitors about Van Gogh's colour strategies and stories. Therefore, the degree to which an idea facilitates effective learning and meaningful engagement will serve as a primary criterion for selection moving forward.

An interactive mirror to know your colour & emotion

Emotional

4.4 Concept Development

4.4.1 Ideas Integration and Grouping

All raw ideas—both those generated through individual ideation and those collected during the co-creation workshop—were first organised into thematic groups based on their *primary user action*. These categories were inductively derived from recurring patterns in the collection. (See Appendix K for details.)

Another example is a word association game in which users describe a painting using their own language, after which an AI regenerates the painting using those same words—inviting reflection on perception and expression.

- Physical Interaction with Paints and Colour:
Ideas in this group enable users to engage with colour and paint directly, such as mixing colours via body movement or using an artificial paintbrush. These experiences centre around play and intuitive interaction with colour paints.

or a very bold idea: take a box of water and pour them onto the painting. ovserve the paints mix/blend with each other;

BUT, the water box can be a sensor, the canvas can be a display. So they can create a random and blending effect.

Figure 37
(above):
Overview
of all raw
ideas and
groupings
(sketches
come from
group
brainstorm
session, and
text boxes
come from
the author)

The identified categories are as follows:

- Changing Colours within an Existing Painting:
Concepts in this group focus on allowing users to alter colours in Van Gogh's original paintings through various interaction modes, including digital touchscreens and tangible materials.

- Creating or Drawing New Works:
These ideas invite users to create something themselves—such as composing a dish inspired by Van Gogh's palette, designing personalised bracelets, or making other artefacts that reinterpret his colour strategies.

- Prompt–Reveal Concepts (Indirect Education):
This category includes concepts that pose a question, prompt, or task before revealing colour-related insights. For example, a "magic mirror" identifies the user's emotional expression and displays a colour associated with that emotion (e.g., red for anger, yellow for joy).

- Alternative Ways of Observing Paintings or Real-life Objects:
These concepts provide visitors with new ways of perceiving visual work. For instance, one idea proposes a physical corridor fitted with different colour filters, allowing users to walk through and observe the same painting under changing hues and atmospheres.
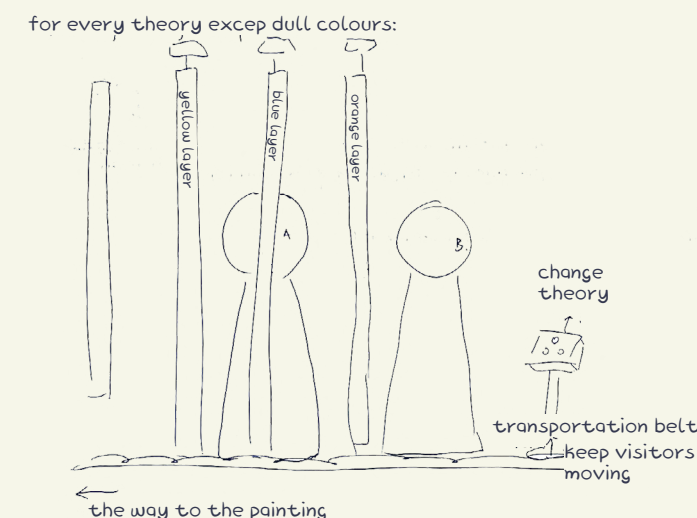
Figure 40:
Concept
of walking
through
different
colour filters

for every theory excep dull colours:

change theory

transportation belt keep visitors moving

the way to the painting

4.4.2 Mapping on Levels of User Engagement

Following the thematic grouping, the idea categories were analysed in terms of user engagement level. Each group was mapped onto one of three defined levels of engagement, as described below:

Level 1 – Low Engagement:
This level involves passive learning. Users primarily observe or perceive information without substantial interaction. The interaction is minimal and brief, typically lasting around 10 seconds. Idea groups mapped to this level include:
- **"Alternative Ways of Observing Paintings or Real-life Objects"**
- **"Prompt–Reveal Concepts (Indirect Education)"**

Level 2 – Moderate Engagement:
Users at this level participate more actively in the interaction process, moving beyond passive observation. However, the degree of creative freedom remains constrained. Interaction duration is longer than in Level 1 but still short, typically under 30 seconds. Idea groups at this level include:
- **"Changing Colours within an Existing Painting"**
- **"Physical Interaction with Paint and Colour"**

Level 3 – High Engagement:
This level is characterised by immersive, reflective learning. Users are fully engaged, both cognitively and physically, with a high degree of agency.
They actively create, reflect, and learn through personal interpretation and experimentation. Idea group mapped to this level:
- **"Creating or Drawing New Works"**
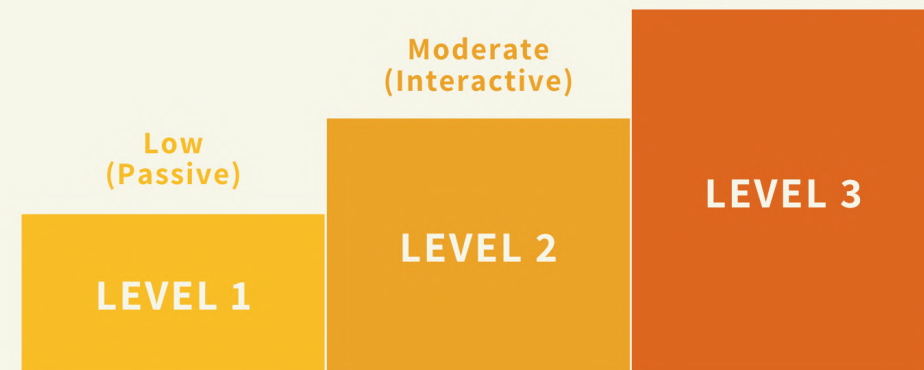
Figure 41: Illustration of the 3 levels of user engagement

These three engagement levels may serve as a framework for shaping the overall user experience. For example, an exhibition could be designed to sequentially guide users from Level 1 to Level 3, deepening their engagement over time. Alternatively, distinct interactive installations could be created for each level independently, allowing for multiple entry points into the experience.

4.4.3 Selected Concepts

Initial Selection

Following the thematic grouping and engagement-level mapping, a preliminary selection process was conducted to filter the most promising ideas. Ideas were excluded when they failed to meet one or more of the six *design criteria* defined in Section 3.4:

Criteria 3: Intuitive and easy to use
– Excessive cognitive load (e.g., "too many inputs," "too much text or audio involved")
– Lack of interaction clarity (e.g., "interaction flow unclear," "emotions too subjective and potentially confusing")

Criteria 4: Informative and educational
– Not clearly educational or merely informative without supporting learning outcomes (e.g., "not very educational," "only fun and surprising," "more informative than educational")
– Insufficient connection to Van Gogh's colour strategies or the museum context (e.g., "off-topic," "connection to the exhibition context unclear or confusing")

Criteria 6: Practical in the museum context
– Infeasible due to spatial or operational constraints (e.g., "space limitations," "too time-consuming")
– Concerns about sensory accessibility (e.g., "preferably no sound to avoid disturbing visitors")
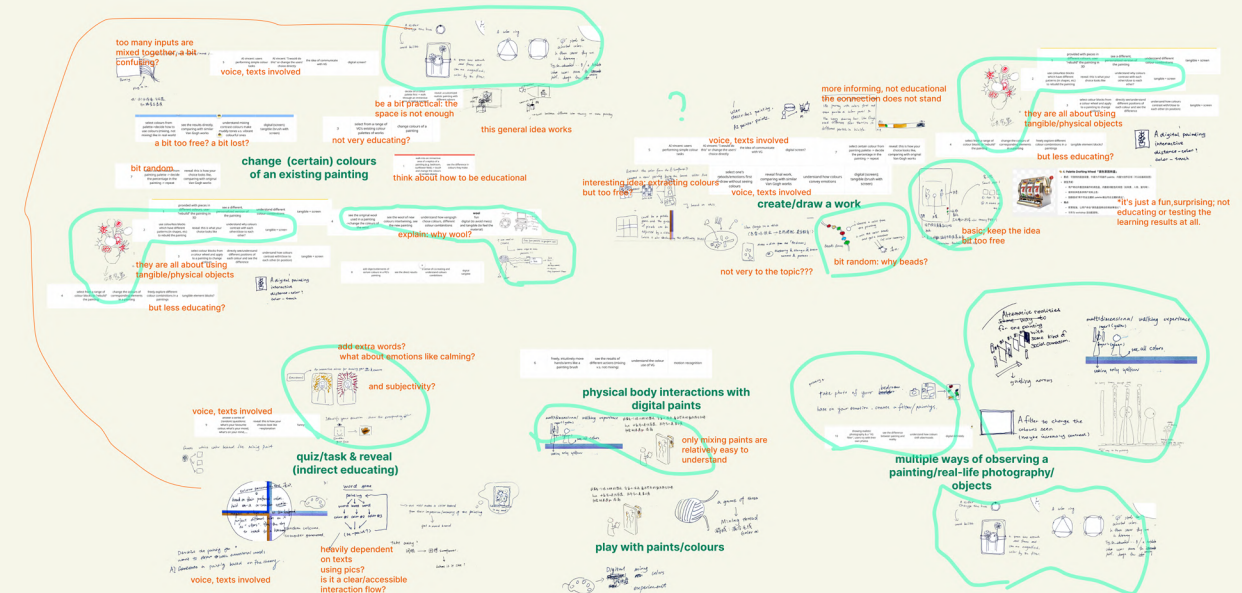
Figure 42 (below): Overview of Initial Concept Evaluations (Orange comments: critical remarks; Light green circles: selected ideas)

The goal was to select a balanced set of ideas representing each user engagement level, while collectively covering as many of Van Gogh's four colour strategies as possible. The initial ideas will be discussed as follows.

Level 1: Low Engagement (Passive Learning)

1.A. Magical Mirror
A digital mirror detects the user's facial expression and displays a colour associated with that emotion, followed by a Van Gogh painting utilising similar colours. This idea aligns with the emotional expression strategy.

1.B. Painting Filters
Visitors view a painting through a series of digital or physical filters, each simulating one of Van Gogh's colour strategies. With proper explanation, this concept can introduce all four strategies through comparative perception.
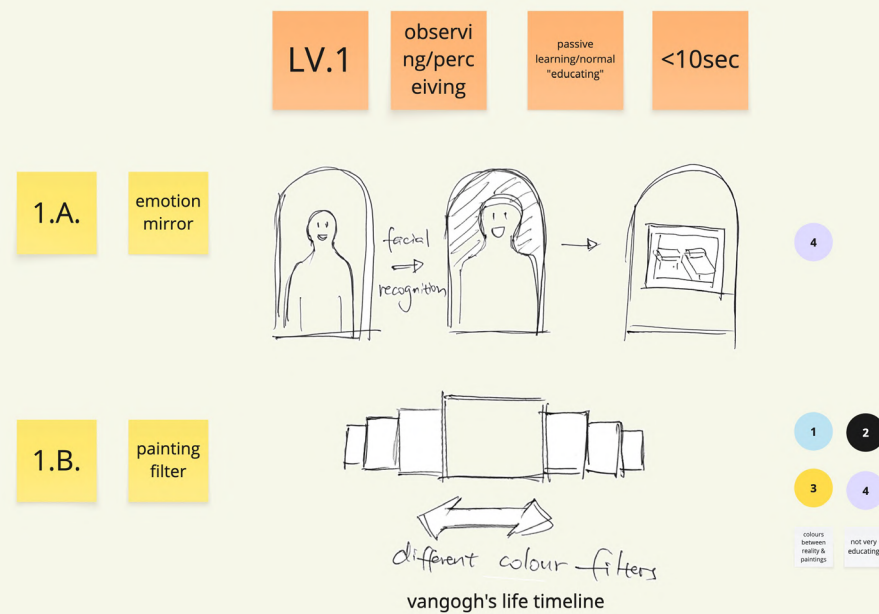
Level 2: Moderate Engagement (Interactive)

2.A. Interactive Wool Ball
Inspired by Van Gogh's use of wool to test colour combinations, this concept allows users to modify wool thread colours and see corresponding changes in the painting. It can communicate both contrasting colour usage and hue variation.

2.B. Visible Colour Wheel
A large interactive colour wheel reveals the dominant colours in specific areas of a painting and their spatial relations on the wheel. Users can rotate the wheel to adjust colour harmonies while retaining the original strategy logic.

2.C. Mixing Van Gogh's Palette
Users interact with a digital simulation of Van Gogh's painting palette, dragging and blending colour paints to explore how dull colours are produced. This idea focuses on his practice of mixing paints directly, although it only reflects one specific strategy and requires significant explanatory effort.
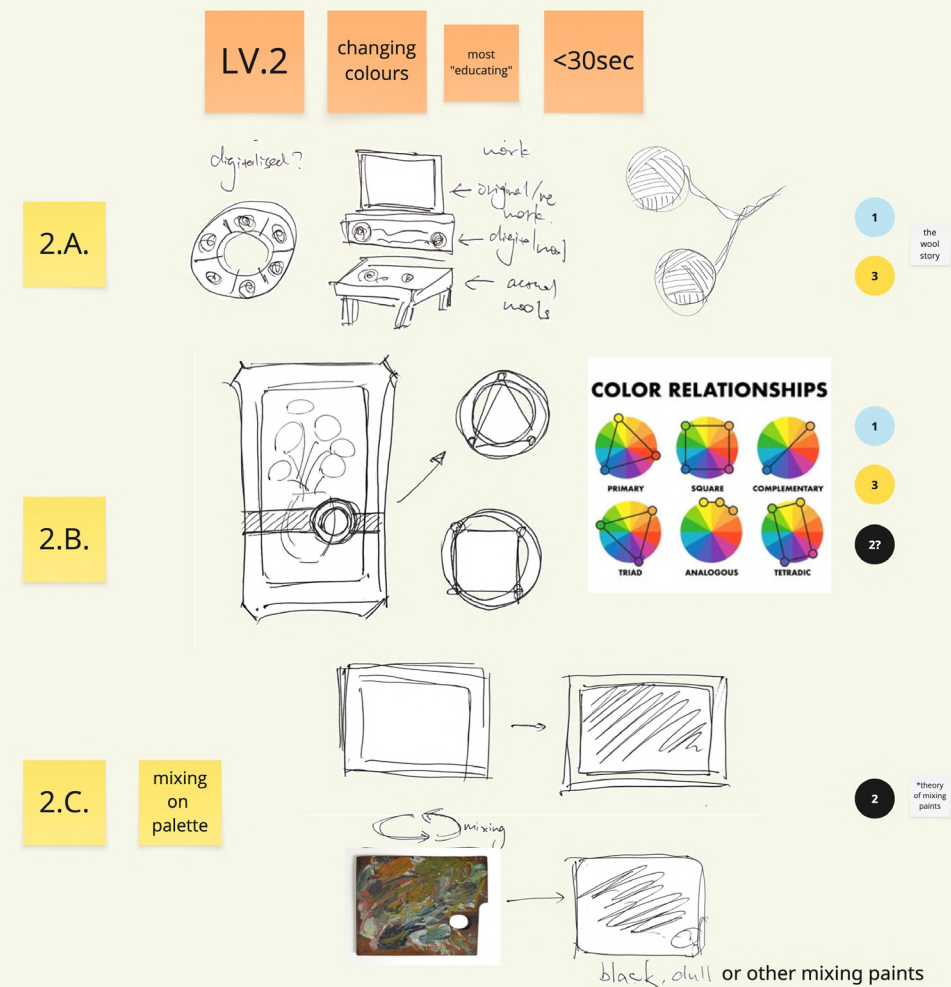
Level 3: High Engagement (Creative and Reflective Learning)

3.A. DIY Colour Souvenirs
Based on the bracelet idea from the workshop, users create personalised artefacts (e.g., postcards or digital compositions) using colours from Van Gogh's paintings. The interaction is open-ended but lacks explicit educational structure.

3.B. Reconstructing Paintings with New Palettes
Visitors rearrange colours in familiar works (e.g., Sunflowers, The Bedroom) using palettes derived from other Van Gogh paintings. While this concept promotes playful exploration, its educational clarity is limited.

LV.3	(re)create/"testing"	unnecessary? least educating/reflective learning	<30sec

3.A. DIY souvenir

colour pairing game?

Colour Line
- **Format:** A conveyor-belt-like installation resembling a production line, with one side for raw colours and the other side as a blank canvas.
- **Interaction:**
  - Users place different colours at the entry point of the belt (representing colour decisions).
  - The system mixes these "colour ingredients," and a mechanical arm prints the resulting colour strips onto a "personal canvas."
  - Users collect their own colour tracks and bind them into a "colour journey booklet."
- **Highlights:**
  - Ritualistic and collectible in nature.
  - The accumulation of choices becomes an artistic response.

3.B. "recreate vangogh's painting using colours of his"

Palette Collage Desk 「Palette Collage Desk」
- **Format:** A large table with numerous magnetic "colour chips" printed with different painting palettes.
- **Interaction:**
  - Users select desired combinations from different palettes (e.g., "Sunflower Yellow + Bedroom Blue").
  - They collage their chosen palette combinations on the desk surface, with frames or silhouettes at the edges for colouring.
  - Challenge cards can be introduced, e.g., "Use the palette of The Potato Eaters to create a joyful atmosphere."
- **Highlights:**
  - Supports practice in "colour language translation," e.g., telling happy stories with cheerful colours.
  - Functions like a visual vocabulary collage, encouraging creative reinterpretation.

Further Selection

A second round of selection was conducted based on practical constraints and educational alignment, and here are the rationale of some of the decisions:

1.A. Magical Mirror
Not selected: Facial expressions are subjective and unreliable; emotional interpretations of colour may vary widely across individuals and cultures.

2.A. Interactive Wool Ball
Selected: Strong connection to Van Gogh's personal story; the wool metaphor needs clear explanation.

2.C. Mixing Van Gogh's Palette
Not selected: Although interesting, it addresses only a narrow aspect of Van Gogh's colour strategy and requires extensive explanation, making it less suitable for a concise educational format.

3.A. DIY Colour Souvenirs
Not selected: While engaging, the interaction lacks structured educational content and could consume excessive time or materials.

3.B. Reconstructing Paintings
Not selected: Time-intensive and not clearly educational; risks diluting focus from core learning objectives.

In conclusion, *Concept 1.B., Concept 2.A. and Concept 2.B.* were eventually selected for further evaluations.

Reflection

At the same time, reflections on Van Gogh's four colour strategies revealed their varied nature and difficulty of being communicated simultaneously. Key relational insights included:

1. (2) Mixing paints is the opposite of both (1) contrasting colours and (3) same-hue variation, as the latter two involve placing colours side by side rather than blending.
2. Emotional expression (4) is more abstract and subtly present in all three other strategies.
3. Strategies (1) and (3) share a theoretical foundation in colour wheel relationships.

These findings highlight that not all four strategies can be fully integrated into a single concept; instead, they need to be selectively prioritised or omitted depending on their fit with the final concept.

— insight 1
— insight 2
— insight 3
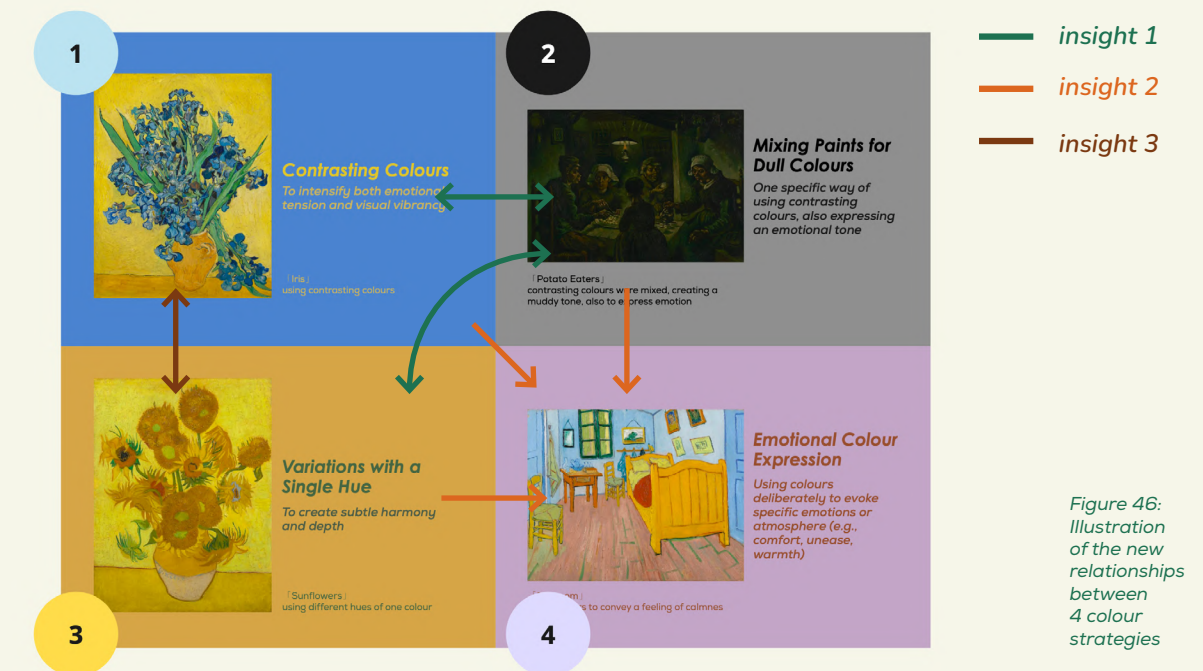
Figure 46: Illustration of the new relationships between 4 colour strategies

What's more, although the Level 3 concepts enable rich emotional expression and open-ended exploration, they were excluded from further development in this phase due to their limited effectiveness in supporting explicit learning outcomes. The project focuses on designing educational installations that help visitors clearly understand Van Gogh's colour strategies. Compared to Level 1 and Level 2 concepts, the Level 3 ideas were often too free-form, time-consuming, or lacked direct links to the educational content (which also partly conflicted with the balance of freedom and clarity defined in Section 3.4, Criterion 1: Attractive and engaging). Therefore, *Level 1 and 2 concepts* were considered more suitable for the project's primary goal.

That said, Level 3 concepts remain valuable for future iterations, particularly for use as end-stage experiences or affective extensions that encourage reflection.

Concepts Elaboration

Concept 1: Vincent's Colour Filters (Level 1 – Observation)

Users view a real-life image or rendering of a Van Gogh painting through a set of four colour filters, each representing a specific colour strategy. The filters may be physical (e.g., acrylic slides) or digital (e.g., swipeable overlays).

This concept supports comparative observation and can encompass all four strategies, provided sufficient interpretive explanation is offered.

Concept 2: Interactive Colour Wheel (Level 2 – Interaction)

An interactive colour wheel displays the dominant colours in selected areas of a painting and their positions on the colour wheel. Users rotate the wheel to explore alternative yet strategy-consistent colour combinations in the painting.

The concept may be implemented digitally or physically and clearly communicates core principles of contrast and colour harmony.

Concept 3: Choosing Colours like Van Gogh (Level 2 – Interaction + Storytelling)

Van Gogh once experimented with balls of wool to try out colour combinations before applying them to his canvases, saving costs on expensive paints.

This concept allows users to change colours in an original painting through a digital wool interface, referencing Van Gogh's method of using wool to test colour combinations. The colour changes are reflected in both the wool and the painting, helping users explore new harmonies while remaining connected to the original story of Van Gogh.
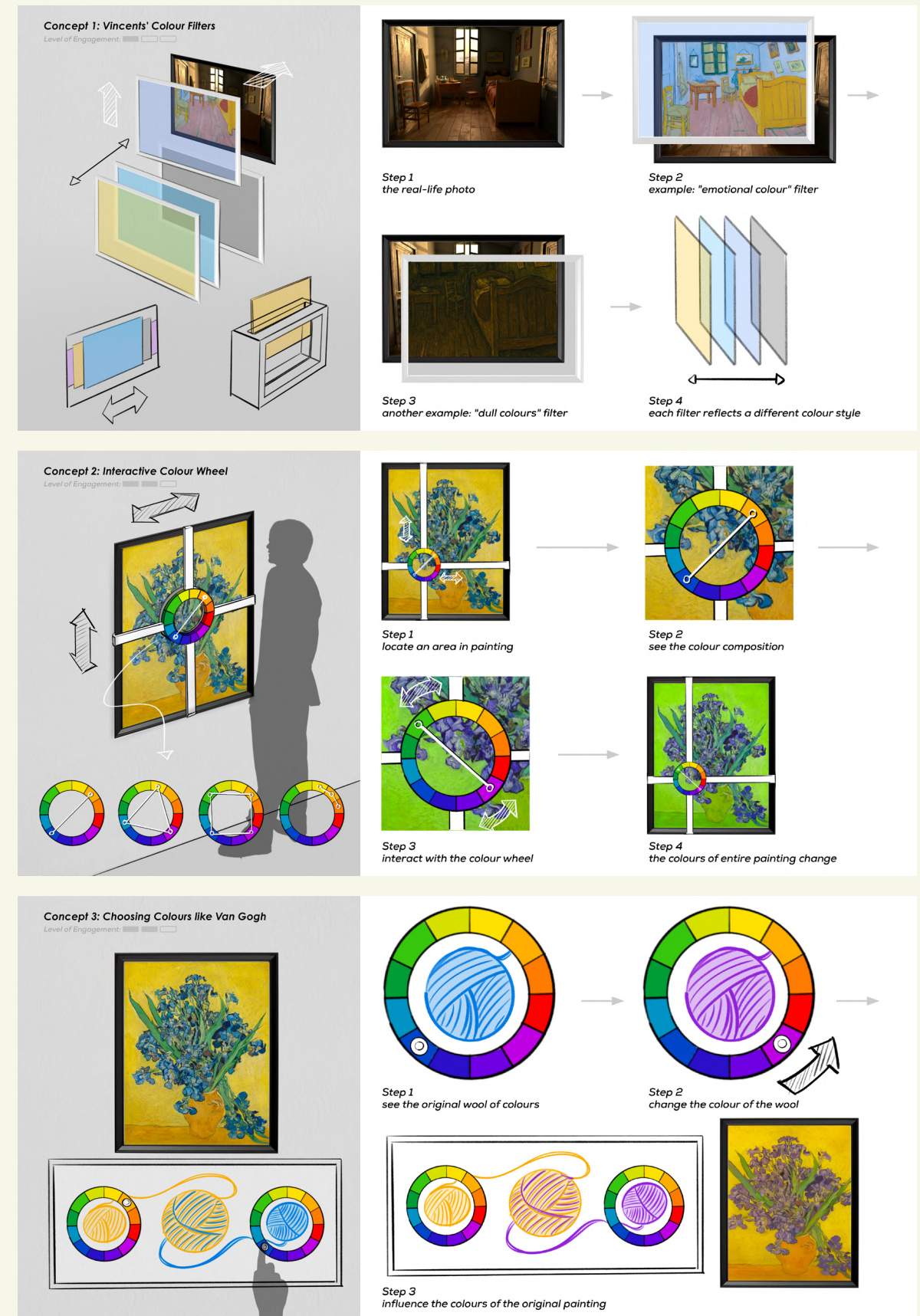
Figure 47 (top): Concept Overview – Vincent's Colour Filters

Figure 48 (middle): Concept Overview – Interactive Colour Wheel

Figure 49 (bottom): Concept Overview – Choosing Colours like Van Gogh

Concept 1: Vincents' Colour Filters
Level of Engagement:

Step 1 the real-life photo

Step 2 example: "emotional colour" filter

Step 3 another example: "dull colours" filter

Step 4 each filter reflects a different colour style

Concept 2: Interactive Colour Wheel
Level of Engagement:

Step 1 locate an area in painting

Step 2 see the colour composition

Step 3 interact with the colour wheel

Step 4 the colours of entire painting change

Concept 3: Choosing Colours like Van Gogh
Level of Engagement:

Step 1 see the original wool of colours

Step 2 change the colour of the wool

Step 3 influence the colours of the original painting

4.5 Concepts Evaluation

After developing the three final concepts, an evaluation process was conducted to assess their feasibility, relevance to the museum context, and effectiveness in conveying Van Gogh's colour strategies. The aim was to support the final concept selection based on a broader range of expertise beyond the designer's own perspective.

4.5.1 Evaluation Process

Session Setup

Five employees from the Van Gogh Museum were invited to individual online evaluation sessions, each lasting around 30 minutes. Their professional backgrounds included *marketing, UX design, project coordination, content curation, and licensing*.

The employees were asked to asses the three concepts and place the concepts on a 2×2 matrix with the axes "Fitting the Van Gogh Museum" and "New and Special"— criteria chosen because employees, with their extensive museum experience, were considered best positioned to judge both relevance to the museum and the novelty of the concepts. Further details of the materials and procedure are provided in Appendix L.

Figure 50: Example of concepts evaluation materials – the 2x2 matrix

Results

The results gathered from the participants include 3 matrices of the 3 concepts and key comments on the 3 concepts.

Concept 1: Vincent's Colour Filters
Most participants placed this concept in the upper-right quadrant of the matrix— relatively new and fitting to the museum—though not at the topmost corner.

Key comments include:

- Physical implementations were preferred over digital versions for their tangible and interactive quality.
- Visual materials must remain authentic; digitally "generated" images may not be accepted. Line drawings or photography are more appropriate.
- Loose, movable parts (such as interchangeable filters) are not permitted in the museum and would need redesign.
- The concept helps visitors metaphorically "see through Van Gogh's eyes."
- Additional explanation may be needed to ensure the four colour strategies are clearly communicated.
- Showing multiple paintings could enhance depth and engagement.

*The coloured notes and dots below represent the diverse professional roles involved in the museum context, including marketing and branding (pink), digital products (orange), project coordination (blue), content curation (green), and licensing assistance (yellow).

Figure 51 (above): Matrix Position and Comments for Concept 1

Participants also placed this concept on the right side of the matrix, recognising its educational potential, though some noted that the colour wheel is not a novel element in itself.

Key comments include:

- Again, physical interfaces were seen as more engaging than purely digital ones.
- Clear instructional guidance is needed to avoid confusion—both in how to interact and what the learning takeaway should be.
- The concept effectively educates about core colour theories.
- To reduce complexity, the interaction could be split into two separate installations: one for identifying colours, one for modifying them.
- There were concerns about potential congestion if interaction time exceeds 30 seconds.
- More paintings could be used to explain different colour strategies.

*The coloured notes and dots below represent the diverse professional roles involved in the museum context, including marketing and branding (pink), digital products (orange), project coordination (blue), content curation (green), and licensing assistance (yellow).

Figure 52 (above): Matrix Position and Comments for Concept 2

Concept 3: Choosing Colours like Van Gogh
This concept received the most favourable feedback and was placed by all five participants in the upper-right corner of the matrix—high in both originality and contextual fit.

Key comments include:

- The concept is original, personal, and strongly connected to Van Gogh's actual process.
- The story-driven aspect aligns with the museum's humanistic and narrative-based values.

- Some visitors may find the concept confusing if the wool story is not introduced beforehand.
- Though it may be less educational in directly teaching all four colour strategies, the narrative value compensates for this limitation.
- Integrating a colour wheel can enhance understanding of the underlying theory.
- Physical elements could enrich the experience, but practical concerns such as hygiene, maintenance, and cost must be addressed.
- Visitors are usually more interested in stories than knowledge - Even they are interested insome knowledge, that would be because of the story behind it.

*The coloured notes and dots below represent the diverse professional roles involved in the museum context, including marketing and branding (pink), digital products (orange), project coordination (blue), content curation (green), and licensing assistance (yellow).
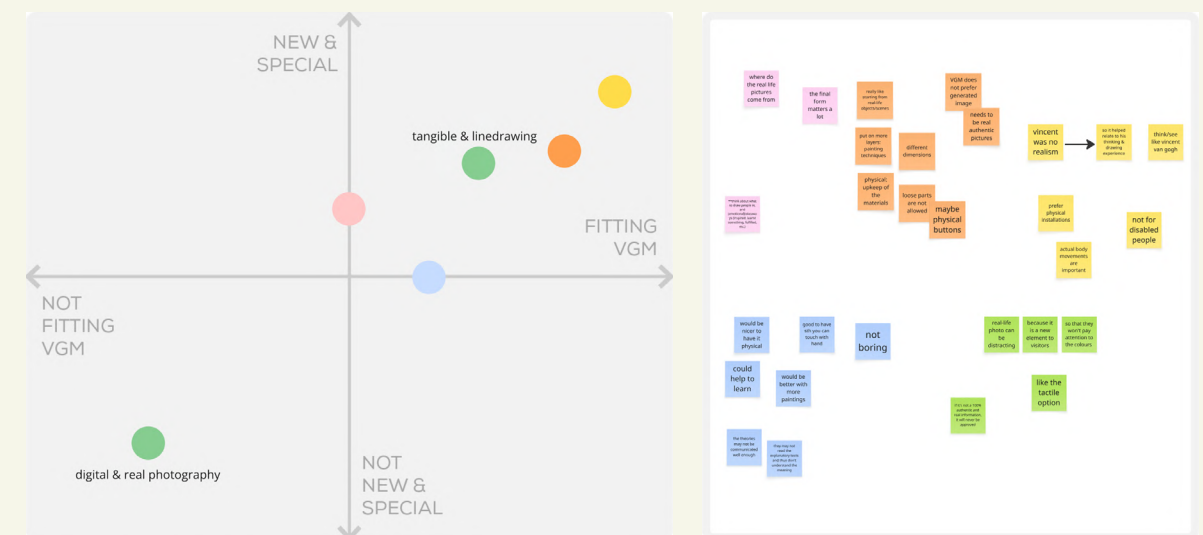
Figure 53 (below): Matrix Position and Comments for Concept 3

4.5.2 Reflections

Among the three concepts, Choosing Colours like Van Gogh was identified as the most promising direction. Its strong *narrative basis, emotional resonance, and alignment with the museum's values* made it stand out. While it may not convey every aspect of Van Gogh's colour strategies in detail, the personal storytelling aspect was considered highly effective in engaging visitors.

4.6 Conclusions - Develop

Based on the evaluation findings and alignment with project goals, the concept *"Choosing Colours like Van Gogh"* was selected for final development among all the ideas generated from individual and group ideations. It will be further refined to balance narrative richness with educational clarity, integrating both digital and physical elements where appropriate.

To further develop this concept, the following improvements were identified from evaluation session:

- Increase its educational clarity by better integrating the colour strategies within the interaction.
- Introduce physical elements where feasible, without violating museum constraints (e.g., no loose parts, low maintenance).
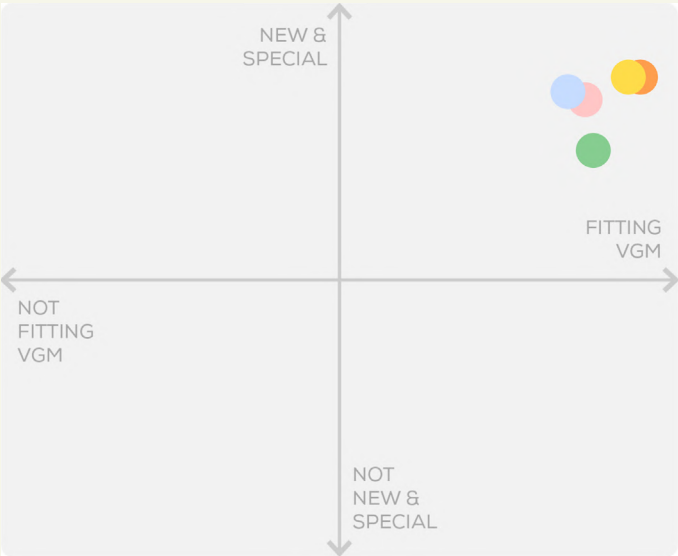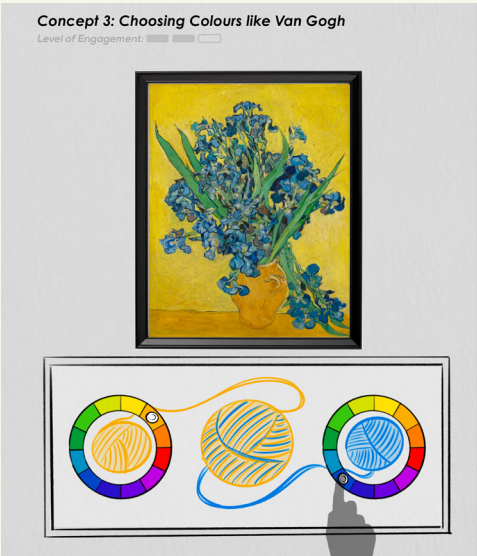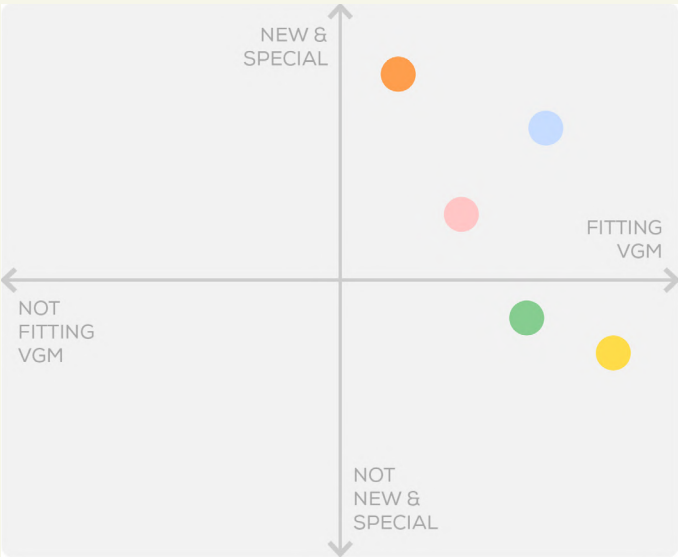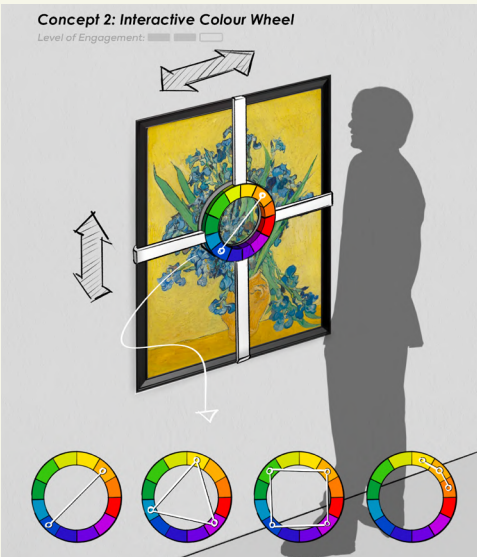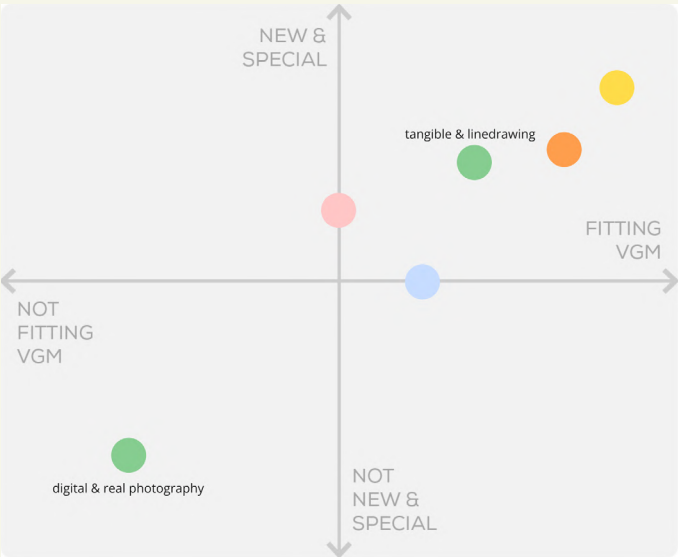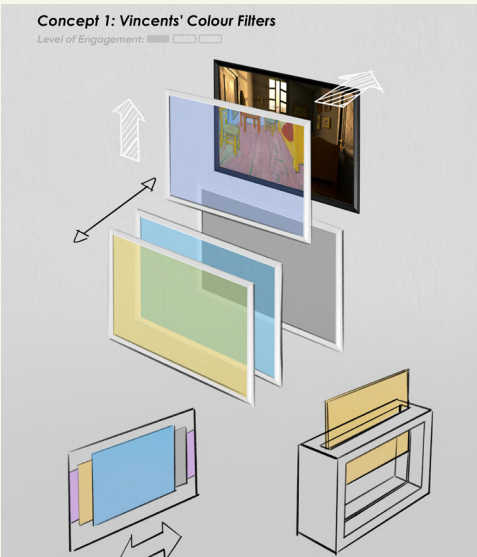
Figure 54 (right): Overview of all 3 concepts' evaluation results

Concept 1: Vincents' Colour Filters
Level of Engagement:

tangible & linedrawing
digital & real photography

NEW & SPECIAL
FITTING VGM
NOT FITTING VGM
NOT NEW & SPECIAL

Concept 2: Interactive Colour Wheel
Level of Engagement:

NEW & SPECIAL
FITTING VGM
NOT FITTING VGM
NOT NEW & SPECIAL

Concept 3: Choosing Colours like Van Gogh
Level of Engagement:

NEW & SPECIAL
FITTING VGM
NOT FITTING VGM
NOT NEW & SPECIAL

Chapter 5

Deliver

5.1 Final Concept Refinement

With the final concept identified in Chapter 4, this chapter focuses on its refinement and concrete development. Based on the evaluation findings, several specific improvements and considerations were formulated, guiding the refinement process:

- Enhancing Educational Clarity:
A visible and accessible colour wheel is planned to help visitors intuitively grasp basic principles of colour theory. The design will also aim to clearly reference the original colour combinations from Van Gogh's paintings and their positions on the wheel.

**- Integrating Physical and Digital Elements:**
Where possible, physical materials—such as wool textures—will be incorporated to strengthen multisensory engagement. Digital displays will support dynamic visual feedback and colour transformation.

- Meeting the Six Evaluation Criteria
The concept will be further developed to meet the general six criteria defined in Section 3.4: *attractive and engaging, surprising, intuitive and easy to use, informative and educational, inspiring and thought-provoking, and practical in the museum context*.

For example, this involves ensuring intuitive use by minimising cognitive load, avoiding visitor congestion, limiting interaction duration, and eliminating loose or high-maintenance components.

Figure 49 (reproduced): Concept Overview – Choosing Colours like Van Gogh (see also in Section 4.4.3)
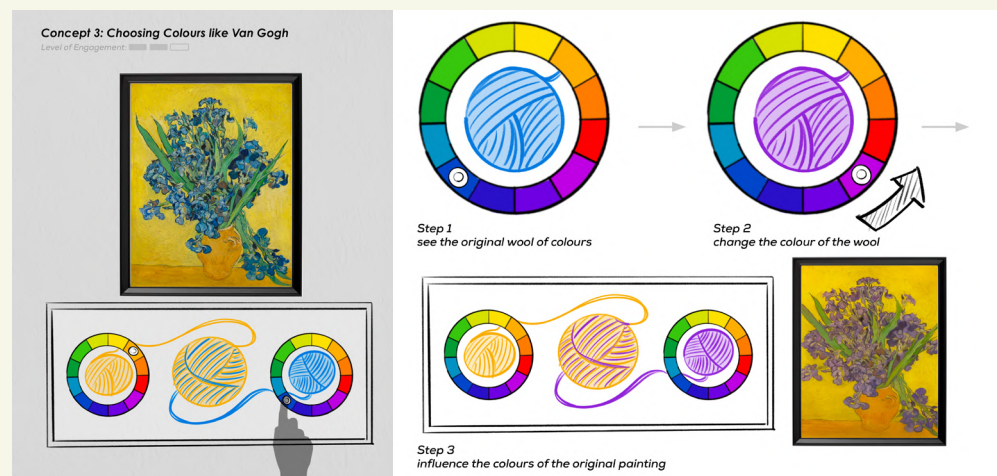
5.2 Final Design

The final design consists of two main aspects:

1. The *interaction interface***, presented on an interactive tabletop;**
2. The *installation layout***, designed as a cohesive spatial experience within the museum context.**

5.2.1 Interaction Flow & Interface Design

Interaction Logic

An outline of the interaction flow was first developed to support a clear and meaningful visitor experience.
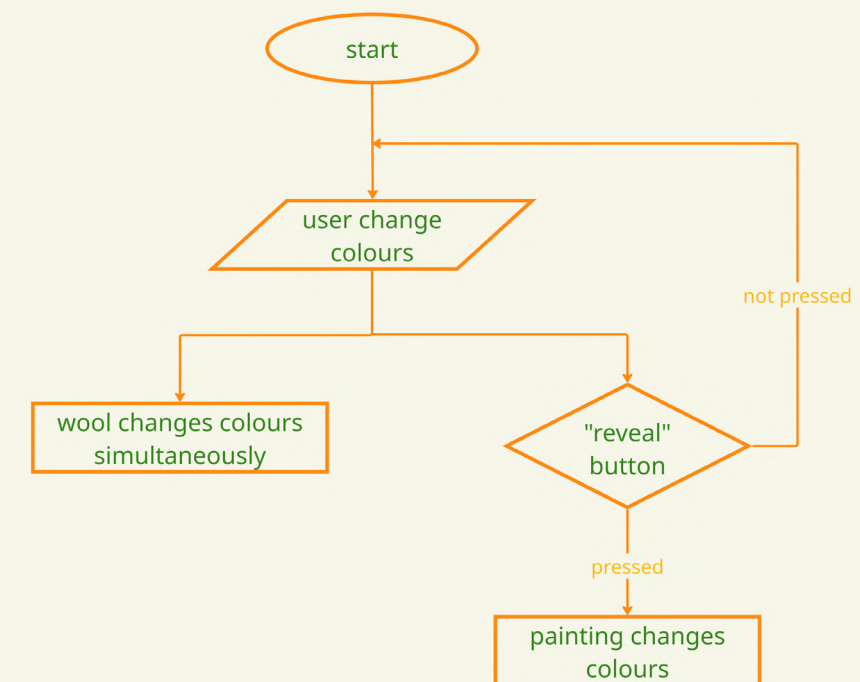
Figure 55: Interaction flowchart

Although the interaction is not complex, it was considered essential to separate two stages: users should first explore and adjust the colours of the wool, and only upon confirmation trigger a "reveal" that updates the painting. This delayed reveal mirrors Van Gogh's own process of experimenting with wool threads before applying colours to canvas, thereby enriching the interpretive depth of the interaction.
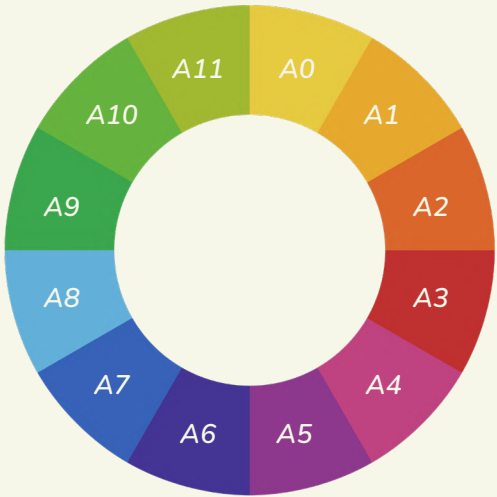
Interface Design

In response to evaluation feedback, the design centres around a colour wheel paired with a digital wool representation.

The HSB (Hue–Saturation–Brightness, also known as HSV) model was first introduced by Alvy Ray Smith in 1978 as a perceptually intuitive alternative to RGB for user interface and graphics applications. In this model, hue is represented by an angle around a circle (0°–360°), while saturation and brightness denote the colour's vividness and lightness, respectively.

The colour wheel follows a 12-hue circular structure, covering the 0–360° hue spectrum. Saturation and brightness values are adjusted to align with the typical palette and visual impression of Van Gogh's works, ensuring aesthetic harmony between selectable colours.

A0: H50 S72 B90
A1: H40 S80 B90
A2: H20 S80 B85
A3: H0 S75 B75
A4: H330 S65 B75
A5: H300 S60 B55
A6: H250 S65 B60
A7: H220 S70 B72
A8: H200 S55 B85
A9: H130 S65 B65
A10: H100 S65 B70
A11: H 70 S73 B72

Figure 57 (below): Overview of interface design sketches

Several interface design options were considered during this phase around the concept of the colour wheel. Some of the important ideas will be discussed.
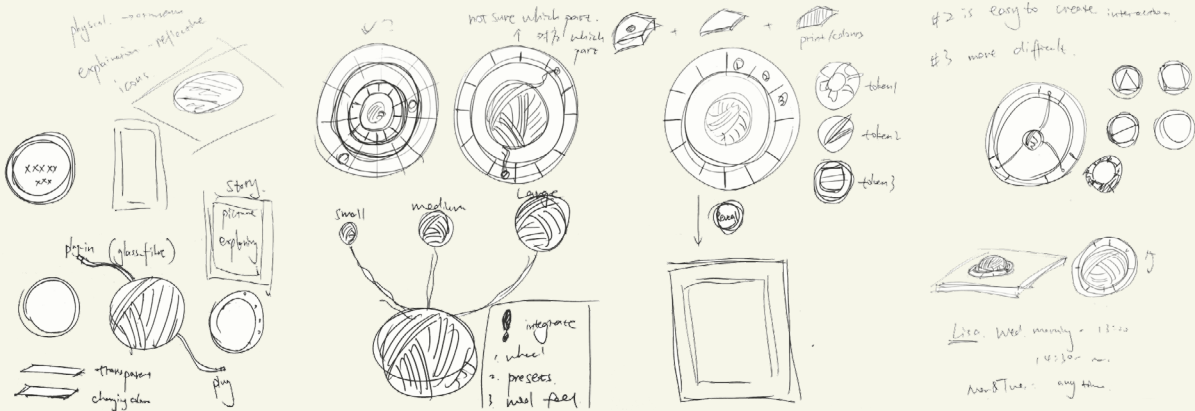
Initially, the concept explored using wool-like forms at the centre of the colour wheel, with threads extending outward to indicate selected colours. Material experiments involved options such as light tubes or soft translucent materials. However, this direction was ultimately discarded due to concerns over durability, material realism (plastic did not convincingly resemble wool), and overall visual coherence.
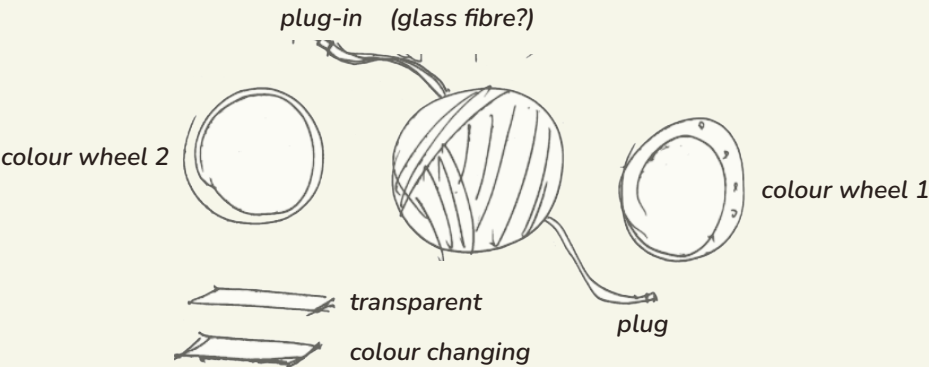
Figure 58: One of the sketch using extending threads

plug-in   (glass fibre?)

colour wheel 2

colour wheel 1

transparent

colour changing

plug

The design then shifted to a hybrid approach: using a digital wool ball displayed at the centre, controlled by physical input through the colour wheel. A key challenge emerged: how to enable users to modify different parts of a painting separately? Using multiple colour wheels was excluded due to spatial complexity, cost, and loss of educational value, as all colours need to be seen in relation on a single wheel to support learning.

The chosen solution introduces tokens, each representing a key colour area in the painting. These tokens can be repositioned on different segments of the colour wheel, updating the corresponding wool section and, upon confirmation, the painting.
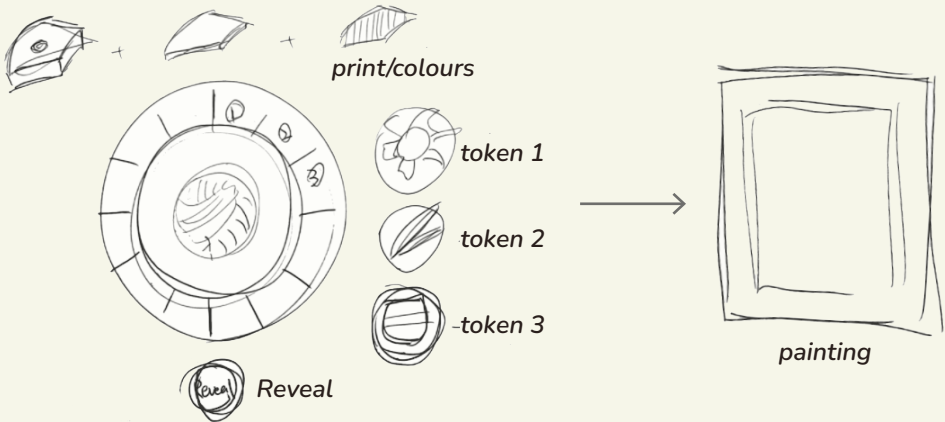
Figure 59: Token–Based Interaction Concept

print/colours

token 1

token 2

token 3

Reveal

painting

To further reduce complexity, the colour-changing wool ball will be represented using static images rather than more advanced methods such as Blender modelling or animation.

Tokens & Selected Paintings

The number of tokens was set to three. Fewer tokens would limit visual impact; more would overcomplicate interaction. In this case, two paintings were selected for further development: Irises and Sunflowers. These two works are: 1. Well-known and recognisable; 2. Representative of two of the colour strategies (contrasting colours & complementary colours within one sigle hue); 3. Visually simple, allowing tokens to logically correspond to major elements such as petals, leaves, vase, and background. 4. Similar in composition and palettes, which help reduce development complexity while offering a high return on effort—an important consideration given the project's scope as a single-person project.

Each token is designed with a graphical symbol indicating its linked element (flower, leaf, background & vase) in the painting, improving intuitiveness.


Figure 60: The two paintings and the icons of their tokens representing flowers, leaves and the vase

Structure Design

A central design challenge concerns the placement of the three tokens on the colour wheel. Since loose parts are prohibited in museum installations, the tokens cannot be detachable elements; instead, they must be integrated into a fixed structure, such as a *sliding rail* system.

Figure 61: Illustration of a sliding rail structure

Cross Section:
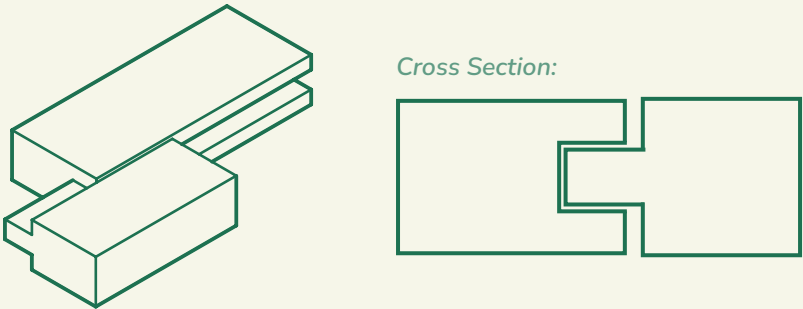
One possible solution is to place each token on a separate rail positioned at different radii of the colour wheel. This would allow all three tokens to move independently across the 12 colour blocks. However, such a configuration would make the structure larger and unnecessarily complex. Moreover, for educational purposes, it is important to display all colours within a single unified wheel, so that their relative positions remain clear.
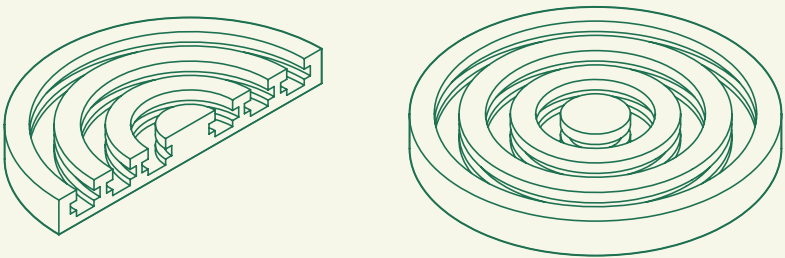
Figure 62: Illustration of three different rails in the same colour wheel at different radius

Another option is to align the three rails at the same radius but at different heights. While this arrangement maintains a compact wheel, it introduces significant mechanical challenges, particularly for wiring and sensor placement, and would likely complicate the overall construction.
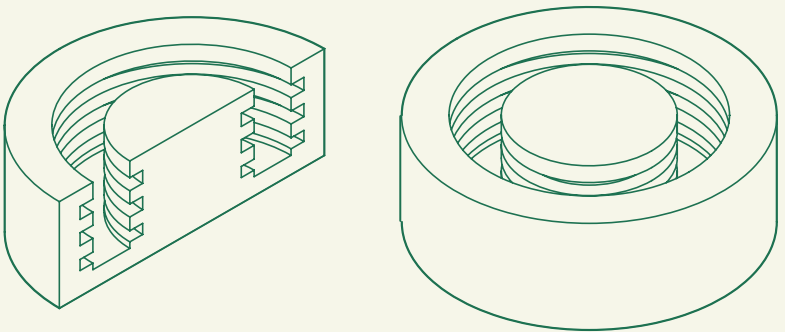
Figure 63: Illustration of having all three tokens on different rails with the same radius but at different heights

Eventually, a *single shared rail* was chosen for all three tokens. This solution provides a good balance between interactivity and feasibility. Tokens are fixed in order (e.g., clockwise: flower, leaf, background), cannot overlap, and must occupy distinct colour positions. This results in a finite but still large number of colour combinations (12*11*10/3*2*1=220 in total).
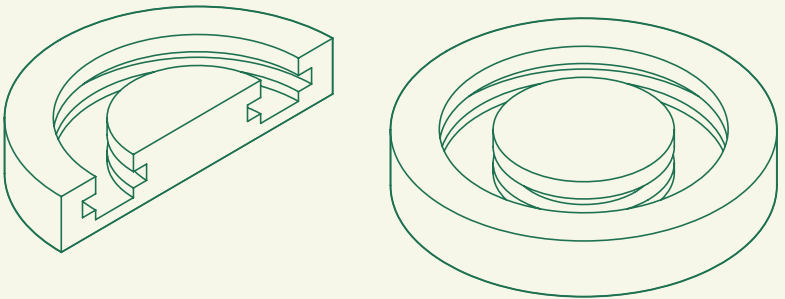
Figure 63: Illustration of a single shared sliding rail structure

Interface Design Presentation

The final design integrates the interaction flow, colour wheel interface, token system, and structural solution into a coherent installation concept. To ensure token colour visibility and user safety, each token includes a cutout window filled with transparent material (e.g., acrylic), which prevents finger entrapment while displaying the selected colour clearly.

5.2.2 Installation & Space design

To support a holistic interaction experience, the installation was designed in full detail, including its spatial layout and visual composition in the museum environment. The setup consists of a wall display and one or more lower operating tables.

Space Layout & Elements Arrangement

The overall design consists of the following elements:

- **Two original sets**: including original painting, wool ball, and colour wheel showing authentic colours; presented physically, e.g., wall stickers

- **Two physical interactive interface**: to control colours

- **Two new colour-changing sets**: including new versions of the painting and wool ball with altered colours; presented digitally via projection

- **Reference object**: A display of Van Gogh's original wool ball box (an existing museum artefact), introducing his colour exploration method and sparking visitor curiosity.

Figure 65: Reference object: the box containing colourful wool (Van Gogh Museum, n.d.)

Figure 66 (below): Overview of sketches on installation space design

To optimise spatial flow and intuitive user engagement, several layout iterations were developed to explore how these elements could be most effectively arranged within the exhibition space.

In the initial sketch, a single operating table was placed in the centre, hosting both interactive interfaces. Above it, on the wall, were the new colour-changing digital paintings aligned horizontally, with the original painting groups on either side. Digital wool balls were centred within the interactive interfaces on the operating table for immediate feedback visibility.

■ *Physical Original Set*
(painting & wool ball)

□ *Interactive Interfaces*
(with digital wool)

□ *Digital Display*
(with Users' Choices)

After iterations, several key improvements are made :

- **Wall-mounted wool display:** Although initial concepts considered table-based digital wool, placing them on the wall near the new paintings instead of on table allows for: 1. Easier visual comparison between original and changed versions; 2. Reduced congestion (wall-mounted displays can be viewed by more people simultaneously, some of whom may not need to use the controllers).

- **Scale adjustments**: Both original and new paintings were scaled to 60% of their real-life size (e.g., Sunflowers: from 95×73 cm to 57×44 cm) to emphasise comparison with the adjacent colour wheels and wool balls. Both physical and digital colour wheels on the wall are 34.5 cm in diameter, with both balls of wool 20 cm in diameter; The size of the table-based interaction wheels are 30 cm (outer diameter) and 18 cm (inner diameter).

- **Split interaction tables:** The centered table was divided into two separate stations on the left and right side to reduce congestion and clarify the presence of two independent experiences, enabling parallel use by different visitor groups.

- **Box of wool placement:** Positioned centrally between the two stations, the historical wool box serves as both an educational anchor and a visual attractor.

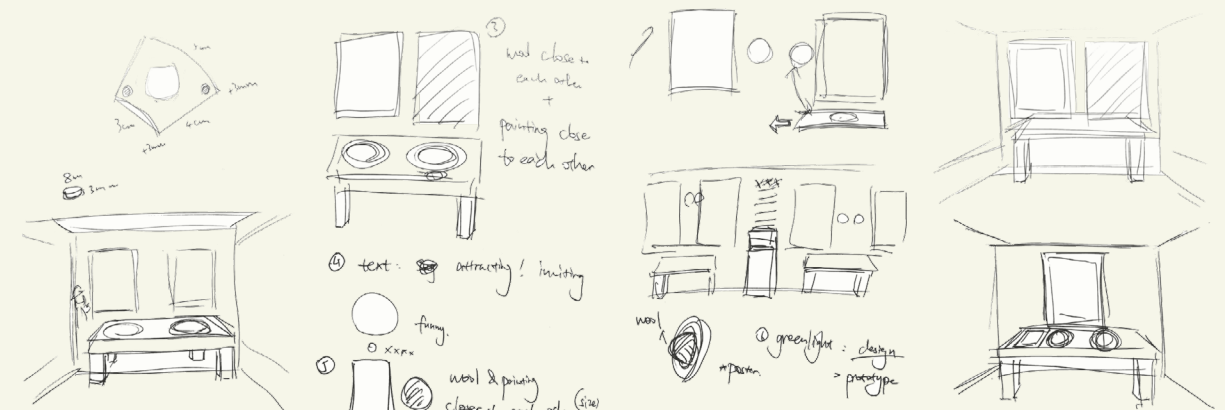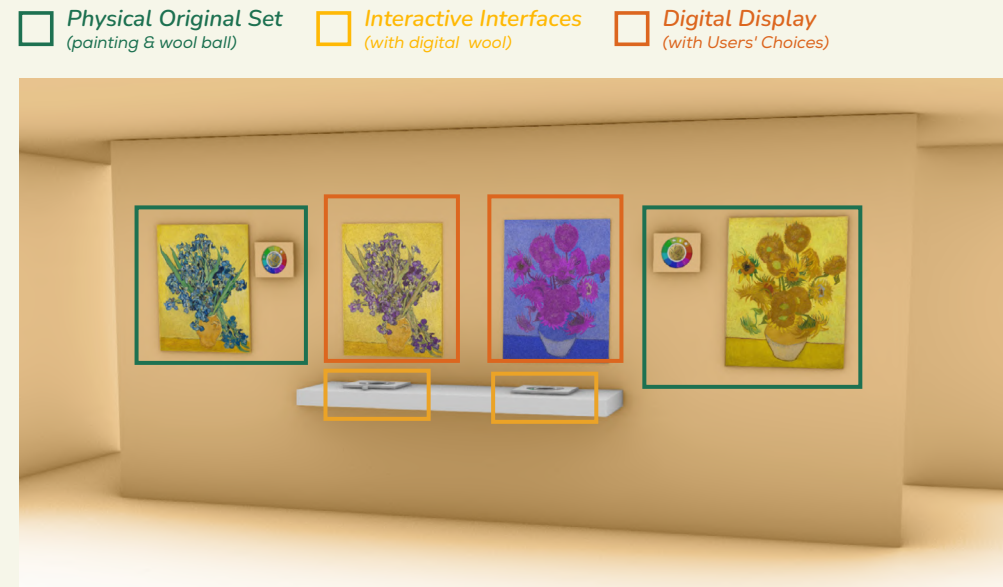- **Controller positioning:** Each physical controller is placed directly beneath its corresponding digital wool and painting display for intuitive cause-effect understanding.

Installation & Space Design Presentation

The final design integrates the interaction flow, colour wheel interface, token system, and structural solution into a coherent installation concept. To ensure token colour visibility and user safety, each token includes a cutout window filled with transparent material (e.g., acrylic), which prevents finger entrapment while displaying the selected colour clearly.
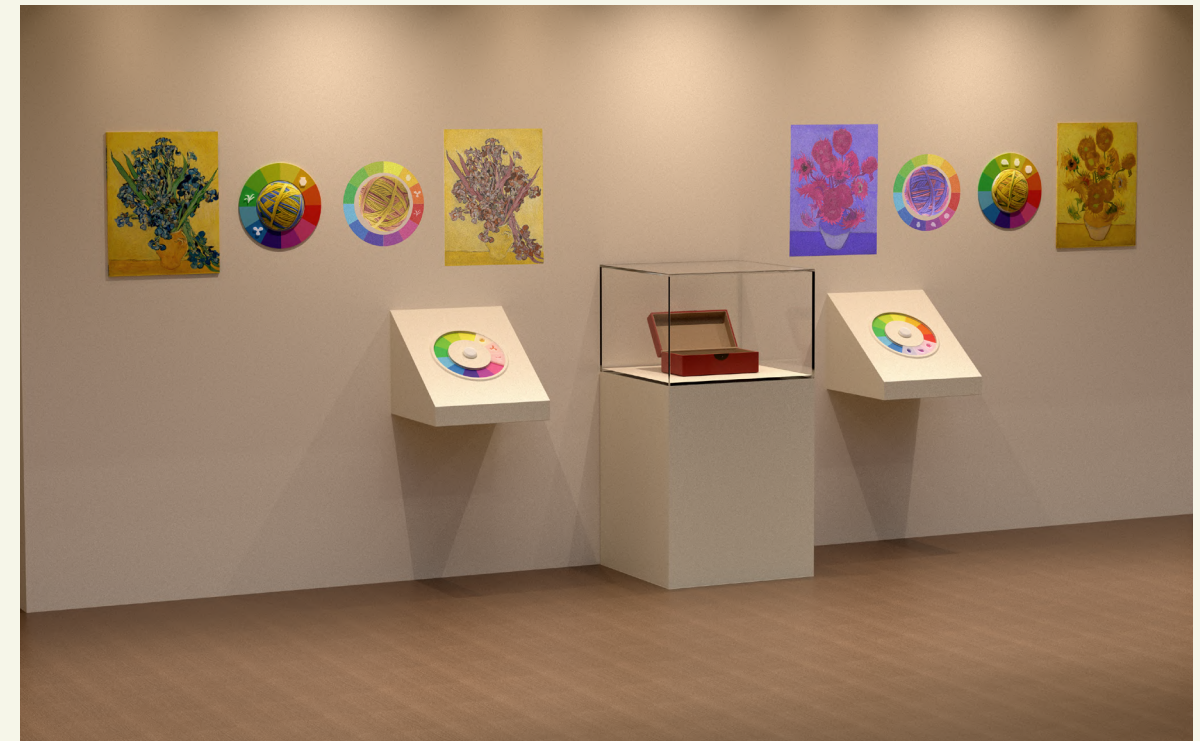
Ergonomics Validation

According to German BGIA-Report 2/2007, based on ISO 11226, a forward head tilt of 0–25° is rated optimal, 25–85° still acceptable, and angles beyond 85° uncomfortable. This standard informed the height and tilt of the visual and interactive surfaces for a standing user context in a museum setting. (BGIA, 2007)

Parameter	Direction of movement	Guideline values for evaluation [°]	
Inclination of the head	+: forwards (flexion)	green:	0 to 25
	−: backwards (extension)	yellow:	25 to 85
		red:	> 85
		red:	< 0

with reference to
ISO 11226 [4]
(without consideration of the secondary conditions stated in the standard)
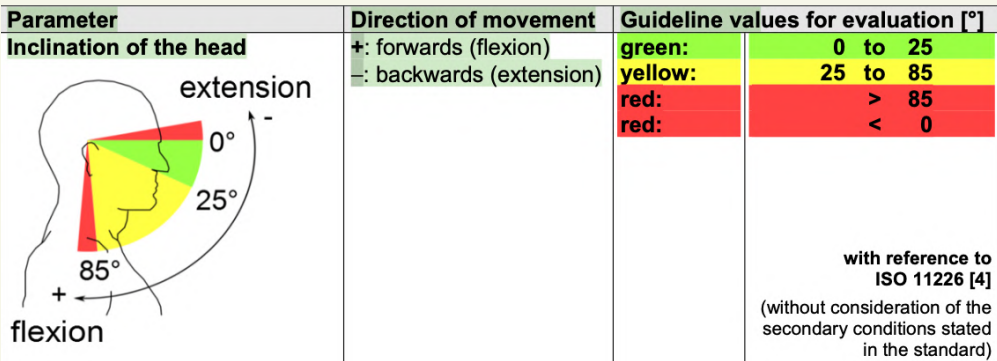
Anthropometric parameters (e.g., elbow height, eye height) follow the AWE Nr. 108 dataset, which covers the 5th to 95th percentiles of European adults aged 18–65, which closely aligned with VGM's target visitor population (BAuA, 2007).

No. (see fig.)	Description of Measurement	Percentile		
		5	50	95
1	stature (body height)	1530	1719	1880
2	eye height	1420	1603	1750
3	shoulder height	1260	1424	1570
4	elbow height	960	1078	1190
5	chest depth (meso-sternal level)	170	215	250
6	crotch height (equivalent to the tailor's measurement "inside leg")	709	816	890
7	tibiale height	397	472	530
8	hip breadth	300	359	400
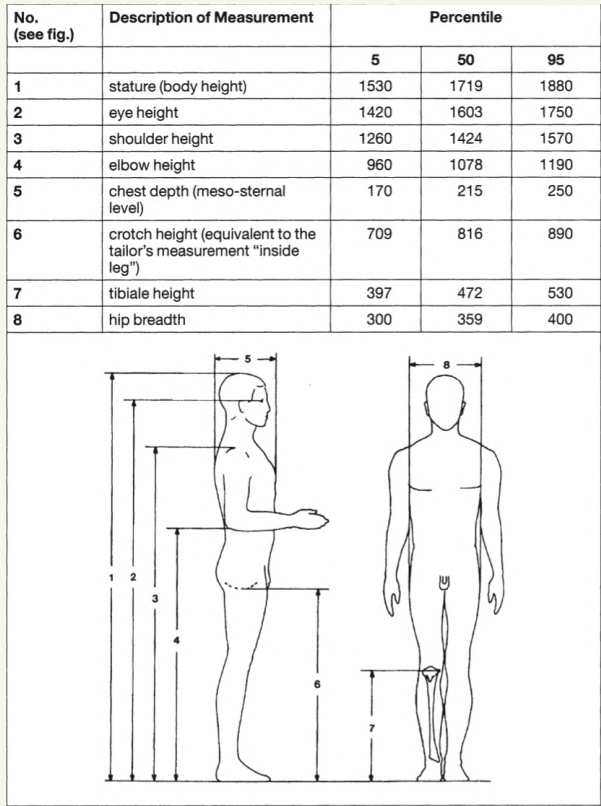
The interactive surface adopts a 35° forward tilt, aligning with recommendations from ISO 9241-5 and DIN EN 29241, ensuring visual and manual comfort.

The following design parameters were derived from these ergonomic analyses, demonstrating that the adopted measurements meet human–factors requirements.

- Centre of wall-mounted wheels and paintings: aligned with P50 eye height (1603 mm) and not exceeding P95 height thresholds (1880mm).

- Table height: aligned with P5 elbow height (960 mm). Resulting gaze angles range between ~40° (P5) and ~55° (P95), within the "acceptable posture" zone.

- The angled table surface reduces neck strain while maintaining optimal reach and visibility.
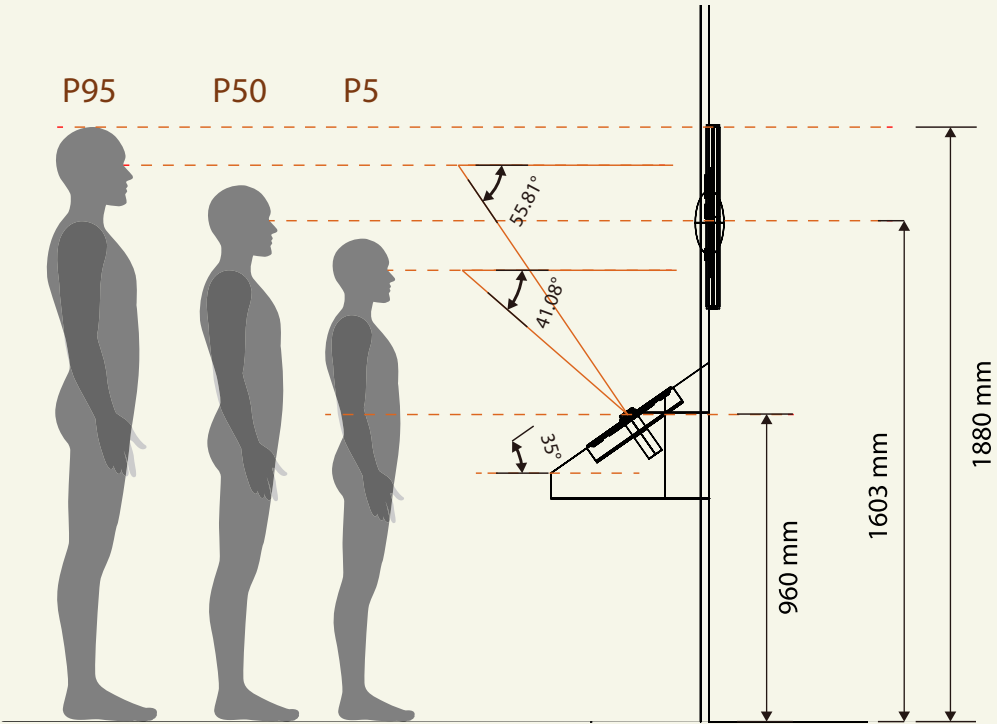
5.2.3 Final Design Presentation

Select Colours Like Van Gogh!
Kies kleuren zoals Van Gogh!

What would YOUR colour choice be?
Welke kleur zou JIJ kiezen?

" ... een violet boeket ... tegen een opvallende citroengele achtergrond ... is een effect van verschrikkelijk uiteenlopende complementariteiten die elkaar versterken door hun tegenstelling."
——*Vincent van Gogh, 1890*

"... violet bouquet ... against a striking lemon yellow background ... is an effect of terribly disparate complementaries that reinforce each other by their opposition."
——*Vincent van Gogh, 1890*

Supportive Texts

In the final design, supportive texts are incorporated to attract, guide, and engage visitors. As advised by the museum content curator, the guiding principle is "the fewer, the better." Therefore, long explanations of the wool story were omitted, as they are already addressed elsewhere in the exhibition. All texts are presented bilingually, in both Dutch and English.

- Introductory titles and prompts

A large introductory sentence invites visitors to join: "**Select Colours Like Van Gogh**". Below, a smaller prompt—"**What would YOUR colour choice be?**"—further encourages participation and experimentation.

- Contextual and explanatory texts

To help visitors clearly distinguish the original set from the interactive set, and to strengthen the educational and inspirational value of the installation, quotes from Van Gogh's letters describing Irises and Sunflowers are positioned around the original works:

"'**... violet bouquet ... against a striking lemon yellow background ... is an effect of terribly disparate complementaries that reinforce each other by their opposition.'**
——Vincent van Gogh, 1890" (Van Gogh Museum, 2009)

"'**It's a type of painting that changes its aspect a little, which grows in richness the more you look at it ... I have the sunflower, in a way.'**
——Vincent van Gogh, 1889" (Van Gogh Museum, 2009)

- Instructional texts

Simple and direct instructions ensure clarity of use. On the outer edge, visitors read "**Move the tokens to change colours!**", while the central button is accompanied by "**Press button!**".

Move the tokens to change colours!
druk op de knop!
Press button!
Verplaats de tokens om de kleur te veranderen!
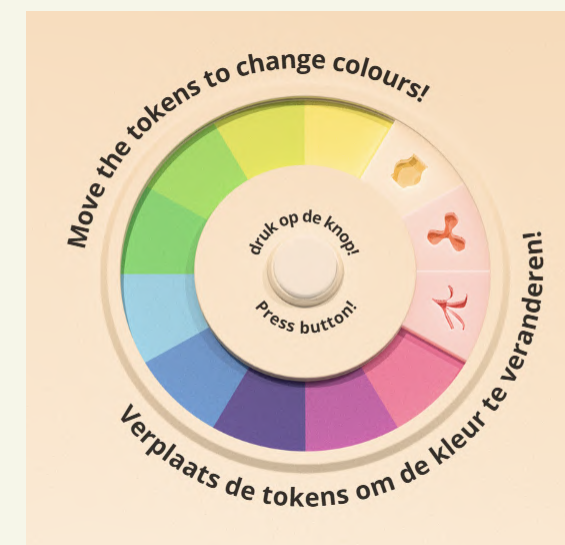
5.2.4 User Interaction Steps

The ideal user interaction steps in design are described as follows:

Step 1: Observe original set by Van Gogh
Usesr will first observe the original colour combinitions in the original painting created by Van Gogh.
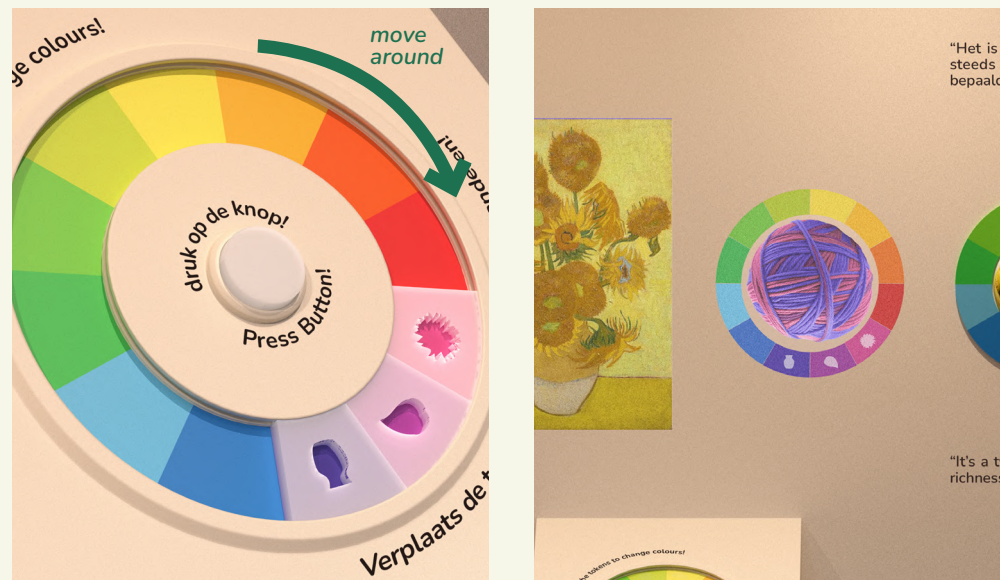
Step 2: Move tokens on the colour wheel to test combinations
Users can quickly start by moving around the 3 tokens on the colour wheel on the operating table. The digital wool projection will change its colours simultaneously with the tokens changing their positions.

Step 3: Reveal and compare your colour choice with Van Gogh's original
The central button can be pressed to reveal the updated painting after users are satisfied with the colour combination shown in the wool.
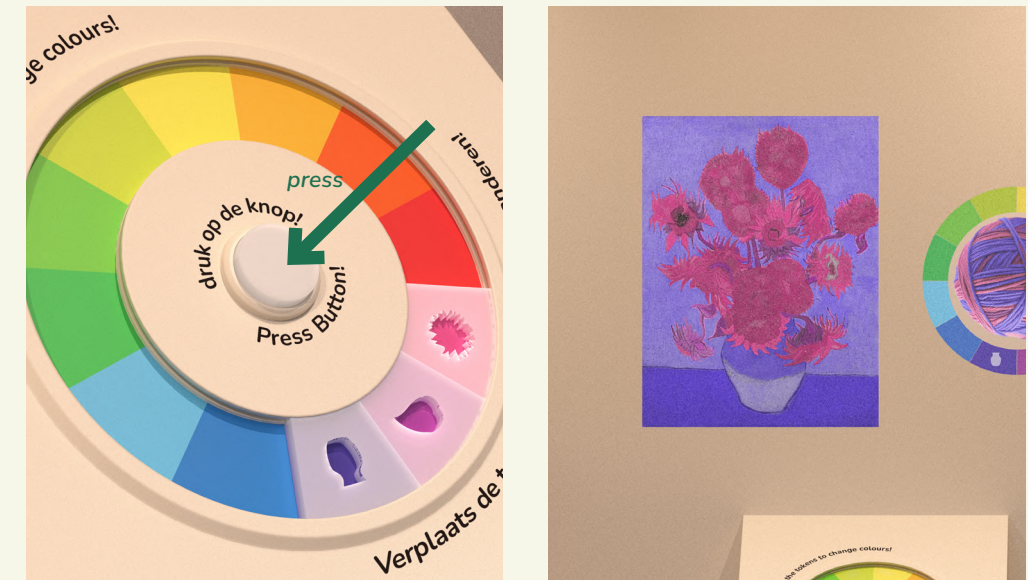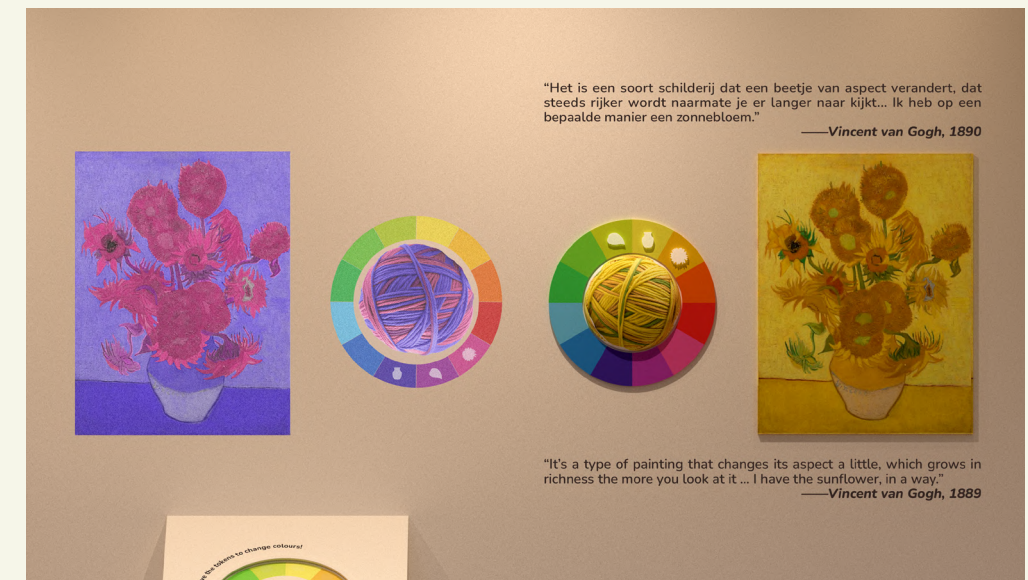
Step 4: Compare and reflect on your choices
Observe the new effects in the digital display and the entire setting. Compare the new wool with the original wool, compare the new painting with the original painting, and reflect on the reasons why different effect were created.

5.3 User Journey Design

	stage 1	stage 2	*stage 3	*stage 4
	TRIGGERED	**APPROACH**	***INTERACT**	***REFLECT**
User Actions	Observe	Observe other visitors Read information	Interact with the device Compare results	Think about reasons Discuss with friends
User Emotions	*intrigued* *curious*	*more interested* *curious*	*thinking* *surprised* *amazed* *challenged*	*satisfied* *inspired* *reflecting* *enlightened*
Design Touchpoints	· Installation setup · Title on the wall	· Box of wool · The original set · Van Gogh's quotes · Interactive device	· Prompts: "What would YOUR colour choice be?" · The original set · Van Gogh's quotes · Interactive device	· Interactve device · The original set · The rest of the exhibition that follows sthis interaction

Figure 82 (top): Illustration of user journey design

The user journey of the installation consists of four stages: *Trigger, Approach, Interact, and Reflect & Takeaway.*

Visitors may be drawn in by curiosity (Stage 1) and become more engaged by observing others or reading introductory texts (Stage 2). Some visitors already feel satisfied at this stage, choosing to watch rather than actively participate. Others proceed to experiment with the tokens on the colour wheel (Stage 3), which offers a surprising and enjoyable moment, though not all continue into deeper reflection. The ideal pathway encourages visitors to progress to Stage 4, where they connect their interaction with Van Gogh's colour strategies, discuss their choices, and take new perspectives into the rest of the exhibition. While not every visitor will reach this final stage—since preferred learning styles and levels of engagement vary— the design aims to maximise opportunities for reflection, supported not only by the device itself but also by references later in the museum tour that re-activate the experience.

Stage 1 – Triggered:
Visitors notice the wool box or interactive device, sparking curiosity.

Stage 2 – Approach:
Some remain observers, reading the short texts or watching others. For some visitors, this stage alone is a complete and satisfying experience.

Stage 3 – Interact:
Others engage directly, moving tokens and comparing outcomes. This creates surprise and hands-on learning, though some may stop here without further reflection.

Stage 4 – Reflect & Takeaway:
Ideally, visitors are prompted to think about their choices, discuss with companions, and connect their insights to Van Gogh's colour strategies. The installation is designed to encourage this step. Its effectiveness can be reinforced when later parts of the exhibition revisit the theme, helping visitors view subsequent artworks with a fresh perspective.

5.4 Prototype Development

The prototype was developed in two parts—**programming** and **physical construction**—with the purpose of validating design feasibility and preparing for user testing. It demonstrates that the design logic, interaction flow, and structural concept are all technically achievable, while offering a tangible preview of how the installation might function in practice. See Appendix M for developing details.

5.4.1 Programming

The programming was developed in *Processing* and connected to *Arduino* for physical input. Following the same interaction flow illustrated in *Figure 55*, the system detects user input from tokens and the button, identifies the corresponding image regions, and applies colour transformations in real time.

To achieve accurate segmentation, custom RGB-coded masks were created for petals, leaves, and background in pictures, enabling reliable colour changes.

An Arduino Mega controlled 12 Hall sensors placed beneath the colour wheel. Each token contained a distinct magnet configuration, allowing the programme to recognise both its position and identity. Processing then updated the wool ball and painting displays accordingly.

This setup **successfully reproduced all intended interactive behaviours, matching the final design vision. (See Appendix N for full code.)**

Figure 83: Photo of testing programming codes

5.4.2 Physical Prototyping
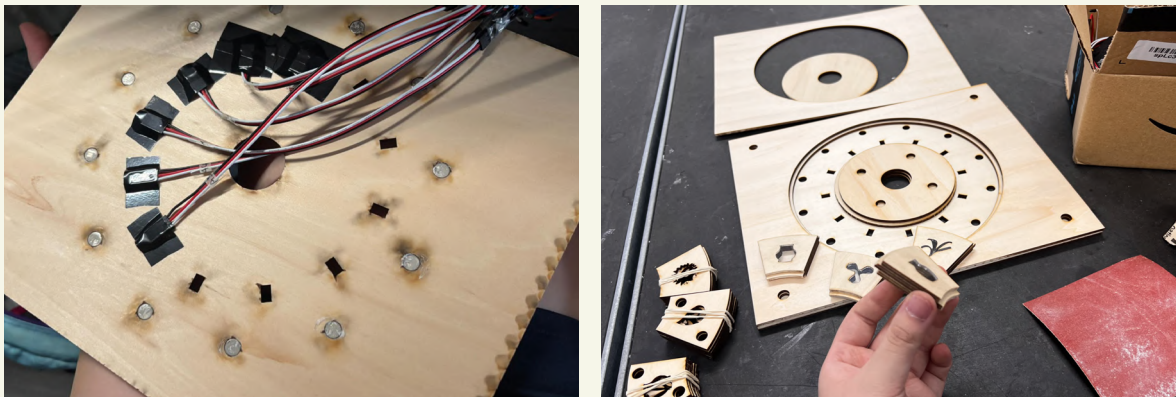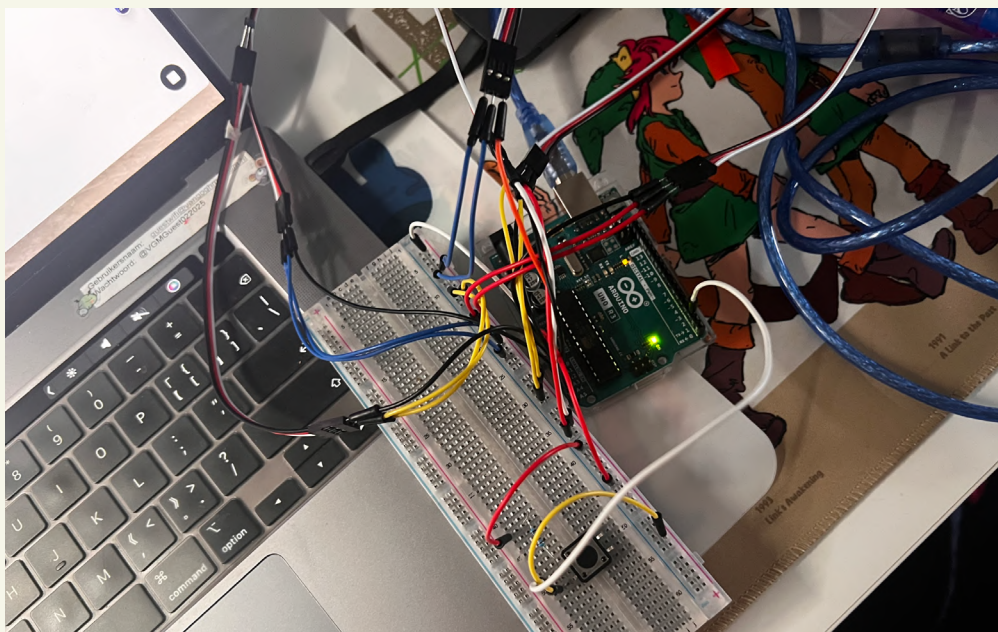
Figure 84 (above): Photos of assembly process

The physical prototype was constructed primarily to validate structural feasibility.

Materials and tools included laser-cut plywood and acrylic, 3D-printed button components, neodymium magnets, and Hall sensors, etc. Assembly combined glued joints for permanent fixation with magnets for detachable elements, balancing stability with flexibility.

A three-layer plywood structure created sliding rails, allowing tokens to move smoothly across the colour wheel. Each token was fabricated with a transparent acrylic window to clearly display the selected colour.

The final prototype measured 250 mm × 300 mm × 100 mm.

Compared with the final design proposal, **the prototype was scaled down (colour wheel diameter reduced from 300 mm to 206 mm), used simplified materials, and left components partially exposed rather than enclosed. A laptop screen temporarily replaced the projected display.**
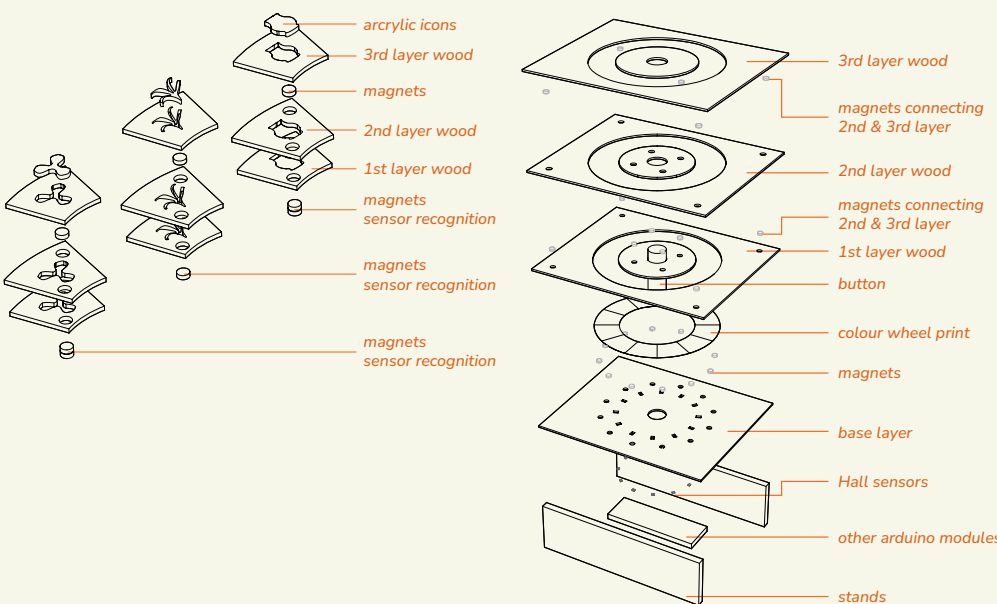
Figure 85: Exploded view of layered structures of tokens and the interaction base

arcrylic icons
3rd layer wood
magnets
2nd layer wood
1st layer wood
magnets sensor recognition
magnets sensor recognition
magnets sensor recognition

3rd layer wood
magnets connecting 2nd & 3rd layer
2nd layer wood
magnets connecting 2nd & 3rd layer
1st layer wood
button
colour wheel print
magnets
base layer
Hall sensors
other arduino modules
stands

5.4.3 Final Prototype Status

Despite these simplifications, the final prototype successfully captured the essence of the design. It enabled full interaction through tokens and button, established a seamless connection between physical and digital components, and realistically visualised colour changes in both the wool and the paintings. Overall, the prototype demonstrated all key functions and structures, closely reflecting the intended design, including the instruction texts on the prototype.

This working prototype confirmed the high feasibility of the concept and provided a credible platform for subsequent user testing.
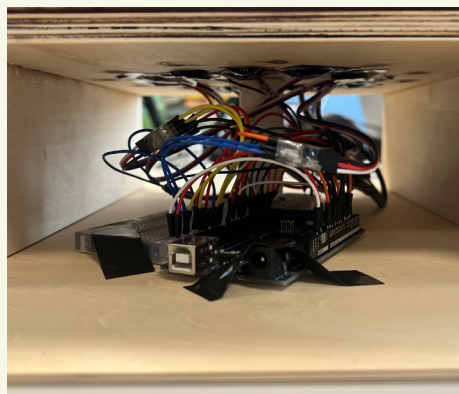
5.5 Final User Test

During the prototyping process, several informal quick tests were conducted with peers, friends, and museum staff. While the overall feedback was positive, the design could only be meaningfully evaluated through testing with real visitors at the Van Gogh Museum using the final prototype.

5.5.1 FInal User Test in VGM

Setup

The user testing took place in the café area of the Van Gogh Museum and lasted about 15 minutes per participant. Recruitment followed the same proactive approach as in the research phase: participants were randomly approached and invited by the author, but unlike earlier stages, which focused mainly on urban omnivores, selection here was broader to capture a wider range of visitor perspectives.

Each session centred on the interactive prototype, beginning with a short introduction to Van Gogh's wool story and contextualisation of the concept. Participants then engaged with the prototype before completing a short Likert-scale questionnaire based on the first five criteria defined in Section 3.4 (engaging, surprising, intuitive, informative, thought-provoking). The sixth criterion, practicality in the museum context, was assessed separately through the author's observation. All conversations were audio-recorded and later analysed using statement card analysis to extract qualitative insights.

See Appendix P & Q for more setup details and testing materials.

Results

In total, 12 participant groups (17 individuals) took part in the test, with 11 full conversation transcripts collected.

Quantitative results from the Likert-scale surveys were overall positive: averages were 4.7 for fun and engaging, 4.2 for surprising, 4.2 for intuitive, 4.5 for informative, and 4.5 for thought-provoking. Almost all participants considered the prototype highly attractive and engaging.

For qualitative analysis, about 160 effective statement cards were generated and clustered into eight themes. Five reflected the survey criteria, while three additional topics emerged from recurrent patterns and are supported by observations. (See Appendix R for the full list of statement cards.)

1. Attractive and engaging (criteria 1):
Most participants found the setting of the concept attractive and the interaction highly enjoyable, especially the freedom to change painting colours and use the tactile tokens. This was reinforced by the fact that almost all of participants engaged for a relatively long time during testing.

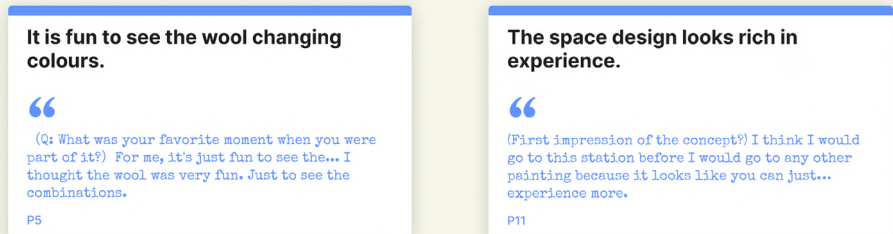**It is fun to see the wool changing colours.**

"

(Q: What was your favorite moment when you were part of it?) For me, it's just fun to see the... I thought the wool was very fun. Just to see the combinations.

P5

The space design looks rich in experience.

"

(First impression of the concept?) I think I would go to this station before I would go to any other painting because it looks like you can just... experience more.

P11

2. Surprising (criteria 2):
The animation and instant visual feedback created a strong sense of surprise, and most participants felt this form of interaction was novel within a museum context.

The results I have are surprising.

"

(Q: Is it surprising?) Some color combinations look surprisingly nice together. It's cool to see what unexpected combinations you can come up with.

P8

We've never seen this before.

"

We've never seen this before... the way it changed was really a wow effect every time... especially for the first time." (Q: "Was it surprising?")

P4

3. Intuitive and easy to use (criteria 3):
Most users quickly understood the logic of the interaction after short exploration. A few initially missed the button's role but managed to figure it out by observing others, while the texts were clear and helpful, and only the iris token icon caused some confusion.

I didn't understand how to interact right away. It took a bit of time.

"

Maybe it's just me... I was a little late in my head... how do I do it, and oh, press the button... so I think it was nice, but I just had to learn it.

P3

The instructions are very helpful.

"

(Q: Did the text help?) Yeah, I read it. It's super helpful. Especially because it's like two different things you have to do, so one is the tokens and one is the button.

P5
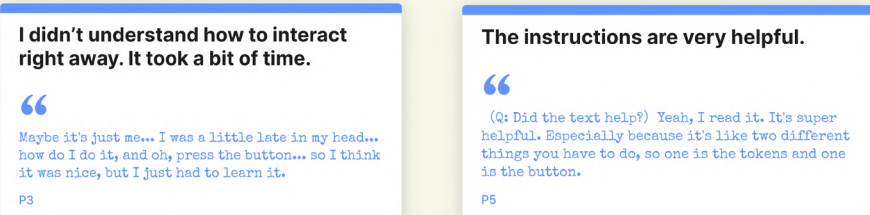
4. Informative and educational (criteria 4):
The interaction helped participants grasp Van Gogh's colour strategies in an intuitive way. However, observations showed that while they remembered the experience, only a few could clearly verbalise the underlying colour theories.

I learned about the wool story.

"

(Q: Informative?) Yes — learned about the wool box and Van Gogh's method of choosing colours.

P9

I learned about the effects of different positions (of colours).

"

(Q: Informative?) Realized how different positions can create high contrast or close colour schemes.

P9
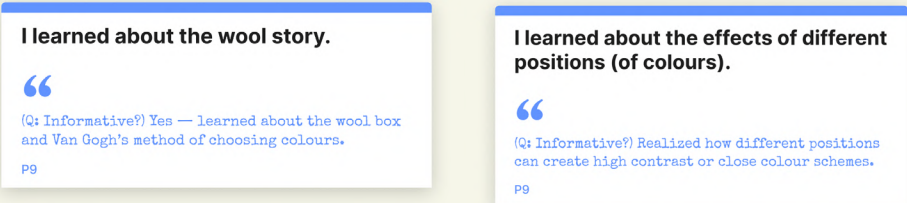
5. Inspiring and thought-provoking (criteria 5):
The most common takeaway was: "I see why Van Gogh chose these colours now." Most participants reached this understanding after comparing their own selections with the originals, rather than during the interaction itself. This effect was especially clear among duo visitors, who engaged in active discussions, while solo visitors tended to reflect more briefly.

The interaction process makes me remember the story longer.

"

(Q: Informative?) Yes, of course. If you have this little wool box... some people will read it... but if you have... the thing that you can do something by your own, more people will stop there... and you will remember it longer.

P11

By comparison, I learned something about Van Gogh's colour choices and his reasons.

"

I think that Van Gogh has a good reason why his painting is like that, because this one [mine] is not so good as the original... so I think I learned something. (Q: "Do you feel like you have learned something?")

P3

6. Influence of the original set in the design:
Many participants agree that the original set supported comparison and understanding of colour changes, but was often overlooked during interaction.

> **I didn't pay much attention to the original group.**
>
> "
>
> *I was just trying to do something of my own.*
>
> P1

> **The original set helped me realize the different positions of the colours.**
>
> "
>
> *I did notice that those colors were closer and then those ones weren't. After I revealed it and got it to like the original actual painting, I noticed that for the top one, they were all closer together.*
>
> P2
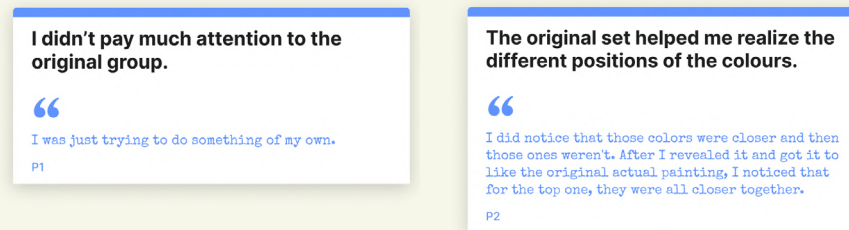
7. Relation to Van Gogh's story and experience:
Many participants stated they better understood the wool story through the prototype. A few even described the interaction as making them feel closer to Vincent's own colour experiments.

> **The experience makes me feel like I am doing what Van Gogh used to do.**
>
> "
>
> *Yeah, it makes me feel like I'm trying to do what Van Gogh used to do. (Q: "Does it make you feel like you relate to his experience?")*
>
> P3

> **The experience of wool story adds to the overall museum experience.**
>
> "
>
> *(Q: Related to Van Gogh's experience with wool?) It's a good touch to use something in the museum and expand on it(the wool story). Cool to take the wool story as a starting point and turn it into this.*
>
> P8

8. The element of wool:
Roughly half of the participants paid little attention to the wool ball, concentrating directly on the painting. Those who noticed it, however, regarded it as a charming and meaningful detail that added to the overall experience.

> **The wool is a cool detail, but I pay more attention to the painting.**
>
> "
>
> *(Q: Did you notice the wool or painting first?) Actually, I was more focusing on the painting... that's the one who really change. But the wool... changes right away if you change the color. So, you can see before you press the button... a vision how it will look like... it's also a cool detail, but I mostly looked at the painting on the left side.*
>
> P11

> **It was also interesting to see the difference between chosen colours in wool between in the painting.**
>
> "
>
> *I realized mostly that the choice that we made was totally different than the one we ended up with.*
>
> P9

5.5.2 Discussion

Findings & Insights

Drawing on the preceding findings, several deeper insights emerge:

- Some participants intuitively experimented with contrasting or complementary colour pairings, often inspired by the original paintings.

- All but one participant engaged for a relatively long time, indicating high desirability. However, long interaction may cause congestion in an actual exhibition.

- Only three participant groups clearly articulated the designed experience of connection between the wool interaction and Van Gogh's creation process; others had partial interpretations. Regardless of noticing the wool or not, all visitors had positive experience from the interaction.

- Overall, the interface and texts are straightforward and can remain as they are; the centre button, however, was sometimes ignored.

- The guiding question ("What would your choice be?") and the title ("Choose colour like Van Gogh") strongly shaped visitors' thinking and behaviour—for example, they tried to answer the question and sometimes copied the original set.

Implications for Improvements

Thus, based on the insights above, the design can be improved in the following ways:

- Rephrase the guiding questions to prompt reasoning and self-assessment—for example: "What might explain the differences from the original painting?" (to cue underlying colour principles) and "Are you satisfied with the wool colours?" (to focus attention on the wool first).

- Make the centre button more obvious—for instance, use a contrasting material or a more eye-catching colour.

- Create a more continuous, consistent visitor journey across the exhibition: introduce the wool story and Van Gogh's colour-testing process before the interaction stations (e.g., a brief panel or short video) so visitors arrive primed and potentially use the interaction as intended.

Limitations

There are limitations in the user testing design, as follows:

- The majority of participants (10/12) interacted only with Sunflowers due to time constraints, so findings may be biased toward that single set.

- Sitting in the museum café rather than standing in the gallery may have influenced visitor mindset and interaction behaviour (e.g., longer interaction time or more attention on verbal instructions instead of texts), and may not fully reflect in-gallery use.

- Although all participants passed the wool box and its text in the permanent collection, only 2 groups noticed or recalled this narrative. The explanation given in the testing was brief, which may have reduced understanding of the intended connection.

- The sample was small and convenience-based due to practical constraints, limiting generalisability and the precision of estimates.

Therefore, further in-gallery testing is recommended to validate and refine the initial findings.

5.6 Conclusions – Deliver

This chapter translated Select Colours Like Van Gogh from concept to a resolved interaction and spatial design, and validated its feasibility through a working prototype and on-site testing.

The evaluation from final user testing shows that the design meets all six criteria defined in Section 3.4: User testing insights confirmed strong performance on the first five—engaging, surprising, intuitive, informative, and thought-provoking. For the sixth, practicality, prolonged interaction suggested possible congestion; yet this was likely amplified by the café testing context, and museum staff considered the design generally acceptable for gallery use. The sixth criterion can therefore also be regarded as fulfilled.

In conclusion, the final design is both feasible and desirable, fulfilling all six evaluation criteria while directly responding to the guiding design goal from Section 4.2.

Figure 99 (right): Picture of the final prototype in final user testing

Chapter 6

Conclusion

6.1 Discussion

The project set out with a basic design goal defined in Section 1.1.2:

[Design an interactive prototype to experience, understand and utillise the theories and stories of colours reflected in Van Gogh's works for visitors in the Van Gogh Museum.]

Later with the insights from user research and iteration, the guiding design goal was defined in Section 4.2:

[An inviting and easy experience where visitors feel engaged, attracted, and curious—wanting to touch and try—without pressure, fear, or boredom. Through quick, hands-on interaction, they learn about Van Gogh's colour theories in a way that is enlightening and reflective, even without fully understanding, while not having to think too much.]

Alongside these goals, the project worked with six criteria (Section 3.4): (1) attractive and engaging, (2) surprising, (3) intuitive and easy to use, (4) informative and educational, (5) inspiring and thought-provoking, and (6) practical in the museum context. These criteria acted as a consistent framework throughout the process—guiding ideation, shaping design decisions, and structuring evaluation.

- Attractive and engaging: From early co-creation to final user testing, the concept consistently proved engaging; visitors were drawn to the tactile interaction and colour transformation, fulfilling the ambition of an inviting, hands-on experience.

- Surprising: Iterative testing confirmed the impact of the reveal animation, which provided novelty and delight in a museum context.

- Intuitive and easy to use: Most visitors understood the interaction quickly, demonstrating clarity of entry. Minor challenges (such as overlooking the central button) suggest areas for refinement but do not undermine overall intuitiveness.

- Informative and educational: This criterion was only partly met. While participants intuitively explored colour relations, few articulated theoretical understanding, and the wool story often went unnoticed, indicating the need for stronger contextualisation.

- Inspiring and thought-provoking: Visitors frequently reflected when comparing their palettes with Van Gogh's originals. This shows the design can trigger reflection, although often after the interaction rather than during it.

- Practical in the museum context: Technical feasibility and independence from staff intervention were achieved, and museum staff confirmed suitability for the exhibition context. Still, prolonged interaction times may cause congestion, requiring careful placement and pacing.

Taken together, these reflections suggest that the project has largely realised its guiding goal, excelling in engagement, surprise, and intuitiveness, while exposing limitations in educational clarity and large-scale implementation.

Beyond these six criteria, the evaluation can also be framed in terms of desirability, feasibility, and viability (Brown, 2009; IDEO.org, 2015). *Desirability* was confirmed through strong user responses: the design was engaging, intuitive, and thought-provoking. *Feasibility* was demonstrated by the seamless integration of physical and digital components, validated through prototyping and technical testing. *Viability* was recognised by Van Gogh Museum staff, who saw potential for integration into future curatorial strategies; while concerns about interaction time and visitor flow were raised, these were not considered critical barriers.

Overall, the discussion indicates that the project has succeeded in meeting its central ambition: transforming Van Gogh's colour strategies into an accessible and meaningful museum experience, while also revealing valuable directions for further refinement.
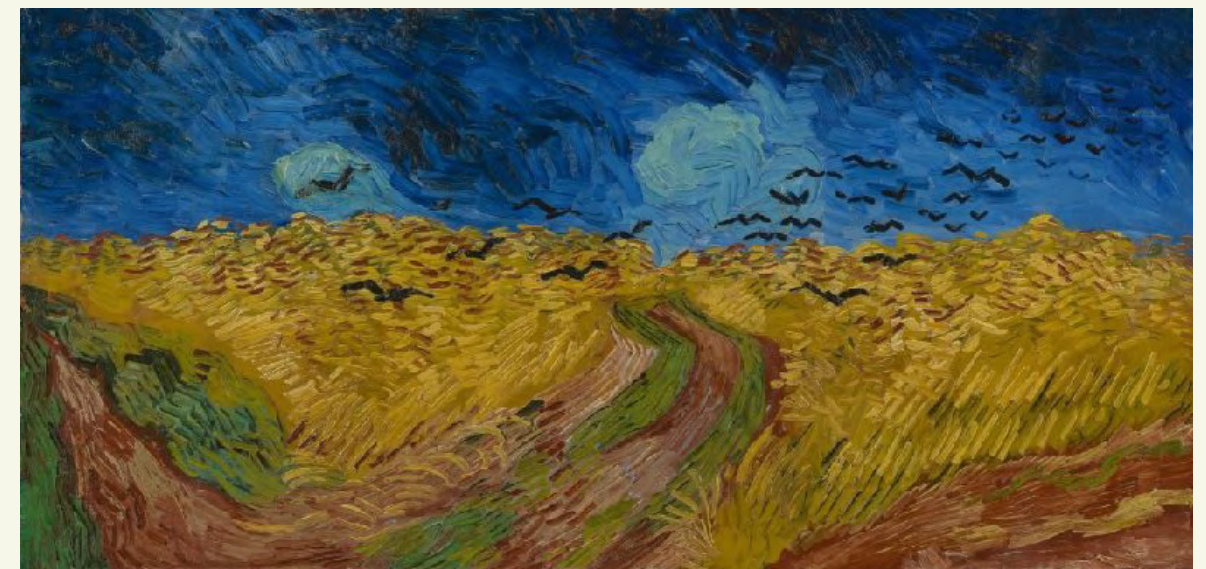

Figure 100: With the masking method, Wheatfield with Crows can also be the subject of this interactive installation: in this case, sky, wheatfield and the path, the grass can change colours seperately.

6.2 Recommendations

For future implementation and further development, four recommendations can be made:

1. Location and visitor journey:
Place the installation in a spacious part of the permanent collection, ideally mid-tour, and introduce the wool story and Van Gogh's colour-testing process beforehand (e.g., through a short panel or video). Reinforce the experience later in the tour by re-activating the theme, helping visitors connect reflection to subsequent artworks.

This addresses Criterion 4 (educational) and the reflective requirement of the design goal, but was not implemented in the project due to limited control over gallery layout and café-based testing within the project scope.

2. Painting selection & scalability:
The mask-based method is technically extensible to any painting. However, for clarity and usability, the chosen works should have a limited palette with distinct dominant regions. For more complex paintings, only the most vibrant and contrasting areas should be included. For example, Wheatfield with Crows could be used by separating sky, wheatfield, path, and grass into distinct regions (See Figure 100).

This recommendation strengthens Criterion 4 (educational) and potentially Criterion 1 (Engaging) by offering a broader and more representative picture of Van Gogh's colour strategies, but it was not realised in the project due to time constraints and the focus on two iconic, recognisable paintings (Irises and Sunflowers).

3. Educational depth:
Adjust supporting texts or guiding prompts that cue thinking, such as "What might explain the differences from the original painting?" or "Are you satisfied with the wool colours?" These can shift the experience from playful exploration toward deeper reflection.

This recommendation responds to Criterion 4 (educational) and Criterion 5 (thought-provoking), but was not implemented because feasibility testing was prioritised, and there was insufficient opportunity to test the effect of extended textual guidance in the gallery.

4. Further testing:
Conduct larger-scale evaluation in the actual gallery context with diverse visitor groups, to validate learning impact and assess congestion dynamics in actual galleries. This addresses Criteria 1 (engagement), 2 (surprise), and 6 (practical), but was not undertaken due to restricted access to exhibition spaces and the limited timeframe of the graduation project.

Figure 101:
Final design
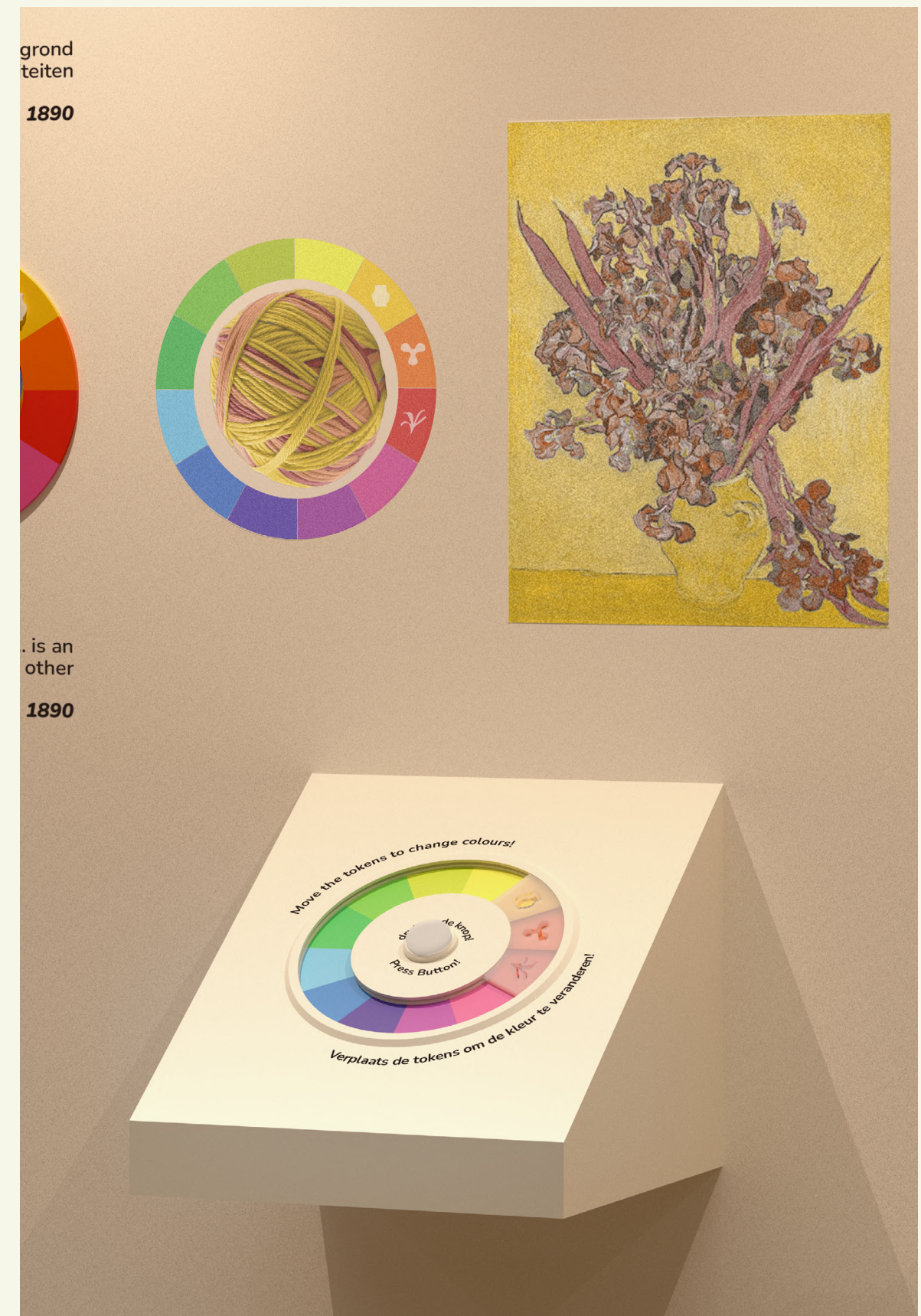
References

Wikipedia contributors. (n.d.). Van Gogh Museum. Wikipedia. Retrieved May 11, 2025, from https://nl.wikipedia.org/wiki/Van_Gogh_Museum

Design Council. (2005). The 'Double Diamond' Design Process Model. Retrieved from https://www.designcouncil.org.uk

Sleeswijk Visser, F., Stappers, P. J., van der Lugt, R., & Sanders, E. B. N. (2005). Contextmapping: Experiences from practice. CoDesign, 1(2), 119–149.

Sanders, E. B.-N., & Stappers, P. J. (2012). Convivial toolbox: Generative research for the front end of design. BIS Publishers.

Zimmerman, J., Forlizzi, J., & Evenson, S. (2007). Research through design as a method for interaction design research in HCI. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 493–502). Association for Computing Machinery. https://doi.org/10.1145/1240624.1240704

Vincent's Colours. (n.d.). Van Gogh Museum. https://www.vangoghmuseum.nl/en/art-and-stories/stories/vincents-colours

Berube, P. (2022). Towards a more inclusive museum: developing Multi-Sensory approaches to the visual arts for visually impaired audiences. https://doi.org/10.22215/etd/2022-15375

Guo, K., Fan, A., Lehto, X., & Day, J. (2021). Immersive Digital Tourism: The role of multisensory cues in digital museum experiences. Journal of Hospitality & Tourism Research, 47(6), 1017–1039. https://doi.org/10.1177/10963480211030319

Not, E., & Petrelli, D. (2018). Blending customisation, context-awareness and adaptivity for personalised tangible interaction in cultural heritage. International Journal of Human-Computer Studies, 114, 3–19. https://doi.org/10.1016/j.ijhcs.2018.01.001

Obrist, M., Gatti, E., Maggioni, E., Vi, C. T., & Velasco, C. (2017). Multisensory experiences in HCI. IEEE Multimedia, 24(2), 9–13. https://doi.org/10.1109/mmul.2017.33

Schifferstein, H. N. J., & Tanudjaja, I. (2004). Visualising fragrances through colours: The mediating role of emotions. Perception, 33(10), 1249–1266. https://doi.org/10.1068/p5132

Lin, A., Scheller, M., Feng, F., Proulx, M. J., & Metatla, O. (2021). Feeling colours: Crossmodal correspondences between tangible 3D objects, colours and emotions. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (pp. 1–12). ACM. https://doi.org/10.1145/3411764.3445373

Ouyang, M. Y. (2021). Psychology of colour in user experience/interaction: 'Emotional Colour in Visualisation' theory in interaction design. In 2021 2nd International Conference on Intelligent Computing and Human-Computer Interaction (ICHCI) (pp. 339–343). IEEE. https://doi.org/10.1109/ICHCI54629.2021.00076

Ucelli, G., Conti, G., De Amicis, R., & Servidio, R. (2005). Learning using Augmented Reality Technology: Multiple Means of Interaction for teaching children the Theory of Colours. In Lecture notes in computer science (pp. 193–202). https://doi.org/10.1007/11590323_20

Zhang, P., & Han, X. (2021). Understanding colour perception and preference: A cross-cultural study of colour-emotion associations. Color Research & Application, 46(5), 1041–1052. https://doi.org/10.1002/col.22688

Ucar E. (2015, September 8). Multisensory Met: touch, smell, and Hear art - the Metropolitan Museum of Art. https://www.metmuseum.org/zh/perspectives/multisensory-met

Museo Tiflológico. (n.d.). Museo tiflológico ONCE. https://museo.once.es/otras-webs/english

Pairet, P. (n.d.). Ultraviolet by Paul Pairet. https://paulpairet.com/#restaurants

Plutchik, R. (2001). The nature of emotions: Human emotions have deep evolutionary roots, a fact that may explain their complexity and provide tools for clinical practice. American Scientist, 89(4), 344–350. http://www.jstor.org/stable/27857503

Sanders, E., & Stappers, P. (2012). Convivial Toolbox: generative research for the front end of design.

BGIA – Institute for Occupational Safety and Health. (2007). Evaluation of static working postures according to DIN EN 1005-4 and ISO 11226 (BGIA-Report 2/2007). Sankt Augustin, Germany: German Social Accident Insurance (DGUV). https://www.dguv.de/medien/ifa/en/fac/ergonomie/pdf/evaluation_of_physical_work_load.pdf

International Organization for Standardization. (2000). ISO 11226:2000 – Ergonomics – Evaluation of static working postures. Geneva, Switzerland: ISO.

Federal Institute for Occupational Safety and Health (BAuA). (2007). AWE 108: International anthropometric data for work-place [PDF]. Bonn, Germany: Author. Retrieved from https://www.baua.de/DE/Angebote/Publikationen/AWE/AWE108e.pdf

Shenzhen Kuongshun Electronic Business Co., Ltd. (n.d.). RC522 MFRC-522 RFID module. Retrieved July 28, 2025, from https://nl.sz-kuongshun.com/uno/uno-board-shield/rc522-mfrc-522-rfid-module.html

RiceLee. (n.d.). 360 degree rotary encoder module. Retrieved July 28, 2025, from https://ricelee.com/product/360-degree-rotary-encoder-module

Department of European Paintings. (2010, March 1). Vincent van Gogh (1853–1890). In Timeline of Art History. The Metropolitan Museum of Art. Retrieved August 8, 2025, from https://www.metmuseum.org/en/essays/vincent-van-gogh-1853-1890

Van Gogh Museum. (2024). Van Gogh Museum strategic plan 2025–2028. Van Gogh Museum. https://www.vangoghmuseum.nl/en

Frayling, C. (1993). Research in art and design. Royal College of Art Research Papers, 1(1), 1–5.

Koskinen, I., Zimmerman, J., Binder, T., Redström, J., & Wensveen, S. (2011). Design research through practice: From the lab, field, and showroom. Morgan Kaufmann.

Kirk, A. (2021). Word cloud. In Sage Research Methods. Sage. https://methods.sagepub.com/chart/word-cloud

Porter, M. M., & Niksiar, P. (2018). Multidimensional mechanics: Performance mapping of natural biological systems using permutated radar charts. PLOS ONE, 13(9), e0204309. https://doi.org/10.1371/journal.pone.0204309

Smith, A. R. (1978). Color gamut transform pairs. SIGGRAPH '78: Proceedings of the 5th Annual Conference on Computer Graphics and Interactive Techniques, 12(3), 12–19. https://doi.org/10.1145/800248.807361

Van Gogh Museum. (2009). Letter from Vincent van Gogh to Theo van Gogh, Arles, on or about Friday, 24 May 1889 (letter no. 870). In L. Jansen, H. Luijten, & N. Bakker (Eds.), Vincent van Gogh: The letters. Van Gogh Museum, Huygens ING. Retrieved August 17, 2025, from https://vangoghletters.org/vg/letters/let870/letter.html

Van Gogh Museum. (2009). Letter from Vincent van Gogh to Theo van Gogh, Arles, 22 January 1889 (letter no. 573/741). In L. Jansen, H. Luijten, & N. Bakker (Eds.), Vincent van Gogh: The Letters. Van Gogh Museum / Huygens ING. Retrieved August 17, 2025, from https://vangoghletters.org/vg/letters/let573/letter.html

Brown, T. (2009). Change by design: How design thinking creates new alternatives for business and society. Harper Business.

IDEO.org. (2015). The field guide to human-centered design. IDEO.