



Evaluating the *ArtBot Guide*: A Toolkit for Enhancing Engagement with Digitized Museum Collections

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Abstract

Museums face an ongoing challenge in creating interfaces that engage visitors with their digitized collections and accompanying content within exhibitions in a meaningful, intellectually stimulating, and affective way. The *ArtBot Guide*, a web-based toolkit inspired by the interdisciplinary and critical-making approach of Digital Humanities, offers a novel solution. This toolkit comprises two key elements: the PolyCube, a dynamic visual representation mapping the spatial and temporal origins of collection artifacts and their interrelationships, and a Chatbot application, a conversational digital companion that facilitates self-paced exploration of specialized knowledge. This article integrates theories of digital humanities and interface design, curatorial practices in the post-digital museum, and the critical dynamics of situated knowledge production, reception, and dissemination. The proof-of-concept toolkit is tested in its two differing prototypes within two exhibitions: one examining gender and art-historical canonization processes, and the other addressing the contested colonial legacies within museum collections. These case studies illustrate the *ArtBot Guide*'s potential to enhance visitor engagement while at the same time critically reflecting on the use of digital tools in contemporary museology.

Keywords Museum collection digitalization · Digital interfaces · Chatbot application · Post-digital museum · Meaningful engagement · Contested legacies of collections

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1 Introduction

Since the 1980s, Western museums have progressively integrated digital technologies into their practices, enabling new ways of presenting and interacting with cultural heritage (Clough, 2013). Today, most large-scale Western museum collections have been digitized and made widely available via web-based platforms, accompanied by a growing wealth of digital content¹. In this ubiquitously digital era, screen-based interfaces have the potential to serve as more than static displays—they can become dynamic, interactive spaces that mediate knowledge, evoke affect, and foster intellectual engagement (van der Tuin & Verhoeff, 2022). However, museums continue to grapple with a significant challenge: how to design interfaces that not only display digitized collections but also engage visitors with them in meaningful ways (McTavish, 2008; Drucker, 2011; Matthews & Aston, 2013; Whitelaw, 2015; Waern & Løvlie, 2022).

Yet another fundamental challenge, often less explicitly acknowledged, is that digital technologies are not neutral. They carry embedded logics of power, extraction, and epistemic authority that can replicate and reinforce inequalities within the museum space (Noble, 2018; Klein & D'Ignazio, 2020). As museums turn interactive tools to mediate visitor engagement, they risk uncritically adopting digital infrastructures that privilege dominant narratives while marginalizing others. Noble (2018) has demonstrated how algorithmic systems can reinforce racial, gendered, and colonial biases, shaping what is seen and what remains hidden. Similarly, Klein and D'Ignazio (2020) argue that data-driven tools often reflect systemic inequities, as they rely on datasets shaped by existing social and institutional hierarchies. In the context of museum digitization, this means that chatbots and interactive visualization tools do not merely provide access to knowledge—they shape it, filtering which histories are surfaced, how collections are framed, and who is centered or excluded in these narratives. These concerns are particularly pressing in museums dealing with contested colonial collections, where digital mediation can either reinforce or challenge historical asymmetries in knowledge production and representation.

The *ArtBot Guide* is a proof-of-concept toolkit, that proposes an innovative solution to the first of these challenges, while keeping the latter in mind. Rooted in the interdisciplinary spirit of digital humanities (Drucker, 2012; Klein & Gold, 2016), the *ArtBot Guide* is a web-based smartphone toolkit designed to go beyond mere digitization, transforming museum collections into meaningful interactive experiences.

The first *ArtBot Guide* prototype was based on the curatorial narrative *The Tears of Eros: Moesman, Surrealism, and the Sexes* exhibition at the *Centraal Museum* in Utrecht at the beginning of 2020. The toolkit features two primary components: the PolyCube, a visual tool that maps the spatial and temporal origins of collection artifacts and their interrelationships (ideated by Windhager et al., 2018), and a Chatbot application, a digital conversation partner that allows visitors to explore curated

¹ The authors acknowledge the global digital divide as a significant and ongoing challenge. Only a fraction of the worlds' heritage collections has been digitized, and the process of digitization is proportionally unequally distributed. There are, however, different levels of work needed to be done. This paper aims to provide a toolkit for enhancing meaningful visitor engagement that holds the potential of tackling internal normative and colonial narratives within local Western museums.

narratives about exhibitions and artifacts at their own pace. The *ArtBot Guide* was designed not only to enrich interaction with the exhibition's physical and digitized singular artifacts and the collection as a whole but also to reveal the often-hidden social, historical, and cultural contexts embedded within them. The PolyCube helps visitors visualize these complex interconnections, while the Chatbot application transforms each artifact into a node of layered narratives. This offers opportunities for personalized and self-paced exploration. By embedding these digital tools within the curatorial framework, the *ArtBot Guide* represents a move toward more meaningfully interactive forms of museum engagement—while simultaneously raising questions about how its technological infrastructure shapes the knowledge it mediates.

This article is organized into six main sections. The first section details the design and development in the proof-of-concept state of the *ArtBot Guide*, including its conceptual underpinnings and possible technical implementation strategies. The second section provides a speculative walkthrough of *The Tears of Eros* exhibition and illustrates how the toolkit facilitates meaningful engagement. The third section situates the *ArtBot Guide* within broader theoretical discourses on digital museology and curatorial practices, digital humanities and interface design, as well as situated knowledge making practices.

To evaluate and test its broader applicability, in section four, the *ArtBot Guide* was adapted for a second case study: the contested colonial Nias/Indies Masks collection from the *University Museum Utrecht*. Here, the focus shifts to investigating how the *ArtBot Guide* can contribute to decolonizing exhibition practices by enabling visitors to critically engage with colonial histories and narratives. The process of adapting the toolkit technically and conceptually for this context is discussed. Finally, qualitative feedback from user surveys is analyzed to assess the toolkit's potential for broader real-world application and its capacity to support inclusive and thought-provoking museum experiences.

In section five, further theoretical reflections situate the tool within wider societal knowledge production dynamics. In section six, conclusion, lessons learned from the design and implantation of the *ArtBot Guide* from both case studies follow.

2 The Design Process of the *ArtBot Guide*

The *ArtBot Guide* is a critical making (Hertz, 2018)² and design thinking³ toolkit in the spirit of larger Digital Humanities endeavors. The toolkit was created with the specific *The Tears of Eros: Moesman, Surrealism, and the Sexes* boundary-pushing art exhibition in mind that took place at the *Utrecht Centraal Museum* (15 February to 16 August 2020) and was curated by Nina Folkersma, Marja Bosma, and Maia Kenney. The *ArtBot Guide* working group consisted of a social scientist, two digital

² Critical making was coined as a concept by Matt Ratto around 2008. The term should act as a glue between criticality, usually thought of as a linguistic endeavor, and making, usually associated with pure craftsmanship.

³ Originating from the engineering community, design thinking aims to solve problems across disciplines in a creative and playful team-based setting. Its main characteristic is designing for user-centeredness. In other words, the person using the design solution should be benefiting from it in meaningful ways.

humanities scholars, a cultural theorist, and an IT specialist. Curator Maia Kenney provided important museum and topic-related insights. The *ArtBot Guide* concept was ideated through the design thinking cycle in multiple working sessions over three consecutive months. The toolkit, in its proof-of-concept state, aims to function as a starting point in thinking about the possibilities of engaging more meaningfully and affectively with digitized collections in museum spaces.

2.1 The Tears of Eros: Moesman, Surrealism, and the Sexes Exhibition

The exhibition departed from the work of Surrealist painter Johannes Moesman (1909–1988). The only André Breton-approved Dutch first-generation Surrealist, Moesman remained a complicated figure in the Dutch art scene until his final days. His work, often highly eroticized and transgressive, frequently challenged societal norms and artistic conventions in the Netherlands, a country where Surrealism never gained the same foothold as in France or Belgium. Moesman's provocative depictions of female bodies, infused with both humor and unease, sparked debates about the intersection of eroticism, objectification, and artistic freedom. His resistance to aligning with Dutch modernist movements, combined with his idiosyncratic interpretation of Surrealism, led to a career that was both celebrated and sidelined—recognized internationally yet often at odds with the mainstream Dutch art establishment. Even in later years, his work continued to provoke questions about censorship, gender, and the role of Surrealism in the Dutch cultural landscape. This cemented his status as an outsider within his own artistic community (Bosma, 2020). The *Centraal Museum* now hosts 113 items related to Moesman in their (digital) collection.

The exhibition had two primary aims: first, to contextualize Johannes Moesman within an international Surrealist framework (*Room One*), and second, to significantly expand the conventional understanding of Surrealism. Assistant curator Maia Kenney explained that while Moesman served as the exhibition's starting point, the curatorial approach sought to position him within broader global Surrealist narratives while simultaneously advocating for the recognition of women and gender non-conforming artists, whose contributions have historically been overlooked (Kenney 2020, personal communication, 20 May).

Departing from and problematizing the works of traditionally accepted surrealist artists (*Room Two*), the exhibition further illuminated works by female, and non-binary artists (*Room Three*), and dug deeper into the historical roots of the movement (*Room Four*). The exhibition also offered a contemporary perspective (*Rooms Four and Five*) on the themes explored in 1920s Paris, engaging with topics of power-relations between men, women, and non-binary people and complex current social issues such as the *#MeToo* movement, gender nonconformity, and reproductive rights.⁴

⁴ Since the exhibition was closed due to the COVID-19 pandemic, a virtual tour of the four main rooms of the exhibition was created by "Author" and assistant-curator Maia Kenney. See for a visual impression of the 360 tour: *The Tears of Eros 360 Tour - File Archive v2.zip - Google Drive*.

2.2 Technical Description of the ArtBot Guide

The *ArtBot Guide* toolkit is envisioned as a web-based interface for a handheld mobile device, consisting of the PolyCube (Windhager et al., 2018) and a Chatbot application. The strength of the *ArtBot Guide* lies within the combination of the two highly adaptable tools. It is important to note that the first proof-of-concept prototype was only a mock-up along which different technical implementation strategies were discussed.

Designed by Florian Windhager, Saminu Salisu, Günther Schreder, and Eva Mayr, the PolyCube model information visualization interface provides multiple ways of engagement with a collection—from a geographical map (left side cube of Fig. 1) to a more abstract time-space constellation, visualizing the different categorical aspects of the collection (middle cube of Fig. 1) or the relationships between the separate collection data point objects (right side cube of Fig. 1). It also offers three different formats for seeing the ways of engagement—in a space-time cube, as ‘time chunks’ juxtaposed or, lastly, superimposed onto one another. For the first prototype of the *ArtBot Guide*, only the geographical map space-time cube visualization of the PolyCube was chosen (left side cube of Fig. 1), as it allowed us to support *The Tears of Eros* exhibitions’ curatorial time-space narrative and because of the limited screen space available on a handheld mobile device. Depending on the exhibition objectives, different visualizations can potentially be chosen from the options provided by the PolyCube.

The designer team initially offers two possible ways of making the PolyCube available to interested audiences - as a web-based platform or as an interactive screen at the entry of a museum (Windhager et al., 2018: 13). For *The Tears of Eros* exhibi-

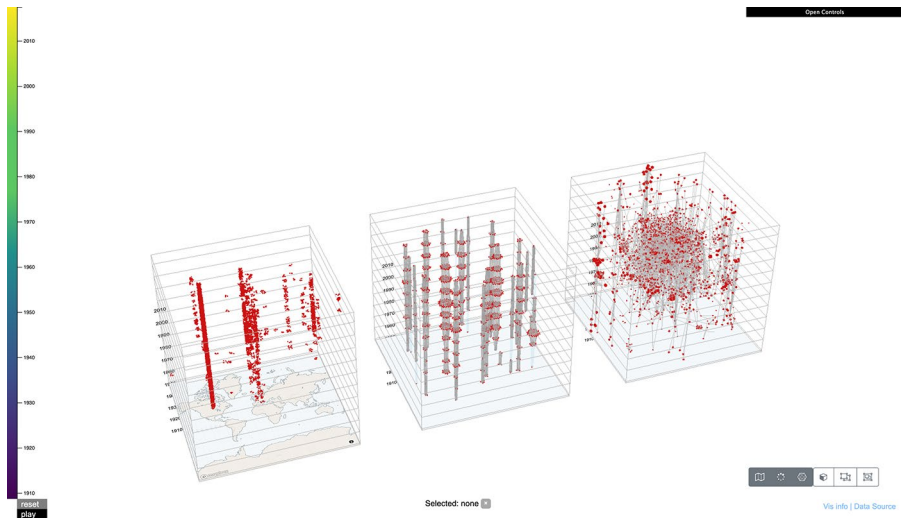


Fig. 1 A screenshot from The PolyCube Model. Use Case: IMDB Data.¹⁶

¹⁶ See: <https://github.com/Simon-Dirks/polycube-chatbot>

tion an adapted web-based solution was used. Room by room, the exhibition aimed to build on the traditional narrative of what Surrealism is, adding aspects of complexity over time, space, gender, and themes explored. Within the *ArtBot Guide* application, the PolyCube would move along with the visitor, designed as an integral part of a smartphone web-based interface. The metadata of the digitized/exhibition-specific artworks displayed in exhibition rooms would be visualized in the PolyCube model upon entering respective rooms - artist names, genders, artwork creation time, and place. The single works of art would be assembled in an interactive visualization as data points in a space-time cube and, as a result, provide a mental model of the room. The constellations of data points in different rooms throughout the visitor's journey would function as an aid in visualizing the unfolding of the main goal and narrative of the exhibition — differentiating and making more nuanced the traditional art historical narrative of Surrealism.

The Chatbot application⁵, linked to a Data Knowledge Base, offers opportunities for making state-of-the-art knowledge and background information accessible about individual exhibition objects and the collection as a whole. It can be linked to information from publicly available encyclopedia-like webpages (for example, *Wikipedia*) or specialized art institution resources like the *Metropolitan Museum of New York*. Here of crucial importance is the reflection as to what kind of resources are being provided for the visitor. A substantiated, critically reflected-upon preselection by the curators is of most importance. The Chatbot can also be linked to the rich and usually complex research information gathered by curators especially for the exhibition that usually does not make it onto exhibition walls. The Chatbot therefore functions as a conversation partner that has information available on factual knowledge around the specific exhibition topic online and the specialized research narrative work done for the exhibition by its curators. This information can be called up in detail on-demand. Navigating through the exhibition by following a personal route, individually chosen “sticky images” (Bal 2000, as cited in *AUTHOR*) can then be explored in more depth, strongly providing for an interest- and affect-driven experience.

In the temporary exhibition *The Tears of Eros*, the two tools, the Chatbot and the PolyCube, work alongside each other. The PolyCube provides the context—a birds-eye view of the single exhibition rooms, as well as the whole exhibition collection, while the chosen knowledge databases provide contextual and additional detailed information on a specific artwork, as well as on a general knowledge level. After seeing the zoomed-out perspectives on the exhibition collection in the PolyCube model (for example, general space-time orientation, as well as how the artworks relate to the theme of the specific room) it would then be possible to zoom into the very minute details and contexts of a single artwork through the Chatbot function.

The *ArtBot Guide* smartphone application is intended to function on a (museum-associated) webpage. The main technology for developing the *ArtBot Guide* consists

⁵ The most analyzed examples of museums using Chatbots up until the contemporary moment include the Anne Frank House in Amsterdam, which uses Facebook Messenger, the Cooper-Hewitt Museum offering “Object Phone” since 2013 which answers spoken questions about objects within the collection, and the House of Milan, a group of four historical home-museums in the city that offers a Chatbot game for exploring the physical surroundings, also operating on Facebook Messenger. In the latter example, 66% of engaged visitors identified the Chatbot as a useful learning tool (Gaia et al. 2019: 320).

of Angular, a TypeScript-based open-source web application framework, in combination with Ionic, an open-source software developing kit for mobile application development.⁶ All artwork-related information relevant for the Chatbot option is foreseen to be stored in a structured Linked Data Knowledge Base (database). This data could either be stored using self-hosted and open-source tools such as Virtuoso (<https://github.com/openlink/virtuoso-opensource>), Oxigraph (<https://github.com/oxigraph/oxigraph>), or any other graph database or triple store providing a SPARQL endpoint. Alternatively, an existing (free and open) knowledge base such as Wikidata (<https://www.wikidata.org/>), which provides a SPARQL endpoint out of the box could be used.

In the application, users would be presented with a short introductory text, after which they could ask free questions (e.g., “Who was Johannes Moesman?”). The answers to the questions would be retrieved from the Linked Data Knowledge Base by using SPARQL queries, a semantic language often used for querying Linked Data knowledge bases.

The Linked Data aspect of this database means that the information is structured in a way that allows the computer to make links/relations between the objects, people, places, etc. This would also allow for the retrieval of more associative and contextual information. There are many approaches to Linked Data question answering⁷. We propose using a pattern-based approach to construct SPARQL queries from natural language (e.g., Steinmetz et al., 2019), instead of relying on black-box AI-driven approaches such as Large Language Models (LLMs), both because of environmental considerations (Strubell et al., 2019) and a desire for transparency and algorithmic explainability. In the proof-of-concept prototype, Wikipedia and Tate Britain were linked for testing purposes.

As for user data and input – it would generally not be stored. However, it might be of interest to curators and researchers to see what kind of questions are asked by the visitors, and if the answers received were appropriate. In this context, we envision an opt-in system where users can give explicit consent for their questions to be (temporarily) stored for evaluation purposes.

3 The Tears of Eros: Moesman, Surrealism, and the Sexes Experienced with the ArtBot Guide

Upon entering Room One of the exhibition, *Exploration of Sexuality*, the visitor would be welcomed by the Chatbot application and given a shortened version of the introductory text on the museum wall. A PolyCube would appear underneath the first message, substantiating the claim that Surrealism evolved in Paris in the 1920s and 1930s and that traditional members of the movement were men only. A “cognitive collage” of different artists, names, and paintings would be assembled in a men-

⁶ “A custom web application is developed using the widely used, web-based Angular framework, combined with Ionic, a front-end framework. These frameworks make it easy to adhere to current standards and create an accessible user interface similar to what the average internet user is used to,” *AUTHOR* explains.

⁷ See Questions Answering over Linked Data (<https://qald.aksw.org/>) for a series of challenges on the topic.

tal model on a geographical map, marking their space-time origins. Further on, the Chatbot would offer to ask further questions of interest to the audience. (see Fig. 2.).

Entering Room Two, *Women as Fetish*, a shortened version of the curator's introduction would be displayed above the PolyCube visualization. This time the data points are scattered around wider Europe. The time slider moves between the 1920s (with most works made around then) and 2013. 2013 only marks Meret Oppenheims, one of the few well-known female Surrealists. The PolyCube would also color-code Oppenheim: the only orange dot, a woman artist, on the map, making the traditional male-dominated Surrealist narrative excruciatingly evident.

Room Three, *The Women of Surrealism*, would introduce the curatorial thinking behind the artwork exhibited above the interactive PolyCube visualization, showing a sudden orange and yellow dot explosion of works of art created by women and gender non-conforming artists respectively across time and geographic locations from North and South America and Europe. The *ArtBot Guide* would offer to ask any clarifying questions as to the works seen in the room or the wider context of the time.

The final Room Four, *The Cult of the Divine Marquis*, would introduce Marquis de Sade as a common theme that unites many artists working with surrealist themes and would show the PolyCube visualizations time-slider going all the way back to

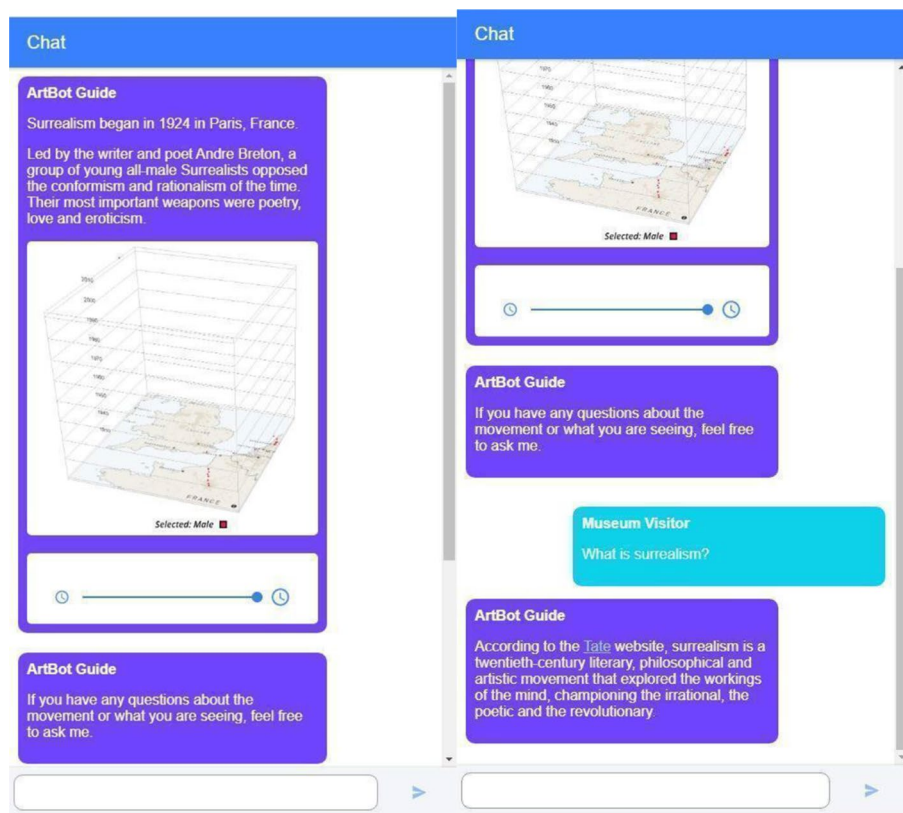


Fig. 2 Mock-up of the *ArtBot Guide* in room one

the 1700s. It would also show geographic locations of the works exhibited, covering North America and Europe. If one had never heard about Marquis de Sade before, a short piece of information from a Wikipedia article could be retrieved (see Fig. 3.).

Before leaving the exhibition, the *ArtBot Guide* would offer an overview of the entire digitized exhibition collection data in PolyCube. It would reveal the fact that there were men, women, and non-binary artists working on the themes of Surrealism in the 1930s in Paris and around the world ever since then. Furthermore, the very Paris- and male-centered movement (as recorded in traditional art histories) would have exploded in not only space and gender but also in time, showing the themes present in Surrealism going back to at least the 1700s and still being discussed in the contemporary moment. Visually, there would be a shift from an all red-dotted map centered around the 1930s Paris to a map showing Europe and the Americas throughout the twentieth century covered in red, orange women artists, and yellow non-binary artists scattered around the space.

The PolyCube would have visualized and made the origin and contextual meanings of the exhibited artworks (and therefore the curatorial narrative) prominently visible, the Chatbot function - upon interest providing additional information. It can therefore be argued that, overall, the *ArtBot Guide* would make for a meaning-

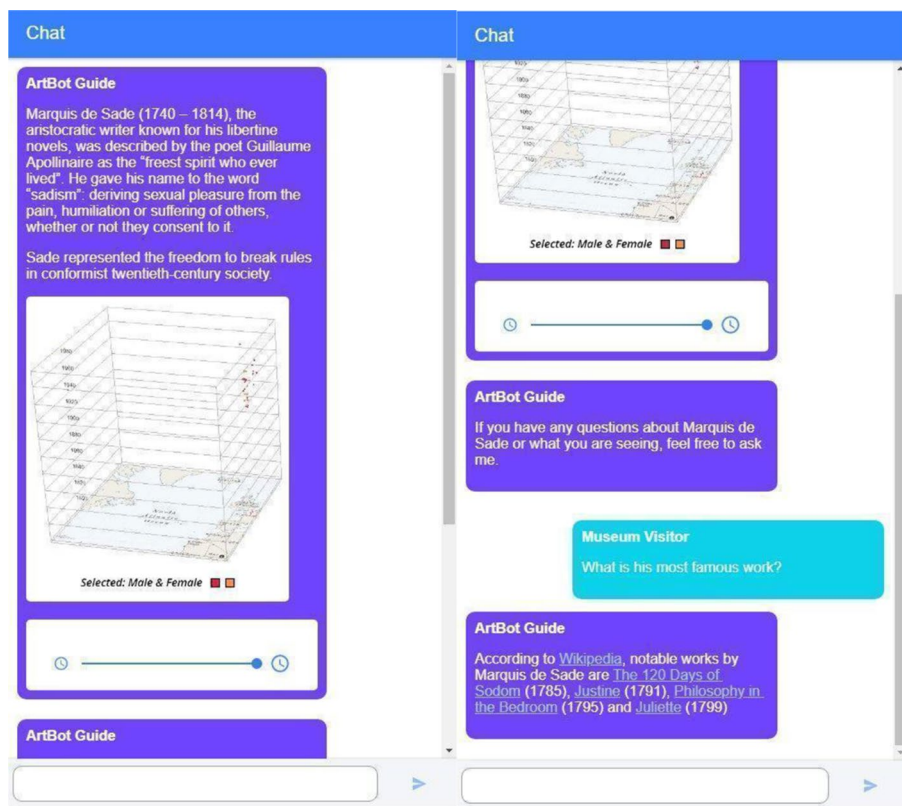


Fig. 3 Mock-up of the *ArtBot Guide* in room four

ful (dealing with intentions, origins, contexts, and/or semantic contents), adaptive knowledge providing and an affect-driven visitor engagement that assists in building one's own coherent and meaningful narrative from the information gathered throughout the exhibition experience.

4 A Reflection on the Theoretical Grounding of the *ArtBot Guide* Toolkit for *The Tears of Eros* Exhibition

4.1 Digital Museology and Curatorial Practices

Leading Western art museums have entered what has been termed a “postdigital” phase (Parry 2010), where digital technology is no longer confined to a separate department but has become an all-encompassing feature of the museum. New digital spaces, particularly museum-associated webpage interfaces, have emerged as sites for exploring innovative forms of engagement with both temporarily and permanently exhibited digitized collections.⁸

One of the dominant forces in this digitization process is Google Arts & Culture, whose director, Amit Sood, identifies three widely accepted benefits of collection digitization: expanded accessibility and outreach to both new and existing audiences; the ability to explore artwork in minute detail; and the option for users to download and “make the artworks their own” (Sood, 2016).⁹ While these benefits are often framed as democratizing, such narratives obscure the extent to which digitization is shaped by corporate imperatives, commercial extraction, and specific epistemic frameworks. As Nanna Bonde Thylstrup argues in *The Politics of Mass Digitization* (2024), large-scale digitization projects—particularly those led by corporate entities—are not neutral acts of preservation or accessibility. Rather, they involve processes of selection, omission, and infrastructural control, reinforcing existing inequalities in knowledge production and privileging certain forms of engagement over others.

The digitized object collection interface also assumes interactivity as a key feature of the digital experience. McTavish (2008: 232) reflects on this expectation of interactivity, highlighting the delicate balance between physical interactivity (such as zooming into the details of a painting) and intellectual operations (engaging with the subject matter and meaning of the artwork). Yet the type of engagement enabled by platforms like Google Arts & Culture is shaped by commercial logics, often privileging high-resolution visual consumption over deeper curatorial or contextual exploration. As Thylstrup (2024) emphasizes, corporate-driven digitization projects frequently commodify access to knowledge, extracting value from cultural heritage while dictating the terms under which it is encountered, interpreted, and circulated.

⁸ In the case of the Dutch *Rijksmuseum*, a digitally accessible update is provided on *Operation: Night Watch*, the largest conservation project to be ever conducted for the star piece of their collection, Rembrandt's *Night Watch*. online. See <https://www.rijksmuseum.nl/en/stories/operation-night-watch/story/lead-containing-layer-to-protect-the-night-watch>,

⁹ See “*Rijksstudio*”, critical case study of collection digitization in Rühse (2017).

Foregrounding these dynamics is essential to understanding that technologies are not neutral—they embed assumptions about what constitutes legitimate interaction, who controls access, and how cultural heritage is mediated. The involvement of corporate actors in digitization raises fundamental questions about who benefits from digitized museum collections, whose histories are amplified or erased, and how public institutions increasingly rely on private infrastructures to shape engagement with cultural heritage. Recognizing these stakes is crucial for critically examining digital interfaces in museum contexts, as well as for developing alternative models that resist extractive tendencies in favor of more inclusive, transparent, and ethically grounded approaches to digitization. Collections within the new public space may have achieved interactivity but, upon closer inspection — in most cases only the surface level has been touched as of yet.

“A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing.” (ICOM n.d.)

Reads the latest ICOM definition of a museum. The aspiration to offer educational, enjoyable, knowledge sharing and reflection provoking experiences beyond trivial interactivity cannot be achieved through surface level interactions. Thus, the current challenge for this new space of museum interfaces is to develop tools and toolkits that engage interested audiences with the artworks’ meanings (Junginger et al., 2020) — intentions, origins, contexts, and/or semantic contents (Bal, 2007) – in an intelligent and affective way. Our proposed model, the *ArtBot Guide*, strives for a meaningful engagement in an intelligent and affective way with post-digital museum’s digitized artifacts in supporting an active creation of visitors’ own narratives - providing contextual, new and critical knowledge on the subject matter at hand, while letting them combine the information provided with related information on their own terms in an integrated space.

4.2 Digital Humanities and Interface Design

In the case of the *ArtBot Guide* for *The Tears of Eros* exhibition, the interface was built inspired by recent reflections on the concept and use of it within Critical Digital Humanities. Johanna Drucker argues that the user interface is different from the linear and finite constraints of print media (such as the traditional wall descriptions in museums) and thus can provide a space for mental provocation in cultural contexts, as our bodies and sensory apparatuses actively engage with the new environment (Drucker, 2011). Mitchell Whitelaw has critiqued interfaces of digitized cultural collections, arguing that the traditional search-box entry point does not support exploration of the collection unless you know exactly what you are looking for. Instead, Whitelaw proposes “generous interfaces”—that “[.] would also enrich interpretation by revealing relationships and structures within a collection” (Whitelaw, 2015). In the past decade

there has been notable interest going beyond the surface-level approach for online collections (Glinka, 2018, Glinka & Dörk 2018, Windhager et al., 2018, Windhager et al. 2019), to reveal their meanings – the inner structures of a collection - that might not have been visible when stored in paper-based catalogs or put on exhibition walls. Additionally, Media scholar Brandon Hookway has defined the intelligence of an interface in terms of the extent to which the human–machine interface enables adaptive forms of interaction (Hookway, 2014).

Within the *ArtBot Guide*, the PolyCube visualizes the exhibitions’ narratives, the displayed individual artworks and the collection as whole, essential space-time dimensions, revealing an easy to grasp, explorative (Whitelaw, 2015) abstracted visual image of the collection room by room (Windhager et al., 2018). Thereby, moving beyond search-box collection exploration dynamics. Meanwhile, the Chatbot function intelligently (Hookway, 2014) adapts to the visitors needs and can provide additional and personalized information) on the collections meanings - artefacts’ intentions, origins, contexts, and/or semantic contents, provoking meaningful engagement.

4.3 Performative Materiality

To further ground the potential of *ArtBot Guide*-like toolkits for future applications to be built, from a theoretical perspective, it is important to mention the changing thinking about materiality in relation to digitality. Poststructuralism and postmodernism, freeing historical objects from a strictly materialist epistemology, view “[.] knowledge of the “real” as derived through our ideas and concepts, including linguistic, spatial, cultural, and ideological compulsions” (Cameron, 2007: 53). Drucker’s concept of digital performative materiality, which moves beyond both material objectivity and postmodern perspectivism, emphasizes the perception of digital objects as an interpretive *event* that is essentially a dynamic human – nonhuman interaction and writes itself into the larger frameworks and latest thinking about performativity - coming into being.¹⁰

Just as the artworks on a museum wall, the clickable dots within PolyCube or digital objects in the form of digitized museum exhibition artworks within the Chatbot application are received, perceived, and given meaning, language, and significance/urgency. Both the material and digital objects’ materialities become entangled with a human being encountering and at the same time *performing* the work, producing a very situated experience-, drive-, disposition-, and capacity-formed meaning (Drucker, 2013).

¹⁰ “The notion of performativity has a distinguished career in philosophy,” (Barad, 2003) writes Karen Barad to further recount the traditional trajectory that is initiated by British philosopher J.L. Austin interests in speech acts, then updated by Jacques Derrida’s poststructuralist ideas. Further on, Judith Butler has reworked the notion of performativity in relation to identity through Foucault’s productive effects of regulatory power, saying that gender is not something with inherent essence, it is rather a doing. Barad then goes on to explain her addition to the discussion. All bodies, not merely “human” bodies, come to matter through the world’s iterative intra-activity—its performativity.

4.4 The *ArtBot Guide* within the Post-Authentic Framework

Additionally, Lorella Viola has recently described the post-authentic framework as a useful method in thinking about digital objects and tools -.

The post-authentic framework re-examines the digital as situated and partial, an extremely convoluted assemblage of factors and actors, themselves part of wider networks of situated components, processes and mechanisms of interaction and the various forms of power embedded in computational processes and beyond. As such, far from being mere immaterial copies of the originals, digital objects are acknowledged as bearing consequences which transcend traditional questions of authenticity; digital objects are never finished nor they can be finished; countless versions can endlessly be created through processes that are shaped by past decisions and in turn shape the following ones. Thus, the post-authentic framework engages with both products and processes which are understood as never neutral, as incorporating external, situated systems of interpretation and management and therefore bearing consequences which go beyond the object-centred culture of authenticity. (Viola, 2023, p. 140)

The *ArtBot Guide* is indeed a post-authentic object at the core of which are two highly adaptable tools – the PolyCube and a Chatbot application. Both tools and their combinations can be iterated in endless versions both in terms of narrative content as well as technical characteristics. The critical reflection aspect within the above-described first proof-of-concept prototype was the curators' boundary pushing art historical narrative. It should also be noted that the PolyCube space-time visualization can be critiqued as positively normative – meaning, it shows the contemporary political map and a standardized historical timeline. Both have been rightfully argued not to suit impartial, situated and affective knowledge representation within the humanities (Drucker, 2020). However, within the public-oriented *The Tears of Eros* case exhibition, it was agreed upon to best focus on the curators' main art-historical boundary pushing exhibition narrative, in keeping the PolyCube as its supporting visualization. In other cases, it could be valuable to look more into the graphical representations of space and time to make them even more evidently a situated, partial, adapted, lived experience.

With each iteration, knowledge within the *ArtBot Guide* will always be situated differently. Both in terms of narrative content and the implied technical functions and visualizations. With each iteration, the choice of use of the PolyCube functions should be reflected upon, as well the use of Chatbot in terms of technical implementation and databases linked. Additionally, it should be decided upon which of the choices should be communicated directly to the visitor and which should remain implied.

4.5 The Institutional Challenge of Meaningful Visitor Engagement in the Age of the Post-Digital Museum: the *ArtBot Guide* Contribution

In the physical museum exhibition space for *The Tears of Eros: Moesman, Surrealism, and the Sexes*, color-coded rooms gave sensory cues as to when a new topic began and what to pay more attention to. Conceptually, it was a challenging exhibition, demanding basic Western cultural-historical knowledge of the twentieth century, the more specialized art historical knowledge of and around the period, and

knowledge of surrealist symbolism in particular. It aimed to deconstruct and reconstruct the traditional narratives of Surrealism. Walking through the exhibition without the help of an *ArtBot Guide*-like toolkit, one could read artists' birthplaces and the artworks' creation years, but the information of and around the collection was hardly contextualized. The separate works of art remained an aggregation of cognitive collages. Additionally, an individual visitor who has partial knowledge about the complex topics being discussed may leave without the necessary processing and encoding of the experience. A museum visitor familiar with the topics, alternatively, might leave longing for additional contextualized details.

Interfacing with the digitized exhibition through the *ArtBot Guide* provides a mental model and an accompanying data visualization that shows the inner logics of the digitized exhibition collection to both types of visitors. The digitized images take up a complimentary life within the PolyCube model as dots in the space-time cube, grounding the artists' birthplaces and the artworks' creation years within the overarching narrative of what is Surrealism in a mental model. The Chatbot application allows users to call up related information on demand for a specific artwork or any other exhibition related topic based on personal interest. The *ArtBot Guide* does not disrupt the physical exhibition space. It builds upon it, making visible the profound curatorial work that has gone into the conception and realization of the exhibition—normally remaining hidden and inaccessible.

Work on the *ArtBot Guide* departed from reflections on post-digital museums' pressing need to engage visitors with their digitized collections in meaningful ways, with the digital humanities notion of generous interfaces and the concept of performativity in mind. The speculative user experience has aimed to show that the *ArtBot Guide* interface can provide visitors with the possibility to perform knowledge of and around a collection and its' exhibition in a meaningful, generous, engaging, and curiosity-driven manner. However, with every iteration, it is of crucial importance that critical reflections in terms of content and technical solutions should be made.

4.6 Interlude: From *The Tears of Eros* To the Nias/Indies Mask Collection

The *ArtBot Guide* interface was initially created for a boundary-crossing art exhibition after it was already conceptualized. The biggest learning point for further testing was the fact that the *ArtBot Guide* has the potential to be a complementary curatorial toolkit. In the physical exhibition or online space, it could support an exhibition narrative in an interactive way and include enriched information that otherwise would remain behind closed doors, as illustrated in the case of *The Tears of Eros*.

The traditional narrative of Surrealism was to become more nebulous room by room. Yet the exhibition was not planned with the explicit thought in mind that the first room would represent male artists in the 1920s Paris (as illustrated by the PolyCube) or that the last room would represent women and non-binary artists alongside male artists in a timeline spanning more than two hundred years, making the traditional Surrealist narrative explode in time, space, and gender. Kenney also noted that it could have been valuable to see the works interactively visualized at the time of conceptualizing the exhibition and its narrative unfolding through the rooms to make these curatorial choices more conscious and explicit both for curators and visitors.

Due to the COVID-19 pandemic, the originally planned visitor test of the application was no longer possible before the temporary exhibition was taken down. Since we deemed it crucially important to further explore museum visitor experiences with the *ArtBot Guide*, the pandemic allowed us to do it in an altogether different setting - context- and collection-wise. The Nias/Indies mask collection at the *University Museum* was chosen as a viable case study to explore whether the *ArtBot Guide* has the potential of being a museum exhibition complimentary toolkit for meaningful visitor engagement on multiple levels and, at the same time, test the capabilities of the *ArtBot Guide* in assisting with the creation of contested museum exhibitions that require new forms and narratives. The themes of un/gendering an art-historical narrative and decolonizing a museum collection share a critical and creative edge that makes for a good testing site for work on the three levels of meaningfulness, knowledge and information, and affect and embodiment.

5 Case Study - The Nias/Dutch East Indies Mask Collection

The Nias/Indies masks collection is one of the largest and rarest assemblages of plaster casts in the Netherlands (Sysling, 2016). Currently housed at the *University Museum Utrecht*, the collection consists of 131 facial casts of individuals from the Island of Nias near the Sumatran coast of Indonesia, created in the early twentieth century by physical anthropologist Johannes Pieter Kleiweg de Zwaan. As was common in colonial-era anthropological research, these casts were made as part of an effort to categorize human physical traits, reflecting the now-discredited racial theories that sought to classify populations based on their physiognomy. While the collection stands as a significant historical artifact, it is also a stark reminder of the ways in which scientific practices were intertwined with colonial power structures. Today, the collection raises pressing ethical questions about the representation of colonial subjects, the legacy of scientific racism, and the responsibilities of museums in critically engaging with such contested heritage. (Lai, 2023) (see Fig. 4).

In the case of the Nias/Indies masks, an exhibition to be supported by the *ArtBot Guide* had not yet been realized. Rather than being a complementary tool to a real time exhibition, the *ArtBot Guide's* content was the sole carrier of a possible future exhibition narrative. The content of the *ArtBot Guide* was created from scratch in collaboration with “Author”, the museum curator Drs. Reina de Raat, and the project manager and fundraiser Jet Blokhuis. To do so, first, the PolyCube function part of the *ArtBot Guide* was worked out. PolyCube by PolyCube, it was conceived in a stage-like fashion, each one representing a different layer of information about de Zwaan's practices and that of his peers in chronological order - i.e., who, what, when, and where. Second, the Chatbot questions and answers were created to unpack the PolyCubes' data and provide more information to users, sharing research that had been collected about the masks (see Fig. 5). This process allowed us to visualize and finetune the exhibition narrative to be presented in the *ArtBot Guide*.

When redesigning the *ArtBot Guide* for the Nias/Indies mask case study the prototype was made operational. Within the second prototype, the Chatbot function of the *ArtBot Guide* was altered to fit a real-life technical solution in comparison to the



Fig. 4 The contested Nias/Dutch East Indies masks in the *University Museum Utrecht* depot

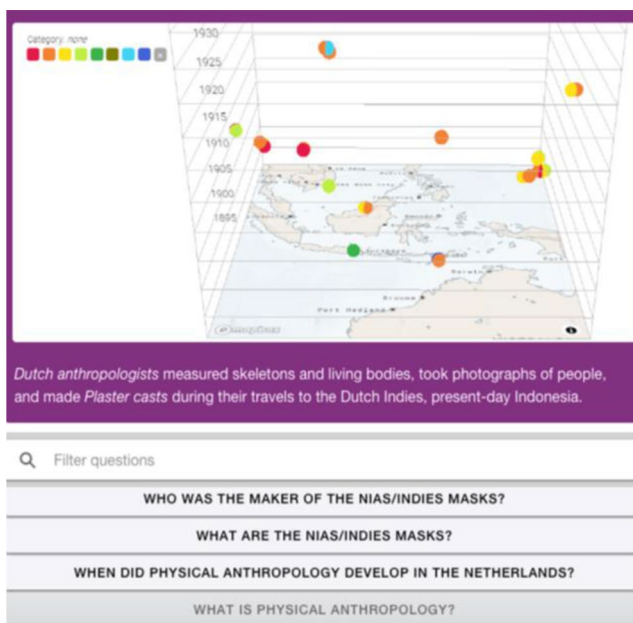


Fig. 5 Combination of the polycube and chatbot function in the Nias/Indies masks case study

ideal but never fully implemented Linked Data Knowledge Base version described above.¹¹

The exhibition narrative to be presented by the *ArtBot Guide* was designed with the purpose of contextualizing Johannes Pieter Kleiweg de Zwaan and his practices in physical anthropology while shedding light on the collection's colonial heritage, associated museological practices, and their implications.¹² This was important for the curators and “Author” as museums exhibiting colonial collections can encounter colonial aphasia in their displays (Bijl, 2012; Binter, 2014, Van Huis, 2019). Colonial aphasia is an occlusion of knowledge, a difficulty to generate vocabulary about complex colonial pasts, and a pushing away, an attempted un-doing. In museums, it manifests as “a struggle to find appropriate means to address the contested imperial and colonial legacy of [...] collections” (Binter, 2014: 343).

This issue can be addressed by actively engaging visitors with the colonial histories of artifacts, the museological practices that have shaped their display, and the broader implications of these narratives (Binter, 2014; Blom, 2014; Wekker, 2016). The ethics of exhibiting objects that bear the traces of colonial violence remains a highly contested issue, requiring careful consideration of how museums handle, interpret, and make these artifacts accessible to the public¹³. As Odumosu (2020) argues, displaying colonial-era objects is not merely an act of historical preservation—it is a curatorial decision that determines how colonial violence is remembered, framed, or even perpetuated in the museum space. Such displays risk reproducing extractive dynamics, treating artifacts as decontextualized objects of study rather than as witnesses to histories of dispossession, coercion, and suffering.

As previously discussed, meaningful engagement requires more than just cognitive understanding. It involves visitors developing a deeper awareness of an artifact's origins (its colonial past and the ethical dilemmas of its acquisition), its context (how museums have historically contributed to the perpetuation of colonial narratives and hierarchies), and its semantic significance (Bal, 2007; Wood & Wolf, 2008). However, a purely cognitive approach fails to account for the affective dimensions of encountering these artifacts—their haunting presence, their spectral weight, and the ways they embody histories of displacement, racialized violence, and epistemic erasure. Odumosu (2020) argues that colonial objects often carry an “excess of meaning”, existing not just as historical artifacts but as deeply affective and unsettling presences that demand an ethical and emotional reckoning.

¹¹ Rather than typing their questions and relying on the Linked Data Knowledge Base, users could select questions from a pre-existing list, designed by the working team. Questions were grouped by theme and keywords of all associated questions were shown, allowing users to choose based on their interest from associative and contextual information about the Nias/Indies masks and their colonial heritage, museological practices, and their implications on the present. Within the Chatbot questions and answers, links to the original sources were made available to allow users to further learn about the respective collection if they had the desire to do so.

¹² The term implications refers to the enduring power dynamics and privileges, the perpetuation of hierarchies, and colonial narratives in the present. The etymology of implication refers back to the word “entanglement”.

¹³ Raising a fundamental but, in the context of this article, rhetorical question: should such artifacts be displayed at all?

Meaningful engagement, therefore, is not just a matter of critical reflection (American Psychological Association, 2018; ICOM, n.d.) but also of reckoning with the discomfort, grief, and haunting legacies these objects invoke. Colonial aphasia—the systematic silencing or erasure of colonial histories—prevents audiences from fully confronting these complexities (Gardner, 2013; Blom, 2014; Wekker, 2016). Thus, to explore the capabilities of the *ArtBot Guide* as a curatorial toolkit that produces meaningful engagement of visitors with museum artifacts through the case study of a colonial collection meant exploring its ability to reduce the risk of colonial aphasia and reckon with the objects haunting legacies.

5.1 Presenting the Nias/Indies Masks with the *ArtBot Guide*

Upon opening the *ArtBot Guide*, and as illustrated by Fig. 6a short welcome text appeared, and users had the opportunity to select one of three questions. Each of these questions allowed users to choose from follow-up questions or click on keywords to see all related questions and answers, tailoring users' experiences to their interests. Overall, questions in the *ArtBot Guide* explored such topics as the practice of physical anthropology and the making of plaster casts; the Nias/Indies masks and their maker de Zwaan; in an attempt to introduce the experience and perspective of Nias locals, Hono-Hono's experience is shortly introduced; as well as a reflection on the decolonization of museums.

The first question expanded on the use of physical anthropology to quantify the human body to study the origin, evolution, and diversity of people (Tuttle, 2018). Thus, emphasizing the use of these practices by Dutch scientists to gain knowledge about the colonies and their inhabitants (Sysling, 2015). To illustrate the extent of these practices in the Netherlands and the variety of materials used, an associated PolyCube focuses on Dutch anthropologists' journeys to the Dutch Indies and represents the different materials they generated (See Fig. 7 below). It shows the location

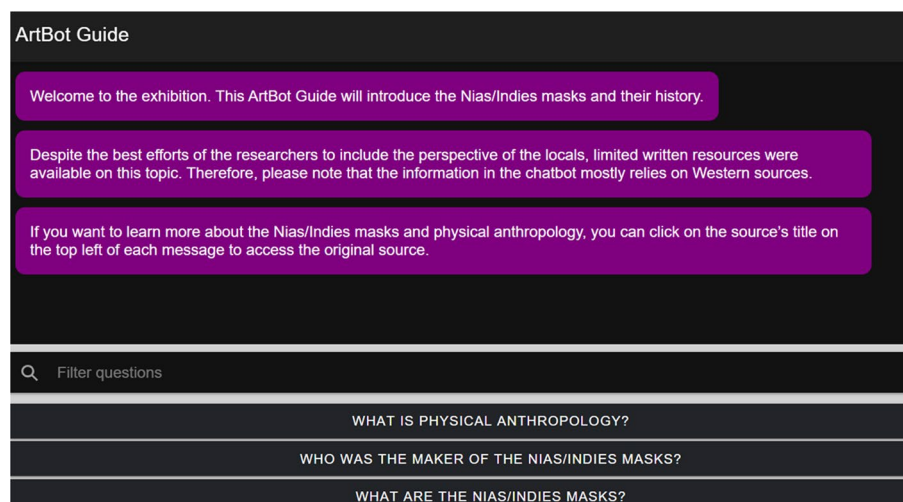


Fig. 6 Image of the *ArtBot Guide* Introduction

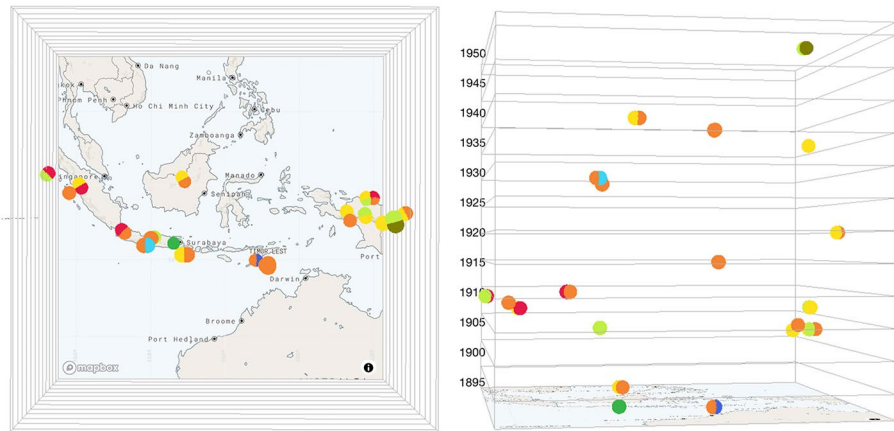


Fig. 7 Travels and material produced by Dutch anthropologists in the late nineteenth and twentieth centuries

of the journeys of de Zwaan and 10 of his contemporaries in the Dutch Indies on a horizontal map (on the left), the year in which they did so on a vertical timeline (on the right). The different colors represent the different types of material generated by these anthropologists. Here, red illustrates plaster casts, orange - measurements, yellow - photographs, light green - human remains, dark green - films, and blue - illustrations made by Dutch anthropologists.

Follow-up questions mentioned that physical anthropology developed in the Netherlands in the late nineteenth century, peaking in the 1920s–30s, inspired by French and German practices (Sysling, 2015); the expansion of the Dutch colonies to outer and lesser-known islands allowed anthropologists in the occupying forces to conduct fieldwork (Sysling, 2015); from the nineteenth century forward, science was used to justify the colonial expansion, claiming that people living in the colonies were less advanced, and needed to be educated (Goss, 2009); Dutch physical anthropologists generated knowledge about the Dutch Indies, writing books and sending gathered material to institutions and museums. A PolyCube showed the authors, titles of the books/articles, their year and place of publication, the name of the museums, their locations, the exhibited materials, and acquisition years (see Fig. 8). The horizontal map on the right image shows the location of the publication house of each written source and the location of the museums the photographs and plaster casts described above were sent to. The vertical timeline on the left side indicates the time of publication of written sources and the year in which other materials were acquired by institutions. Here, orange represents photographs, yellow - human remains, red - plaster casts, light green - books, dark green - articles.

Other follow-up questions focused on plaster casts. In physical anthropology, they were considered the most objective way to capture the human body (Sysling, 2015); exhibited to convey the characteristics of racial groups and train audiences to recognize these features and used for the creation of death masks, in art, or medicine (J. Blokhuis 2020 personal communication, 11 November). Further questions expanded on the locals' reactions to such practices. Despite being scared, indigenous people

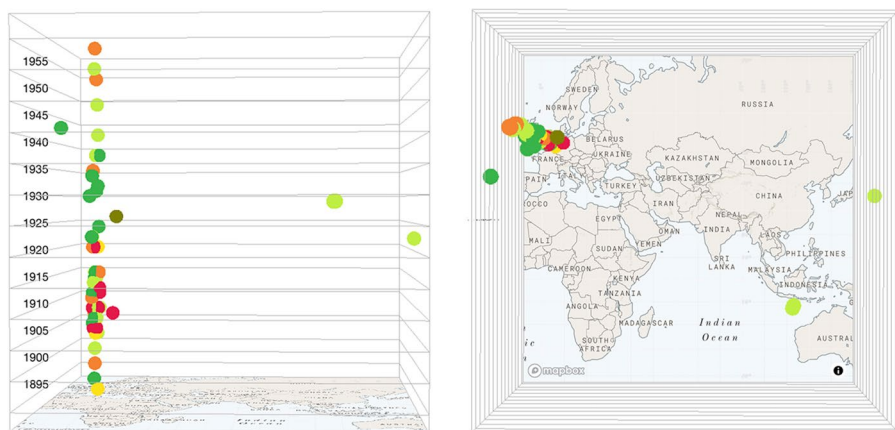


Fig. 8 Exhibition of the material generated by Dutch physical anthropologists in the Dutch Indies, and publication of written material about their findings

(especially prisoners) were often “persuaded” to participate by the colonial administration (Sysling, 2015, Sysling, 2016). Regarding the controversial aspects of physical anthropology, the final sub-question emphasized that these practices were used in the context of Dutch colonial rule, forcing indigenous people under their power (Brassem, 2020). Moreover, they created hierarchies of races, which were part of societal and scientific racist beliefs at the time (Baker, 2020).

One question investigated the identity of Nias/Indies masks maker Kleiweg de Zwaan, highlighting his role in colonial administration and importance in the institutionalization of physical anthropology. The “What are the Nias/Indies masks?” questions mentioned that the Nias masks are 64 face casts from Nias people, and the Indies masks are 67 face casts from Batavia citizens (Sysling, 2015). Follow-up questions expanded on their location and time of creation. A PolyCube illustrated the Nias/Indies and Minangkabau masks¹⁴ through time to show their journey from the colonies to the Netherlands (see Fig. 9). It points to the place of origin of the Nias, Minangkabau, and Batavia locals on the map and represents the location of the masks through time, from museum to museum. Specifically, this PolyCube gives information about the location of the institutions, when, and which masks. Here, orange shows the location of the creation of the Nias molds, red - the Minangkabau molds, yellow - the Batavia molds, light green - the location of the Minangkabau casts, dark green - negative copies of the Minangkabau casts, teal and dark blue - the location of the creation of the Nias/Indies masks from their molds, purple and dark pink - the Nias/Indies casts, light pink - copies of the Nias/Indies masks.

Yet another question introduced a Nias local called Hono-Hono, his experience of the violence of colonial rule, and the discomfort of getting his face plastered (Rijksmuseum n.d.). The controversial nature of the masks was emphasized—specifically their use to classify, typecast, and control colonial subjects (Sysling, 2015). A Poly-

¹⁴ The Minangkabau masks are the second half of the collection of plaster casts made by Kleiweg de Zwaan during his journey.

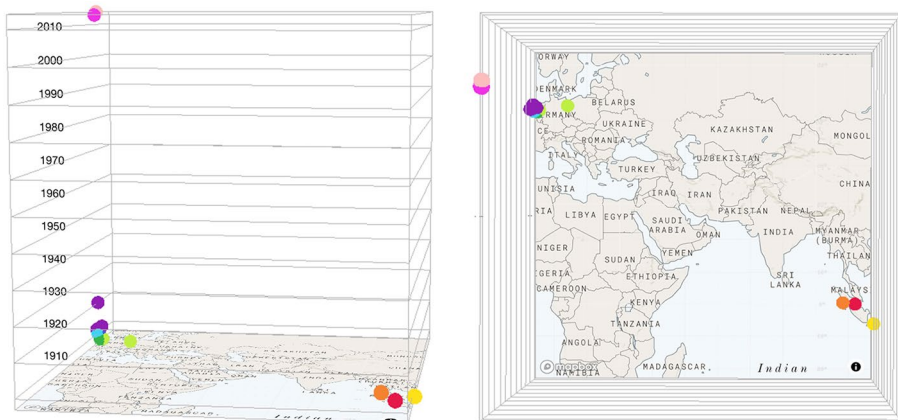


Fig. 9 Locations of the Nias, Minangkabau, and Indies masks through time

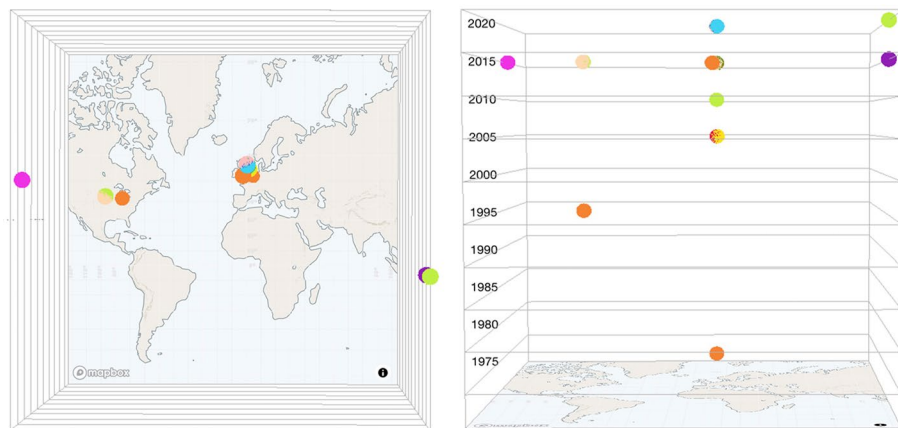


Fig. 10 Perpetuation of the knowledge about the Nias/Indies, and Minangkabau masks in the contemporary era

Cube illustrated this distribution of knowledge to the present, and the recent more critical view of these masks (see Fig. 10). It showed contemporary books and articles mentioning the Nias/Indies and Minangkabau masks and their exhibition space. It includes the location (on the left) and time (on the right) of publication/exhibition. Here, red represents reviews, orange, and dark pink - paper and digital articles, yellow - 3D scans, light green and purple - books and book chapters, dark green - the Nias casts, kaki - copies of the Nias casts, teal - the Indies casts, dark blue - the Minangkabau casts, light pink- photographs. However, it is important to pose the question here if this data-centric display does not distract from the historical weight of these objects, almost like a de-sensitizing device.

Finally, the question of how to decolonize the Nias/Indies masks was explored— a task that is both urgent and deeply complex. Decolonization in this context is not

simply a matter of reframing narratives within the museum but involves rethinking the very conditions under which these objects were taken, collected, categorized, and displayed. It requires acknowledging that these masks are not merely artifacts frozen in time but objects with ongoing histories, entangled in colonial violence, epistemic erasure, and contemporary struggles for representation and restitution (Stoler 2011).

To engage visitors in this conversation, the *ArtBot Guide* Chatbot invited them to critically reflect on what decolonization might mean in relation to the masks. Rather than offering a singular definition, the Chatbot posed questions that encouraged viewers to consider multiple possibilities: Should these objects be physically returned to Nias? How can museums facilitate dialogue with descendants of those whose faces were cast? What role should institutions play in repairing the harm caused by colonial collecting practices? By prompting visitors to actively engage with these dilemmas, the Chatbot sought to transform the museum from a site of passive observation into one of ethical and historical reckoning.

It is important to recognize that this iteration of the *ArtBot Guide*'s Chatbot operates through a set of pre-defined questions and responses, which are themselves the result of deliberate curatorial decisions. These questions, while designed to prompt critical engagement, reflect the priorities and viewpoints of its creators—predominantly white, institutional actors—and were shaped by the limitations of existing sources. As such, the tool reproduces some of the very dynamics it seeks to critique. By structuring user interaction through fixed inquiry paths, it narrows user agency and reinforces institutional authority and narratives.

Perspectives from indigenous communities, especially those affected by the production and circulation of the Nias and Indies masks, both in the past and present, are notably absent. Sources including these perspectives could not be found for this iteration of the *ArtBot Guide*. This absence was acknowledged in the introduction of the Chatbot. A project to reconnect with Indigenous communities and incorporate their voices began only after this version was completed, with the aim of including them more fully in future developments of the toolkit for the *University Museum Utrecht*. This shows that beyond digital engagement, institutional steps are also being taken to address the colonial legacies embedded in these objects. The *University Museum Utrecht* and the *Rijksmuseum* have been awarded an NWO grant to launch a research project that aims to reconnect the Nias masks to their place of origin and its communities (DUIC Redactie, 2020). While the full scope of this project is still unfolding, it signals an important shift toward collaborative, rather than unilateral, curatorial decision-making. Rather than treating the masks as objects of study for Western audiences, this initiative seeks to establish a dialogue with the communities from which they were taken, acknowledging their rightful role in shaping the future of these objects.

This is especially important as the implicit assumption of a white, Western audience in curatorial framing reinforces exclusionary practices, making it difficult for broader, more diverse publics to engage with these objects in ways that acknowledge their enduring emotional and historical weight.

To foster a truly inclusive and ethical museum space, it is necessary to go beyond standard interactive engagement models. Museums must consider whether and how colonial objects should be exhibited, develop strategies to foreground affective and

embodied responses, and actively reimagine curation as a site of repair rather than passive display. This requires not only interrogating the narratives that shape colonial collections but also rethinking the role of museums in addressing their own complicity in historical and ongoing forms of violence.

Decolonization, then, is not a singular action but an ongoing process—one that requires museums to move beyond symbolic gestures toward structural changes in how knowledge is produced, who has authority over cultural heritage, and how histories of colonial extraction are addressed. The case of the Nias masks illustrates both the potential and the challenges of this work, raising broader questions about what it means to truly decolonize museum collections—not just in rhetoric but in practice.

5.2 Survey Set Up

The *ArtBot Guides*' ability to engage audiences with the colonial heritage of the Nias/Indies masks was assessed by a somewhat heterogeneous group of 11 participants of different age groups and nationalities, who were recruited leveraging the researcher's personal network (see Table 1). The *University Museum*'s main target audiences are families with children (8–14 years old). However, out of the five families the survey was sent to, only one sent their answers back (participant eight). As the museum's visitors do not exclusively consist of families, this research has also conducted surveys with people from other groups, specifically, teenagers who study in Utrecht (15–18 years old), Utrecht University students (19–35 years old), and 50+ parents who have expressed an interest in visiting the museum. These survey responses did not aim at representing the perspective of people from these audiences but rather giving this research preliminary insights on what aspects of the *ArtBot Guide* need to be improved in further research.

Due to COVID-19, an exhibition within the museum could not be created or visited. Participants were asked to interact with the *ArtBot Guide* from their home. They were sent a survey, which included a short introduction of the *ArtBot Guide* and instructions on how to navigate the toolkit. These instructions were followed by a link to the *ArtBot Guide* and a picture of the Nias/Indies masks. The survey asked a

Table 1 List of survey participants

	Number of survey response	Age	From	Date of survey
1		15 years old	The Netherlands	6 December 2020
2		63 and 60 years old	The Netherlands	6 December 2020
3		22 years old	Romania	6 December 2020
4		17 years old	The Netherlands	7 December 2020
5		26 years old	Uganda	8 December 2020
6		27 years old	Sint Maarten	8 December 2020
7		31 years old	The Netherlands	9 December 2020
8		40 and 13 years old	Belgium	9 December 2020
9		15 years old	The Netherlands	16 December 2020

first set of questions about their ability to engage with the collections' colonial past, museological practices, and their contemporary implications on a web-based interface in their home setting (see Table 2). Meaningful engagement was explored with respect to participants' gaining of new knowledge, changing their perspectives of the Nias/Indies masks and physical anthropology in general, as well as reflecting on and further questioning the information given to them, driven by their own interests. A second set of questions focused on their experience with the technicalities of the *ArtBot Guide* (see Table 3).

5.3 Findings: The Potential of the *ArtBot Guide* to Meaningfully Engage Audiences with the Contested Nias/Indies Masks Collection

This study assessed the potential of the *ArtBot Guide* to facilitate meaningful engagement with the contested colonial legacy of the Nias/Indies masks collection in exploring its ability to reduce the risk of colonial aphasia and reckon with the objects' haunting legacies. The findings are structured around three key dimensions: the participants' engagement with the colonial past, their reflection on museological practices, and their consideration of the present-day implications of colonial legacies. These results highlight the strengths and limitations of the *ArtBot Guide* in fostering critical and reflective user experiences, as well as the technical and contextual challenges that need to be addressed for future iterations.

5.4 Engaging with the Contested Colonial Past

The *ArtBot Guide* demonstrated its potential to facilitate engagement with the contested colonial legacy of the Nias/Indies masks collection, albeit with varied levels of success. Several participants reported gaining new insights into the collection's colonial context, noting that the tool encouraged them to think critically about the past and to question the narratives presented. For example, participants noted that the *ArtBot Guide* provided a structured entry point to explore the controversial nature of the masks, moving beyond surface-level information. However, engagement was uneven across the cohort. Four participants struggled to reflect critically or question the information provided, with two specifically indicating that they did not feel the *ArtBot Guide* gave them enough space to process and think about the contentious aspects of the collection.

A lack of familiarity with the subject matter emerged as a significant barrier for some participants. Participant Five, for instance, noted that the information felt inaccessible due to their limited prior knowledge. Others, such as Participant Nine, expressed disinterest in the subject, dismissing the *ArtBot Guide* content as "boring." These findings underscore the importance of presenting content in ways that are both accessible and engaging, particularly for audiences who may lack foundational knowledge or intrinsic interest in the topic.

Table 2 Survey questions and answer about the content of the *ArtBot guide*

Questions	Answers
Which ArtBot question(s) did not interest you?	Most voted questions - When did anthropology develop in the Netherlands? - How did Dutch anthropologist share their findings to the public?
Why?	1 Does not seem special 2–3 Interested in all the questions 4–7 Self-evident answers 8 Not interested in details 9 Questions are not about history
Which question(s) did you find most interesting?	Most voted question - How did locals react to anthropological practices?
Why?	1–8 Learned something new 2–7 Personal interest/preference 3- 4-6-7 Questions that focus more on controversial aspects, reflecting more on the practices and locals' experiences challenge participants to reflect more critically 5 Increased curiosity 9 Has most to do with history
What message do you take away from the exhibition?	1-2 Sounds interesting/ Horizon broadening 3-5-7 Did not identify a message 4-6-8-9 Learned about the nias/Indies masks, Dutch physical anthropological practices and their racist and colonial history
Has the ArtBot Guide given you enough room for thinking about the controversial nature of the Nias/Indies masks and physical anthropology?	Yes for both (7) No for both (2)
Why or why not? (please explain in as much details as possible)	1-2-3-4-8 Enough information about it, questions addressed topics in clear and understandable way 2-3-4-6 Interest sparked, engaged, leads to reflection 3 Should rephrase questions to address reader directly 5 Not familiar with both topics 3-6-7 Request more questions addressing and more details about the controversial nature of the masks and physical anthropology, addressing the audience directly 9 Because nowadays these kind of things are unthinkable, but they were common a hundred years ago.
After interacting with the ArtBot Guide, has your impression of the masks changed from your seeing them?	Yes (7) A bit, but leaning more to no (1) I had never heard about the masks (1)
How has your impression changed?/What is your impression of these masks now? (please explain in as much details as possible)	6–9 Lack of prior knowledge about the masks does not provide good starting point to change their perspective 1-3-4-7 Shift from “silly”, “cool”, “scientific” objects to more vivid understanding of the situation that led to the creation of the masks and the associated suffering/locals' experiences 2-5-8 Thinks more about and wants to learn more about the masks and colonialism
Has the ArtBot Guide given you enough room for thinking about the role of museum in creating and perpetuating hierarchies and colonial narratives?	Yes (4) No (4) Somewhat (1)

Table 2 (continued)

Questions	Answers
Why? Why not? (please explain in as much details as possible)	1–8 Clear explanations and many opportunities given to do so 2 onderzoeksdrang en tijdgeest van de wetenschappers 3–4–6–7 Want more information on the role of museums and their practices, the locals' perspective in the past and present 5 the topics are new to participant 9 Reflect on the Dutch public's perspective on these practices and whether they were controversial in the past
Has the ArtBot Guide given you enough room for thinking about the impact of the colonial past on the present?	Only one answer “yes” by participant 9 Other participants did not answer
Why? Why not?	No answer
If you could have typed in your own questions, what else would you have wanted the ArtBot Guide to include?	1–4–8 More details about how and why the masks were made and locals' reactions 3–7–9 More information about Dutch colonialism and other/similar colonial practices 6 More information about present day reactions to the masks and Dutch colonial legacy (from locals and museums) 5 no questions

Table 3 Survey questions and answers about the technicalities of the artbot guide

Questions	Answers
What problems did you encounter while using the ArtBot Guide?	2–3–4 “Handling the cubes” 4–7 Data visualization is confusing 3–4 Need additional explanations on how to interact with them 1–4–5–6 Messages appear too quickly/Scrolling up and down the pages 9 Lack pictures
What did you like about this experience and why?	8–3–4 Learning dimension, surprising 3–7 Engaging, defining own questioning line and sequence 1–2 Innovativeness of the format 5 The falling in of texts makes it easier to read 6 The questions variety 9 Nothing did not understand the purpose of it
What did you dislike about this experience and why?	1 Online, wish for a real life experience 2 Nothing 3–5 Too many messages and text falling in too fast 4 The questions order 5 Requests less visuals 6–7 Requests more information (more specific information, more questions, through links) 7–9 Request more visuals 8 Too much details/information
What would you change about the ArtBot Guide to improve it?	1–7 More visual material, audio material 2–4 Introduction to the app/how to use it 3 What mentioned above 5 Decrease message speed 6 More detailed answers 8 Nothing 9 More entertaining layout

5.5 Reflection on Museological Practices¹⁵

The *ArtBot Guide* aimed to encourage users to reflect on the role of museums in perpetuating colonial narratives and hierarchies, particularly through the PolyCube visualization. While some participants successfully initiated reflections on these themes, others struggled to fully engage with this aspect of the tool. Four participants reported being unable to critically assess the role of museums, attributing this difficulty to a lack of sufficient information in the *ArtBot Guide*. For example, Participant Four noted that while the tool provided a starting point for reflection, it lacked the depth needed to explore broader colonial practices, such as the issue of “roofkunst” (looted art). Despite this limitation, Participant Four’s ability to draw on prior knowledge demonstrates the *ArtBot Guide*’s potential to spark critical thinking, even when its content is incomplete.

The technical functionality of the PolyCube also influenced participants’ ability to engage with museological practices. Several participants encountered difficulties interacting with the PolyCube. This includes issues with cubes disappearing behind Chatbot responses and rendering problems on certain browsers. Additionally, users could not click on data points for further exploration, limiting their ability to fully engage with the metadata. These usability issues significantly detracted from the tool’s effectiveness, with three participants explicitly stating that the PolyCube function was difficult to understand. Providing clearer instructions and addressing these technical challenges will be critical for enabling deeper engagement.

Participants Six and Three noted that the Chatbot questions alone did not provide enough depth to fully foster critical reflections on these practices. While the Chatbot initiated engagement, it did not sufficiently disrupt the conventions of how audiences are typically encouraged to think about museum objects—as artifacts to be observed, rather than as haunting remnants of colonial violence. This suggests that for the PolyCube and Chatbot to achieve their full potential, they must work in tandem, not only through improved content curation but also through an approach that makes space for the profound affective weight of these objects.

Despite these challenges, the PolyCube remains a promising tool for visualizing the hidden structures and metadata of digitized collections. By tracing how artifacts entered the museum and became embedded within its institutional narrative, the PolyCube has the potential to illuminate the often-concealed processes of acquisition, classification, and display that shape museum collections. In doing so, it contributes to a more transparent and self-reflective curatorial practice, challenging the idea that objects simply exist in museums as neutral cultural specimens. Instead, as a first step towards decolonization, it explores ways to overcome colonial aphasia by highlighting the constructed nature of museum narratives and inviting viewers to interrogate how knowledge about these objects is mediated.

However, on a deeper level, it can be argued that this technical approach to transparency—mapping provenance and museum metadata—does not, in itself, reckon

¹⁵ Museological Practices Refers To Museums’ Exhibition Practices. How Museums Present Themselves, How They Present Information, What Information They Present, How They Have Acquired Artifacts, the Narrative They Share with Visitors, and so on

with the deeply unsettling and ethically fraught nature of the objects in question. The Nias/Indies masks are not simply artifacts; they are traces, remains of human beings whose bodies were subjected to the extractive gaze of colonial anthropologists. They do not just represent colonial violence; they embody it, bearing the imprint of a history in which people were measured, categorized, and reduced to objects of racialized study. This history cannot simply be “made transparent”—it must be reckoned with emotionally, ethically, and politically.

5.6 Considering Present-Day Implications

Engaging participants with the present-day implications of colonial legacies proved to be one of the most challenging aspects of this case study. While the *ArtBot Guide* succeeded in making certain curatorial processes more transparent, it struggled to create space for visitors to fully reckon with the ethical dilemmas surrounding the display, framing, and ongoing institutional control of colonial-era artifacts. Only three participants demonstrated the ability to critically reflect on issues such as the role of looted art in museums, the problematic history of colonial anthropological practices, and the absence of Indonesian perspectives in the interpretation of the Nias/Indies masks. This raises urgent questions about how museums can move beyond simply “presenting” colonial histories toward actively challenging the conditions that maintain colonial power structures in the present.

One key takeaway from the implementation of the *ArtBot Guide* in a colonial collection context was its problematic reliance on Western epistemological frameworks. By primarily drawing from Western sources, the tool unintentionally reinforced the very knowledge hierarchies it sought to expose. Moreover, its emphasis on visualizing metadata—tracking provenance, categorization, and institutional movement—risked turning these masks into mere data points, stripping them of their deeply affective and ethical weight. As Odumosu (2020) argues, data visualization often operates as a de-sensitizing device, transforming traces of colonial violence into abstract, technical information that distances viewers from the lived realities and human suffering embedded in these objects.

What is needed, then, is a shift from a de-sensitizing approach to a sensitizing one—one that does not merely provide “objective” data but actively foregrounds the weight of colonial history and forces viewers to question their own positioning as museum spectators. This means asking: How should we encounter these objects? What does it mean to stand before them in a Western museum space? What assumptions shape our viewing? Moving beyond detached visualization tools, museums must create interfaces that invite critical discomfort, ethical reckoning, and emotional engagement, allowing visitors to feel the unsettling presence of these objects rather than simply process their metadata. This once more underlines the fact that the *ArtBot Guide* is a vessel that has to be filled with deeply reflexive curatorial input.

The testing context also played a role in limiting engagement. The absence of a physical or virtual museum exhibition to accompany the *ArtBot Guide* distanced participants from the collection’s context, making it harder for them to connect the tool’s content with its broader implications. Without the spatial and curatorial framing that an exhibition provides, participants encountered the *ArtBot Guide* in rela-

tive isolation, which may have contributed to a more detached and analytical mode of engagement rather than an emotionally or ethically engaged one. This reinforces the idea that the *ArtBot Guide* functions best as a complementary resource within a museum setting, where it can support and enhance curatorial narratives rather than a stand-alone tool. When integrated into an exhibition space, the *ArtBot Guide* has the potential to bridge historical knowledge with sensory, affective, and ethical engagement, ensuring that audiences are not only informed about colonial histories but also implicated in their ongoing consequences.

One clear pathway toward achieving this is the direct inclusion of voices from impacted Nias communities in shaping both interpretation and presentation. Instead of reinforcing a Western framework of historical authority, integrating Nias perspectives could disrupt the passive consumption of knowledge and reframe these masks as active sites of dialogue, historical continuity, and contemporary reckoning.

Decolonizing museum engagement requires more than acknowledging provenance or reinterpreting collections—it demands a fundamental shift in how museums approach, display, and invite encounters with colonial artifacts. Rather than allowing visualization tools to sanitize or distance the violence inherent in these objects, museums must create spaces where historical pain is neither obscured nor neutralized, but confronted and collectively reimaged.

5.7 Technical and Usability Challenges

Technical limitations emerged as a significant barrier to user engagement across all dimensions. Participants encountered issues with the Linked Data function, which they found difficult to navigate, and several noted that Chatbot messages appeared too quickly, disrupting their reading experience. Additionally, participants suggested incorporating visual or audio materials to make the *ArtBot Guide* more engaging and accessible.

The usability challenges of the PolyCube were particularly pronounced. Participants reported difficulty understanding how to interact with the visualization, with several noting that clearer instructions and more intuitive design would enhance their experience. Addressing these issues in future iterations is essential for unlocking the full potential of the *ArtBot Guide* as a tool for critical engagement.

Overall, the *ArtBot Guide* represents a valuable step forward in the development of interactive curatorial toolkits. By building on these findings and incorporating user feedback, future iterations can refine its ability to connect audiences with contested collections, foster critical dialogue, and support more inclusive and reflective curatorial practices.

6 Further Theoretical Reflections

From the perspective of digital geography, the *ArtBot Guide*'s interface operates at the intersection of online and offline spaces, linking digital interaction to the materiality of museum collections. As Maalsen (2024) argues, geographers have increasingly shifted from viewing digital and physical spaces as dichotomous to understanding

them as co-constitutive, embedded within material realities and affective engagements. The *ArtBot Guide* exemplifies this shift by positioning the PolyCube as a digital structure that allows visitors to navigate spatial and temporal dimensions of collections, while the Chatbot extends curatorial narratives into interactive and personalized exchanges.

Feminist scholar Donna Haraway's (1991) concept of *situated knowledge* provides another crucial lens for understanding the *ArtBot Guide*'s epistemological framework. Rather than presenting museum collections as neutral or universally accessible, the PolyCube and Chatbot could further emphasize the localized, contingent, and context-dependent nature of knowledge production. Designing digital interfaces that acknowledge the biases and historical contexts embedded in collections is essential for fostering critical museum experiences.

A related issue is the ethics of data mediation. Critical data studies scholars (e.g., Richterich, 2018) emphasize the role of data intermediaries in managing the flow of information between creators and users. In the case of the *ArtBot Guide*, the PolyCube and Chatbot function as such intermediaries, filtering and structuring visitor access to curatorial knowledge. Understanding how these digital tools structure engagement—and whose perspectives are prioritized—remains a key concern for ensuring ethical and inclusive museological practices.

Beyond spatiality, media studies emphasize the temporal dimensions of digital interfaces and how they structure knowledge consumption. The *ArtBot Guide* not only helps visitors navigate historical timelines but also introduces a specific *time of the interface*—shaping how visitors engage with museum collections at different speeds and depths. Leszczynski and Elwood (2022) explore how computational interfaces mediate temporal experiences, from instant data retrieval to slower, reflective modes of engagement. The *ArtBot Guide*'s affordances—such as dynamic zooming, Chatbot-guided inquiry, and layered metadata visualizations—reflect this interplay between immediacy and contemplation. By critically analyzing how digital tools compress, expand, or restructure the temporality of museum engagement, we can refine the *ArtBot Guide*'s potential for fostering deep, meaningful interactions with cultural heritage.

7 Conclusion

Based on the PolyCube model (Windhager et al., 2018) and the Chatbot function, the *ArtBot Guide* was developed in the context of *The Tears of Eros: Moesman, Surrealism, and the Sexes* exhibition at the Utrecht Centraal Museum. The preliminary mock-up prototype of the *ArtBot Guide* demonstrated the potential to enrich the engagement of visitors with post-digital museum collections and foster meaningful interaction in three primary ways. First, the PolyCube function of the *ArtBot Guide* offers an interactive birds-eye view of exhibition metadata, allowing users to recognize patterns and deepen their understanding of the collection through an interactive mental model, one that is not possible through analogue curatorial practices alone. This model serves as a cognitive framework for integrating additional insights about the exhibition and for exploring connections between individual artifacts. Second,

the Chatbot function enables museum curators to make their research and extensive knowledge databases accessible in a structured and interactive format, effectively “subtitling” exhibitions for visitors. Finally, the digital interface of the *ArtBot Guide* allows for self-paced learning, shifting away from the traditionally rigid, one-size-fits-all museum experience toward an adaptive model where visitors control the depth and specificity of information they engage with.

The potential of the *ArtBot Guide* to cultivate meaningful engagement with exhibition visitors was further explored through its first operational prototype. In the case study of the contested colonial Nias/Indies mask collection at the *University Museum Utrecht*, the tool’s ability to foster deeper visitor engagement was highlighted, while also exposing key contested colonial heritage curation challenges and outlining areas for cultural sensitivity improvement.

While the toolkit allows for meaningful engagement, it is continuously stressed that the contents provided to the visitor have to be critically reflected upon content creation. Both how the individual artefacts and the collection are visualized within the PolyCube, as well as what kind of knowledge and how is provided through the Chatbot. Additionally, in the light of the post-authentic framework, ways of providing critical reflection for the visitor about the content and technical aspects of the *ArtBot Guide* should be looked into. For instance, this could take the form of notifications reflecting on the sources from which information is drawn or, indeed, certain voices lacking presence.

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