



**Beyond the Glass:
Enhancing Accessibility for Visually Impaired Visitors to Preserved Exhibits at the
KwaZulu-Natal Museum**

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DECLARATION

Submitted in fulfilment / partial fulfilment of the requirements for the degree of M-ART, in the Graduate Programme in Digital Arts
University of KwaZulu-Natal, Pietermaritzburg, South Africa.

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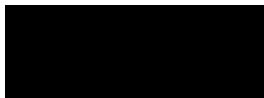
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Abstract

This study looked at how museum artefacts can be made accessible to people who are visually impaired. It focused on two Victorian insect models from the KwaZulu-Natal Museum and explored how they could be experienced through touch, sound, and language. The work drew on New Museology, Inclusive Design, and the Social Model of Disability to think about accessibility as both a design challenge and a social concern. A practice-led approach was used. The artefacts were scanned, modelled, and reproduced as tactile 3D prints. Braille labels and audio descriptions in both English and isiZulu were created to help participants interact with the models independently. Testing took place at the University of KwaZulu-Natal with three visually impaired participants. Observation, reflection, and questionnaires were used to record their responses. The findings showed that tactile and audio tools helped participants explore with confidence and interest. They valued the use of isiZulu and suggested small changes, such as adding clearer spatial cues. Overall, the project showed that inclusion improves through small, practical steps, teamwork, and user feedback. It also demonstrated how museums can share their collections in ways that feel welcoming and meaningful to all visitors.

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Chapter 1: Introduction

As custodians of culture, museums play a significant role in how people interpret and access history, science, and identity. Despite their public-facing mission, a lot of museums still continue to exclude audiences through design decisions that do not prioritise participants and accessibility, instead prioritising preservation and visual display. Museum visitors who are blind or partially sighted often experience exhibitions as purely visual display and not accessible, with glass enclosures and visual labels offering little to no alternative sensory experience. Addressing this inequality is not just legally and ethically important; it is also an essential step toward inclusive practice (Hooper Greenhill, 2000; Sandel, 2007)

Museums are essential cultural institutions that preserve, interpret, and present both material and immaterial history. They function as spaces for social inclusion, critical reflection, and public involvement, not just merely as educational venues. However, despite their educational objectives and social responsibilities, some museums around the world continue to present artefacts and exhibitions in ways that are not accessible to some portion of the public, particularly visitors with disabilities. Among these, individuals who are blind or partially sighted endure recurring exclusion due to museum spaces that rely heavily on visual modes of communication. Display cases, written labels, and graphical panels assume sight as the default, leaving out those who rely on and perceive information by tactile, aural, and spatial means (McGinnis, Carrs, & Garland, 2016)

In recent decades, international initiatives have pushed for more inclusive practices in museum spaces. The United Nations Convention on the Rights of Persons with Disabilities (CRPD, 2006) recognises the right of people with disabilities to have equal access to cultural places, resources, and experiences as others. Inclusive design, universal access, and participatory exhibition-making have all emerged as ethical and practical answers to museums' exclusionary practices. Despite these advancements, executions are still not even. Museums in the Global North have made significant progress in introducing tactile exhibits, Braille labels, and audio descriptions. However, in the Global South, including South Africa, accessibility is sometimes seen as an afterthought rather than an important design principle (Graham & Brown, 2021).

In the South African context, inclusion and equity are foundational components of the country's post-apartheid remodelling program. Public institutions, including museums, are expected to support national objectives that prioritise social justice, equality, and human dignity. South Africa's *White Paper on the Rights of Persons with Disabilities* (2015) mandates that public institutions remove barriers to participation and provide appropriate accommodation for all users. However, some South African museums have not created consistent policies for making their collections accessible to those with visual impairments. Exhibits remain mostly visual with little tactile or audio-based materials. Museum education and curatorial practices, for the most part, have mostly followed preservation-focused and visually dominant approaches (Neves, Queiros, & Pereira, 2018)

The KwaZulu-Natal Museum, located in the city of Pietermaritzburg, demonstrates many of these issues, though staff are aware of the current limitations and have begun introducing measures to address them. According to Wesley Flanagan, Assistant Head of Exhibitions at the museum, efforts are underway to improve accessibility through initiatives such as the

inclusion of Braille-printed labels and the review of exhibition layouts to better accommodate visitors with visual impairments (Flanagan, personal communication, 2 April 2025).

Founded in 1904, the museum was originally part of the colonial Natal Society and evolved in accordance with the Eurocentric pattern of classification and public display. This early direction continues to impact the institution's curatorial approaches, which mostly pay attention to static, visually oriented displays. One of the museum's distinctive yet underutilised collections consists of the enlarged Victorian-era insect models. These artefacts include spiders, ants, beetles, and other invertebrates. They were initially designed for educational purposes, durable and detailed, with the aim of supporting scientific education and public learning. However, despite their tactile potential, the model artefacts are now exhibited behind glass; they are visible but cannot be touched, making them inaccessible to blind and partially sighted visitors.

In the 1960s, Laura Kelsall, who worked in collaboration with the Natal Museum while employed by the Natal Education Department, developed a series of travelling educational kits that included tactile teaching materials (KZN Museum Centenary Book, 2004). These kits were produced using objects and replicas drawn from the museum's collections and were distributed to rural schools as part of an outreach initiative. Through this work, Kelsall was directly connected to the museum's educational programming, extending its collections beyond the physical gallery space. Although largely overlooked today, her initiative demonstrates that tactile and participatory approaches were once integrated into the museum's broader educational mission. This current study builds on this legacy to propose a contemporary model of accessible exhibition design.

To rethink how preserved artefacts may be made accessible to blind and partially sighted visitors, this study employs a participatory, practice-led methodology. It focuses on co-designing an interpretative toolkit for the KwaZulu-Natal Museum's Victorian insect artefacts, which includes 3D-printed tactile reproductions, multilingual audio descriptions, and Braille labelling. The study uses LiDAR¹ (Light Detection and Ranging) scanning technology to digitally capture detailed forms of the existing artefacts, which are then processed using Blender, an open-source 3D modelling program, and reproduced through 3D printing. The tactile replicas are tested and refined through engagement with visually impaired students recruited through the UKZN Disability Support Unit. Although this research is undertaken as a full Master's dissertation, the co-design process serves as a practice-based component that forms part of the data collection. The design stages, feedback, and reflections that emerge from this process will be analysed and discussed in the dissertation as evidence of how inclusive interpretation can be developed through practical experimentation and user participation.

This study is consistent with both national and international policy frameworks that encourage inclusive design and fair cultural access. It responds to the ethical responsibility of museums to represent and accommodate all members of the public, including those who learn through tactile, spatial, and aural experiences. It also contributes to the emerging field of inclusive museology, which advocates for a shift from viewing accessibility as a compliance issue and framing it as a creative, interpretative, and community-driven endeavour.

¹ LiDAR is a remote sensing technology that uses pulsed laser signals to measure distances and generate precise three-dimensional digital models of objects or environments.

Importantly, this research addresses issues unique to the South African museum sector, such as resource limitation, historical inequalities, and infrastructure constraints. Rather than relying on solutions created in wealthier nations from the Global north, this study proposes a low-cost, culturally applicable model for access. Technologies such as LiDAR scanning and 3D printing are tailored to fit with local conditions, and collaborations with the university department of the disability unit ensure community participation throughout the entire process.

This study holds significance beyond this immediate case study. This study provides a model for other institutions dealing with comparable accessibility issues by demonstrating how inclusive interpretation may be incorporated into exhibition design from the beginning. It illustrates how small, targeted interventions developed collaboratively with users may have far-reaching repercussions for institutional transformation. The KwaZulu-Natal Museum, therefore, serves not just as a research venue but also as a model for how museums in South Africa and the Global South can take concrete steps toward more inclusive futures.

Research Problem

Museums have long relied on sight-based modes of display and interpretation, which limits access for visitors who are blind or partially sighted. At the KwaZulu-Natal Museum, artefacts such as the enlarged Victorian insect models remain behind glass and inaccessible to touch. This study responds to that gap by exploring how inclusive display practices can transform these visual displays into multisensory learning experiences. Guided by New Museology, Inclusive Design, and the Social Model of Disability, the research investigates practical ways to remove physical and sensory barriers and to create museum interactions that promote independence, cultural relevance, and equal participation for visually impaired visitors.

Main-Objective

To investigate how inclusive interpretation strategies, informed by New Museology, Inclusive Design, and the Social Model of Disability, can be designed and applied to strengthen accessibility and engagement for visually impaired visitors interacting with the enlarged Victorian-era insect artefacts from the KwaZulu-Natal Museum.

Sub-Objectives

1. To identify the main accessibility barriers associated with the Victorian-era insect artefacts from the KwaZulu-Natal Museum through site observation and consultation with museum staff.
2. To digitally reproduce the enlarged spider and beetle artefacts using LiDAR scanning and 3D tactile modelling techniques.
3. To co-design interpretative tools, including tactile replicas, Braille labels, and audio guides, in collaboration with visually impaired participants.
4. To test and evaluate the developed interpretative tools within a controlled environment to gather user feedback, assess educational value, and measure accessibility outcomes.
5. To develop practical and transferable guidelines for inclusive interpretation that can inform future accessibility initiatives at the KwaZulu-Natal Museum and similar institutions.

Main Question

How can inclusive interpretation strategies, guided by New Museology, Inclusive Design, and the Social Model of Disability, improve accessibility and engagement for visually impaired visitors engaging with the enlarged Victorian-era insect artefacts from the KwaZulu-Natal Museum?

Sub-Questions

1. What specific barriers limit accessibility for visually impaired visitors engaging with the Victorian-era insect artefacts at the KwaZulu-Natal Museum?
2. How do visually impaired users perceive and interact with tactile, audio, and Braille-based interpretation tools developed through a co-design process?
3. What educational and emotional benefits arise from tactile and multisensory interpretation of museum artefacts?
4. What practical and logistical challenges occur during the digital replication and tactile adaptation of museum artefacts?
5. How do principles of New Museology and Inclusive Design inform both the creation and evaluation of inclusive interpretation strategies based on museum collections?

This study is guided by a qualitative, practice-led methodology that combines creative production with participant engagement. The approach involves developing and testing tactile replicas, Braille labelling, and audio descriptions with visually impaired participants. Through this process, the study collects data not only from participant feedback but also from the design stages themselves, allowing practical experimentation to inform the analysis and conclusions.

The theoretical framework draws on New Museology, Inclusive Design, and the Social Model of Disability. These frameworks provide the foundation for rethinking how museums can shift from object-centred display traditions toward inclusive and participatory practices. Together, they position accessibility as an interpretative and ethical responsibility rather than an afterthought of exhibition design.

This study contributes to broader efforts in South Africa to remove institutional obstacles to cultural participation and advance scholarship on inclusive museology. By working directly with users affected by visual barriers, the research supports a shift in museum thinking. Visitors are not treated as passive observers but as active participants in shaping interpretative content. This reinforces the practical application of both national policy directives and international frameworks such as the United Nations *Convention on the Rights of Persons with Disabilities* (CRPD, 2006), placing accessibility at the centre of museum engagement strategies.

Chapter 2: Literature Review

This literature review aims to position this research within the broader field of scholarship and practice on museum accessibility and interpretation strategies, with a major attention on tactile and multisensory interpretation for blind and partially sighted visitors. It investigates major problems, case studies, theoretical views, and technologies that are directly relevant to this study's objectives. This review also highlights gaps in current practice, especially within the South African context, where accessibility measures are uneven despite progressive policy frameworks and public commitments to inclusion.

This chapter is organised thematically, moving from global discourses to the specific realities of the KwaZulu-Natal Museum. It starts by examining how international scholarship and policy define and frame accessibility, stressing critiques of visually dominant display forms and rising adoption of tactics aimed at overcoming such limitations. McGinnis, Carr, and Garland (2016) challenge traditional museum displays for prioritising sight and text-based interpretation, thereby restricting engagement for visitors who rely on non-visual means of learning. Neves, Queirós, and Pereira (2018) underline these concerns, pointing out that a lot of museums continue to lack tactile, auditory, and spatial resources, even where accessibility is stated as a major institutional value.

This review then turns to global case studies that illustrate varied approaches to inclusive practice. Institutions such as the Museo Tifológico in Spain and the Louvre's Tactile Gallery in France have incorporated tactile replicas, Braille labels, and audio guides into their permanent exhibitions. These interventions are evaluated critically, while recognising their value and acknowledging the shortcomings of tokenistic approaches that fail to embed accessibility into curatorial and interpretative processes (Classen, 2012; Serota, 2018). The analysis of all these cases underscores the need for participatory design processes that involve users in shaping both the content and form of interpretation.

The focus then narrows to the KwaZulu-Natal Museum, a national cultural institution with a colonial legacy that has shaped its collections, display strategies, and public involvement. Its Victorian-era enlarged insect models are particularly noteworthy, as they were originally created for public education but are now currently inaccessible to blind and partially sighted visitors due to their presentation behind glass. This review draws on the museum's history of tactile education, particularly Laura Kelsall's outreach kits from the mid 20th century, which show that inclusive practices had precedence locally. This historical initiative provides the groundwork for reintroducing tactile engagement in ways that are relevant to contemporary audiences and adhere to modern accessibility criteria.

Another important area of concentration is technological innovation. LiDAR scanning and 3D printing have been identified as effective tools for producing tactile replicas of preserved artefacts. Remondino and El-Hakim (2006) show how good these scanning methods are in capturing intricate surface features, while Blaser et al. (2002) stress on the cognitive and emotional advantage of tactile interaction with museum exhibits. These technologies are discussed ethically in relation to authenticity, cultural context, and the interpretative decisions that come with replication of artefacts (Pye, 2016; Cookie & Buckley, 2021). This literature review also talks about the importance of user testing and iterative design in ensuring that replicas are both accurate and relevant to their intended audiences. Policy and accessibility standards are evaluated in terms of their role in shaping museum practice. International

frameworks such as the UN *Convention on the Rights of Persons with Disabilities Act* (1990), as well as South Africa's *White Paper on the Rights of Persons with Disabilities* (2015), are examined for their influence on institutional method to access. Practical guidance from institutions such as the Royal National Institute of Blind People (RNIB) is also taken into account as it offers comprehensive recommendations for tactile graphics, audio description, and accessible labelling. This review views these policies and standards as tools for guiding user-centred design, rather than as simply compliance checklists.

Finally, this chapter addresses gaps and opportunities in South African museum practice. It addresses the challenges identified in this literature, such as limited funding, lack of staff training, and limited community engagement in design processes. This study is positioned as a direct response to these issues, using a co-design methodology that actively incorporates visually impaired users in the creation and evaluation of interpretative tools. The goal is to show how preserved artefacts behind glass, such as the Victorian insect models at the KwaZulu-Natal Museum, can be reinterpreted in ways that are accessible, contextually appropriate, and co-created with the intended users. This thereby sets a precedent for similar initiatives in the region and beyond.

2.1 Rethinking Museum Access Globally

The idea of accessibility in museums has developed considerably over the last few decades. Earlier discussions focused mainly on physical entry, such as ramps, lifts, and parking spaces, while recent approaches recognise that inclusion involves far more than reaching the exhibition floor. True accessibility means being able to experience, interpret, and contribute to cultural spaces on an equal basis. The International Council of Museums (ICOM, 2017) stresses that museums should serve all members of society, yet studies show that many institutions still centre their exhibitions around sighted audiences (Sandell, 2007). For visitors who are blind or partially sighted, this visual dominance continues to create barriers to meaningful engagement with collections and displays.

As museum practices have evolved, accessibility has come to be understood as a shared social, cultural, and ethical responsibility rather than a matter of physical adjustment. It involves recognising the diversity of visitors' needs and designing environments that support different ways of perceiving and understanding objects. The following discussion identifies three major commitments that have emerged from international research and practice as essential to rethinking accessibility in museums: recognising sensory diversity, using policy frameworks as design tools, and embedding participatory design and collaboration. Together, these commitments highlight how accessibility should be approached as both a creative and ethical responsibility. They also provide the conceptual foundation for the more detailed case studies explored in Section 2.2.

2.1.1 Recognising Sensory Diversity

Museums have historically been shaped by nineteenth-century beliefs that knowledge is best acquired through sight (Hooper-Greenhill, 2000). This visual tradition produced exhibition practices centred on glass cases, distant viewing, and text-heavy explanations, reinforcing the idea that seeing equates to knowing. Although museums have since embraced education and inclusion as central to their missions, this visual bias remains deeply ingrained. McGinnis, Carr and Garland (2016) argue that the conventional display format assumes a single sensory

mode of engagement, excluding visitors who rely on touch, sound, or spatial awareness for understanding.

Recognising sensory diversity challenges this assumption by acknowledging that human perception is multisensory. Visitors engage through touch, hearing, smell, movement, and language, as well as sight. Neves, Queirós and Pereira (2018) emphasise that tactile, auditory, and spatial cues enable visitors with different sensory abilities to experience museum content equitably. Falk and Dierking's (2013) contextual model of learning supports this idea by identifying three interrelated contexts that shape museum experience: the personal, the sociocultural, and the physical. Learning occurs when these contexts interact, which requires design strategies that respond to diverse sensory and cognitive needs.

Designing for sensory diversity means integrating multiple interpretative routes within exhibitions rather than relying on visual presentation. This includes tactile models, audio descriptions, textured materials, and interactive elements that invite touch and sound. Accessibility also extends beyond sensory modes to include linguistic and cognitive dimensions. Multilingual interpretation, plain-language texts, and affordable entry options address broader inequalities that often overlap with disability. According to guidance from the Royal National Institute of Blind People (RNIB, 2015) and the American Alliance of Museums (AAM, 2018), these forms of access are central to an inclusive visitor experience. Both organisations encourage museums to prioritise consistency in tactile labelling, provide clear and safe circulation paths, and ensure that information is available in large print or audio formats compatible with screen readers.

Recognising sensory diversity reframes accessibility as an essential part of the interpretative process rather than a supplementary service. Exhibitions that incorporate tactile and auditory interaction create richer learning experiences for all audiences, not just those with disabilities. Touch and sound can reveal textures, forms, and atmospheres that written labels cannot, while movement through space allows visitors to form personal connections with objects. Inclusive design theorists such as Mace, Hardie and Place (1998) and Hamraie (2017) argue that accessibility designed from the outset benefits everyone, reinforcing the idea that inclusive design is not a special accommodation but good practice.

This commitment also aligns with the growing view of museums as social and dialogic spaces. Hooper-Greenhill (2000) describes the “post-museum” as an institution that encourages participation, multiple interpretations, and shared learning. Recognising sensory diversity supports this shift by allowing visitors to contribute their own ways of knowing, moving beyond passive observation to active exploration.

2.1.2 Using Policy Frameworks as Design Tools

Accessibility in museums is also supported and strengthened by international and national policy frameworks that frame inclusion as a human right. The United Nations *Convention on the Rights of Persons with Disabilities* (CRPD, 2006) sets out that cultural participation and access to heritage are integral to social equality. It calls on member states to promote access to cultural materials in formats that suit different needs. Similarly, the *Americans with Disabilities Act* (ADA, 1990) established enforceable standards for public institutions that have influenced cultural policy worldwide. In South Africa, the *White Paper on the Rights of Persons with Disabilities* (2015) mandates public institutions to identify and remove barriers to participation and to make reasonable accommodations for all users.

These frameworks are not only legal tools but also ethical guides for cultural practice. They transform accessibility from a matter of goodwill into a professional duty. When applied thoughtfully, they can shape how museums plan, design, and evaluate exhibitions. The RNIB's *Design for Everyone* (2015) and the AAM's *Accessible Exhibition Design* (2018) are examples of guidelines that translate policy into practical recommendations. These include providing tactile maps, designing clear signage with good contrast, ensuring lighting levels suitable for low-vision visitors, and embedding accessibility testing within exhibition planning.

Graham and Brown (2021) observe that while policies provide strong direction, implementation remains inconsistent, particularly in the Global South. Institutions often struggle with limited budgets, lack of expertise, or competing priorities that relegate accessibility to the margins. This gap between policy and practice highlights the need for measurable strategies and ongoing accountability. Policies are most effective when they are not treated as external compliance measures but are built into the museum's internal structures, job descriptions, and funding plans.

When museums use policy frameworks as design tools, they can plan accessibility in a structured and sustainable way. This approach also promotes transparency and encourages collaboration between different departments, from curatorial teams to education and facilities management. It ensures that accessibility is not left to individual staff members but becomes part of institutional identity. In this sense, policy frameworks act as both a roadmap and a benchmark, helping museums evaluate progress and communicate their commitments clearly to funders, partners, and the public.

2.1.3 Embedding Participatory Design and Collaboration

The third commitment emphasises that accessibility should be developed with, not just for, the people it serves. Sandell (2007) argues that museums must move away from interpreting audiences as passive consumers of knowledge and instead treat them as co-creators in shaping meaning. This approach is consistent with Hamraie's (2017) idea that inclusion is achieved through ongoing participation and collective authorship rather than isolated acts of accommodation.

Participatory design brings users, designers, and museum staff into shared dialogue. By involving people with disabilities directly in the design and testing of exhibitions, museums gain deeper understanding of what accessibility means in practice. Collaboration allows for iterative learning, where feedback informs continual improvement. It also challenges the traditional hierarchy that places curators as experts and visitors as receivers of knowledge. Graham and Brown (2021) highlight that partnerships between museums, universities, and disability organisations are especially valuable in resource-limited settings. They enable access to technical expertise, 3D modelling, tactile production methods, and assistive technology that may not exist within the museum itself. These partnerships also create opportunities for mutual training, where museum professionals learn from disabled collaborators about tactile reading, navigation, and audio description.

Embedding collaboration within institutional culture transforms accessibility from a one-time project into an ongoing practice. It ensures that inclusion is sustained even when staff or leadership change. Participatory design also promotes a sense of ownership among users,

reinforcing the museum's role as a shared public space. Hooper-Greenhill's (2000) concept of the post-museum captures this transformation: museums become dynamic institutions that respond to community needs, share authority, and view audiences as active participants in interpretation.

Incorporating participatory methods can also improve the emotional and educational impact of exhibitions. When visitors recognise that their feedback influences design decisions, they are more likely to feel represented and respected. This connection strengthens the relationship between the museum and its audiences, encouraging repeat visits and word-of-mouth engagement. Over time, this collaborative model can help museums rebuild trust with communities who have historically been excluded from cultural participation.

The global discourse on museum accessibility demonstrates that meaningful transformation depends on recognising sensory diversity, applying policy frameworks as practical design tools, and embedding collaboration through participatory design. Each commitment addresses a specific dimension of inclusion: the visitor experience, institutional structure, and design process. Together, they form a comprehensive framework for building accessible and inclusive museum practice.

In essence, these commitments present accessibility as both a moral and creative imperative. They encourage museums to design with empathy, to use policy as an active resource, and to share authority with their audiences. This broad perspective provides a foundation for action and helps bridge the gap between theory and implementation.

In summary, the global discourse provides a framework for action. The next section examines selected case studies to explore how these commitments have been realised in practice. The examples discussed will identify effective methods, recurring challenges, and transferable lessons that can inform the development of tactile interpretation for preserved artefacts at the KwaZulu-Natal Museum.

2.2 Global Case Studies and Critical Contrasts

The previous section identified three main commitments that guide inclusive museum practice: recognising sensory diversity, drawing on policy frameworks as guiding principles, and embedding participatory collaboration. These principles form the foundation for understanding how accessibility has been interpreted and implemented across different cultural and institutional contexts. To move from theory to practice, it is useful to examine specific examples that demonstrate how museums have attempted to realise these commitments within their exhibitions and visitor experiences.

This section analyses five selected case studies from different regions that represent a range of approaches to inclusive design: the Museo Tifológico in Spain, the *Hoy Toca el Prado* project at the Museo del Prado, the Smithsonian 3D Digitisation Programme in the United States, the Museo Tattile Statale Omero in Italy, and the Louvre Tactile Gallery in France. These examples were chosen for their diversity of context, scale, and methods, as well as for the way they collectively reflect current global discourse on accessibility. Each case is examined in relation to its production methods, interpretative strategies, and levels of user engagement.

Rather than offering a catalogue of initiatives, the aim here is to critically compare and contrast how these examples address accessibility through different forms of design and participation. The discussion considers both their achievements and limitations, exploring how factors such as technology, policy, and community involvement influence outcomes. Figures included in this section illustrate key design features, such as tactile replicas, spatial layouts, and multisensory installations, and are referred to in the discussion to show how accessibility has been translated into material form.

Together, these examples reveal how inclusive interpretation can be approached through different pathways, depending on available resources and institutional priorities. They also highlight recurring challenges, such as cost, maintenance, and sustainability, that affect accessibility initiatives globally. The analysis that follows begins with the Museo Tifológico in Madrid, one of the earliest and most influential examples of a museum designed specifically for blind and partially sighted visitors.

2.2.1 Museo Tifológico (Madrid, Spain)

The Museo Tifológico, located in Madrid, was established in 1992 by the Organización Nacional de Ciegos Españoles (ONCE). It is one of the first museums in the world created entirely for blind and partially sighted visitors. The museum's design and collection were conceived around the idea that touch is a valid and essential way of understanding art and heritage. Rather than adapting existing displays, the Museo Tifológico was built to prioritise accessibility from the outset, demonstrating that inclusion can be integral to institutional identity (Museo Tifológico de la ONCE, 2023).

The museum's collection includes hundreds of tactile models of architectural monuments, artworks, and original sculptures that can be explored by hand (Museo Tifológico de la ONCE, 2023). Many of these models are produced through silicone moulding and resin casting, using materials such as polyurethane and plaster that are durable yet smooth enough for tactile reading. The models are finished with matte coatings to prevent glare and to create a comfortable surface texture for visitors with partial sight. Braille and large-print labels accompany each exhibit, and audio descriptions are available through handheld devices. The collection combines traditional craftsmanship with more recent 3D-printing techniques, ensuring that the replicas are both detailed and safe for touch (Museo Tifológico de la ONCE, 2023).

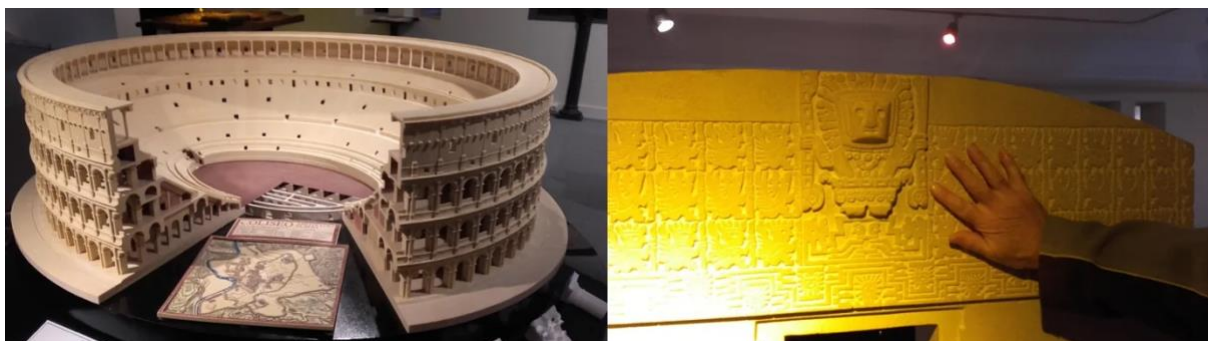


Figure 1: Tactile architectural models at the Museo Tifológico, Madrid (Source: Atlas Obscura, 2020, "Museo Tifológico")

Spatial layout is another critical aspect of the museum's design. Circulation routes are wide and free from obstacles, and the exhibits are positioned at accessible heights for both seated

and standing visitors. Lighting levels are moderate and evenly distributed, which benefits visitors with residual vision. Clear tactile pathways and railings help visitors navigate independently, creating a sense of autonomy that is often missing in conventional museums. A major strength of the Museo Tiflológico lies in its continuous consultation with visually impaired audiences. As part of ONCE, the museum maintains an ongoing dialogue with users who provide feedback on tactile clarity, surface quality, and object durability. This participatory process has allowed the museum to refine its displays over time, ensuring that they remain both accessible and engaging (Museo Tiflológico de la ONCE, 2023).. In this respect, the museum represents a strong application of participatory collaboration, one of the three commitments discussed in Section 2.1.

Critically, the museum's approach demonstrates that inclusion does not necessarily rely on advanced technology but can be achieved through thoughtful, user-centred design. The main limitation of the Museo Tiflológico is its narrow thematic range: the focus on European monuments and art reflects the cultural interests of its founding period and limits global representation. Additionally, while the museum has recently begun exploring digital reproduction techniques, its online resources remain minimal, restricting access for remote audiences.

Despite these constraints, the Museo Tiflológico remains a landmark in inclusive museology. It shows that when accessibility is treated as a foundation rather than an addition, it can transform both the visitor experience and the museum's social role. Its long-term success illustrates how sensory diversity, community participation, and sustained institutional commitment can create meaningful inclusion within realistic resource limits.

2.2.2 Hoy Toca el Prado (Museo del Prado, Spain)

The Hoy Toca el Prado ("Touching the Prado") project, launched by the Museo del Prado in Madrid in 2015, represents a landmark initiative in transforming visual art into accessible tactile form (Museo Nacional del Prado, 2015). The project sought to provide blind and partially sighted visitors with direct access to some of the museum's most celebrated paintings by converting them into tactile reliefs. Six artworks were selected for the initial exhibition, including *Mona Lisa* and *Apollo in the Forge of Vulcan*. Each piece was reproduced as a three-dimensional relief using advanced digital imaging and resin printing processes that allowed visitors to explore the paintings through touch.

The process began with high-resolution digital photography and infrared scanning to capture every layer of the original paintings (Museo Nacional del Prado, 2015). The images were then processed using "Didú" technology, developed by the design studio Estudio Durero (Museo Nacional del Prado, 2015), which transformed tonal values into raised textures. Each printed layer of UV-cured resin corresponded to variations in depth and composition, creating a relief surface that retained the artwork's main structural features. After printing, the reliefs were mounted on lightweight panels coated with a matte, non-reflective finish to optimise tactile comfort. Braille labels and large-print texts provided contextual information, and an accompanying audio guide described composition, colour, and artistic technique in detail (Museo Nacional del Prado, 2015).



Figure 2: Visitor exploring a tactile relief painting from the “Hoy Toca el Prado” exhibition, Museo del Prado, Madrid (Source: Museo Nacional del Prado, 2015)

The exhibition layout was designed to allow visitors to move freely between the reliefs, with sufficient space for guided interpretation and independent exploration. Museum educators were trained to facilitate tactile engagement, explaining how to approach the reliefs through hand movement and orientation. The project also incorporated public feedback from blind and partially sighted participants during testing sessions, which informed adjustments to texture depth, labelling, and overall presentation (Museo Nacional del Prado, 2015).

One of the main achievements of *Hoy Toca el Prado* was its innovative use of digital technology to reinterpret two-dimensional art for tactile perception. The reliefs demonstrated that complex visual compositions could be translated into legible tactile structures without losing artistic integrity. The inclusion of audio description enhanced the multisensory experience, while the high production quality conveyed respect for both the artworks and their new audiences. The project aligns strongly with the first and third commitments identified in Section 2.1, recognising sensory diversity and embedding participatory collaboration by blending tactile, auditory, and user-informed design.

However, the project also reveals important limitations. Because of the high cost and labour intensity of the resin-printing process, only a small number of paintings could be converted, and the exhibition ran for a limited period. The reliefs themselves were too fragile for permanent display, which restricted their use to controlled settings. Moreover, the project’s focus on fine art reflects the priorities of a major national institution and may not be directly transferable to smaller or resource-limited museums.

Despite these constraints, *Hoy Toca el Prado* remains a defining example of how technology can support inclusive interpretation when applied with creative and ethical intent. It demonstrates that access for blind and partially sighted visitors can be both intellectually and aesthetically engaging. The project continues to inform similar initiatives in Europe and Latin America, proving that tactile reproduction of paintings is not merely a technical exercise but an interpretative re-imagining that invites new ways of perceiving art.

2.2.3 Smithsonian 3D Digitisation Programme (Washington D.C., USA)

The Smithsonian Institution in Washington D.C. has become one of the leading centres for digital innovation in cultural heritage through its 3D Digitisation Programme (Smithsonian Institution, 2020). Established in 2013, the programme aims to document, preserve, and share the museum’s extensive collections through advanced scanning and modelling technologies. A key part of this initiative involves using 3D printing to create tactile replicas that improve accessibility for blind and partially sighted visitors. These models allow audiences to

physically engage with objects that are otherwise too fragile, rare, or protected for direct handling.

The production process begins with high-precision 3D scanning, often using structured-light or laser-based systems to capture the surface geometry and texture of artefacts. The resulting digital models are refined through software such as Autodesk ReCap and Blender to remove scanning artefacts and optimise tactile clarity. Once processed, the models are printed using polylactic acid (PLA), a lightweight, biodegradable plastic known for its safety and durability. The printed replicas are typically produced at a 1:1 scale, although some are enlarged to highlight key features for tactile reading. After printing, the models are sanded and sealed with a thin acrylic coating to ensure smoothness and to withstand repeated handling (Smithsonian Institution, 2020).



Figure 3: Visitor handling a 3D-printed fossil replica from the Smithsonian 3D Digitisation Programme, Washington D.C. (Source: Smithsonian Institution, 2020)

These tactile replicas have been incorporated into educational programmes and exhibition spaces across the Smithsonian's network of museums, including the National Museum of Natural History and the National Air and Space Museum. In these contexts, visitors can explore printed fossils, spacecraft components, and animal skeletons through touch. The institution has also made many of its digital files freely available online through the Smithsonian's open-access platform, enabling other museums, schools, and research institutions to download and reproduce the models for teaching and accessibility purposes. This approach extends the museum's inclusive mission beyond its physical walls and shows how technology can promote global access to heritage (Smithsonian Institution, 2020).

The strengths of the Smithsonian's 3D Digitisation Programme lie in its scalability and ability to share knowledge widely. By releasing files under open-access terms, the institution allows others to adapt the models for their own educational or accessibility goals. The tactile quality of the replicas is also strong, with well-defined edges and forms that support non-visual exploration. The initiative reflects the first commitment discussed in Section 2.1, recognising sensory diversity by integrating touch as a legitimate and valued interpretative method.

However, the programme also presents several limitations. While it has advanced the technical and scientific aspects of digital preservation, the accessibility component remains largely expert-driven. Most of the replicas were designed by digital technicians and curators without direct involvement from blind or partially sighted users. As a result, the tactile clarity and interpretative usefulness of the models can vary depending on the complexity of the

original object. The cost of specialised equipment and software also means that smaller institutions may struggle to reproduce the Smithsonian's results at the same level of quality. Despite these challenges, the Smithsonian 3D Digitisation Programme demonstrates how large-scale technological initiatives can support inclusive access when aligned with educational goals and public engagement. Its model of sharing digital assets represents an important shift in how museums understand accessibility, not only as a visitor service but as a form of knowledge sharing. This approach offers valuable lessons for resource-limited contexts, showing that digital collaboration can extend the benefits of accessibility beyond the boundaries of the museum itself.

2.2.4 Museo Tattile Statale Omero (Ancona, Italy)

The Museo Tattile Statale Omero, located in Ancona, Italy, is one of the most influential examples of a museum dedicated to tactile interpretation (Museo Omero, 2024).. Founded in 1993 by Aldo Grassini and Daniela Bottegoni, both of whom are blind, the museum was established to make art accessible to everyone through touch (Museo Omero, 2024). It has since grown into an international model for inclusive museology, combining sculpture, architecture, and design with educational and sensory learning programmes.

The museum's collection includes plaster, resin, and bronze replicas of classical and contemporary sculptures, as well as tactile architectural models of famous monuments. Many of these replicas were produced through direct moulding and traditional casting methods, allowing for faithful reproduction of texture and form. Surfaces are carefully finished to remove sharp edges and to emphasise details that can be recognised by touch, such as folds in clothing, facial contours, or structural lines. The tactile quality of each piece is prioritised over visual resemblance, ensuring that every replica can be understood through hand exploration.



Figure 4: Tactile sculpture gallery at the Museo Tattile Statale Omero, Ancona (Source: Museo Tattile Statale Omero, 2024, official website)

The layout of the Museo Omero is designed to facilitate independent navigation. Exhibits are displayed at heights that allow both standing and seated visitors to engage comfortably. Pathways are wide, with textured floor guides that connect different sections of the museum. Braille and large-print labels accompany each exhibit, and audio descriptions are available for visitors who prefer verbal interpretation. The museum also offers workshops that teach tactile literacy, guiding participants in how to explore objects systematically and interpret spatial and material relationships through touch.

A key strength of the Museo Omero lies in its educational outreach and commitment to inclusive learning. Its programmes extend beyond the museum space into schools,

universities, and rehabilitation centres, where the tactile approach is used to support art education and sensory development. The museum also collaborates with artists and designers to produce new tactile works, demonstrating that accessibility can foster creative innovation. This integration of educational practice and artistic production reflects the principles of participatory collaboration and sensory diversity outlined in Section 2.1.

The museum's long-term sustainability and institutional recognition also set it apart. It is publicly funded and operates under the Italian Ministry of Cultural Heritage, which ensures continuity and alignment with national accessibility policies (Museo Omero, 2024). This relationship illustrates how strong policy frameworks can sustain inclusive institutions over time.

Despite these strengths, the Museo Omero faces certain challenges. Its reliance on traditional materials and static displays means that it has been slower to adopt new digital or interactive technologies that could extend its reach to remote audiences. While its tactile collection remains exemplary, expanding digital access could enhance its global impact and allow for wider dissemination of its methods.

Even so, the Museo Tattile Statale Omero stands as a leading example of how tactile engagement can be elevated from a supplementary feature to the central philosophy of a museum. By combining craftsmanship, education, and social inclusion, it demonstrates that accessibility can redefine the purpose of cultural institutions, turning them into spaces of shared learning and creative participation.

2.2.5 The Louvre Tactile Gallery (Paris, France)

The Tactile Gallery at the Louvre Museum in Paris represents one of the earliest and most enduring examples of tactile access to art within a major cultural institution (Musée du Louvre, 2023). Established in 1995, the gallery was designed to allow blind and partially sighted visitors to experience sculpture through touch (Musée du Louvre, 2023). It features high-quality replicas of selected works from the museum's collection, displayed specifically for tactile engagement. The initiative reflects a deliberate move away from the traditional "do not touch" policy of most art museums, recognising that tactile exploration is both a legitimate and necessary way of perceiving and understanding form.

The replicas in the Tactile Gallery are produced using plaster and resin casting methods that preserve the original scale and shape of the sculptures while ensuring durability and safety. Each object is prepared for handling by smoothing sharp edges and applying a matte surface finish that is pleasant to the touch. The selection includes classical works such as *Venus de Milo* and *The Seated Scribe*, among others that represent different historical periods and artistic styles. Visitors are encouraged to explore these objects independently, with staff on hand to offer guidance and to explain how to approach the sculptures through hand movement and tactile orientation.



Figure 5: Visitors exploring sculpture replicas in the Tactile Gallery, Musée du Louvre, Paris (Source: Wikimedia Commons, CC BY-SA 4.0)

Interpretation within the gallery integrates both tactile and auditory modes. Braille and large-print labels provide contextual information about each piece, and audio guides describe the sculpture's composition, pose, and artistic background. The layout is intentionally open, allowing visitors to navigate comfortably around the displays. Each sculpture is mounted at a height suitable for both seated and standing visitors, reinforcing the museum's commitment to accessibility and independence.

One of the strengths of the Tactile Gallery lies in its longevity and consistency. Unlike temporary exhibitions, it forms a permanent part of the Louvre's offering, signalling that accessibility is integral rather than supplementary. The gallery is also used as a training space for educators and museum professionals who want to learn about tactile interpretation and inclusive exhibition design. This long-term integration of accessibility into the Louvre's programming demonstrates the effectiveness of policy alignment and institutional commitment over time.

However, the Tactile Gallery also faces certain limitations. The selection of objects, while diverse, remains relatively small compared to the Louvre's vast collection, and most tactile engagement is confined to this single gallery rather than being integrated throughout the museum. This separation can reinforce the idea that accessibility is a specialised area rather than an inclusive norm. Additionally, the reliance on static replicas limits opportunities for incorporating new digital or interactive methods that could expand the experience further.

Despite these challenges, the Tactile Gallery remains a significant example of sustainable accessibility within one of the world's most prominent museums. It demonstrates that tactile engagement can coexist with conservation and curatorial integrity when designed with intention and care. The gallery embodies the principles of sensory diversity and participatory access outlined in Section 2.1, offering visitors a direct, physical relationship with art that transcends visual barriers. Its success has influenced numerous museums internationally, proving that inclusion can be achieved through simple yet meaningful design choices that recognise touch as an essential form of cultural understanding.

2.2.6 Critical Comparison and Discussion

The five global case studies analysed above demonstrate a shared commitment to improving accessibility for blind and partially sighted visitors, yet they reveal notable differences in approach, scale, and sustainability. Each example interprets the principles of sensory diversity, policy-based design, and participatory collaboration in ways that reflect its

institutional context and available resources. Together, they provide valuable insights into how inclusive practices can be adapted to different museum environments.

A common strength across all five institutions is their emphasis on tactile interpretation as a legitimate and enriching form of engagement. The Museo Tifológico and Museo Omero integrate touch as a primary interpretative mode, showing that accessibility can be built into a museum's identity rather than added later. The tactile reliefs of the Hoy Toca el Prado project and the replicas produced through the Smithsonian 3D Digitisation Programme illustrate how technology can extend sensory diversity by transforming visual content into tactile experiences. The Louvre Tactile Gallery, meanwhile, provides a stable and enduring model of how tactile access can be sustained within a major art museum without compromising conservation.

These examples collectively support the idea that sensory diversity enhances visitor experience. The use of different materials, including resin, plaster, and PLA plastic, demonstrates the flexibility of tactile production. Low-cost materials, such as those used in the Museo Tifológico and Museo Omero, show that accessibility can be achieved without relying on expensive technology. Conversely, the Hoy Toca el Prado project and the Smithsonian's programme demonstrate that advanced digital methods can achieve exceptional precision and global reach when resources allow. Both approaches contribute to a broader understanding of inclusion, suggesting that sensory access can take multiple forms depending on institutional capacity and cultural focus.

Policy alignment and institutional frameworks also play a critical role. The Museo Omero benefits from long-term government support through the Italian Ministry of Culture, which has ensured stability and consistent funding. Similarly, the Louvre Tactile Gallery has endured for nearly three decades because accessibility was embedded within the museum's official strategy rather than treated as a temporary initiative. In contrast, the Hoy Toca el Prado exhibition, despite its innovation, was limited by its short-term funding and project-based structure. The Smithsonian's open-access model introduces a different form of policy alignment, extending inclusion through digital sharing rather than formal legislation. These variations reveal that sustained accessibility depends as much on institutional governance and policy integration as on creative design.

The role of participation differs significantly among the five examples. The Museo Tifológico, as part of ONCE, engages directly with its primary audience through continuous feedback and testing, resulting in displays that respond to lived experience. The Museo Omero also demonstrates participatory design by involving visually impaired founders and staff who shape the museum's philosophy and teaching methods. In contrast, the Smithsonian's 3D Digitisation Programme remains largely expert-driven, with limited input from blind or partially sighted users in the design process. The Hoy Toca el Prado project included user testing during prototype development but did not establish an ongoing participatory structure. The Louvre Tactile Gallery lies between these approaches, depending more on consultation than full co-design. This comparison highlights that participation strengthens accessibility, yet it is often the most challenging element to sustain consistently across institutions.

The analysis also identifies several recurring challenges. The first is sustainability, as many accessibility projects depend on temporary funding or short-term exhibitions, which restrict their long-term influence. The second is maintenance, since tactile models and digital systems

require ongoing care to remain safe and functional. The third challenge concerns visibility. When accessibility is confined to a single gallery, as in the Louvre's case, it can unintentionally separate inclusive practice from the wider museum context. Overcoming these barriers requires institutional commitment that embeds accessibility into every aspect of organisational culture.

Despite these limitations, the five examples collectively suggest an emerging framework within museological scholarship for understanding inclusive practice. They demonstrate that effective accessibility relies on three interrelated conditions: design that embraces sensory diversity, governance that embeds accessibility into policy and planning, and collaboration that includes users as active partners. Institutions that address all three tend to achieve long-term and meaningful results. The Museo Tifológico and Museo Omero exemplify this holistic approach, while the technological and digital innovations of the Prado and the Smithsonian provide models for experimentation and extended reach. The Louvre's sustained commitment highlights the importance of continuity and accountability within institutional frameworks.

Taken together, these global examples show that inclusive interpretation is not limited by geography or resources but by institutional will and imagination. As discussed in Section 2.1, the effectiveness of these initiatives depends on how well institutions balance sensory diversity, policy-based design, and participatory collaboration. Where all three commitments are aligned, accessibility becomes sustainable and meaningful. Where one is absent, inclusion often remains partial or temporary.

Each case presents a viable path toward transforming museums from spaces of observation into spaces of participation. The lessons drawn from these case studies form a foundation for translating global principles into local practice, particularly in the context of South African museums. The next section focuses on the KwaZulu-Natal Museum to examine how these insights can inform the development of tactile interpretation for preserved artefacts within a resource-conscious and participatory framework.

2.3 Cultural Specificity and the KwaZulu-Natal Museum Context

The KwaZulu-Natal Museum, located in the city of Pietermaritzburg, was formerly known as the Natal Museum. Established in 1904, it is one of South Africa's oldest heritage institutions and remains a significant centre for the preservation and interpretation of natural and cultural history. The museum's founding was deeply connected to the nineteenth-century colonial desire to embed European scientific and cultural authority within South Africa. As early as 1849, Reverend James Green proposed the establishment of a museum in Pietermaritzburg that would promote the study of science and culture among the settler community (KZN Museum Centenary Book, 2004). His vision reflected a broader imperial project that positioned European institutions as markers of "civilisation" within colonial territories (Bennett, 1995). When the Natal Society eventually took up the initiative, it followed a distinctly Eurocentric model of collecting and interpretation, reinforcing classificatory systems that mirrored imperial hierarchies (Coombes, 2004; Dubin, 2006). From its inception, the museum functioned as part of an imperial network of knowledge extraction, presenting African heritage through the lens of European science and classifying African cultures as subjects of curiosity rather than living knowledge systems (Coombes, 2004).

2.3.1 Early Development of the KwaZulu-Natal Museum

The KwaZulu-Natal Museum, formerly known as the Natal Museum, formally opened in 1904 with collections that reflected the European scientific interests of the late nineteenth and early twentieth centuries, particularly the European passion for taxonomy, comparative anatomy, and ethnography. The Natal Society, which was largely made up of settler elites, collected natural history specimens, that includes birds, insects, reptiles, and mammals, all around the province of KwaZulu-Natal. Fossils and mineral samples were catalogued, aligning with colonial ambitions to document and exploit natural resources (KZN Museum Centenary Book, 2004). Such practices reflect what Bennett (1995) describes as the museum's role in organising knowledge in ways that supported governance and resource control within imperial systems. In addition to natural history, the museum acquired ethnographic collections from across southern Africa, often obtained through networks of missionaries, colonial officials, and amateur collectors. These artefacts were presented in glass cabinets with very limited contextualisation, strengthening a hierarchical view of African cultures as subjects of scientific observation.

Displays were significantly influenced by curators and staff such as F. Teschner, a taxidermist employed in the early twentieth century. Teschner created enlarged insects like ants, spiders, and beetles, and mounted many specimens. The Victorian insect models, which are the main focus of this study, were designed to enlarge details invisible to the human eye (KZN Museum Centenary Book, 2004). They helped make the study of entomology more accessible for settler audiences during that period when microscopes were not commonly available. Yet while they serve one group's educational purpose, they fulfil the authority of European science and bolster assumptions about the superiority of the Western knowledge system over indigenous ways of knowing.

Colonial museums like this one did not just preserve or interpret; they also served as instruments of empire (Coombes, 2004; Bennett, 1995). They legitimised colonial expansion by presenting Africa as a region to be studied, categorised, and governed. As Dubin (2006) argues, such institutions often naturalise racial and cultural hierarchies through seemingly neutral displays of science and heritage. Thus, the museum contributed to constructing a narrative of European modernity against African heritage.

2.3.2 Colonial and Apartheid Legacies

Throughout the twentieth century, the KwaZulu-Natal museum (up until the first general election in 1994) evolved into a site where European scientific traditions were privileged over indigenous knowledge systems. Natural history collections were organised to emphasise mineralogy, zoology, and entomology through techniques that depend heavily on visual classification (KZN Museum Centenary Book, 2004). In contrast, reductive lenses that presented the colonial project to classify and other African communities were used to present ethnographic material (Coombes, 2004). Displays of cultural artefacts frequently strip artefacts of their living context, portraying them as static artefacts of a supposedly vanishing people. African knowledge was positioned as peripheral and European knowledge as dominant in this interpretative framework, which served to reinforce larger social inequalities.

During apartheid, these legacies were reinforced. Museums were used as tools of ideology, creating narratives about race, culture, and progress (Dubin, 2006). The KwaZulu-Natal

Museum's displays privileged sight-based and text-heavy interpretation, assuming literate and largely white audiences. These curatorial practices prevented participation from blind and partially sighted visitors, as well as many marginalised South Africans. Accessibility was not considered, either physically or interpretatively. Moreover, the apartheid-era segregation of cultural institutions meant that many black South Africans were denied access to museum education programmes, reinforcing generational inequality (Coombes, 2004; Dubin, 2006).

The emphasis on a single interpretative lens resulted in barriers that continue to shape the museum's structure and visitor experience. This visual paradigm continues to prioritise observation over participation, limiting multisensory engagement and reinforcing exclusion for visitors who rely on tactile and auditory modes of learning. Institutional priorities also tend to focus on preservation rather than participation, meaning that accessibility initiatives are often peripheral or temporary. The lack of consistent funding and staff training for inclusive design further compounds these issues. As a result, the museum continues to reflect a legacy of exclusion that privileges sight, literacy, and Western epistemologies, creating challenges for broader participation and cultural equity in the present.

2.3.3 The Victorian Insect Models: From Pedagogy to Exclusion

Among the museum's historical holdings, the enlarged Victorian-era insect models stand out as distinctive examples of early scientific pedagogy. Created in the early twentieth century under the direction of F. Teschner, these models include detailed reconstructions of spiders, ants, and beetles designed for public education (KZN Museum Centenary Book, 2024). They were intended to make the microscopic visible, turning natural science into a visual spectacle accessible to settler audiences. In doing so, they reflected the broader educational goals of colonial museums, which sought to disseminate scientific knowledge while reinforcing Western authority.

Today these same artefacts are preserved behind glass in ornate Victorian cabinets. Their enlarged forms, once celebrated for educational clarity, now serve primarily as aesthetic objects of display. For blind and partially sighted visitors, they are inaccessible both physically and conceptually. The cabinets that hold them still embody nineteenth-century ideals of order and containment, demonstrating how older museological structures continue to influence interpretation. These insect models therefore embody two overlapping histories: they are reminders of colonial visual pedagogy and potential instruments for inclusive reinterpretation. If reproduced as tactile replicas, they could re-establish their educational value and demonstrate how historical artefacts can be used to bridge the divide between visual and multisensory learning.



Figure 6: Victorian-era Insect Models Displayed Behind Glass at the KwaZulu-Natal Museum (2025)

The continued presence of the insect models highlights both continuity and possibility. They reveal the persistence of a visual paradigm that privileges observation over participation, yet they also offer a practical way to challenge that paradigm by introducing tactile and auditory interpretation into existing displays.

2.3.4 Early Experiments with Inclusion: Kelsall's Travelling Cases

Although accessibility has often been overlooked, the KwaZulu-Natal Museum's history includes moments of innovation that align with inclusive principles. One of the most notable examples is the work of Laura Kelsall, who in the 1960s developed more than 600 travelling cases of artefacts for use in schools (KZN Museum Centenary Book, 2004). These cases contained resin casts, labelled diagrams, and tactile teaching aids that allowed students, particularly in rural areas, to engage with scientific and cultural material through touch. Kelsall's project reflected a forward-thinking understanding of educational access long before accessibility became a formal policy concern in South African museology.



Figure 7: Laura Kelsall's Travelling Cases, KwaZulu-Natal Museum (2025)

The significance of Kelsall's initiative lies in its recognition of tactile learning as a legitimate educational method. It demonstrated that inclusive teaching tools could be developed using available resources and distributed widely. Yet this progressive legacy was not maintained. The museum today lacks permanent tactile exhibits, Braille labelling, or consistent audio

interpretation. Kelsall's work now stands as an early example of what was possible, illustrating how inclusion tends to appear in cycles, emerging through individual initiative and fading without institutional support. The absence of continuity in such projects underscores the importance of embedding accessibility into policy rather than relying on the enthusiasm of individuals.

2.3.5 Contemporary Practice and Gaps

In recent decades, the KwaZulu-Natal Museum has broadened its scope to include exhibitions on natural science, social history, and anthropology, reflecting a growing awareness of its role within a democratic society. Despite this progress, accessibility for disabled visitors remains uneven and largely uncoordinated. Some exhibitions have introduced interactive elements, but these are seldom designed with visually impaired audiences in mind. Feedback from staff and visitors recorded in the centenary reflections suggests that inclusion is often achieved through partnerships with external organisations rather than being embedded within institutional policy (KZN Museum Centenary Book, 2004; Makhanya, 2019).

In an interview conducted for this study, Wesley Flanagan, Assistant Head of Exhibitions at the KwaZulu-Natal Museum, observed that while there is recognition of the importance of accessibility, practical progress has been limited by funding constraints and insufficient expertise in inclusive design (Flanagan, personal communication, 12 October 2025). He explained that most efforts have been short-term, driven by collaborations with universities or specific grant projects. Long-term planning and internal accountability structures have yet to be established. Flanagan emphasised that sustainable change will require formal staff training, budget allocation, and strategic direction from management to ensure accessibility becomes part of the museum's operational framework.

The absence of tactile replicas, audio guides, and integrated Braille continues to highlight the dominance of visual display. Exhibitions remain reliant on text and vitrines, excluding those who interpret the world through non-visual means. These conditions reveal a gap between institutional awareness and implementation, where accessibility exists as a concept but not as consistent practice.

National disability rights frameworks, such as the *White Paper on the Rights of Persons with Disabilities* (2015), call on cultural institutions to remove barriers to participation. Yet implementation remains inconsistent, often hindered by inadequate resources and limited professional development (Graham and Brown, 2021). The gap between policy and lived experience emphasises the need for research-led, practical interventions. Unless inclusion is built into long-term planning and budgeting, accessibility will remain dependent on individual initiative rather than institutional responsibility.

The issue is not only material but conceptual. Accessibility in museums is frequently equated with physical infrastructure like ramps and lifts, which, while essential, do not address interpretative barriers. For visitors who are blind or partially sighted, the absence of tactile models, Braille captions, and audio interpretation means exclusion from the very knowledge museums claim to make public. The Victorian insect models and similar displays reveal this imbalance and present an opportunity to shift towards multisensory engagement that connects preservation with participation.

2.3.6 Relevance of the Present Study

This study identifies the Victorian insect models as both a symbolic and practical point of departure for improving accessibility at the KwaZulu-Natal Museum. These artefacts can be documented in high detail through LiDAR scanning without disturbing their preservation. Using 3D printing and open-source modelling software, tactile replicas can then be produced as accessible surrogates designed in collaboration with blind and partially sighted users. Participants recruited through the UKZN Disability Support Unit will provide input on aspects such as scale, texture, and ease of interpretation, ensuring that the replicas are both accurate and meaningful.

Audio description was developed in English and isiZulu to contextualise the models and ensure linguistic inclusion. Braille labels, produced with the UKZN Disability Support Unit, enabled independent access to written information. Through these combined measures, accessibility becomes a practical and collaborative process rather than a symbolic addition.

By reinterpreting the Victorian insect models and their display cabinet, this research directly engages with the museum's colonial history of containment and visual dominance. It reframes these objects as tools for social and educational transformation, demonstrating how preserved artefacts can be used to promote participation and equality. Accessibility is positioned as a fundamental responsibility within democratic South Africa, not as an optional enhancement.

The co-design process ensures that inclusion grows through dialogue rather than prescription. It challenges historical hierarchies in which museums spoke for their audiences instead of working with them. This reflects the broader transformation of South African museology, which now emphasises participation, responsiveness, and the integration of community knowledge (Coombes, 2004).

Expanding accessibility through this case study holds broader relevance for South African museums. It demonstrates that inclusive practice is achievable even within constrained budgets through collaboration, creativity, and local expertise. The Victorian insect models thus serve as an example of how historical artefacts can be re-imagined to bridge the divide between exclusion and participation, and between colonial heritage and democratic transformation.

2.4 Adapting Inclusive Practices to the Global South

Adapting inclusive museum practices to the Global South is not a matter of duplicating successful models from Europe and North America. Rather, it requires rethinking the commitments identified earlier in this chapter, particularly sensory diversity, policy integration, and participatory collaboration, within contexts shaped by different social histories, languages, and material conditions.

Some museums in South Africa and similar regions continue to operate within buildings and systems shaped by colonial and apartheid legacies. They face limited budgets, uneven access to technology, and highly diverse audiences with varying literacy levels and cultural expectations. In these environments, inclusive design must be both realistic and contextually grounded. This section discusses how inclusive strategies can be reshaped to suit these

conditions, focusing on sustainability, cultural specificity, and meaningful engagement with visually impaired visitors (Coombes, 2004; Makhanya, 2019; Graham & Brown, 2021).

2.4.1 Structural and Cultural Realities

The first challenge facing museums in the Global South is structural. Many institutions struggle with persistent funding shortages that affect staffing, training, and the maintenance of exhibitions. Budgets often prioritise preservation and security, leaving limited capacity for tactile models, audio guides, or Braille production. The lack of dedicated accessibility training means that even where inclusive technologies are available, they may not be implemented effectively (Graham & Brown, 2021). Physical constraints compound these challenges. Older museum buildings frequently lack accessible circulation routes, appropriate lighting for low-vision visitors, and surfaces suitable for tactile wayfinding. In some cases, reliable electricity or Wi-Fi cannot be guaranteed, making app-based or digital systems impractical.

These realities highlight the need for an approach that balances ambition with practicality. Rather than promising complete institutional transformation, museums can focus on targeted interventions that demonstrate value and build internal support. Small-scale projects, such as introducing tactile replicas for a single exhibition or creating multilingual audio tours, can produce visible impact while establishing a foundation for broader reform. A gradual, evidence-based approach also helps build trust among staff and funders who may initially view accessibility as an added expense rather than an integral part of museum function.

Cultural and linguistic diversity further complicates accessibility in South Africa. Museums in KwaZulu-Natal, for example, cater to audiences who speak multiple languages and interpret objects through different historical and cultural lenses. For accessibility to be meaningful, interpretation must acknowledge these perspectives. Audio descriptions and tactile labels should therefore be multilingual and culturally contextual. Using both isiZulu and English as standard interpretative languages allows visitors to engage through familiar vocabularies while still accessing scientific information. Translations should be developed collaboratively with local communities to avoid literal or culturally insensitive phrasing.

Cultural specificity also shapes interpretative focus. Imported models of accessibility often centre universal narratives of art or science, while South African audiences may value stories that connect artefacts to regional histories and lived experience. Adapting interpretation means writing audio and tactile materials that address who collected the object, why it was displayed, and how these choices relate to local identity. Access in this sense is not only technical but ethical, encouraging reflection on colonial histories and their influence on present-day representation (Coombes, 2004).

2.4.2 Innovation, Technology, and Local Craft

Innovation in the Global South depends on frugal and sustainable methods rather than expensive technology. While museums in the Global North often rely on advanced scanning and proprietary software, many African institutions achieve inclusive results using low-cost, open-source tools. LiDAR scanning provides precise, non-invasive documentation of fragile objects, but when unavailable, structured light or manual modelling can achieve similar results. Open-source software such as Blender reduces costs for mesh editing and digital

preparation. For fabrication, PLA filament is affordable, easy to handle, and safe for touch. The focus should remain on tactile clarity rather than technological sophistication.

The Victorian insect models at the KwaZulu-Natal Museum illustrate this principle well. Because these artefacts are already rich in tactile detail, the goal of adaptation is not to reproduce them perfectly but to emphasise key textures and forms that communicate meaning through touch. Enlarging specific features, smoothing sharp edges, and pairing the replicas with clear audio guidance can enhance understanding without overreliance on technology. Technical innovation is valuable only when it improves accessibility and can be maintained sustainably.

Low-tech methods are equally important. Raised-line diagrams printed on swell paper, tactile floor plans near entrances, large-print labels, and offline audio players can all enhance inclusion at minimal cost. Local craft ecologies also offer valuable opportunities for collaboration. Skilled artisans can contribute through wood carving, resin casting, or beadwork that communicates form and texture. These partnerships strengthen community engagement and produce replicas that feel culturally authentic rather than imported. As Imrie (2012) argues, locally produced designs often carry a stronger sense of ownership and are more sustainable because their maintenance can be handled within the community.

Designing for touch also requires attention to conservation and safety. Detachable replicas, protective coatings, and durable tactile signage extend the lifespan of accessibility tools. Many access initiatives fail not because of design flaws but because maintenance was not considered at the outset. Ensuring durability is especially critical in high-contact environments like public galleries, where objects are subject to frequent handling.

2.4.3 Participation, Training, and Collaboration

Adaptation without participation risks producing tools that appear inclusive but fail to meet real needs. Co-design with blind and partially sighted users is therefore a central component of sustainable accessibility. Direct engagement allows designers to test tactile legibility, scale, and surface texture before final production. Short participatory sessions, where users handle prototypes and share feedback, can reveal insights that no manual or policy guideline can provide. These exchanges should occur throughout the process rather than only at the evaluation stage.

In South Africa, partnerships with university disability units and local advocacy organisations provide a practical way to recruit participants and ensure ethical engagement. Participants should be compensated fairly, and considerations such as transport, time, and comfort should be built into project budgets (Neves et al., 2018). Beyond improving design outcomes, co-design fosters institutional learning. When curators, educators, and technicians work directly with visually impaired visitors, they develop an understanding of tactile reading, audio pacing, and the emotional aspects of touch-based interpretation. This kind of experiential knowledge cannot be acquired from guidelines alone (Falk & Dierking, 2013).

Collaboration also addresses capacity challenges. Because resources are unevenly distributed, partnership models can extend expertise and equipment across institutions. Universities can offer access to scanning facilities and 3D printers, while museums contribute curatorial insight and access to collections. Disability organisations can assist with training and

recruitment. Small, clearly defined agreements or memoranda of understanding can formalise these relationships without creating heavy bureaucracy.

Training forms the backbone of sustainable adaptation. Staff development workshops on audio description writing, tactile label production, and facilitation for mixed-ability groups can be incorporated into regular museum training programmes. Practical exercises, such as describing a complex object in three minutes using plain language or guiding a visitor's hand safely across a model, help staff build confidence in direct engagement. Institutions that invest in regular accessibility training are more likely to sustain inclusion once external projects or funding end (Graham & Brown, 2021).

2.4.4 Evaluation, Examples, and Lessons

Accessibility initiatives improve through reflection and iteration. Evaluation does not need to depend on complex data systems. Simple observation checklists can record where visitors begin touching an object, how long they interact, and where confusion arises. Short exit interviews and comment cards can capture what visitors found helpful or unclear. Testing audio descriptions for pacing and clarity, and then refining them based on feedback, is an inexpensive but effective way to improve communication (Braun & Clarke, 2006). Continuous cycles of testing and adjustment help museums build stronger, user-informed systems without relying on large budgets.

Several institutions across the Global South illustrate how such adaptive strategies can succeed. The Origins Centre at the University of the Witwatersrand has developed tactile components and guided sensory tours for interpreting rock art. Low-cost raised graphics and community-recorded audio stories accompany these exhibits, providing layered interpretation that connects heritage with lived experience (Graham & Brown, 2021). In Cape Town, Iziko Museums have experimented with touchable casts and bilingual labels for natural history displays. Although these projects depend on external funding and are therefore episodic, both examples show that accessibility becomes more effective when tactile design is integrated with narrative interpretation rather than treated as a separate add-on. In this way, they demonstrate that accessibility is achievable when design and storytelling are planned together (Makhanya, 2019).

Elsewhere, museums in Latin America and Asia have produced practical accessibility outcomes. The Museum of Tomorrow in Rio de Janeiro and the Football Museum in São Paulo integrate tactile floor plans and locally voiced audio guides to support large, mixed-ability audiences (*Museum of Tomorrow*, 2015; Football Museum signage and local reports). The National Museum of Anthropology in Mexico City employs embossed maps and raised-line diagrams to assist navigation across its galleries (Encyclopaedia Britannica, 2026). In India, the National Museum in New Delhi operates tactile galleries that use resin and stone replicas supported by trained guides who provide multilingual verbal descriptions (National Museum of India Anubhav Initiative, 2026). Across these examples, accessibility appears to develop incrementally through pilot projects and gradual refinement rather than single, large-scale interventions, suggesting ongoing adaptation and user feedback (Neves, Queirós & Pereira, 2018).

2.4.5 Avoiding Tokenism and Implications for KwaZulu-Natal

Tokenism remains one of the greatest risks in accessibility work. Tactile stations or audio files that are added superficially, without connection to the broader narrative, can reinforce exclusion rather than resolve it. Inclusive design should therefore begin with a clear understanding of purpose. If the aim is to communicate form, the tactile replica should prioritise shape and texture. If the goal is to explain function, cross-sections or movable parts may be necessary. Audio guides should lead visitors through exploration using clear spatial cues, and label placement should be consistent so that expectations are predictable. The design must always fit the interpretative intention rather than serve as decoration (Classen, 2012).

For the KwaZulu-Natal Museum, these lessons have immediate relevance. The Victorian insect models provide an ideal pilot project through which the institution can apply these adaptive principles. By combining targeted LiDAR scanning, open-source digital modelling, and affordable 3D printing, the museum can produce tactile replicas supported by bilingual audio and concise Braille labels. Short co-design sessions with visually impaired students can establish the most legible size for the spider model, appropriate mounting height, and the textures that best convey anatomical detail. Low-tech complements, such as raised cabinet diagrams and offline audio players, can ensure reliability when digital systems fail. Staff training focused on touch facilitation and basic maintenance can support long-term use. Regular evaluation cycles will allow for gradual refinement and help build an internal case for expanding similar initiatives across other galleries.

Adapting inclusive practices to the Global South is therefore not about copying established models but about aligning ideals with local realities. It depends on cultural specificity, collaboration, and achievable steps that build momentum over time. When accessibility is treated as a shared responsibility rather than a technical challenge, it becomes sustainable and meaningful for the communities that museums serve.

2.5 3D Digital Technologies in Museums: LiDAR and 3D Printing

New digital technologies have transformed the way museums preserve, interpret, and share collections. In particular, scanning technologies such as LiDAR and fabrication techniques such as 3D printing have opened up new opportunities for accessibility. These tools allow institutions to document artefacts in high resolution, create digital archives, and fabricate tactile replicas that can be safely handled by visitors. For visually impaired visitors, these technologies hold a very special significance, as they enable multisensory engagement with artefacts that are otherwise visually or physically inaccessible (Remondino & El-Hakim, 2006; Blaser et al., 2002). This section explores the role of LiDAR and 3D printing in museum practice, assessing both their potential and their limitations in resource-constrained contexts such as South Africa.

2.5.1 3D Modelling and Open-Source Tools

LiDAR is a remote sensing method that uses pulsed lasers to measure distances and generate three-dimensional point clouds. In cultural heritage contexts, LiDAR is valued for its ability to capture detailed geometry of artefacts without physical contact, making it especially suitable for fragile or encased artefacts (Remondino & El-Hakim, 2006). For museums, this non-invasive quality is crucial in balancing conservation and access.

Editing also allows curators and designers to customise models for tactile interpretation. For

example, surface textures can be exaggerated, proportions adjusted, or cross-sections created to emphasise features that enhance haptic legibility. This technique requires iterative testing with visually impaired users to confirm what level of detail is beneficial and what might overwhelm or confuse. In this sense, the technology does not replace interpretation but works in tandem with participatory design processes.

Digital models can also be annotated, embedded with metadata, or paired with audio guides to form multimodal interpretative tools. These files can be shared across platforms, allowing for replication in schools, community centres, and partner museums. Such portability broadens the scope of accessibility interventions and demonstrates the collaborative potential of digital heritage.

2.5.2 3D Printing: Materialising Digital Access

3D printing translates digital models into physical surrogates. The major advantage of museum accessibility is the creation of tactile replicas that visitors can touch without causing damage to the real artefact. Printed replicas enable blind and partially sighted visitors to explore shape, scale, and texture through touch, which is often the most effective sensory channel for learning.

Commonly used materials include PLA (polylactic acid), a biodegradable plastic that is affordable, durable, and safe for handling. PLA holds surface detail well, making it suitable for reproducing intricate forms such as insect anatomy (Blaser et al., 2002). Alternative materials such as ABS (acrylonitrile butadiene styrene) or flexible TPU (thermoplastic polyurethane) can also be explored, depending on tactile requirements. Experimentation with finishes, such as matte versus glossy surfaces, further enhances tactile clarity.

At the KwaZulu-Natal Museum, replicas of the Victorian-era insect model could be scaled into different sizes: one can be at the same scale as the actual historical model, and another closer to the insect's natural proportions. This multiple variation will allow visitors to understand both the enlarged detail and the actual size of the species. Such interpretative flexibility exemplifies the strength of 3D printing in creating contextually relevant experiences.

2.5.3 Integration into Exhibition Design

While replicas are powerful tools, their effectiveness relies on integration into broader exhibition design. A printed artefact presented without interpretative support risks tokenism. Replicas must be paired with clear audio guides, tactile labels, and well trained facilitators. Mounting should prioritise safe, stable handling while encouraging exploration. Replicas can be incorporated into multisensory stations where soundscapes, descriptive audio, and tactile diagrams work together to create a very rich interpretative experience.

Museums internationally have shown the potential of 3D technologies. The Smithsonian Institution has distributed open-access 3D print files, enabling educators and museums worldwide to create their own tactile collections (Hutchinson & Eardley, 2020). The British Museum has piloted 3D printed surrogates of fragile artefacts for handling sessions, though debates about authenticity remain (Pye, 2016). These examples show how 3D printing can democratise access when applied thoughtfully.

2.5.4 Limitations and Considerations

Despite their great potential in enhancing accessibility to artefacts in museum context, LiDAR and 3D printing are not without some limitations. The cost of equipment, training, and maintenance can be significant, particularly for museums that are underfunded. Technical expertise is required not only for scanning artefacts, but also for processing and printing with 3d printers, which may not always be available. In addition, replicas inevitably raise questions of authenticity and representation, since decisions about scale, texture, and emphasis shape user perceptions (Cooke & Buckley, 2021).

Sustainability is another concern. Printing requires time, energy, and materials, and ongoing maintenance is important to ensure replicas remain safe for handling. Conservation staff may express concern that tactile surrogates risk replacing engagement with original artefacts. Clear communication and labelling are necessary to distinguish replicas and contextualise their purpose.

2.5.5 Opportunities for the Global South

For museums in South Africa and the wider Global South, LiDAR and 3D printing offer unique opportunities to remove traditional accessibility barriers. By focusing on targeted, high-value artefacts, institutions can then demonstrate the value of inclusive design even with low resources. Collaboration with universities and makerspaces can provide access to equipment and expertise. Collaborative projects can also generate training opportunities for staff, bringing new skills within institutions.

The KwaZulu-Natal Museum is well-positioned to drive such innovation. By digitising and reproducing the Victorian insect models, it can both preserve fragile historical artefacts and create inclusive experiences that honour the museum's educational mission. The project would serve as a demonstration of how resource-constrained museums can adapt global technologies to local conditions, balancing ambition with practicality. In this way, 3D digital technologies represent not only powerful technical tools but also catalysts for collaborative, multisensory interpretation that repositions access as central to the museum's role in democratic South Africa.

2.6 Ethical Considerations of Using Tactile Replicas

The use of tactile replicas in museums raises important questions about authenticity, authority, and representation. Replicas, by their very nature, are interpretative rather than neutral. Every decision made during production, from the choice of scale and material to the emphasis of surface textures, influences how users perceive the original artefact. As Pye (2016) points out, replicas cannot be understood as direct stand-ins for originals. They embody curatorial and technical choices that must be made explicit if they are to serve as legitimate interpretative tools.

Authenticity is a highly sensitive issue in heritage institutions. Visitors often regard the aura of the original as central to the museum experience. Tactile replicas can therefore spark debates about whether they dilute or undermine the authority of the "real." However, denying access altogether, especially for visually impaired audiences, risks perpetuating deeper ethical failures. As Parry (2007) argues, inclusion should outweigh purist concerns when access is at

stake. Replication, if transparently framed, can serve as a bridge rather than a replacement, offering users meaningful contact while preserving fragile artefacts.

A recurring challenge is how to ensure that visitors understand what they are touching. Without clear contextualisation, replicas risk being mistaken for originals, which can mislead rather than empower. Museums must therefore label tactile surrogates unambiguously and provide interpretative explanations of why they were produced. Transparency acknowledges the distinction between the original and the replica, while still affirming the educational and interpretative value of the latter (Cooke & Buckley, 2021).

An example most often cited is the British Museum's replica of the Rosetta Stone. While tactile access allowed blind visitors to engage with the artefact, critics pointed out that important surface wear and inscription gaps were omitted from the replica, resulting in a different understanding of the artefact's history (Pye, 2016). This instance highlights the necessity of documenting and communicating the choices made in creating replicas. Omissions, however unintentional, can significantly alter meaning.

Beyond questions of authenticity, replicas also raise ethical concerns regarding whose perspectives they represent. Traditional curatorial techniques often position replicas as neutral teaching tools, but they can reproduce biases if designed without input from disabled users or communities connected to the artefacts. Cooke and Buckley (2021) argue that replicas should be evaluated not only for their physical fidelity but also for their cultural legibility. This means considering how design choices resonate with local narratives, values, and identities.

The concept of interpretative justice is relevant here. According to Parry (2007), fair interpretation requires providing all visitors with meaningful ways to access cultural heritage. Replicas designed collaboratively with visually impaired users meet this obligation more fully, as they reflect lived experience rather than abstract compliance. Co-design ensures that tactile tools convey not just form but also the interpretative cues that matter most to the people using them.

The materials used in replicas also carry ethical implications. PLA, ABS, and resin each have different tactile properties, durability, and ecological footprints. Choices about material are not neutral: they impact sustainability, user comfort, and environmental conservation. PLA, for example, is biodegradable and considered environmentally friendly, but may wear faster under heavy handling. Resin may capture detail more precisely, but it is more fragile and less safe for frequent touch. Ethical decision-making requires balancing tactile fidelity with safety, longevity, and ecological responsibility (Blaser et al., 2002).

Conservation ethics must also be considered. Replicas are often produced to protect originals from damage; nevertheless, if they are poorly designed, they may themselves degrade quickly, resulting in waste and disappointment. Museums must make plans for ongoing maintenance, cleaning, and replacement. Museums failing to do so risk creating a cycle of interventions that are unsustainable, which can also undermine long-term accessibility.

Another ethical dimension is with regard to how replicas represent cultural artefacts. In some circumstances, artefacts have deep spiritual or ceremonial significance that complicates replication. Producing tactile versions without consultation may be perceived as disrespectful or appropriative. Museums must therefore engage with source communities to determine

what forms of replication are acceptable, and how replicas should be contextualised. This is especially relevant in South Africa, where colonial histories have left legacies of dispossession and misrepresentation (Coombes, 2004).

The Victorian insect models at the KwaZulu-Natal Museum are less culturally sensitive than some ethnographic collections, but they still embody colonial pedagogical values. Replicating them without critical framing risks reinforcing narratives of European scientific authority. The ethical task, then, is to acknowledge these legacies openly and to use replication as a means of reframing the models within inclusive, democratic, and participatory narratives. Reinterpreting these models through tactile replication also engages postcolonial concerns about representation and power, particularly the need to reconsider how objects formed within colonial knowledge systems are framed for contemporary audiences (Coombes, 2004; Said, 1978).

Ethical use of tactile replicas requires involving users in every stage of design. Co-design workshops with blind and partially sighted participants allow for iterative feedback on size, texture, and clarity. This participatory technique ensures that replicas are physically accurate and hold meaning experientially. It affirms the rights of disabled people in shaping cultural and historical interpretation, in accordance with the principles of the UN Convention on the Rights of Persons with Disabilities (CRPD, 2006).

For the KwaZulu-Natal Museum, co-design is not an optional enhancement but a crucial ethical commitment. Workshops with visually impaired students through the UKZN Disability Support Unit will determine whether replicas emphasise features such as legs, fangs, or body segmentation, and how tactile exploration is best guided. This user-led process ensures that replicas do not simply reproduce colonial scientific displays but instead become tools of empowerment.

Well-designed tactile replicas can also foster emotional connections that challenge stereotypes about disability. Visitors often assume that blind and partially sighted people cannot engage with museums. By facilitating active exploration, replicas demonstrate otherwise, reshaping perceptions of both artefacts and audiences. Emotional engagement arises when replicas are paired with audio stories, contextual cues, and participatory facilitation. In this sense, replicas become not only educational devices but also ethical instruments of inclusion (Chatterjee & Noble, 2013).

Ultimately, the ethical use of tactile replicas requires balancing preservation, access, and justice. Preservation demands that fragile artefacts remain protected. Access requires that all visitors have opportunities to engage meaningfully. Justice insists that disabled audiences are not treated as afterthoughts but as co-authors of cultural experience. Achieving this balance requires ongoing dialogue, transparency, and accountability.

For the KwaZulu-Natal Museum, replicating the Victorian insect models using LiDAR scanning and 3D printing offers a practical way to balance preservation, access, and justice. Preservation is ensured by keeping the original artefacts safely behind glass while creating accurate digital scans that record their form in detail. Access is achieved through tactile replicas supported by Braille and bilingual audio interpretation, allowing visitors with different sensory needs to engage directly with the collection. Justice is pursued through a co-design process that involves visually impaired participants in shaping the form, texture, and interpretative presentation of the replicas.

This balance is maintained by designing the replicas to be durable, safe for handling, and clearly labelled as reproductions, which protects both the integrity of the originals and the transparency of interpretation. By embedding consultation and feedback into every design stage, the project ensures that accessibility decisions are informed by users rather than imposed on them. In this way, the tactile replica and its display environment aim not only to preserve heritage but to redistribute interpretative authority and foster equitable participation. This approach demonstrates how inclusive practice can uphold conservation ethics while extending cultural access, turning preservation, access, and justice into complementary rather than competing goals.

2.7 Policy Frameworks and Standards for Disability Rights and Cultural Access

This section examines key policy frameworks that shape the principles of disability rights and cultural access within museum practice. Both international conventions and South African national policies define accessibility as a human right and provide guidelines for how public institutions should remove barriers to participation. These standards form the legal and ethical foundation on which inclusive museology is built.

2.7.1 International Frameworks

International frameworks like the United Nations *Convention on the Rights of Persons with Disabilities* (CRPD, 2006) have had a significant impact on the global discourse on disability rights and cultural access. The CRPD emphasises the right of persons with disabilities to participate fully in cultural life, including equal access to cultural materials, performances, and heritage institutions. Article 30 explicitly requires states to ensure access to monuments, museums, and other cultural sites in accessible formats. For museums, this establishes a binding obligation to prioritise accessibility not as an optional feature but as a legal and ethical mandate.

In the United States, the *Americans with Disabilities Act* (ADA, 1990) has had a transformative influence on cultural institutions. It demands that public spaces, including museums, provide reasonable accommodations and remove barriers that exclude disabled visitors. The ADA has spurred innovations such as tactile tours, accessible signage, and audio guides, many of which have become international benchmarks. Similarly, European standards, such as those promoted by the European Disability Forum, have encouraged museums to develop inclusive strategies, often linked to funding incentives and accreditation processes.

The Royal National Institute for the Blind (RNIB) in the United Kingdom has created specific guidelines for accessible museum practice. These include recommendations for tactile maps, Braille and large-print labels, multisensory programming, and audio description. Although they are designed in a Northern context, these standards are widely referenced globally as practical benchmarks for what accessibility in cultural institutions should look like. UNESCO has also played a massive role through toolkits and capacity-building programs for accessible cultural and historical heritage. These international efforts altogether set a baseline expectation: museums must move beyond symbolic gestures to embed accessibility in structural and interpretative design.

2.7.2 National Frameworks in South Africa

South Africa has its own robust policy landscape. The *White Paper on the Rights of Persons with Disabilities* (2015) is the primary national framework, mandating all public institutions to remove physical, informational, and attitudinal barriers. It places accessibility as a constitutional right tied to equality, dignity, and non-discrimination. For museums, this translates into a duty to ensure that exhibitions, interpretative materials, and spaces are accessible to all visitors, regardless of ability.

Other national policies, including the *Promotion of Equality and Prevention of Unfair Discrimination Act* (2000), emphasise the obligation of institutions to prevent exclusion. The *National Heritage Resources Act* (1999) emphasises the protection and promotion of cultural heritage, which implicitly requires inclusive access to ensure that heritage belongs to all South Africans. The Department of Arts and Culture has also issued accessibility guidelines for cultural programming, though implementation remains inconsistent.

Despite this strong legislative base, studies highlight a continuous gap between policy and practice (Makhanya, 2019; Graham & Brown, 2021). Many museums interpret accessibility narrowly, placing too much emphasis on compliance with physical infrastructure requirements such as ramps or lifts, while neglecting interpretative dimensions like tactile models, audio description, or multilingual labelling. This gap highlights the value of research projects that test and demonstrate practical ways to operationalise policy commitments.

2.7.3 Policy-Practice Gap

The disconnect between policy ambition and on-the-ground reality reflects multiple factors. Due to shortages in resources, museums often prioritise urgent operational needs over accessibility initiatives. Staff may lack training in disability awareness or inclusive design, limiting their ability to translate policies into action. Institutional cultures sometimes regard accessibility as a compliance burden rather than as an opportunity for innovation. These challenges are compounded by insufficient monitoring and accountability mechanisms to enforce accessibility requirements.

For visually impaired visitors, the policy-practice gap translates into ongoing exclusion. A ramp may allow entry to a museum, but once inside, the absence of tactile models, Braille labels, and descriptive audio prevents meaningful engagement. In this way, formal compliance coexists with substantive exclusion. Addressing this requires moving beyond minimum standards toward a proactive, participatory approach.

2.7.4 Practical Standards and Guidelines

Practical standards from institutions like RNIB and UNESCO provide concrete tools for bridging the policy-practice gap. Rather than retrofitting accessibility later, UNESCO's *Accessible Documentary Heritage* guidelines emphasise integrating accessibility from the earliest stages of heritage planning (Darvisky & Manning, 2020). RNIB's guidelines emphasise consistency in tactile labelling, clarity in audio description, and provision of multisensory experiences that benefit all visitors, not only disabled visitors (RNIB, 2015).

The International Council of Museums (ICOM) reinforces accessibility as part of its ethical framework. The *ICOM Code of Ethics for Museums* urges institutions to serve all members

of society and promote equitable access to heritage (ICOM, 2017). This expectation has been increasingly linked to funding and accreditation processes, implying that accessibility is no longer only a moral imperative but also a practical necessity for institutional sustainability.

Applying these standards in South Africa requires contextual adaptation. For example, to reflect the country's linguistic diversity, multilingualism must be built into accessibility strategies. Tactile and audio resources should include both English and isiZulu at the KwaZulu-Natal Museum, ensuring inclusivity at both language and sensory levels. Similarly, the architectural reality of older colonial buildings without specifically designed accessible elements should also be taken into consideration when developing guidelines for tactile navigation. Low-cost technologies, such as swell paper² for tactile diagrams or offline audio players, can help adapt global standards to local realities.

2.7.5 Implementation Challenges

Although there is a robust framework, implementation in South Africa is still a challenge. Museums typically depend on external donors or university partnerships for accessibility projects. Without long-term institutional commitment, such initiatives risk being short-lived. An example in point is the sporadic use of tactile replicas in certain South African institutions, which were introduced through pilot projects but not sustained once external funding ended (Graham & Brown, 2021). This raises ethical and practical concerns about continuity: accessibility has to be institutionalised rather than treated as an experiment.

Training and awareness remain important. Frontline staff play a crucial role in facilitating access, yet they are usually not involved in formal planning. Accessibility protocols should include staff training in guiding visually impaired visitors, describing exhibits, and maintaining tactile resources. Without this, even a properly designed tactile replica and label can fail in practice.

2.7.6 Implication for the KwaZulu-Natal Museum

For the KwaZulu-Natal Museum, policy frameworks are not abstract requirements but are practical drivers of transformation. The White Paper gives a mandate for the removal of all barriers, while the CRPD situates accessibility as a human right. This study positions itself within these obligations, demonstrating how tactile replicas, Braille labels, and audio guides can operationalise policy commitments in ways that are sustainable and contextually appropriate.

By piloting these strategies with the Victorian insect models, the museum can then provide a model for how accessibility policies can be implemented in practice. The case demonstrates that compliance need not be burdensome but it can generate innovative, participatory, and culturally resonant approaches. In this way, the KwaZulu-Natal Museum can serve as an example to other institutions in South Africa and the Global South, demonstrating how progressive policy frameworks can transition from rhetoric to reality.

2.8 Local Adaptation: Gap and Opportunities in South African Museums

² Swell paper (also known as microcapsule paper) is a special heat-reactive paper used to create tactile graphics. Printed areas expand when exposed to heat, producing raised lines that can be read by touch.

South African museums occupy a unique position shaped by the country's colonial and apartheid history. Institutions such as the KwaZulu-Natal Museum were initially established to serve settler elites and framed heritage through Eurocentric taxonomies. Collections were categorised to emphasise European scientific authority, while African cultural artefacts were displayed as ethnographic curiosities, stripped of their living contexts (Coombes, 2004). These legacies continue to shape contemporary museum practice, where the dominance of visual presentation and textual interpretation continues to marginalise audiences with different sensory or cultural modes of engagement.

During apartheid, museum access was structurally unequal. Due to segregated cultural norms, black South Africans were frequently excluded from mainstream institutions or presented only as subjects of ethnographic display. This exclusion extended not only to content but to the very design of exhibitions, which assumed literate, sighted, and privileged audiences. For visually impaired visitors, the combination of visual dominance and wider political marginalisation meant near total exclusion from museum experiences. These historical conditions form the framework against which accessibility must be reimagined today.

Despite post-apartheid reforms and progressive policy frameworks, South African museums continue to struggle with accessibility in practice. Rather than a complete absence of awareness, the challenge lies in translating policy commitments into sustained design practice.

Tactile engagement, audio description, and Braille labelling are rarely integrated systematically. Where initiatives exist, they are often the result of temporary projects funded by external donors or universities. For example, the Origins Centre at the University of the Witwatersrand has undertaken tactile tours for rock art interpretation, but these remain limited in scope and depend on periodic funding (Graham & Brown, 2021). Similarly, the Iziko Museums in Cape Town have introduced occasional tactile casts in natural history galleries, yet these efforts have not been scaled across exhibitions.

At the KwaZulu-Natal Museum, accessibility is not yet integrated into the institution's core practices. While the museum has engaged in educational outreach and interactive programming, its main displays, like the Victorian insect models, remain inaccessible to blind and partially sighted visitors. Braille labels are absent, audio guides are lacking, and tactile replicas have not been introduced. Visitor experiences, therefore, continue to be visually exclusive, replicating the exclusions of the past despite the presence of progressive policy frameworks.

Several factors contribute to this ongoing gap. Resource constraints are among the most frequently cited barriers. Many museums operate on small budgets, with funding directed primarily toward building and facility maintenance, staff salaries, and conservation. Accessibility initiatives, which are seen as supplementary, are often deprioritised. This financial constraint is compounded by a lack of technical expertise in digital technologies such as LiDAR scanning and 3D printing, which are usually perceived as expensive and complex.

Another obstacle is institutional culture. Accessibility is typically treated as an external requirement rather than an internal value. Staff may lack training in disability awareness, and decision-makers may not see accessibility as vital to the museum's mission. Without strong institutional commitment, accessibility projects risk remaining isolated and symbolic. The

absence of evaluation and monitoring mechanisms further undermines continuity, as successful initiatives are not documented or replicated.

Colonial legacies also continue to shape content. Exhibitions often retain interpretative frameworks that prioritise European scientific knowledge while neglecting indigenous perspectives. In such contexts, accessibility risks being applied superficially, without addressing more fundamental questions of representation and narrative justice. True adaptation requires not only technical tools but also critical reflection on whose voices are included and how stories are told.

Despite these challenges, significant opportunities exist to modify and integrate accessibility in South African museums. The KwaZulu-Natal Museum provides a compelling case. Its Victorian insect models are both historically significant and educationally rich. The museum can create inclusive interpretative tools without compromising conservation by digitising these models with LiDAR scanning and producing tactile replicas through 3D printing. These replicas, when paired with isiZulu and English audio description and Braille labels, can significantly transform the visitor experience for visually impaired audiences.

The insect models also reveal how local adaptation can build on existing strengths. Enlarged and detailed, they are naturally suited for tactile exploration. Their replication requires relatively minimal scaling or surface exaggeration, making them efficient candidates for accessible reproduction. By selecting such artefacts, the museum demonstrates how targeted interventions can maximise impact while remaining feasible within resource constraints.

Local adaptation is strengthened through community partnerships (Sandell, 2007; Janes & Conaty, 2006). Collaborations with institutions such as university Disability Support Units provide expertise in accessibility and direct engagement with visually impaired users. Such partnerships reflect participatory design principles that emphasise co-creation and user feedback in exhibition development (Hamraie, 2017; Neves, Queirós & Pereira, 2018). These collaborations extend the reach of museums beyond their walls, embedding them within broader social networks of inclusion.

Universities play an important role in this process. Through partnerships, museums can access technical expertise, equipment, and student labour to support scanning, modelling, and evaluation. These collaborations reduce costs while fostering innovation and capacity building. They also provide students with opportunities for experiential learning, strengthening the link between academic research and public heritage.

Staff training is widely recognised as a central component of sustainable accessibility practice (RNIB, 2015; Graham & Brown, 2021). Frontline staff, educators, and curators require skills in guiding visually impaired visitors, describing artefacts clearly, and maintaining tactile resources. Training that includes practical exercises in audio description, tactile facilitation, and disability awareness helps embed accessibility into institutional culture rather than relying on individual initiative (Sandell, 2007).

Capacity building also involves developing expertise in digital technologies within museum teams (Parry, 2007). While tools such as LiDAR scanning and 3D printing may appear technically complex, research suggests that institutional familiarity grows through hands-on experimentation and cross-sector partnerships (Remondino & El-Hakim, 2006).

Local adaptation also thrives on low-cost innovation. Not all solution requires advanced technology. Raised-line diagrams, embossed maps, and tactile floor plans can provide affordable and effective orientation tools. Local artisans can create replicas using wood, clay, or resin, relying on traditional craft skills. These approaches not only reduce costs but also incorporate accessibility within local cultural practices, creating designs that resonate with community identities.

In multilingual contexts like South Africa, producing audio guides and Braille labels in multiple languages enhances accessibility while also affirming cultural diversity. For the KwaZulu-Natal Museum, incorporating isiZulu alongside English ensures that accessibility is not only sensory but also linguistic, reflecting the identities of local visitors.

Evaluation is important for ensuring that accessibility initiatives are meaningful and effective. Observation, feedback forms, and interviews with visually impaired visitors provide insights into how tools are used and experienced. Iterative evaluation allows for continuous improvement, ensuring that replicas, audio guides, and labels meet real needs. Sharing evaluation results also improves institutional knowledge and provides evidence for scaling up accessibility across other collections.

The cultural sensitivity of artefacts must also be considered while adapting them locally. Replication is made more difficult by the possibility that certain artefacts have ceremonial or spiritual value. In such cases, consultation with source communities is essential to determine appropriate forms of access. For the KwaZulu-Natal Museum, the insect models are less culturally sensitive, but they still reflect colonial pedagogical values. Replicating them without critical framing may perpetuate narratives of scientific authority. Ethical adaptation, therefore, requires transparency, contextualisation, and a commitment to inclusive storytelling.

This discussion of local adaptation flows into the broader theoretical and conceptual framework of the study, demonstrating how South African museums can address historical exclusion while building models of inclusive practice that are both sustainable and contextually grounded.

2.9 Summary and Gaps in Literature

The literature reviewed in this chapter demonstrates that accessibility in museums has been extensively discussed across international, national, and local contexts. Global scholarship has consistently underlined the dominance of visual interpretation and the ways this marginalises audiences with different sensory needs. McGinnis, Carr, and Garland (2016) show that traditional exhibition practices place too much focus on visual display, while Neves, Queirós, and Pereira (2018) emphasise that most museums have yet to incorporate sensory diversity into their design. These insights collectively demonstrate the global recognition of accessibility as a key challenge for contemporary museology.

The review of international case studies also highlights evidence of both innovation and limitation. Institutions like the Museo Tifológico in Spain have shown how tactile replicas, Braille labelling, and multisensory tours can transform visitor experiences. However, scholars like Classen (2012) warn against risks of tokenism, where tactile access is introduced symbolically rather than as a fully integrated strategy. Similarly, the Smithsonian Institution's accessibility agenda, though widely praised, has been critiqued by Serota (2018) for

insufficient community participation. These examples demonstrate the tension between technical provision and meaningful engagement. They demonstrate that access is not just about tools, but about embedding those tools in participatory processes that reflect local context and user priorities.

The literature on Global South contexts emphasises the unique challenges faced by museums in Africa, Latin America, and Asia. Makhanya (2019) and Graham and Brown (2021) point out that inadequate resources, inadequate training, and weak institutional prioritisation often reduce accessibility to fragmented or temporary interventions. South African museums, despite progressive policies such as the *White Paper on the Rights of Persons with Disabilities* (2015), continue to show a gap between policy rhetoric and practice. Examples such as the Origins Centre and Iziko Museums demonstrate partial attempts at tactile and audio access but also reveal difficulties in sustaining and evaluating these initiatives. These findings point to the need for low-cost, contextually grounded, and participatory approaches to accessibility in South Africa.

Another strand of literature investigates the role of technology. Remondino and El-Hakim (2006) show how scanning technologies can generate accurate three-dimensional models for cultural heritage. The adoption of LiDAR scanning and 3D printing has expanded opportunities for non-visual access, with institutions such as the British Museum and Smithsonian creating digital archives and tactile replicas. However, Cooke and Buckley (2021) caution that these technologies can become distractions if not incorporated in user-centred design. High-tech interventions must be balanced with low-tech alternatives, such as raised diagrams and tactile floor plans, that are often more sustainable in resource-constrained environments.

Ethical considerations also appeared frequently in the literature. Pye (2016) stresses that replicas are never neutral: their design and presentation inevitably shape interpretation. The example of the British Museum's Rosetta Stone replica illustrates how omissions in tactile replication can distort the original artefact's history. Cooke and Buckley (2021) further highlight that replicas should be culturally legible and emotionally resonant, not merely technically accurate. These debates highlight the importance of transparency, labelling, and co-design to ensure that replicas enhance rather than distort museum interpretation.

Policy frameworks are another important area. International standards such as the CRPD (2006), the ADA (1990), and RNIB guidelines all lay solid foundations for inclusive practice. In South Africa, the *White Paper on the Rights of Persons with Disabilities* (2015) and the *National Heritage Resources Act* (1999) establish accessibility as a constitutional right. However, studies by Makhanya (2019) and Graham and Brown (2021) reveal that implementation remains uneven, with most institutions interpreting compliance in limited ways. These findings highlight the need for practical demonstrations of how policies can be operationalised effectively within South African museums.

Local adaptation studies emphasise the importance of contextual specificity. Coombes (2004) critiques South African museums for retaining colonial modes of representation. Recent evaluations reveal that accessibility initiatives are still sporadic, poorly documented, and rarely sustained. However, opportunities for innovation exist in partnerships with universities, non-governmental organisations, and disability organisations, which can provide both technical expertise and community connections. The KwaZulu-Natal Museum, with its

Victorian insect models, represents an ideal case for demonstrating how targeted, participatory interventions can create meaningful accessibility in resource-limited contexts. Taken together, the reviewed literature highlights several gaps that this study aims to address. First, while global case studies demonstrate the potential of tactile and digital tools, research on how these can be adapted sustainably within South African museums is limited.

This project responds by applying LiDAR scanning and 3D printing in a resource-conscious, locally grounded way.

Second, existing literature often critiques tokenism but offers fewer practical models of co-design with visually impaired users. This study fills that gap by emphasising participatory creation and iterative testing in its methodology.

Third, although South Africa's policy frameworks are progressive, there is limited evidence of how they can be implemented within specific institutions. By piloting accessible replicas and interpretative tools at the KwaZulu-Natal Museum, this study demonstrates how legislation can move from rhetoric to practice.

Another gap concerns representation and narrative framing. While most literature places more emphasis on technical solutions, only a few studies address how replicas and accessibility tools can be used to challenge colonial legacies and create inclusive narratives. This study contributes by reframing Victorian insect models not only as teaching tools but also as symbols of exclusion that can be reinterpreted for justice and equity. Finally, there is a need for evaluation and evidence of impact. Many initiatives are inadequately documented or assessed, leaving a lack of empirical data on how visually impaired visitors experience accessibility measures. This research addresses that gap through interviews, observations, and thematic analysis that foreground user perspectives.

This literature emphasises that accessibility is both a global challenge and a local opportunity. While international models provide inspiration, their direct application to South Africa is limited by contextual realities. This literature review demonstrates that South African museums must embrace participatory, context-specific, and low-cost strategies if accessibility is to be sustainable. The gaps identified highlight why the KwaZulu-Natal Museum and its Victorian insect models offer a compelling site for research. By addressing the shortcomings in current practice and literature, this study aims to contribute both theoretically and practically to the transformation of museum accessibility in the Global South.

Chapter 3: Theoretical and Conceptual Framework

This chapter sets out the theoretical and conceptual framework that guides this study. Because accessibility in museums involves historical, social, cultural, and practical components, no single theory can address the complexity at hand. The analysis therefore draws on a combination of approaches that work together. New Museology provides the institutional critique and reorientation toward dialogic, socially embedded practice. In parallel, the study engages both postcolonial and decolonial theory. Postcolonial theory helps analyse how colonial power has shaped representation and interpretation in museums. Decolonial theory pushes the inquiry toward active undoing of colonial logics by centring knowledge sovereignty, community voice, and reparative practice in the present.

Within postcolonial theory, the study focuses on a defined set of ideas that are most relevant to museums. These include orientalism and the construction of the “other,” representational otherness, hybridity and the third space, and epistemic violence. Intersectionality is employed as a bridge between these critiques to the lived realities of disabled visitors which shows how exclusion operates across overlapping identities and conditions.

Alongside these theoretical perspectives, the practical and interpretative dimensions of the research are shaped by two conceptual frameworks, which are Inclusive Design and the Social Model of Disability. These frameworks translate questions of equity and justice into concrete strategies for exhibition design and interpretation. They approach disability as a product of social and environmental barriers, not individual deficit, and they embed participation into design processes from the outset. Together, the theoretical and conceptual tools ensure that accessibility is treated as both a matter of justice and a matter of practice. The chapter now outlines each framework in turn, beginning with New Museology and its relevance for reimagining the museum as a socially responsive institution.

3.1 New Museology

The concept of New Museology came up in the late twentieth century as scholars and professionals started to critique the shortcomings of traditional or “old museology”. Peter Vergo’s 1989 volume *The New Museology* argued that museums had become overly focused on artefacts and collections, forgetting the wider social, cultural, and political context in which they functioned (Vergo, 1989). Traditional museology placed the authority of curators at the centre, portraying exhibitions as a definitive statement of knowledge. Visitors were seen as passive consumers, with exhibitions intended to affirm institutional authority. This approach provided very little opportunity for dialogue, multiple perspectives, or recognition of diverse audiences.

The emergence of New Museology transformed museums into socially embedded institutions. They were understood as sites where power, identity, and culture meets instead of a general sites for preservation. Hooper-Greenhill (2000) expanded this view with the concept of the “post-museum”, an institution that encourages inclusivity, participation, and multiple forms of knowledge. In this concept, exhibitions are conceived as open, dialogic, and multimodal; visitors are active participants in the construction of meaning. Museums evolve into spaces for reflection, debate, and preservation.

One of the most important contributions of New Museology has been its rejection of curatorial neutrality. Every decision about collecting, interpreting, and displaying artefacts

reflects values and perspectives. According to Sandell (2007), museums can either reinforce prejudice or actively challenge it. This recognition places responsibility on museums to promote inclusion, empathy, and social justice. They are more than simply repositories of culture; they are active participants in shaping public understanding and collective memory.

This critique is particularly relevant to the KwaZulu-Natal Museum. Its history is shaped by colonial and apartheid policies that excluded African knowledge systems and marginalised black audiences. Displays like the Victorian insect models are examples of this legacy, as they were designed for colonial audiences and prioritised sight as the primary medium of engagement. Reinterpreting these artefacts through tactile replicas and inclusive narratives illustrates how New Museology's emphasis on responsibility can be implemented.

New Museology calls for a shift from object-centred to people-centred practice. This transition does not reduce the significance of collections but rather reframes them as tools for dialogue and connection rather than ends in themselves. Hooper-Greenhill (2000) stresses the importance of promoting diverse ways of learning, such as touch, sound, and embodied experience. Janes and Conaty (2006) argue further that participation and collaboration with communities must be incorporated into institutional practices, not treated as occasional initiatives.

The insect models demonstrate this need. They are visually impressive but cannot be touched since they are locked behind glass. In a people-centred model, they can be recreated as tactile replicas, paired alongside audio interpretation and co-design educational tools. This transition reveals how New Museology can shift the attention away from artefacts as spectacles to artefacts as catalysts for inclusive engagement.

Dialogue is another main principle of New Museology. Museums are encouraged to present exhibitions as sites where different perspectives can be shared. According to Message (2013), museums are cultural activists with responsibilities to engage with pressing social issues. Participation becomes crucial to this process. It entails redistributing authority by allowing community voices to shape interpretation and representation.

Scholars have argued that accessibility initiatives benefit from participatory approaches that redistribute interpretative authority (Sandell, 2007; Hamraie, 2017). Designing tactile replicas without input from visually impaired users increases the risk of tokenism. Co-design workshops ensure that replicas and interpretative tools are relevant and effective. In the KwaZulu-Natal Museum, involving visually impaired audiences in shaping the reinterpretation of the Victorian insect model is consistent with the participatory ethic of New Museology, making accessibility an integral transformation rather than a symbolic gesture.

New Museology is not a uniform theory, but rather a broad movement that has taken many forms in different contexts (Vergo, 1989; Sandell, 2007). In Latin America, for example, the community museum movement emphasised grassroots participation, with local communities curating exhibitions that reflect their own histories and struggles (Message, 2013). In Europe and North America, New Museology often focused on reforming large national institutions to make them more inclusive and socially accountable (Janes & Conaty, 2006; Sandell, 2007).

In Africa, efforts have centred on reframing collections acquired through colonial exploitation and addressing questions of restitution and representation (Coombes, 2004).

These variations demonstrate the adaptability of New Museology while also highlighting the importance of local context.

The concept has been closely tied to South Africa's post-apartheid transformation. It was anticipated that museums would contribute to nation-building, reconciliation, and the recognition of diverse histories. However, as Dubin (2006) observed in the early post-apartheid period, many institutions struggled to move beyond symbolic adjustments in displays toward deeper structural transformation. Although Dubin's analysis reflects conditions in the first decade after apartheid, subsequent scholarship suggests that similar tensions between representation and institutional change persist (Makhanya, 2019; Graham & Brown, 2021). New Museology therefore remains relevant as a framework for understanding both the progress made and the ongoing challenges in South African museum practice.

Scholars such as Sandell (2007) and Janes & Conaty (2006) argue that the emphasis on inclusivity and dialogue can risk weakening curatorial authority if not carefully structured. Cooke & Buckley (2021) further caution that participatory approaches may lead to superficial consultation if deeper institutional change does not follow. In certain cases, museums adopt the rhetoric of inclusion while leaving deeper structures unchanged. There is also the risk of superficial consultation, where communities are asked for input with no real influence on decision-making. These critiques emphasise the importance of incorporating participatory practices into institutional culture rather than treating them as temporary initiatives.

These critiques are particularly effective in South Africa. Coombes (2004) documents how museums have often sought to signal transformation while still maintaining colonial interpretative frameworks. Dubin (2006) similarly demonstrated that post-apartheid reforms sometimes reproduced exclusionary practices despite the rhetoric of change. New Museology offers tools for confronting these contradictions, but it also necessitates sustained commitment and reflexivity.

The application of New Museology to accessibility at the KwaZulu-Natal Museum means rethinking both the collection and interpretation of artefacts. The Victorian insect models, which were once a tool of colonial pedagogy, can be reframed as inclusive resources, with LiDAR scanning and 3D printing, and tactile replicas can be created to allow blind and partially sighted visitors to interact with these artefacts directly. Combined with audio description in both English and isiZulu, the replicas become more than just a physical artefact; they become part of a broader post-museum vision of multilingual, multisensory participation.

Applying this situates accessibility as a matter of justice rather than a convenience. It is not a technical addition but part of a broader reframing of the museum's role in society.

Accessibility initiatives become examples of the museum's social responsibility, which aligns with Sandell's (2007) call for museums to act as agents of social justice. This way, the KwaZulu-Natal Museum can demonstrate how New Museology can be applied in a resource-constrained context to produce meaningful inclusion.

The call to "decolonise the museum" has gained prominence in academic and activist discourse, particularly in relation to colonial collections and representational power within heritage institutions (Coombes, 2004; Message, 2013). New Museology offers tools for this work by emphasising reflexivity, participation, and the recognition of diverse methods of knowing. By collaborating with communities in the reinterpretation of colonial collections, museums can begin to redress historical injustices.

For the KwaZulu-Natal Museum, this translates to recognising the colonial origin of the Victorian insect models while also reimagining them as resources for inclusive education. Instead of treating them as neutral scientific specimens, the museum can acknowledge their history as part of colonial pedagogy while transforming these models into tools for accessibility. This dual recognition of both the colonial legacy and the inclusive potential aligns with New Museology's emphasis on reflexivity and accountability.

Ultimately, New Museology points toward the creation of "post-museum"; these are institutions that are dialogic, participatory, and socially embedded. For the KwaZulu-Natal Museums, taking up this vision means making accessibility a very important component of its mission. The Victorian insect models, which was once symbols of colonial pedagogy and exclusion, can now become catalysts for inclusive interpretation. This change will not only increase accessibility for visitors with visual impairments but also reposition the museum as a democratic organisation dedicated to cultural equity, not just to improve access for visually impaired visitors.

The transition envisioned by New Museology necessitates courage, resources, and collaboration. It challenges museums to stand up to their pasts while embracing a new responsibility to their communities. By incorporating accessibility and reframing collections as resources for participants into their core identity, museums like the KwaZulu-Natal Museum can begin to integrate the concepts of post-museum.

A brief note on position within decolonial debates is necessary. New Museology's emphasis on dialogue, participation, and reflexivity aligns closely with decolonial goals that seek to unsettle inherited hierarchies of knowledge and authority. In this study the language of decoloniality is used to signal practice that goes beyond critique to redistribution of interpretative authority, multilingual and multisensory access, and collaboration that is accountable to communities who have historically been excluded. This links the theoretical move from object-centredness to people-centredness with practical commitments to knowledge equity.

3.2 Postcolonial Theory

Postcolonial theory, developed by scholars such as Edward Said, Homi Bhabha, and Gayatri Spivak, examines how colonial power relations continue to shape systems of knowledge, cultural representation, and institutional practice. In this study the engagement is focused and practical. It draws on three core ideas that are particularly relevant to museum work: orientalism and the construction of the "other," representational otherness in display, hybridity and the third space, and epistemic violence. These concepts provide a lens for analysing how collections and narratives have been framed, whose voices have been centred or silenced, and where reinterpretation can occur. Museums, as custodians of collections formed during colonial expansion, are implicated in these dynamics, often elevating European science and culture while marginalising other knowledge systems (Said, 1978; Bhabha, 1994; Spivak, 1988).

3.2.1 Orientalism and the Construction of the "Other"

Orientalism, a concept developed by Edward Said (1978), is crucial to postcolonial theory. Said demonstrated how Western institutions produced knowledge about the *Orient* that

reinforced stereotypes of exoticism, passivity, and inferiority. These representations were not innocent, but they served to make legal colonial domination by portraying non-Western societies as not being capable of self-representation. Museums have long played a role in this process by classifying, exhibiting, and interpreting artefacts from colonised societies through Eurocentric frameworks.

Said (1978) does not simply critique representation; he argues that systems of knowledge actively produce and stabilise hierarchies of power. In museum contexts, scholars have applied this insight to show how classification, display techniques, and curatorial authority shape how colonised cultures are perceived (Coombes, 2004; Bennett, 1995). This is particularly relevant to institutions whose collections were formed within colonial frameworks.

In the South African context, museums such as the KwaZulu-Natal Museum contributed to constructing African societies as “others” in need of study, classification, and preservation by outsiders. Ethnographic displays stripped artefacts of their cultural and historical contexts, presenting them instead as evidence of static traditions. The Victorian insect models, although scientific rather than ethnographic, can also be read through this lens. Their production and display reinforced the authority of European science, portraying nature as something to be categorised and controlled for the benefit of settler audiences.

3.2.2 Hybridity and the “Third Space”

The concepts of hybridity and the *third space* were introduced by Homi Bhabha (1994) to explain how cultures interact under colonial conditions. Hybridity disrupts the binary opposition of coloniser and colonised, showing how cultural meaning is negotiated and rearticulated in spaces of encounter. The third space is where new identities and meanings emerge, shaped by both colonial imposition and local agency.

Bhabha’s (1994) concept of hybridity resists fixed cultural identities and instead emphasises negotiation and ambivalence within colonial encounters. Applied to museums, this challenges static or essentialised representations of culture and calls for exhibitions that reflect complexity rather than singular narratives (Message, 2013).

For museums, this concept highlights the possibility of reinterpretation and re-appropriation. The KwaZulu-Natal Museum, for instance, can reframe its Victorian insect models not simply as relics of colonial science but as hybrid artefacts whose meanings can be rearticulated through inclusive, participatory practices. By producing tactile replicas in collaboration with visually impaired users, the museum creates a third space where artefacts once designed to exclude can be experienced differently. This approach acknowledges colonial histories while opening space for new interpretations shaped by local communities.

3.2.3 Epistemic Violence and Silenced Voices

Gayatri Spivak (1988) introduced the idea of epistemic violence, which refers to the ways in which dominant systems of knowledge erase or silence subaltern voices. In museums, epistemic violence occurs when artefacts are displayed without acknowledging their cultural significance, or when narratives are presented that exclude the perspectives of those whose heritage is on display. This violence is not only historical but ongoing, as museums continue to privilege certain forms of knowledge while marginalising others.

Spivak's (1988) question — "Can the subaltern speak?" — raises concerns about whether participatory initiatives genuinely redistribute authority or merely simulate inclusion. In museum studies, this critique has been used to question whether consultation processes meaningfully shift interpretative power or remain controlled by institutional structures (Sandell, 2007).

At the KwaZulu-Natal Museum, epistemic violence is evident in the dominance of sight-based interpretation and the absence of accessible formats for blind and partially sighted visitors. By ignoring alternative sensory modes of knowing, the museum continues to perpetuates a hierarchy of vision that excludes other communities that rely on other senses to learn. Reinterpreting the Victorian insect models through tactile and audio formats can be understood as an act of resistance to epistemic violence, creating space for different forms of knowledge production and validating the experiences of disabled users.

Postcolonial scholars have long critiqued museums for their role in legitimising colonial authority. Coombes (2004) documents how South African museums reinforced racial hierarchies through displays that presented African cultures as timeless and inferior. Even after apartheid, Dubin (2006) shows how some museums has really struggled to move beyond colonial frameworks, often reproducing exclusion despite adopting a new rhetoric of transformation. These critiques underline the need for museums to acknowledge its colonial legacies and also actively strive to dismantle them.

In this study, postcolonial theory provides tools that can be used to analyse how the KwaZulu-Natal Museum's Victorian insect models reflect colonial pedagogies and how they can be reinterpreted for inclusive purposes. By recognising that some of its artefacts have colonial histories, the museum can develop strategies to confront these legacies transparently. Accessibility becomes more than a technical issue: it becomes part of a broader initiative of decolonisation.

Postcolonial theory also informs practical strategies for accessibility. Reproducing the Victorian insect models as tactile replicas is not a neutral act of replication but a deliberate reinterpretation. It acknowledges the colonial history of the objects while reimagining them as inclusive tools for blind and partially sighted visitors. Audio descriptions in English and isiZulu ensure that interpretation is linguistically as well as sensorially inclusive, resisting the dominance of English as a colonial language of science.

By embedding accessibility in postcolonial critique, the project ensures that inclusivity is not treated as a technical fix but as part of a wider struggle for justice. It aligns with Bhabha's idea of hybridity by creating new meanings through participatory design. It responds to Spivak's critique of silenced voices by centring the experiences of disabled users. And it challenges Said's Orientalism by reframing artefacts not as exotic specimens for settler audiences but as resources for community-based learning.

Postcolonial theory ultimately demands that museums confront their colonial legacies and reimagine their roles in democratic societies. For the KwaZulu-Natal Museum, this translates to accepting the colonial history of its collections, confronting the exclusions built into its displays, and actively developing inclusive practices that empower marginalised audiences. The Victorian insect models, which were once symbols of exclusionary pedagogy, become powerful case studies for how artefacts can be reinterpreted to serve new purposes. By integrating postcolonial theory into accessibility initiatives, the museum can move beyond symbolic gestures toward structural transformation. Accessibility becomes part of the work of

decolonising the museum, which is going to ensure that it serves all members of society, not just the privileged few.

3.3 Intersectionality: Understanding Multiple Layers of Exclusion

Intersectionality is used here as an applied bridge between the critiques above and the design frameworks that follow, so that the analysis of colonial representation connects directly to practical questions of access for visitors who experience overlapping forms of exclusion.

Intersectionality, a concept introduced by Kimberlé Crenshaw in 1989, provides a framework for understanding how different systems of oppression interact to create unique experiences of marginalisation. Initially developed to explain how black women in the United States faced discrimination that could not be understood by looking at race or gender alone, intersectionality has since been applied more widely to analyse overlapping forms of disadvantage, including disability, class, sexuality, and geography (Crenshaw, 1989). In museum studies, intersectionality helps reveal how institutions can unintentionally exclude people who experience multiple layers of marginalisation. It prompts museums to recognise that visitors do not experience barriers in isolation but at the intersection of various identities.

Museums have historically operated with a single-axis approach to access. For example, accessibility initiatives might address physical mobility by installing ramps or lifts, while overlooking how disability intersects with cultural identity, language, or socioeconomic status. Crenshaw's framework highlights the inadequacy of such narrow strategies. An intersectional approach requires museums to account for the ways in which race, disability, class, and gender combine to shape experiences of access and exclusion. Sandell (2007) argues that museums are not just passive reflectors of social inequalities but active participants in constructing them, which makes intersectionality a vital tool for critical analysis.

Applying intersectionality to accessibility exposes the limitations of one-size-fits-all solutions. A visually impaired visitor who is also economically disadvantaged may struggle with the cost of transport to a museum, even if tactile resources are provided inside. A blind visitor whose first language is isiZulu may not benefit from an English-only audio description. Without considering these overlapping barriers, accessibility initiatives risk reinforcing inequalities rather than dismantling them.

In South Africa, intersectionality is especially relevant because of the country's history of apartheid and ongoing inequalities. Race, class, and disability remain deeply interconnected. Black South Africans with disabilities are often disproportionately excluded from educational, economic, and cultural opportunities. For some, barriers to museums extend beyond physical access to include language, affordability, and cultural relevance. Coombes (2004) and Dubin (2006) show how South African museums have historically privileged white, literate, and sighted audiences while marginalising others. These exclusions continue in subtle ways, such as reliance on English-only interpretation or failure to consult with disabled communities in exhibition planning.

At the KwaZulu-Natal Museum, the dominance of sight-based displays and the absence of tactile interpretation exclude visually impaired visitors. Yet these exclusions are compounded when visitors are also marginalised by language or class. A visually impaired visitor who speaks isiZulu and comes from a rural area faces layered barriers: lack of transport to the city, lack of financial resources, and lack of materials in their language. Intersectionality makes

visible these multiple, overlapping disadvantages, highlighting the urgency of strategies that address them collectively.

Crenshaw distinguishes between three dimensions of intersectionality: structural, political, and representational (Crenshaw, 1989). Each provides useful insight into museum practice.

Structural intersectionality refers to the way institutions organise access in ways that disadvantage those with intersecting identities. For example, a museum might provide Braille labels but only in English, thereby excluding visually impaired isiZulu speakers. This highlights the need for multilingual and culturally responsive accessibility tools.

Political intersectionality occurs when movements or policies address one form of marginalisation while ignoring others. For instance, disability rights initiatives may focus on ramps and mobility while neglecting the needs of blind or partially sighted people. In South Africa, disability advocacy sometimes prioritises physical mobility, leaving sensory accessibility underdeveloped. Museums must ensure that their policies address the full spectrum of disabilities in conjunction with other axes of exclusion.

Representational intersectionality deals with the ways cultural narratives perpetuate stereotypes. In museum contexts, representational intersectionality arises when disabled people are portrayed as passive recipients of care or inspiration, rather than as active participants in culture. By failing to represent diverse disabled voices, museums risk reinforcing exclusionary narratives.

An intersectional approach to accessibility design requires moving beyond technical solutions to consider the lived experiences of diverse users. This means embedding co-design processes where participants bring their intersecting identities into the conversation. For example, co-creation workshops at the KwaZulu-Natal Museum involving visually impaired participants should not only consider sensory needs but also incorporate linguistic and cultural perspectives. Audio guides in both English and isiZulu are very essential, so too are narratives that connect artefacts to local histories and lived realities. Such design choices recognise that exclusion is not only about disability but about the interaction of disability with language, culture, and socioeconomic status.

Intersectionality also encourages museums to think critically about affordability and outreach. Providing tactile replicas within the museum is insufficient if disadvantaged groups cannot afford to travel there. Partnerships with schools, community centres, and local disability organisations can help address these barriers by bringing resources to communities or subsidising transport. In this sense, intersectionality shifts the focus from the museum's walls to the broader ecosystem of access.

The Victorian insect models at the KwaZulu-Natal Museum provide a case study for applying intersectional thinking. On their own, tactile replicas might address the barrier of visual impairment. Yet intersectionality prompts us to ask: who benefits from these replicas? If replicas are produced but only labelled in English, isiZulu speakers remain excluded. If replicas are placed in the museum but not distributed to rural schools, disadvantaged communities remain excluded. If replicas are created without consultation, disabled voices remain marginalised. Intersectionality requires that these overlapping barriers be recognised and addressed.

Intersectionality also contributes to the broader transformation agenda in South African museums. Post-apartheid reforms have aimed to make museums more inclusive; however, without intersectional thinking, these efforts risk falling short. For example, introducing exhibits that highlight African heritage addresses historical exclusions, but if these exhibits remain inaccessible to blind visitors or are only presented in English, exclusion persists. Intersectionality highlights the need to address multiple axes of marginalisation simultaneously.

By adopting an intersectional approach, museums can better align with democratic values and the principles of social justice enshrined in South African policy frameworks. Accessibility becomes not just a technical requirement but part of a larger commitment to equity and transformation.

Intersectionality offers a very strong framework for understanding and addressing the multiple forms of exclusion that shape museum practice. It reveals how disability intersects with race, language, and class to create compounded barriers, and it demands strategies that address these intersections. Intersectionality, in the case of the KwaZulu-Natal Museum, means recognising that accessibility is inextricably linked to issues of cultural identity, language, and socioeconomic context. It calls out for co-design, multilingual resources, and community partnerships that address barriers both inside and outside the museum.

In this study, intersectionality ensures that accessibility is understood as part of a complex web of exclusions and possibilities not as a one-dimensional issue. It complements New Museology and postcolonial theory by highlighting how power operates across multiple axes, and it strengthens the conceptual grounding of inclusive design. By centring intersectional thinking, this project positions the Victorian insect models as tools not only for accessibility but also for justice, equity, and democratic participation.

3.4 Inclusive Design: Designing for Diversity by Default

Inclusive Design, often linked to Universal Design, developed in late twentieth-century architecture and later spread into education, digital media, and museum work. It was pioneered by Ronald Mace and the Center for Universal Design at North Carolina State University (Mace, Hardie & Place, 1998). Its main idea is simple. Spaces, systems, and experiences should be created so that as many people as possible can use them, regardless of their ability, background, or age (Mace et al., 1998). It does not start from the idea of a typical or average visitor but from the reality that people are different. In a museum, this means planning displays that can be understood and enjoyed by people who see and by those who do not, by readers and non-readers, by adults and children, and by visitors who speak different languages or come from different cultures.

Some museums still take a reactive approach to accessibility. They often make changes only when required by law or when complaints arise. This usually leads to small additions such as ramps or captions that are attached to existing designs rather than built into them. These adjustments are helpful but rarely feel like a true part of the experience. Inclusive Design works the other way around. It starts from the beginning with the aim of creating something that already includes everyone. It sees accessibility as an opportunity for creativity, not a rule to follow. When accessibility is planned in from the start, it becomes part of what makes a design strong and effective, not something that is added later (Imrie, 2012).

In some traditional museums, exhibitions depend almost completely on sight. Visitors are expected to look at objects in glass cases, read the labels, and understand what they see. This

creates barriers for anyone who learns better through touch, sound, or movement. Fleming's (2001) VARK (Visual, Aural, Read/Write, and Kinesthetic) model explains that people have different learning styles: some learn visually, others by listening, some by reading and writing, and some through physical or hands-on engagement. Museums that follow Inclusive Design recognise these differences. They provide multiple ways to experience the same content: tactile models for touch, audio for sound, and clear visual or written information for those who rely on sight.

The Victorian insect models at the KwaZulu-Natal Museum show exactly why this is important. These enlarged specimens were once teaching tools for sighted audiences but are now locked away behind glass. They can no longer be handled or used for learning by touch. The objects still have great educational value, but that value is lost because they are presented in a way that only works for visual learning. Inclusive Design can bring them back to life. By creating 3D-printed replicas, supported by Braille labels and bilingual audio guides, the museum could open these artefacts to blind and partially sighted visitors as well as anyone who benefits from multisensory engagement.

Inclusive Design emphasises that learning is most effective when it engages multiple senses. Chatterjee and Noble (2013) demonstrate that tactile interaction enhances both cognitive and emotional connection, strengthening memory and fostering empathy. Falk and Dierking's (2013) Contextual Model of Learning similarly highlights the interplay of personal, sociocultural, and physical contexts in shaping museum experiences. Multisensory design enriches all three by providing layered forms of meaning-making.

Giaccardi (2012) introduces the idea of *affective affordances*, arguing that design choices can evoke emotional responses that shape how visitors relate to content. A well-crafted audio description can humanise an artefact's history, while a tactile model can generate an embodied sense of connection that sight alone cannot achieve. For the KwaZulu-Natal Museum, adding affective elements to the reinterpretation of the Victorian insect models, such as narrative audio in both English and isiZulu, would ensure the replicas are not only informative but also emotionally resonant.

Inclusive Design also recognises that learning is stronger when it involves more than one sense. Chatterjee and Noble (2013) note that touching objects can improve understanding and emotional connection, helping visitors remember what they learn. Falk and Dierking (2013) describe how museum experiences depend on personal, social, and physical contexts, and that designing for several senses helps connect these dimensions. Giaccardi (2012) uses the phrase "affective affordances" to describe how design can influence emotions. A tactile model can spark curiosity or wonder, while an audio description can make an object's story more personal. For the KwaZulu-Natal Museum, providing short spoken descriptions in both English and isiZulu would not only explain what the visitor is touching but also add warmth and cultural context to the experience.

Participation is another essential part of Inclusive Design. Real accessibility comes from designing with people, not just for them. Co-design allows users to shape the final result, making sure that what is created is genuinely useful. Including visually impaired participants in decisions about texture, scale, and interpretation ensures that the replicas are relevant to their needs. This approach fits closely with the participatory principles of New Museology and connects directly to the Social Model of Disability, which focuses on removing environmental barriers rather than fixing individuals. At the KwaZulu-Natal Museum, workshops with visually impaired students through the UKZN Disability Support Unit will

help shape how tactile replicas and audio materials are produced. In this way, accessibility will come from collaboration, not assumption.

Language plays a central role in inclusion. In South Africa, where many languages are spoken, accessibility cannot stop at physical or sensory design. It must also be linguistic. At the KwaZulu-Natal Museum, English and isiZulu should be used side by side in audio and Braille materials. This helps visitors feel seen and respected. Language choice is not only practical but cultural; it signals belonging and recognition.

Bichard and Coleman (2007) describe Inclusive Design as a form of inclusive innovation, meaning that those who have often been excluded become partners in the creative process. Diversity then becomes a resource rather than a challenge. For the KwaZulu-Natal Museum, this means viewing visually impaired visitors as contributors who bring valuable knowledge, not only as recipients of assistance. Their involvement can make exhibitions more authentic and engaging for everyone.

Inclusive Design also has a broader impact. It shows that accessibility does not depend only on technology or funding but on mindset and collaboration. When accessibility is built in from the start, museums become more open and welcoming. They shift from being spaces that are looked at to spaces that are experienced. For the KwaZulu-Natal Museum, this approach has the potential to turn old teaching tools like the Victorian insect models into living examples of how heritage can be shared with everyone.

3.5 The Social Model of Disability: Shifting from Impairment to Barriers

The Social Model of Disability developed as a reaction to the older Medical Model, which viewed disability mainly as an individual problem. The Medical Model suggested that people with impairments needed treatment or rehabilitation to fit into society. In contrast, the Social Model, introduced by Michael Oliver (1996), turned this idea on its head. It argued that the real problem was not the person, but the environment that failed to accommodate difference. This model separates impairment, meaning a physical or sensory condition, from disability, which refers to the social and environmental barriers that prevent people from participating equally. In other words, people are not disabled by their bodies but by inaccessible design, negative attitudes, and a lack of consideration in planning and policy.

Representation has always been an important part of this discussion. Garland-Thomson (2002) argues that disabled bodies have often been displayed in cultural contexts, including museums and public exhibitions, as objects of curiosity rather than as individuals with agency and knowledge. Disabled people were treated as spectacles or examples rather than as active contributors to culture. The Social Model encourages a complete shift in how institutions represent people with disabilities. Inclusion is not only about physical access but also about changing institutional attitudes, the language used in interpretation, and the ways disabled people are represented in exhibitions and public narratives.

This change in thinking is especially relevant to the KwaZulu-Natal Museum. Many of its displays have historically been based on visual experience, which excludes anyone who cannot see or read the labels. The Victorian insect models show this clearly. They were designed for sighted visitors and have remained behind glass for decades. From a social model perspective, the problem is not the blindness of a visitor but the way the exhibition is

designed. By introducing tactile replicas, Braille captions, and audio description, the museum can remove those barriers and open up the collection to a wider audience.

The Social Model also makes it clear that responsibility lies with institutions rather than individuals. Museums need to examine how their spaces, displays, and policies might unintentionally create barriers. Installing ramps or lifts is a step forward, but access should also include tactile materials, audio interpretation, and inclusive communication. Shakespeare (2006) argues that these ideas should move beyond theory and become everyday practice. The purpose is not to make statements about equality but to create real changes that visitors can feel.

In South Africa, this approach fits well with national legislation and policy. The *White Paper on the Rights of Persons with Disabilities* (2015) calls for all public institutions to remove obstacles that limit participation. Despite this, many museums still struggle to apply the policy fully because of limited funding, skills, or clear planning. The Social Model can provide the structure needed to turn those policies into practical steps. It helps institutions see accessibility not as a special service for a few visitors, but as a standard part of good practice. Participation and co-design are key ideas that connect the Social Model to museum work. Real inclusion happens when disabled people help design the tools that will serve them. In this research, workshops with visually impaired students from the UKZN Disability Support Unit will play this role. By testing ideas about scale, texture, and layout together, the museum will produce tactile replicas that are informed by real experience rather than guesswork. This shared process puts theory into practice by showing that access grows from collaboration.

The Social Model also links to questions of power and knowledge. Museums often position curators and designers as experts and visitors as passive receivers. Involving disabled users as co-designers challenges that hierarchy. It treats their lived experience as another form of expertise. This shift aligns closely with postcolonial and decolonial approaches, both of which argue for a redistribution of authority and for recognising marginalised voices within knowledge production.

Although the Social Model has had a huge influence, it is not without limitations. Some scholars argue that it separates impairment and disability too strictly. Shakespeare (2014) notes that impairment itself can cause pain or fatigue, which cannot simply be solved by social change. Others say that focusing only on social barriers can overlook personal experiences of living with disability. These criticisms do not reject the model but suggest that it should be flexible and responsive to real lives. The Social Model remains valuable because it keeps the focus on what can be changed — the environment, the policies, and the attitudes that create exclusion.

In museums, this approach translates into practical action. It means asking questions like: Who can reach this display? Who can read or touch it? Whose stories are being told, and who is left out? At the KwaZulu-Natal Museum, adopting this model means recognising that the lack of tactile and audio options disables blind visitors more than their impairment ever could. Using LiDAR scanning, 3D printing, Braille, and multilingual audio description directly removes those barriers and gives visitors more control over how they explore. The co-design process planned for this project is one way to apply the Social Model. Working with visually impaired participants ensures that accessibility features are designed from real needs and preferences. This approach creates solutions that are both practical and

empowering. It also strengthens the idea that museums are shared public spaces where everyone has the right to participate and learn.

The Social Model has influenced disability rights legislation, including the United Nations Convention on the Rights of Persons with Disabilities (CRPD, 2006), and has shaped how institutions understand disability as a result of environmental and structural barriers (Oliver, 1996). For the KwaZulu-Natal Museum, using this framework is an opportunity to turn old displays that once excluded people into examples of inclusive practice. The Victorian insect models, once made for sighted education, can become tools that invite touch, curiosity, and shared learning. By doing this, the museum moves closer to its role as a truly public institution that reflects and serves all members of society.

3.6 Synthesis of Theoretical and Conceptual Frameworks

This research brings together several frameworks that each offer a different way to understand accessibility in museums. These are New Museology, Postcolonial Theory, Intersectionality, Inclusive Design, and the Social Model of Disability. None of them works on its own; together they build a structure that connects history, theory, and design practice. The aim is to use them as lenses that help explain where exclusion comes from and how it can be reduced through creative and practical action.

New Museology and Postcolonial Theory both challenge the idea that museums are neutral. They argue that every museum display is shaped by choices about power and perspective. New Museology asks museums to serve communities and to include the public in interpretation instead of presenting fixed truths (Vergo, 1989; Sandell, 2007). Postcolonial Theory reminds us that many museum practices grew from colonial systems of classification that favoured European knowledge and sidelined others (Said, 1978; Bhabha, 1994; Spivak, 1988). When these two ideas are combined, they highlight how the KwaZulu-Natal Museum can shift from repeating inherited narratives to creating more balanced and shared ones.

Intersectionality deepens this understanding by showing that exclusion is rarely about one issue. A person's experience in a museum is affected not only by disability but also by race, gender, language, and economic background (Crenshaw, 1989). In South Africa, where inequality and linguistic diversity are still strong, these layers matter. Using intersectionality keeps the research attentive to real lives rather than abstract categories. It helps identify overlapping barriers, such as when a blind visitor who speaks isiZulu faces both sensory and language obstacles during a museum visit.

Inclusive Design and the Social Model of Disability bring these critiques down to a practical level. New Museology and Postcolonial Theory explain why change is needed, while Inclusive Design and the Social Model show how it can happen. Inclusive Design argues that accessibility should be part of planning from the start rather than an adjustment at the end (Mace, Hardie & Place, 1998; Hamraie, 2017). The Social Model moves responsibility away from individuals and places it on institutions and environments (Oliver, 1996). Both encourage museums to look at barriers they can remove or redesign, rather than focusing on what visitors cannot do.

The Victorian insect models at the KwaZulu-Natal Museum show how these frameworks work together. From the view of New Museology, they can become tools for participation instead of static exhibits. Postcolonial Theory reminds us that these models were made within

colonial science and used to teach European ideas about order and classification. Intersectionality helps to see that their current form continues to exclude groups of visitors for different reasons. Inclusive Design offers practical steps such as creating tactile replicas, Braille labels, and audio guides. The Social Model reframes the whole issue by treating the lack of access as a design problem that the museum can solve.

Although the frameworks come from different disciplines, they share common ground. All emphasise inclusion, fairness, and participation. New Museology calls for dialogue, Postcolonial Theory for recognition of silenced voices, and Intersectionality for awareness of complexity. Inclusive Design promotes collaboration, while the Social Model focuses on structural change. Each adds a piece to the same picture, turning accessibility into a question of justice rather than convenience.

These perspectives also shape how the study itself is carried out. The practice-led approach of creating and testing tactile replicas with visually impaired participants draws on each of them. The critical analysis of the museum's colonial legacy is guided by New Museology and Postcolonial Theory. Intersectionality ensures that participants' different backgrounds and needs are recognised. Inclusive Design and the Social Model direct the hands-on work of co-design, testing, and revision. This combination of theory and practice allows the research to produce knowledge that is both reflective and usable.

Using several frameworks together also helps to balance their limits. New Museology's call for participation can be vague without design guidance. Postcolonial Theory sometimes focuses on critique without suggesting solutions. The Social Model may overlook personal experiences of impairment, and Inclusive Design can miss cultural context if applied mechanically. Working with all of them keeps the analysis grounded in reality while maintaining a strong ethical stance.

Together these frameworks describe a museum that looks backward and forward at the same time: aware of its history but committed to inclusion. For the KwaZulu-Natal Museum, this means acknowledging how colonial and apartheid systems shaped its collections while taking practical steps toward equity. The Victorian insect models, once meant for sighted education, can become shared learning objects that connect people through touch, sound, and language.

The synthesis of these theories shows that accessibility is not one task or checklist. It is an ongoing process that combines critical thought, empathy, and design. When museums apply these frameworks together, accessibility becomes part of how they define themselves rather than something added later. This is the goal for the KwaZulu-Natal Museum and for other institutions seeking to create spaces where everyone can take part in understanding and valuing cultural heritage.

Chapter 4: Research Methodology

This chapter explains the full research methodology that guided the project from its initial planning through to participant testing and reflection. It documents both the technical and qualitative stages that were undertaken to develop tactile replicas of Victorian insect models from the KwaZulu-Natal Museum. The purpose is not only to show what was done but also to record the thinking, decisions, and challenges that shaped the process. This chapter provides a step-by-step account that can serve as a guide for other institutions or researchers who wish to carry out similar work on accessibility in museums.

The research was grounded in a practice-led and qualitative framework, allowing creative production and user participation to inform one another. The practical side of the study focused on producing tactile, Braille, and audio versions of museum artefacts using low-cost, accessible technologies. The qualitative side focused on testing these outputs with visually impaired participants and collecting their feedback. Together, these approaches created a balance between technical experimentation and social engagement.

The chapter is organised to follow the logic of the research process. It begins by describing the overall design and methodological approach, then explains how participants were recruited and how ethical considerations were handled. This is followed by a detailed account of the technical workflow, from LiDAR scanning to 3D printing and final display. Later sections discuss how data was collected and analysed, ending with reflections on limitations and lessons learned.

While this chapter is focused on methods, it also incorporates conceptual reflection. The process of designing tactile models was not treated as a neutral act of reproduction but as a form of inquiry into accessibility itself. Each decision, from the choice of scanning tools to the scale of the printed models, was guided by the aim of creating an inclusive experience that was both affordable and replicable. In this way, the research methodology embodies the same principles of inclusion and participation that underpin the broader goals of the study.

4.1 Research Design and Approach

The study followed a practice-led and qualitative research design that positioned creative production as a central part of knowledge generation. This design approach recognises that designing and testing objects can be a form of inquiry that produces new understanding through the act of making. The research aimed to explore accessibility not only as a concept but as a hands-on process that could be observed, documented, and refined in real time.

The decision to use a practice-led approach was based on the understanding that design can reveal insights that traditional research methods cannot. According to Gray (1996) and Candy (2006), practice-led research treats creative practice as both the method and the outcome of inquiry. In this study, the development of the tactile insect replicas was itself a way of testing ideas about inclusion, materiality, and sensory experience. Every technical step, from scanning to printing, was also an analytical step that exposed new questions about how accessibility is built, how users engage through touch, and how museums can communicate beyond visual means.

This practical process was supported by a qualitative framework that focused on human experience. Qualitative research, as Creswell (2013) explains, seeks to understand meaning

from the viewpoint of participants rather than from external measurement. The project relied on observation, open-ended questionnaires, and reflective documentation to explore how participants interacted with the tactile replicas and interpretative tools. Their comments and behaviours provided detailed feedback that helped evaluate the design decisions.

The research was guided by an interpretivist paradigm, which understands knowledge as socially constructed through interaction and interpretation (Lincoln & Guba, 1985; Creswell, 2013). This perspective suited the aims of the project, which treated accessibility as a dynamic relationship between designer, participant, and artefact. The tactile models were not simply replicas of museum pieces but instruments for dialogue. They allowed participants to share how they perceive, explore, and learn through touch, providing insights that could not have been reached without collaboration.

The project unfolded in two main phases: a development phase and an evaluation phase. The development phase focused on the creation of tactile, Braille, and audio materials. This involved scanning the selected Victorian insect artefacts at the KwaZulu-Natal Museum, refining the digital models in Blender, producing the 3D prints, and preparing the Braille and audio guides. The evaluation phase took place at the Centre for Visual Art on the Pietermaritzburg campus, where three visually impaired participants explored the finished models individually. Observations, field notes, and post-experience questionnaires were used to record their responses. Together, these two phases formed a complete design and testing cycle in which practical experimentation and user engagement informed one another.

Throughout the process, reflexivity played a crucial role. As the researcher and designer, I recognised that my own decisions shaped the outcomes of the project. Choices about material, scale, or placement of labels all affected how participants experienced the replicas. To account for this, I maintained a reflective journal during the study. After each major stage, I recorded observations about what worked well, what could be improved, and how my understanding of accessibility evolved through the making process. This reflection not only supported analysis later on but also encouraged ongoing learning during the project.

The approach also carried an ethical responsibility. Working with visually impaired participants required attention to comfort, independence, and communication. Each session was planned to ensure that participants felt respected and in control of their experience. The goal was to make the research process itself inclusive, so that participants were not merely subjects but collaborators who contributed their knowledge and perspectives.

In summary, the research design integrated creative practice, qualitative inquiry, and reflexive analysis to explore how accessibility can be built into museum interpretation. The tactile replicas served as both research artefacts and catalysts for dialogue. The combination of design and evaluation allowed theory to be tested through practice, demonstrating that inclusion in museums is not achieved by theory alone but through the continuous process of making, testing, and reflecting.

4.2 Participant Recruitment and Ethical Considerations

Recruiting participants was an important part of this study, as the project focused on accessibility for visually impaired users. It was essential to work directly with people who have lived experience of visual impairment to ensure that the evaluation of the tactile replicas

was grounded in real perspectives rather than assumptions. Their feedback was key to understanding how design decisions affected usability, comfort, and learning.

Participants were recruited through the Disability Unit at the University of KwaZulu-Natal (UKZN), Pietermaritzburg Campus. The Disability Unit provides support for students with visual, hearing, and mobility impairments, and it regularly collaborates with researchers conducting accessibility-related projects. Contacting participants through this unit made the process efficient and ensured that recruitment followed the university's ethical procedures for working with students with disabilities.

The first step in recruitment involved sending out a Google Forms questionnaire (see Appendix A for the initial research questionnaire) via the Disability Unit's mailing list. The form contained an accessible summary of the project, written in clear language so that students could read it using assistive technologies. It explained the aim of the study, which was to test tactile replicas of museum artefacts and to gather feedback about their accessibility. It also described what participation would involve, including exploring the models by touch and completing a short questionnaire afterward. The form included a consent section at the beginning, where participants could confirm that they understood the purpose of the study and agreed to take part voluntarily.

The Google Form served as both a recruitment and consent tool, as well as a document to gather feedback on their experience at any museum and to understand their use of tactile accessibility tools. The form clearly stated that participation was voluntary, that data would be treated as confidential, and that participants could withdraw at any time without any consequence. No additional emails or meetings were needed at this stage, as all the required information and permissions were collected directly through the form submission.

The form was distributed to thirteen visually impaired students who were registered with the Disability Unit. Six responses were received, and three of those respondents expressed interest in participating in the practical testing of the tactile models. These three students became the main participants for the study. While the number was small, it was suitable for qualitative research, where the focus is on depth of engagement and the richness of individual experiences rather than the size of the sample.

Each participant who completed the form was informed that the practical testing would take place at the Centre for Visual Art (CVA) on the Pietermaritzburg campus. This location was chosen because the ethical clearance obtained for the study required all activities to occur on university premises. The CVA provided a controlled indoor environment with good lighting, stable tables, and enough open space for easy navigation. The choice of venue ensured compliance with ethical guidelines and created a safe and accessible space for the sessions. Ethical approval for the project was granted by the University of KwaZulu-Natal's Humanities and Social Sciences Research Ethics Committee before the start of data collection. The application process included submitting details of the participant recruitment procedure, consent documentation, and data protection measures. The approval confirmed that the study met the university's standards for research involving human participants. Confidentiality and respect for participants were treated as priorities. No personal names were used in the data analysis or reporting. Each participant was identified by a code (P1, P2, and P3), which appeared on observation notes and questionnaire responses (see Appendices B & C for the observation note and post-experience questionnaire). Data was stored on a password-protected device and was accessible only to the researcher. The Google Form

responses were downloaded and stored securely, and all raw data will be destroyed after the completion of the study in line with university policy.

The ethical process also considered accessibility beyond physical participation. The consent form was designed to be compatible with screen readers so that participants could listen to the information before submitting their response. The layout of the testing environment was arranged to ensure safety and comfort. There was seating available for those who preferred to sit while exploring the tactile models. Lighting was even and soft, avoiding glare that could make navigation difficult for participants with partial vision.

Because the participants were already affiliated with the Disability Unit, they were familiar with accessible learning tools and confident in using assistive technologies such as mobile readers and QR code scanners. This familiarity contributed to a smooth testing process, as participants required little guidance in navigating the audio or Braille components of the display. During the sessions, they were given full independence to explore the materials at their own pace while I recorded observations quietly.

Although the participant group was small, the insights gathered were detailed and informative. Each participant provided feedback about the tactile clarity of the models, the readability of the Braille, and the usability of the audio description. Their feedback directly informed later reflection on how museums might adopt similar methods for accessibility. Reflecting on this stage of the research, recruitment through the Disability Unit offered several advantages. It provided a clear ethical structure, reduced communication barriers, and ensured that participants were drawn from a community already engaged with accessibility issues. The decision to use a Google Form for the initial interview simplified the process while maintaining compliance with ethical standards. This approach also showed that effective collaboration with disabled participants can be achieved through straightforward and inclusive methods that respect independence and choice.

In summary, the recruitment and ethical procedures of the study were designed to prioritise inclusion, transparency, and participant comfort. The process upheld the principle that accessibility research must itself be accessible. Participants were given the tools to understand the study, consent independently, and engage in an environment that respected their needs. This foundation ensured that the evaluation phase, described in the following section, was conducted ethically and meaningfully.

4.3 Technical Process: From Capture to Display

This section explains the technical process followed to develop the tactile replicas and their accompanying interpretation tools. It describes each stage of the workflow from data capture to final setup, showing how the artefacts were handled, scanned, processed, printed, and displayed for participant testing. The procedure was designed so that other institutions could reproduce it with similar results using accessible and affordable methods. Each phase is discussed as part of a continuous process in which technical work and reflection informed one another.

4.3.1 LiDAR Scanning and Data Capture

The first step involved capturing accurate three-dimensional data of the selected artefacts. Two Victorian insect models from the entomology collection of the KwaZulu-Natal Museum

were chosen for this project: a spider model and a beetle head model. Both artefacts were made for educational purposes in the early twentieth century and were ideal case studies for tactile reproduction because of their enlarged form and sculptural detail.

Permission to work with the artefacts was granted by the museum's Assistant Head of Exhibitions, Mr. Wesley Flanagan, who also supervised the process. The scanning took place inside the museum in a quiet, well-lit room prepared for the task. The artefacts were carefully removed from their glass cabinet by Mr. Flanagan and placed on a stable table. The controlled environment ensured good lighting and reduced reflections on the varnished surface of the models, which can interfere with scanning accuracy.

The scanning was performed using an iPad Pro equipped with a built-in LiDAR sensor and the Polycam application. This device was chosen because it offers a practical balance between accuracy, portability, and safety for use around fragile heritage objects. The LiDAR sensor creates a detailed point cloud by measuring distances using laser reflections, allowing a complete 3D mesh to be captured without physical contact. The Polycam app was selected for its precise output and its ability to export files directly in standard formats compatible with 3D-modelling software.

Each artefact was scanned from several positions to ensure full coverage of its geometry. The iPad was held at an approximate distance of half a metre from the object while moving slowly around it in a circular motion. Multiple passes were made at different heights and angles to capture the top, sides, and any recessed areas. The Polycam preview screen made it possible to check the mesh in real time and identify incomplete areas. When small gaps appeared, additional scans were performed from the missing perspectives. This process took about forty minutes in total for both artefacts.

The final scan files were exported in both .obj and .stl formats and stored on a secure external drive. These formats were selected because they are widely supported by 3D modelling and printing software. The results showed that high-quality 3D data can be captured using mobile LiDAR tools, provided that lighting and movement are managed carefully. This scanning stage also reinforced the importance of close collaboration with museum staff when handling original objects.



Figure 8: Photograph of the artefacts being scanned with an iPad Pro on a table in a well-lit room.

4.3.2 3D Modelling and Refinement in Blender

The next step involved cleaning and refining the raw LiDAR scans to prepare them for printing. The exported files were opened in Blender, a free and open-source 3D modelling program. Using Blender ensured that the workflow could be replicated by other institutions without the need for costly software.

The initial imported meshes contained background noise and some distortion caused by uneven lighting and reflections during scanning. Using Blender's Edit and Sculpt tools, unwanted background geometry was deleted, and the mesh was smoothed to remove surface irregularities. Small holes were patched with the Fill function, and the overall structure was checked for continuity.

The spider model, which exists as a half-figure, required additional attention to maintain balance and proportion. The curvature of the legs and abdomen was carefully adjusted to match the original model as closely as possible, while the beetle head model required cleaning along its edges where excess mesh data had been captured. Both models were scaled so that the final printed replicas would measure around 300 millimetres in length. This size was chosen because it approximated the original artefacts and was large enough to explore comfortably through touch.

To confirm print readiness, each model was tested using Blender's 3D Print Toolbox to detect non-manifold edges or open geometry that could cause printing errors. Once confirmed, the meshes were exported as .stl files ready for printing. This stage demonstrated the need to balance visual accuracy with tactile clarity. While visual fidelity is important for scientific representation, fine textures that look convincing on screen can feel confusing or sharp when explored by hand. Simplifying and smoothing certain details made the models more readable for tactile learning.

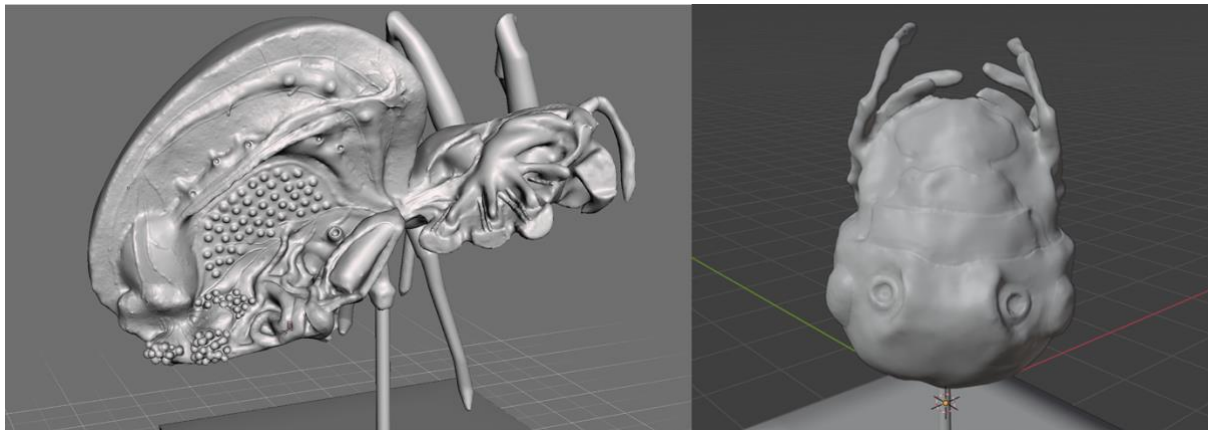


Figure 9: Screenshot of the cleaned 3D model in Blender, showing simplified geometry and smooth surfaces.

4.3.3 3D Printing and Finishing

The finalised .stl files were sent to a professional 3D printing service in KZN for fabrication. Outsourcing the printing was a practical decision due to the limited access to functional 3D printing facilities at the university. This collaboration also demonstrated how local service providers can play a role in accessibility projects.

The models were printed using a Modified Creality K1 Max 3D Printer and PLA-based plastic, a biodegradable and durable material suitable for repeated handling. PLA was chosen for its smooth finish, non-toxic properties, and ability to retain fine surface detail after light sanding. The printing process took a few days, with the larger spider model requiring the longest time due to its volume.

After printing, the surfaces were sanded and polished to remove visible layer lines and ensure a comfortable tactile texture; they were also given a white paint finish. The goal was to maintain clear structural form without sharp edges or roughness that could cause discomfort. Each model was then mounted on a custom wooden base that provided stability and protection. The stands were designed to hold the models at a height that allowed comfortable exploration for both seated and standing visitors. The natural wood finish complemented the neutral tone of the plastic, giving the display an unobtrusive and professional appearance.

The printing phase confirmed that durable and affordable tactile replicas can be produced with basic materials when surface finish is prioritised. The tactile surface needed to be smooth enough for comfort but textured enough to convey the physical characteristics of the artefact. Achieving this balance required several iterations of sanding and checking before the final result was satisfactory.



Figure 10: Photograph of finished printed model mounted on wooden base, ready for display.

4.3.4 Braille and Audio Guide Development

With the physical models completed, attention turned to the interpretative elements that would make them accessible to visually impaired users. These included Braille labels and audio descriptions, both created to provide independent, multisensory engagement without external assistance.

The Braille labels were produced at the UKZN Disability Unit, which has facilities for creating embossed Braille materials. The text for each label was written in both English and isiZulu to reflect linguistic diversity and inclusivity. Each label included the name of the artefact and a short descriptive line to help orient the user before listening to the audio. The labels were printed on cardboard sheets and placed on the table in front of the artefacts. Their position was planned so that users could easily find the Braille and then move smoothly to the QR code beside it.

For the audio guides, scripts were prepared in both English and isiZulu. Each script was concise, designed to last between one and two minutes when read aloud. The recordings were made using a smartphone's Voice Memo application in a quiet room to minimise background noise. Once complete, the files were uploaded to Google Drive, where shareable links were created. These links were converted into QR codes using the QRCode Monkey website. The printed codes were positioned beside braille labels, in front of each tactile model on a table. Participants could scan the QR code with their own devices to hear the audio in either language.

Both the Braille and audio components were tested before installation. The Braille was checked by a Braille-literate reader for accuracy, and the QR codes were tested on different phones to ensure quick scanning. The combination of Braille and audio provided multiple modes of access so that users could choose how to engage with the display.

Appendix D – Scripts for braille and audio description in English and IsiZulu

4.3.5 Installation and Display at the Centre for Visual Art

Because of ethical clearance restrictions, all testing had to be conducted on the university campus rather than inside the museum. The Centre for Visual Art (CVA) on the Pietermaritzburg campus was selected as the testing site. The CVA provided a controlled environment that could replicate the accessibility conditions of a small museum display while remaining close to the university's support resources.

The tactile models, Braille labels, and QR-coded audio descriptions were arranged on a sturdy desk in a well-lit room. The height was chosen to allow both seated and standing participants to reach the models comfortably. The space around the desk was kept clear to ensure safe and unobstructed movement for participants using canes or guides. Lighting was bright but diffused, eliminating glare and shadow while maintaining visibility for participants with partial sight.

Before each session, the area was checked to confirm that the QR codes and Braille labels were correctly positioned and that the models were secure. Participants were guided verbally to the desk and then allowed to explore independently. The display's simplicity was intentional. Accessibility does not always rely on advanced technology but on thoughtful arrangement and attention to human comfort.

The CVA setting also made it possible to maintain privacy and focus during testing. The quiet environment allowed participants to engage with the tactile models and audio without distraction. The display resembled a real museum layout but allowed closer observation for research purposes.



Figure 11: Photograph of full CVA setup showing tactile model, Braille, QR code.

4.3.6 Reflections on Process and Methodological Learning

Each stage of the technical process generated its own insights about accessibility and design. The scanning demonstrated how low-cost tools can achieve professional results when used carefully. The modelling process showed that tactile clarity often requires simplification rather than replication of visual detail. The printing and finishing phases revealed how surface texture affects both comfort and comprehension. Finally, the Braille and audio development confirmed that inclusive design depends as much on communication as on materials.

The process also underlined the importance of collaboration. Working with the museum staff ensured that the artefacts were handled safely, while consultation with the Disability Unit staff helped confirm that the Braille and audio elements met accessibility standards. These partnerships proved that accessibility is best achieved when expertise from different fields is combined.

By the time the display was installed at the CVA, the tactile replicas had become more than reproductions of historical artefacts. They had evolved into research instruments that embodied the principles of inclusive design. Each model represented a set of decisions about how museums might bridge the gap between preservation and participation. The workflow documented here offers a model that can be adapted by other museums, especially those with limited resources, to make their collections more inclusive.

4.4 Data Collection Methods

The data for this study was collected to understand how visually impaired participants interacted with the tactile replicas and their Braille and audio features. The aim was not to produce measurable results but to explore how people experienced and interpreted the models in real situations. A qualitative approach was used because it allowed for detail and depth, focusing on what participants say and do rather than on numbers. Three methods were used together: observation, post-experience questionnaires, and researcher reflection. When combined, these offered a well-rounded view of how accessible design worked in practice.

All sessions took place at the Centre for Visual Art (CVA) on the Pietermaritzburg campus, where the tactile replicas were displayed. Each participant took part individually in a session that lasted about twenty to twenty-five minutes. During these sessions, I worked as both

facilitator and observer. My role was to introduce the space, make sure the participants felt comfortable, and quietly record what they did and said while using the models.

4.4.1 Observation

Observation was the main method of data collection. Watching participants directly provided the clearest picture of how they interacted with the display. Before each session began, I gave a short verbal introduction to help participants get their bearings. I pointed out where the table, Braille labels, and QR codes were located, but I did not explain how to use them. This gave participants freedom to explore and helped reveal how easy or difficult the setup was to use without guidance.

While they engaged with the models, I wrote brief notes on a printed observation sheet that had three sections: behaviour observed, interpretation, and reflection. The notes recorded what participants did, such as how they moved around the model or where they paused. I also described how they reacted to the Braille and audio tools and whether they seemed confident, curious, or unsure. These small behavioural cues were often the most telling.

Observation also made it clear how much design details mattered. For example, most participants naturally started with the Braille label before moving on to scan the QR code. This showed that the placement of these elements made sense and guided exploration smoothly. Insights like this confirmed that earlier design decisions had worked as intended.

Throughout each session, I made a conscious effort not to interrupt or influence what participants were doing. I only stepped in if they asked for help. This allowed me to capture authentic engagement rather than reactions shaped by instruction. Right after each session ended, I reviewed and expanded my notes while everything was still fresh in my mind, adding short reflections about what had gone well and what might need improvement in the future.

4.4.2 Post-Experience Questionnaire

After completing their exploration, each participant filled out a short post-experience questionnaire. This was designed to gather immediate thoughts and feelings about the models and supporting materials. It contained eight open-ended questions about enjoyment, ease of use, and suggestions for improvement. The questions were written in simple, conversational language so that they could be answered easily either verbally or in writing.

The questionnaire made it possible to capture insights that observation alone could not reveal. Participants often reflected on tactile clarity, language choice, and the pace of the audio recordings. Their answers showed how they interpreted the experience in their own words. This feedback helped identify strengths in the design, such as the logical layout, and areas that could be refined, such as improving QR placement or adjusting the tone of the narration.

4.4.3 Researcher Reflection

Alongside participant observations, I also wrote reflections on the observation sheets after each session. These short notes were used to record my own reactions, thoughts, and questions about what I had just witnessed. Including this reflective element acknowledged

that my role as researcher and designer could influence the process and helped keep that influence visible and accountable.

After every session, I used the reflection section of the sheet to summarise what had worked well and what could be improved. My notes described how participants moved through the setup, how easily they used the Braille and audio components, and how their actions compared with what I had expected. Keeping these reflections together with the observation data made it easier later to link what I saw with how I interpreted it.

These short reflections also served as a kind of self-check. They reminded me to keep a consistent approach, stay neutral, and give participants full control of their interaction. Over time, this practice helped refine my method and gave me a better understanding of how my presence shaped the sessions.

4.4.4 Triangulation of Methods

Using more than one method strengthened the data and made it more reliable. Observation showed what participants did, the questionnaires captured what they said and felt, and my reflections documented my own interpretations. Together, these formed a process of triangulation, where information from one source could confirm or explain what appeared in another.

For instance, when a participant smiled or lingered over a certain part of the model, that behaviour often matched a questionnaire response describing the same section as “easy to understand” or “interesting to touch.” Likewise, when hesitation appeared in my notes, it usually matched written feedback about difficulty locating the QR code. These small overlaps between methods gave me confidence that the findings reflected what truly happened during the sessions rather than just my own impressions.

4.4.5 Ethical Data Handling

All data collected in this study was kept confidential and stored securely. Participants were identified only by codes (P1, P2, and P3) instead of by name. Observation sheets, questionnaires, and reflections were saved digitally on a password-protected computer, and any printed materials were kept in a locked cabinet. The data will be stored only for the duration of the project and permanently deleted afterward in line with the University of KwaZulu-Natal’s ethical policy for human research.

4.4.6 Reflection on the Data Collection Process

Collecting data for this project provided meaningful lessons about doing inclusive research. Observing participants without interfering required patience and trust in the design of the setup. The questionnaires showed how much insight could come from just a few open questions. Even with only three participants, the feedback was detailed and revealing. Each person approached the models differently, giving a nuanced view of what worked and what could be improved.

The process also confirmed that accessibility is not only about producing tactile objects but also about creating dialogue and collaboration. Participants were not treated as subjects to be studied but as partners whose feedback shaped the next stages of the work. Their insights

connected design to lived experience and formed the basis for the analysis that follows in the next section.

4.5 Data Analysis

After all three participants completed their sessions, I gathered the observation sheets, questionnaires, and reflection notes to look for patterns in what they said and did. The goal was simple: to understand how they used the tactile models and whether the design made sense to them. Because the project was small and qualitative, the analysis focused on meaning and experience rather than statistics.

I used thematic analysis to organise and interpret the data. This method, described by Braun and Clarke (2006), helps a researcher find common ideas that appear across different sets of qualitative information. It suited the project because it allowed me to work with written notes, short answers, and my own reflections at the same time.

I began by reading everything several times. This helped me relive each session and notice details I had missed while observing, such as how long participants spent on certain parts of the model or how often they paused before finding the QR code. Once I was familiar with the material, I started marking recurring words, comments, and gestures. Each marked section became a small code that captured one idea, such as *finding the label easily*, *surface feels smooth*, or *confusing QR position*.

After organising the codes, I grouped them into broader categories that showed clear connections. These categories became the main themes of the study.

The five key themes that came out of the data were:

Orientation and Navigation – how participants found and explored the models.

Tactile Clarity – how the texture and form supported recognition.

Audio and Braille Tools – how well the interpretative features worked.

Emotional Response – what participants felt during interaction.

Suggestions for Improvement – ideas they offered for future designs.

Each theme was checked against the original notes to make sure it reflected what had actually happened. For example, the theme on orientation matched both what I observed, such as confident hand movements and short pauses, and what participants later said about finding the models easy to locate.

The analysis was not a single step but a loop. I went back to my notes many times to refine the themes and merge overlapping ones. At one point I had listed Braille and audio separately, but I eventually combined them because participants used both together. This back-and-forth process kept the findings true to the data.

Throughout, I reminded myself that my own interpretation shaped what I saw. To stay transparent, I compared the three data sources, observations, questionnaires, and reflections, to see where they agreed or disagreed. This cross-checking gave the analysis a stronger base. The main insight that emerged was that independence mattered most. Participants enjoyed being able to explore on their own without constant help. They appreciated the simple, readable surfaces of the models and felt confident once they located the labels and audio

guides. A few practical issues came up, such as QR codes that were slightly awkward to scan, but overall the setup encouraged curiosity and engagement.

In summary, the thematic analysis helped turn scattered notes into a picture of real experience. It showed that accessibility is successful when design allows people to feel capable, comfortable, and interested, when it invites participation instead of supervision.

Appendix E – Complete coding process

4.6 Reflections and Limitations

Looking back at the project as a whole, I see it as both a success and a learning curve. The work met its aim of producing and testing tactile replicas, but it also revealed the everyday difficulties of combining technology, creativity, and human interaction.

The scanning stage was the first challenge. The iPad Pro and Polycam app captured the shapes accurately, but reflective surfaces and narrow spaces in the spider model made the process tricky. It took several tries to get usable results. That experience taught me that good results depend less on the tool itself and more on the time and care invested in using it.

The modelling phase brought another kind of decision-making. I often had to choose between accuracy and tactile clarity. Too much visual detail risked confusing the sense of touch, while too much smoothing made the models feel lifeless. Learning to judge where that balance lay was part of the creative process and helped me think of accessibility as a kind of translation, turning visual information into something that can be felt and understood differently.

Working with an external printer came with practical constraints. Because the university's printer was unavailable, I relied on a local company. The arrangement caused small delays but also showed that collaboration can be an asset. Some museums and universities in South Africa face similar limitations, and this partnership model proved that meaningful results are still possible without expensive infrastructure.

The participant sample was small; three participants gave more than enough detail for a study that sought depth rather than generalisation. Their one-on-one sessions made it possible to observe individual habits and gather thoughtful feedback.

Holding the sessions at the Centre for Visual Art instead of the museum had both advantages and drawbacks. It limited realism, but it provided a quiet, familiar, and accessible space. The controlled setting made observation easier and kept participants comfortable.

The most powerful lesson came from seeing the emotional impact of accessibility. Watching participants explore freely and respond with interest or delight confirmed that tactile and audio tools are not only aids but also sources of confidence. One participant's satisfaction after identifying a feature on the spider model reminded me that inclusion builds self-belief as much as it removes barriers.

Another reflection concerned cultural relevance. One participant pointed out that the models, while engaging, felt distant from her personal background. That comment stayed with me. It suggests that future projects could draw on local artefacts or narratives so that inclusion speaks not only to ability but also to identity.

Finally, I learned the value of reflexivity. Writing notes after each session showed how my decisions shaped outcomes. I noticed that participants cared more about comfort and clarity than about technical precision, which reminded me to prioritise usability over perfection.

Overall, the challenges of time, equipment, and limited scope were real, yet they enriched the project. They mirrored the conditions many institutions face when trying to make collections accessible with modest resources. The experience confirmed that accessibility is not a finished goal but a continuous act of learning, adapting, and sharing knowledge.

4.7 Summary

This chapter described how the research was carried out, combining design practice, technical development, and qualitative methods to study accessibility within a museum context. It explained how the tactile replicas and their supporting Braille and audio tools were created, tested, and analysed to understand what inclusive design looks like in practice.

The study proved that effective accessibility does not require advanced technology or large budgets. With thoughtful planning, collaboration, and reflection, affordable tools such as LiDAR scanning and 3D printing can transform how collections are experienced. The research also showed that inclusion grows through empathy and participation. The combination of observation, participant feedback, and reflective thinking revealed that tactile and audio materials can give visitors a stronger sense of independence and connection.

In summary, the methodology presented here demonstrates that accessibility is both a creative and social practice. The next chapter builds on these findings. Chapter Five turns to the results of the practice-led project and the experiences of participants, showing how the methods described here led to practical insights about inclusive museum design.

Chapter 5: The Practice of Inclusion – Project Development and Findings

This chapter presents both the practical work and the analysis that came out of this research. It brings together the creative, technical, and human aspects of the project and reflects on how the process of making tactile replicas helped generate new knowledge about accessibility in museums. The chapter is divided into two main parts.

Part A describes the practice-led project in detail. It focuses on how the tactile, Braille, and audio tools were developed from the Victorian insect models at the KwaZulu-Natal Museum. Rather than restating the methods explained in Chapter Four, this section looks at the lived experience of making, what took place, what challenges arose, what was learned, and how each step contributed to a deeper understanding of inclusive design.

Part B presents the findings that came from testing the models with participants. It looks at their feedback, emotions, and suggestions and connects these insights to the theoretical frameworks discussed earlier in the study.

Together, these two parts create a link between practice and interpretation. They show that accessibility is not only about technology but also about empathy, collaboration, and reflection. The creative process of designing and testing the tactile replicas became a way to question and reimagine how museums can engage with visitors who experience the world in different ways.

5.1 Part A: The Practice-Led Project

The practice-led part of the study was where everything came together. This was the creative and experimental stage, where the ideas explored earlier in the dissertation became practical outcomes. The goal was to take two Victorian insect models from the KwaZulu-Natal Museum and reinterpret them as inclusive, multisensory artefacts that could be explored through touch, sound, and language.

The work that followed was planned but also open-ended. Some steps went smoothly, while others required trial, adjustment, and rethinking. Each decision involved a combination of technical skill, observation, and reflection. The process revealed that inclusive design is rarely linear. It grows from experimentation and collaboration, where unexpected results often lead to the most valuable discoveries.

This section tells that story. It explains how the spider and beetle head models were scanned, digitally reconstructed, 3D printed, and finished before becoming part of a tactile display used in participant testing. Unlike the methodology chapter, this section focuses on experience, the moments of learning, the practical challenges, and the decisions that shaped the outcome.

5.1.1 LiDAR Scanning and Modelling

The practical work started at the KwaZulu-Natal Museum, where the scanning of the two Victorian insect models took place. These artefacts, a spider and a beetle head, were chosen because their enlarged scale and detailed structure made them suitable for tactile

reproduction. They were teaching models from the early twentieth century, designed to make microscopic detail visible to students of that period. Their size and construction meant that the details could be more easily captured and later translated into tactile form.

With the help of Mr. Wesley Flanagan, the Assistant Head of Exhibition of the museum, the artefacts were carefully removed from their glass display case and placed on a padded table in a bright, well-lit room. Handling these historical objects was both exciting and intimidating. They are delicate and important, yet this project required me to handle them directly to prepare them for a new kind of educational use.

The scanning was done with an iPad Pro using the Polycam application. The LiDAR sensor allowed for accurate depth capture without touching the objects. To get clean scans, I moved slowly around each artefact, keeping the tablet about half a metre away. The beetle head model was straightforward, but the spider model was more difficult. Its thin legs and hollow half-section caused the scanner to miss parts of the form. I repeated the scans several times, adjusting the lighting to minimise glare and fill in the missing areas.

Once the scans were complete, the files were exported in .obj and .stl formats and opened in Blender for refinement. This was where the creative and technical aspects came together. The spider model required extensive editing because the scan failed to capture the internal anatomy of its half-sliced structure. Using Blender's sculpting tools, I recreated these missing anatomical details by referring to photographs of the original model. I reconstructed the internal forms, shaping and simplifying them so that they could be recognised by touch while still resembling the original.

The beetle head model needed less correction but still required work on its surface ridges and edges. I smoothed out uneven areas and sharpened the outline of its mandibles to make them more tactilely distinct. Cleaning the models became a slow, focused task that felt closer to restoration than simple modelling.

Working in Blender was both technical and sensory. I often imagined how the models would feel once printed, trying to sense texture and proportion through sight alone. Sometimes I paused, looked away from the screen, and visualised a participant's hands tracing along the form. That mental connection between digital design and tactile experience became a guiding principle of this stage. Accessibility, I realised, begins not with the software but with empathy for the user.

When both models were complete, they were scaled to approximately 300 millimetres in length, roughly matching the original museum specimens. The cleaned models were exported again in .stl format, ready for printing. At this point, they felt like new artefacts: digital reconstructions that carried the essence of the originals but were now made for touch instead of display.

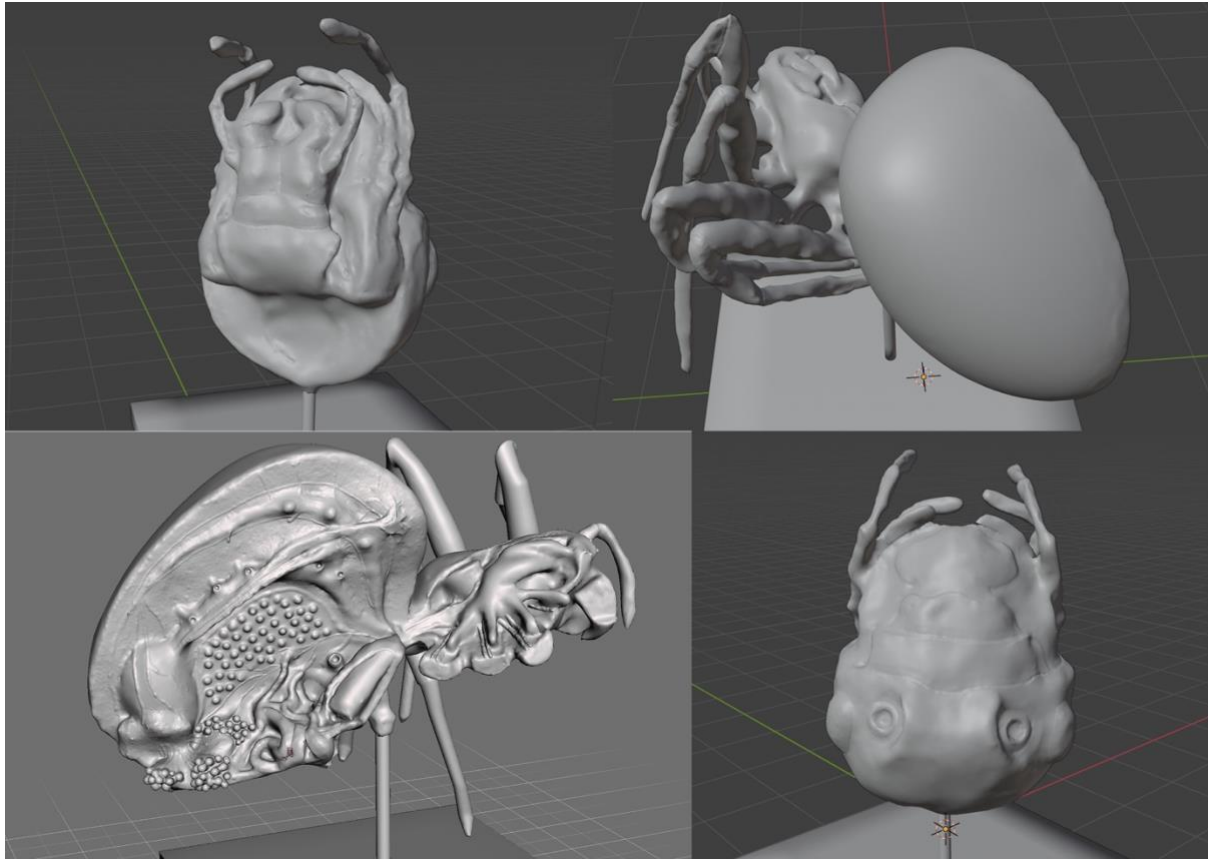


Figure 12: Screenshot of reconstructed spider and beetle head models in Blender showing added inner anatomical details.

5.1.2 3D Printing and Finishing

After the digital models were finalised, they were sent to a professional 3D printing vendor in KZN for production. I provided the final files along with a written design brief describing the scale, finish, and presentation required. The vendor had previous experience working with educational institutions, which made communication about the project smooth and efficient.

Both models were printed at a scale of 300 millimetres, the same size as the originals. To reduce material use and overall weight, the models were hollowed out before printing. This made them lighter and less expensive to produce while still strong enough to withstand regular handling. The models were printed using a Modified Crealty K1 Max 3D Printer with PLA filament, a biodegradable plastic that is lightweight and safe to touch. PLA also has a smooth surface, which makes it suitable for tactile use.

The printing process took several hours for each model because of their complexity. The spider model, in particular, required additional print supports for its legs and reconstructed inner details. Once printing was complete, the vendor handled all of the finishing work. This included sanding the surface to remove visible layer lines, polishing it for a softer texture, and finally painting the models in matte white. The white finish gave the objects a neutral, professional appearance that focused attention on form and texture rather than colour. It also reduced glare, which helped during the final display and made the models easier to view for participants with partial vision.

The completed models were mounted on custom wooden bases that were made according to my design specifications. The bases were sturdy and stable, holding the models at a height that allowed both seated and standing users to reach them comfortably. The light wood complemented the white models, giving the display a balanced, clean, and professional look suitable for both research and public education.

When I collected the finished pieces, the transition from digital design to physical object felt complete. The tactile quality was even better than I had imagined. The beetle head's contours were crisp and easy to follow, and the spider's internal anatomy was distinct and readable through touch. The anatomical details added during modelling had translated well into the physical print.

Although I did not print or finish the models myself, the collaboration with the vendor was crucial. The process showed that high-quality tactile replicas can be produced through clear communication and shared purpose, even without in-house equipment. The key was to maintain focus on accessibility throughout. Every specification, from the size of the model to the choice of paint, was guided by the intention to make the replicas comfortable and informative for touch.

Seeing the printed models for the first time was deeply satisfying. What had started as an abstract design project had become something tangible and inclusive. The objects were faithful to their origins yet had taken on new meaning. They now served as tools for participation, allowing people who rely on touch to experience and interpret museum artefacts in their own way.



Figure 13: Photograph of the 3D printed spider and beetle head models painted white and mounted on wooden stands

5.1.3 Braille and Audio Development

Once the models were complete, the focus shifted to the interpretative tools that would make them fully accessible. The goal from the start was to create a multisensory experience that brought together touch, sound, and text. The Braille labels and audio descriptions were not afterthoughts but central elements of the display. They provided users with the context and information needed to understand the models and their place within the museum collection.

The Braille labels were produced at the Disability Unit at the University of KwaZulu-Natal, where staff are trained in preparing accessible educational materials. Each label was written in both English and isiZulu to reflect the bilingual environment of KwaZulu-Natal and to make sure participants could use the material in their preferred language. Including isiZulu was important. It recognised linguistic diversity and reinforced that accessibility must include cultural and linguistic representation, not only sensory access.

Each label included the artefact's name and a short description. The text was kept brief to allow quick reading while still orienting the user before listening to the audio guide. The labels were embossed on cardboard sheet and trimmed neatly. When I received them, I was struck by how precise and elegant they were. The raised dots formed their own quiet language, one that captured the spirit of the project, communication through touch.

Positioning the Braille labels required some testing. They needed to be easy to reach but placed far enough from the models to avoid confusion. Eventually, they were placed in front of the models, on the table, at a height suitable for reading while seated or standing. The placement allowed users to move naturally from the Braille text to the model and then to the audio guide.

The audio descriptions were created next. The scripts were written in both English and isiZulu. Writing them was more difficult than expected because they had to describe texture, size, and structure clearly while avoiding unnecessary detail. The recordings were made in a quiet room using the Voice Memo app on a smartphone. Each language version was recorded by a fluent speaker to ensure clarity, accuracy, and natural delivery. Each track was about a minute and a half long and followed the same structure in both languages, though with slight differences in phrasing to match natural expression. The tone of voice was calm and clear, similar to that of a museum guide.

Once recorded, the audio files were uploaded to Google Drive, and shareable links were created. These links were then turned into QR codes using the QRCode Monkey tool. The printed codes were placed beside the Braille labels. Users could scan the code with their own phones, making the system simple and self-contained.

Before testing, both the Braille and audio materials were reviewed at the Disability Unit. A Braille reader confirmed that the dots were well defined, and the QR codes were tested on different phones to ensure they worked quickly. The setup proved straightforward and reliable. Participants could access everything with their own devices, which meant the experience did not rely on specialised equipment.

When the audio played alongside the tactile models for the first time, the display came to life. Hearing the description while touching the object created a complete sensory experience that visual display alone could not achieve. Including isiZulu gave the display local character and made it feel grounded in its cultural setting.

Working on these materials taught me that accessibility is a form of storytelling. It is not just about transferring information but about guiding a person's imagination through texture and sound. Every decision, from the length of the script to the order of elements on the table, aimed to support independence while leaving space for personal interpretation.

Seeing everything assembled together, the white tactile models, the Braille labels, and the bilingual audio, was the moment the research felt fully real. The design had moved from idea to practice. The display was no longer only a prototype; it was an inclusive space ready to be used by real visitors.



Figure 14: Photograph showing Braille label and QR code placement beside tactile model, ready for testing.

5.1.4 The Display Setup and Testing Environment

The final stage of the practice-led project involved setting up the tactile display for testing. Because the ethical clearance required that all research activities take place on the university campus, the testing sessions were held at the Centre for Visual Art (CVA) at the University of KwaZulu-Natal in Pietermaritzburg. The CVA offered a quiet and controlled space, which was ideal for focused testing. It also provided an environment similar to a small gallery, allowing the tactile models to be displayed in a way that resembled a museum setting.

The display was arranged along a long table placed against the wall in a bright, naturally lit room. The surface was wide enough to hold both models, their wooden bases, and the supporting interpretation tools. The spider and beetle head replicas were placed side by side with enough distance between them so that participants could move freely without confusion. Each model was accompanied by a Braille sheet and QR code printed on A4 paper. The layout allowed participants to start at one model, explore it by touch, then move naturally to the next.

The Braille sheets were positioned closest to the user, directly in front of each model, while the QR codes were placed just beside them for easy access. The QR codes linked to bilingual audio recordings, one in English and one in isiZulu. This arrangement created a smooth and logical flow: participants could first read the Braille, then listen to the audio description using their phones, and finally explore the physical model in front of them. The surface of the table was low enough for seated use and comfortable for standing participants as well.

The simplicity of the setup was intentional. Nothing in the environment was decorative or distracting. The focus remained entirely on the tactile models and the experience of exploration. The white walls and tiled floor helped keep the space quiet and bright, while the matte white colour of the models stood out clearly against the wooden bases. This contrast helped partially sighted participants orient themselves more easily.

During each session, I welcomed participants individually and gave a brief verbal overview of the space before they began. They were told the basic layout of the table but not given instructions on how to approach the models. I wanted to see how intuitive the setup was and how they chose to navigate it on their own. While they explored, I stood nearby to observe and take notes, ready to assist if needed. Most participants quickly became comfortable with the setup, finding their way around the models and interacting confidently with both the Braille and audio tools.

The quiet atmosphere of the CVA played an important role. The space was large enough to avoid echo and distractions, which helped participants focus on the tactile experience. The sessions often had a calm rhythm, with participants alternating between touching, listening, and pausing to think. The lighting in the room was steady and bright but not harsh, making it easy for participants with partial vision to orient themselves without strain.

One of the most memorable moments came while observing participants fully immersed in their interaction with the models. Each individual took their time to explore the shapes, moving between the tactile surfaces and the audio guides with focus and curiosity. Watching these sessions unfold showed that tactile learning can be both independent and deeply engaging, encouraging participants to interpret and understand the objects in their own way.

The display setup proved that accessibility does not require elaborate technology or expensive materials. What mattered most was the clarity of the layout and the freedom it gave participants to explore at their own pace. The combination of tactile, Braille, and audio elements worked together smoothly, creating an inclusive environment where everyone could engage with the artefacts meaningfully.



Figure 15: Photograph of the display at the CVA showing participants exploring the tactile models with Braille and QR code materials.

5.1.5 Reflections on the Making Process

Looking back on the entire making process, it is clear that this project was as much a journey of learning as it was a creative exercise. The process of designing, producing, and testing the tactile replicas was not only about creating objects that could be touched, but about understanding how accessibility takes shape through collaboration, experimentation, and reflection.

The work began with uncertainty. I had a general plan, but many of the details had to be figured out through trial and adjustment. For example, the first scans of the spider model revealed how easily digital tools can misread complex shapes. At that point, I realised that technology could not replace human judgment. I had to rely on intuition to decide what parts of the scan needed reconstruction and how much detail should be added. This experience taught me that accessibility is often a matter of interpretation. Translating something visual into a form that can be read by touch requires empathy, patience, and a willingness to make creative choices. This process of translation rather than replication echoes New Museology's recognition that display and interpretation are never neutral but shaped by curatorial decisions (Vergo, 1989; Sandell, 2007).

Throughout the modelling and printing process, I became more aware of the balance between accuracy and clarity. It was tempting to focus on reproducing every small detail of the originals, but the goal of tactile interpretation is not perfect replication. It is to make meaning through touch. Simplifying certain textures or adjusting proportions did not reduce the scientific value of the models; instead, it made them more readable to the hand. This idea of "tactile legibility" became central to my thinking about inclusive design. This idea of tactile legibility reflects principles of Inclusive Design, which emphasise usability across different sensory modes rather than privileging sight alone (Mace, 1998; Hamraie, 2017). It also aligns with the Social Model of Disability, which locates exclusion in environmental and institutional barriers rather than in the individual (Oliver, 1996).

The collaboration with the 3D printing vendor was another important part of the learning process. Communicating design intentions clearly and trusting others with the technical production was not always easy, but it showed me that accessibility work benefits from partnership. The vendor's practical knowledge of printing materials, finishing, and mounting helped turn digital files into durable and professional-looking artefacts. Their input also reminded me that accessibility can be achieved through shared effort rather than individual expertise.

Preparing the Braille and audio components added another layer of understanding. Writing and recording the descriptions helped me think about accessibility as storytelling. Every word and every decision about tone affected how the object would be imagined and understood. Including both English and isiZulu made the experience feel rooted in its local context. It reminded me that inclusion is not only about sensory access but also about cultural and linguistic representation.

Setting up the final display and observing participants engage with the models brought all of these insights together. Seeing how participants navigated the table and moved between Braille, audio, and touch confirmed that the design worked as intended. Their independence and focus showed that small design details, like height, spacing, and surface finish, make a big difference in how accessible an experience feels.

At the same time, the process revealed the limits of what can be achieved through design alone. True inclusion depends on more than just physical accessibility. It also relies on communication, openness, and respect for diverse ways of learning and experiencing the world. This became clear when participants offered feedback that went beyond the models themselves, suggesting how museums could create more welcoming and interactive spaces overall. This emphasis on dialogue reflects participatory approaches within New Museology,

which argue that museums should function as spaces of shared authority and collaborative meaning-making (Janes & Conaty, 2006; Sandell, 2007).

Personally, the project changed how I think about design. Before beginning, I saw accessibility as a technical goal, something that could be achieved through tools and processes. By the end, I understood it as a human practice that grows through conversation and collaboration. The making of these tactile models was not just a creative exercise but a method of inquiry. It allowed me to learn from the material itself, from the participants, and from the small challenges that shaped the outcome.

The final models, the Braille and audio tools, and the testing sessions each played a part in teaching me that accessibility is an evolving dialogue between design and experience. It is about creating opportunities for engagement and allowing users to interpret and connect in their own way. This stage of the research demonstrated that inclusive design is not something that can be completed once and for all. It is a continuing process of adaptation, reflection, and learning.

5.2 Part B: Findings

This part of the chapter shares what was learned from the testing sessions with the three visually impaired participants. The main goal was to understand how they engaged with the tactile replicas, Braille labels, and audio guides that were developed from the Victorian-era insect artefacts at the KwaZulu-Natal Museum. In line with the overall aim of the study, these findings explore how inclusive interpretation strategies, based on New Museology, Inclusive Design, and the Social Model of Disability, can make museum artefacts more accessible and engaging for people with visual impairments.

The information used for this analysis came from three sources that worked together to give a rounded picture of the participants' experiences. These were the observation sheet, which recorded behaviour and interaction; the reflection notes written during each session; and the post-experience questionnaires, which captured participants' personal feedback after using the display. Using these sources side by side made it possible to look at what participants did, what they said, and what was learned in the process.

The analysis followed the same process described in Chapter Four. Each set of notes was read several times to become familiar with the material, then coded to identify common ideas and recurring patterns. These patterns developed into themes that describe the main aspects of how participants engaged with the tactile display and its interpretative tools.

Although the artefacts came from the KwaZulu-Natal Museum, the testing was carried out at the Centre for Visual Art (CVA) on the University of KwaZulu-Natal campus. This decision ensured that the sessions met ethical requirements while still keeping the connection to the museum. The CVA offered a quiet and controlled environment that allowed participants to focus fully on exploring the models.

The findings are presented under five main themes that reflect the practical and emotional dimensions of the participants' experiences:

1. Orientation and Independent Navigation
2. Tactile Clarity and Understanding

3. Audio and Braille Accessibility
4. Engagement and Meaning
5. Suggestions and Design Implications

Each theme connects back to one or more of the study's objectives. Orientation and navigation relate to identifying barriers and testing user independence. Tactile clarity and understanding address the effectiveness of the replicas as learning tools. Audio and Braille accessibility focus on how the different senses work together to support inclusion. Engagement and meaning explore the emotional and educational impact of the experience. Finally, the suggestions and design implications section draws together participants' feedback to form recommendations that can guide future inclusive interpretation work.

Together, these findings offer a detailed look at how tactile, audio, and language-based interpretation can open new ways of accessing museum artefacts. They also show that inclusion is not achieved through design alone, but through reflection, testing, and continuous learning from the people who use these tools.

Appendices B–E contain the observation notes, participant questionnaires, audio and Braille scripts, and the complete coding process used to generate the findings presented in this chapter.

5.2.1 Theme 1: Orientation and Independent Navigation

This theme focuses on how participants found their way around the testing space and how they interacted with the tactile display once they arrived at the table. It looks at independence and how much support was needed before they could begin exploring.

When the sessions started, it became clear that finding the display was not automatic. P1 and P2 both needed a short verbal cue to guide them to the right place. Once they reached the table, they were fine and could begin using the materials confidently. P3 managed to reach the table without help but still paused for a few seconds to get a sense of where everything was. That moment of adjustment showed how much even a small spatial cue can make a difference.

After the participants started exploring, their movements followed a similar pattern. Each one began by feeling for the Braille sheet, then scanning the QR code, and finally touching the model. That order wasn't planned by me; it simply came naturally from how the materials were laid out. It showed that the arrangement made sense by touch alone. Everyone could move between each part without confusion or frustration, which was reassuring.

What stood out, however, was that orientation within the room still required help. The CVA testing space was open and quiet, which made things easier, but without that initial direction, most participants would not have known exactly where to start. This became one of the strongest lessons from the study. Accessibility does not start at the artefact. It begins from the moment someone enters the space. If visitors cannot find their way independently, then the design still leaves a gap.

In the post-session feedback, P1 suggested bringing the Braille and model slightly closer together and adding a small tactile marker to help locate them without help. That kind of suggestion says a lot about how visually impaired users think about movement. They look for

logic, rhythm, and small signals that keep the experience smooth. Even small changes like texture lines, raised markers, or soft contrasts in surface can create a sense of direction that feels empowering.

My own reflection after these sessions was that independence is as emotional as it is practical. When participants found something on their own, their posture shifted. They stood taller, smiled, and explored more freely. That moment of confidence is the essence of inclusive design. It is not only about access to information but about having control of the experience.

This theme connects to the first and fourth objectives of the study, which were about identifying barriers and evaluating the effectiveness of the interpretative tools. What these findings show is that the display worked well once participants reached it, but more attention needs to be given to how visitors orient themselves before they begin. Adding gentle environmental cues or tactile pathways in future displays would make the experience more independent and complete.

5.2.2 Theme 2: Tactile Clarity and Understanding

The second theme looks at how clear the models were when explored through touch and whether participants could recognise and understand what they were feeling.

Once participants started exploring, their movements became more confident. At first, their hands moved slowly across the surfaces, but within a minute, the pace picked up. They began tracing outlines, following ridges, and revisiting certain features. P2, for example, spent extra time on the beetle head, running fingers along the mandibles and commenting quietly on the texture. P1 was drawn to the spider model, especially the open half where the interior details could be felt. The way they returned to these areas again and again suggested curiosity and comprehension.

From the feedback and my own notes, it was clear that the models worked well for tactile learning. The size of the objects made them comfortable to hold and explore, and the smooth finish allowed hands to move freely without strain. Participants described them as “clear” and “easy to follow.” That kind of clarity doesn’t happen by accident. It came from the decision to keep the forms simple enough to be read by touch while preserving their main structural features.

P3 also managed to identify the forms correctly but mentioned that the models didn’t feel personally meaningful. That response wasn’t about confusion, but about connection. The artefacts were scientifically accurate, but their subject matter didn’t resonate with everyday experience. This difference between clarity and meaning became an important insight for me. It showed that accessibility has two layers. One is functional, where the object can be read and understood. The other is emotional, where the content feels relevant to the user. Both matter.

Watching the sessions also changed how I think about tactile interpretation. It is not a passive activity. The participants were not simply touching an object; they were learning through touch. They compared, questioned, and re-traced parts until the form made sense to them. Their hands acted like eyes, and every movement built understanding.

My reflection notes mention that the spider model created more engagement because of its inner detail. It gave participants something complex to explore without being confusing. That confirmed that tactile replicas can carry depth and still remain readable if designed carefully. The printing and finishing achieved that balance well.

In terms of design, the lesson here is about finding the right level of detail. Too much makes the object hard to interpret. Too little makes it dull. The goal is to create models that communicate through texture and shape, not through visual decoration.

This theme relates to the second and third objectives of the study, which focused on reproducing the artefacts and testing them with visually impaired participants. The results showed that tactile design can maintain both accuracy and accessibility. The participants understood the models through touch alone, which means the replicas succeeded as learning tools.

Overall, tactile clarity turned out to be one of the strongest aspects of the project. The models were not just objects to be felt but tools that supported exploration and discovery. They turned information into experience, which is what inclusive design should aim for.

5.2.3 Theme 3: Audio and Braille Accessibility

This theme looks at how the participants used the Braille labels and the audio recordings, and how these two features helped them understand the models. Both tools were created so that users could choose the way that worked best for them.

Each participant used them a bit differently. P1 and P2 used both Braille and audio, starting with the Braille and then scanning the QR code to listen. P3 only used the isiZulu audio. They said it felt more natural and easier to follow. Seeing these differences reminded me that accessibility is not one thing that works for everyone. It is about having choices.

The isiZulu audio recording stood out. All three participants said they preferred it to the English one. They liked how it sounded and said it helped them understand what they were touching. The length of each recording, about one and a half minutes, seemed right. It was long enough to explain the details but short enough to hold attention.

The only small difficulty was with scanning the QR codes. Everyone took a little longer to find where to place their phone. After the first attempt, this became easier. This showed that a small raised dot or line near the QR code would help people find it faster.

In the feedback forms, P1 said the Braille was easy to read and that it helped them know what the artefact was before listening. P2 said the audio made it easier to imagine the form while touching it. P3 said the isiZulu version “made more sense” and helped them picture the model clearly. What these comments showed is that language plays a big part in inclusion. For these participants, hearing their own language made the experience feel personal.

During the sessions, I noticed how listening affected exploration. When the audio started, the participants slowed down. They touched in rhythm with what they were hearing, almost following along. It showed how sound and touch can work together to make the object easier to understand. It also kept them focused longer.

This theme links with the study's third and fourth objectives, which looked at creating and testing interpretative tools. The findings confirmed that both Braille and audio were useful and clear. They worked together to give participants confidence and independence. The only improvement needed is a small tactile cue beside the QR code.

5.2.4 Theme 4: Engagement and Meaning

This theme focuses on how participants reacted to the display. It looks at how they felt and what kind of meaning they found in the experience.

From the beginning, all three participants were curious. Once they started exploring, they became fully absorbed. They moved slowly at first, feeling their way, then more freely as they became familiar with the layout. P1 smiled while tracing the spider model and said that touching it "made it real." P2 said they liked being able to handle the models without worrying about breaking them. P3 said the isiZulu audio helped them understand what they were feeling.

I noticed that confidence grew as the sessions went on. The early movements were careful and tentative, but after a few minutes, everyone seemed more relaxed. They traced edges, compared shapes, and spent time on areas they found interesting. When the audio played, they followed the description with their hands, matching the words with the form. It created a flow between listening and touching that made the models come alive.

There were small but powerful signs of satisfaction. When P1 located the Braille label on their own, they smiled before reading it. It was a quiet but meaningful moment. P2 leaned closer while listening to the audio and nodded slightly as they followed along. These gestures showed that independence feels rewarding. For people who are often guided in visual environments, being able to explore on their own is significant.

Still, engagement is more than just access. P3 said the models did not feel personally meaningful. This comment pointed to a deeper question about relevance. The models were accurate and clear but did not connect emotionally. It made me think about how interpretation can go beyond clarity to include cultural connection. When users see themselves or their experiences reflected in the content, meaning becomes stronger.

In my reflection notes, I wrote that participants seemed most engaged when I stepped back and let them decide what to do. When they were free to explore without instruction, the sessions felt natural. That freedom seemed to build confidence and curiosity at the same time. It reminded me that inclusion is not just about making something accessible, but also about creating room for independence.

This theme links with the fourth objective of the study, which was to assess the educational and emotional impact of tactile and multisensory design. The sessions showed that tactile learning builds understanding and confidence, and that personal connection strengthens engagement. The tactile and audio tools together created a sense of discovery that visual display alone could not offer.

In the end, these findings showed that accessibility is not only about providing tools but about creating experiences that feel human and alive. When design allows people to explore freely, it turns access into real participation.

5.2.5 Theme 5: Suggestions and Design Implications

This theme brings together the participants' suggestions and my own reflections about what could be improved. Even though the sessions went well, there were still small details that could make the experience easier and more meaningful for users.

P1 suggested placing the Braille and the models a little closer together and adding small tactile markers that could help locate each part without help. They also mentioned that simple tactile cues in the room, like changes in texture on the floor or a guiding strip on the table edge, could make it easier to move around independently. This comment made me realise how much navigation outside the display itself matters. Accessibility starts with how people find their way, not only with what they touch once they arrive.

P2 was very positive and said there should be “more displays like this.” They enjoyed being able to learn by touch and sound and wanted to see similar work in other spaces. This feedback suggests that the approach is effective and could be expanded. More tactile displays using the same principles could turn inclusion from a single experience into a normal part of public engagement.

P3 suggested adding more background or explanation about what the objects represent. They said it would help to understand how the models relate to the real artefacts or why they were important. Their point was that interpretation should give both physical and cultural context, not only shape and structure. This is a strong reminder that accessibility should also include meaning. Users want to connect with what they are exploring, not just understand it technically.

My own reflections after these sessions echo many of the same points. The models worked well as tactile objects, but the next step is to think about the broader experience. Accessibility can grow by adding spatial cues that support independence and by connecting the content more closely to users' lives and cultural experiences. The feedback also supports future research directions. It highlights the importance of designing not just objects but environments where navigation and orientation are built into the experience.

In summary, the participants' suggestions show that inclusive design is never finished. It is something that must evolve as designers listen, adapt, and respond to what users actually need. The practical ideas that came out of these sessions, tactile markers, closer arrangement, and better contextual explanation, are small but powerful improvements that can make the next stage of development even stronger. These suggestions also connect directly to the fifth objective of the study, which focused on developing practical guidelines for inclusive interpretation that can be applied to future projects.

5.2.7 Synthesis and Conclusion

The findings from all five themes tell a clear story about how tactile, audio, and Braille interpretation can make museum artefacts more accessible and engaging for people with visual impairments. The study was guided by one main objective: *to investigate how inclusive interpretation strategies, informed by New Museology, Inclusive Design, and the Social Model of Disability, can be designed and applied to strengthen accessibility and engagement*

for visually impaired visitors interacting with the enlarged Victorian-era insect artefacts from the KwaZulu-Natal Museum.

This main objective provided the foundation for the entire project, shaping both the practical work and the reflective analysis. It was supported by five sub-objectives that addressed different stages of the research process, from identifying barriers to developing and testing inclusive interpretation tools.

The first theme, Orientation and Independent Navigation, showed that participants were able to explore the models confidently once they reached the table, but they still needed guidance when entering the space. This pointed to the need for environmental cues that can help visitors find displays independently. It directly relates to the first sub-objective, which aimed to identify barriers that limit accessibility and independence.

The second theme, Tactile Clarity and Understanding, demonstrated that the models were clear, comfortable, and easy to interpret through touch. This confirmed that the tactile replicas achieved their purpose as learning tools and supports the second and third sub-objectives, which focused on reproducing the artefacts and testing them with visually impaired participants.

The third theme, Audio and Braille Accessibility, confirmed that the multisensory approach worked well. The bilingual audio was especially effective, with isiZulu preferred for its clarity and familiarity. The Braille and audio together gave participants independence and confidence. This finding connects directly to the third sub-objective, which involved co-designing interpretative tools that respond to user needs.

The fourth theme, Engagement and Meaning, showed that tactile and auditory interaction goes beyond sharing information. It helps to build confidence and emotional connection. Participants responded positively, but the results also showed that cultural relevance strengthens engagement. This theme relates to the fourth sub-objective, which aimed to assess both the educational and emotional impact of the interpretative tools.

The fifth theme, Suggestions and Design Implications, brought together participants' ideas for improvement. Their feedback provided clear, practical recommendations for refining layout, improving navigation, and adding context. This links to the fifth sub-objective, which focused on developing practical guidelines that can inform future inclusive interpretation in museums and similar institutions.

Together, the findings respond directly to the main research objective. They demonstrate that inclusive interpretation, guided by theory and built through co-design, can transform how visually impaired visitors experience museum artefacts. The combination of tactile models, Braille, and audio created a multisensory system that supported independence, confidence, and understanding. At the same time, the research revealed that inclusion is not a fixed achievement but an ongoing process that depends on reflection, dialogue, and continued adaptation. This reflects the Social Model of Disability's focus on structural barriers rather than individual impairment (Oliver, 1996).

The findings also provide a direction for future work. The next step should focus on spatial accessibility and independent navigation, extending the project from single artefacts to larger environments. Designing spaces that include tactile pathways, sound cues, and consistent

orientation markers could create museum settings where visually impaired visitors can explore without barriers and with full independence.

Chapter 6: Conclusion and Recommendations

This chapter concludes the study and reflects on what was learned from exploring inclusive interpretation strategies for visually impaired visitors using the Victorian-era insect artefacts from the KwaZulu-Natal Museum. It brings together the ideas, findings, and experiences discussed in the previous chapters and considers what they mean for museum accessibility and inclusive design practice.

The research set out to investigate how the principles of New Museology, Inclusive Design, and the Social Model of Disability can be applied to improve engagement and access for people with visual impairments. These frameworks provided not only conceptual guidance but also a critical lens through which power, representation, and structural barriers in museum practice could be examined (Vergo, 1989; Oliver, 1996; Mace, 1998). Through a process that combined design, testing, and reflection, the project developed tactile, Braille, and audio tools that allowed participants to explore and understand the artefacts independently. Although the testing took place at the University of KwaZulu-Natal's Centre for Visual Art, the study remained rooted in the museum context, as the artefacts and interpretative aims were directly linked to the KwaZulu-Natal Museum.

This final chapter first revisits the objectives and outlines how each one was addressed. It then discusses the broader meaning of the findings in relation to the theoretical frameworks that guided the study. The later sections provide practical recommendations for museums and designers, highlight the study's contribution to knowledge, and offer a short reflection on future directions for research and practice.

The purpose of this conclusion is not only to summarise what was done but also to reflect on what the process revealed about inclusion and accessibility. It shows that inclusive design is more than a technical or aesthetic challenge. It is an ongoing practice that depends on empathy, collaboration, and a willingness to listen and adapt. This reflects the Social Model of Disability's emphasis on removing environmental barriers rather than locating disability within the individual (Oliver, 1996), and aligns with participatory principles in New Museology (Sandell, 2007).

6.1 Summary of Research Objectives and Outcomes

The study was guided by one main objective and five sub-objectives that together shaped both the design and evaluation stages of the project. Each was achieved through a combination of practical work, participant testing, and reflective analysis.

Main Objective:

To investigate how inclusive interpretation strategies, informed by New Museology, Inclusive Design, and the Social Model of Disability, can be designed and applied to strengthen accessibility and engagement for visually impaired visitors interacting with the enlarged Victorian-era insect artefacts from the KwaZulu-Natal Museum.

This main objective provided the overall direction for the study. It framed the project as both a design experiment and an inquiry into how inclusive practice can be applied in real contexts. The outcomes of the research show that inclusive design can make museum artefacts accessible through multisensory tools that promote independence, participation, and learning. This supports Inclusive Design principles that emphasise usability across different

sensory experiences (Mace, 1998) and aligns with New Museology's emphasis on participation and shared authority (Sandell, 2007).

Sub-Objective 1:

To identify the main accessibility barriers associated with the Victorian-era insect artefacts from the KwaZulu-Natal Museum.

This objective was achieved through site visits, consultation with museum staff, and a review of exhibition conditions. The research found that visually impaired visitors faced both physical and interpretative barriers. The artefacts were displayed behind glass and relied entirely on visual engagement, which excluded tactile learning. These findings became the foundation for developing new forms of access.

Sub-Objective 2:

To digitally reproduce the enlarged spider and beetle artefacts using LiDAR scanning and 3D tactile modelling techniques.

This objective was met during the technical stage of the research. Using an iPad Pro with Polycam and Blender software, high-quality 3D models of both artefacts were created. The models were cleaned, refined, and printed at a suitable scale for tactile use. The process showed that accessible replicas can be produced using affordable tools and open-source software.

Sub-Objective 3:

To co-design interpretative tools, including tactile replicas, Braille labels, and audio guides, in collaboration with visually impaired participants.

This objective was fulfilled through the iterative development of the interpretative materials. Feedback from the UKZN Disability Unit helped shape the Braille and audio components, ensuring that both English and isiZulu were included. Together, the tactile replicas, Braille labels, and audio descriptions formed a complete multisensory system that supported independence and inclusion.

Sub-Objective 4:

To test and evaluate the developed interpretative tools within a controlled environment to gather user feedback and assess accessibility outcomes.

This objective was achieved through testing sessions at the Centre for Visual Art. Each of the three participants interacted with the models individually, and data were collected through observation, reflection, and questionnaires. The results showed that participants could explore the models confidently once oriented and that the interpretative tools worked effectively together. The feedback also revealed areas for improvement, particularly in spatial orientation and contextual storytelling.

Sub-Objective 5:

To develop practical and transferable guidelines for inclusive interpretation that can inform future accessibility work at the KwaZulu-Natal Museum and similar institutions.

This final objective was achieved through the analysis of participant feedback and researcher reflection. The findings produced practical insights for inclusive museum design, including

the importance of tactile clarity, the value of bilingual audio, and the need for environmental cues that support independent navigation.

Taken together, the main objective and the sub-objectives guided the research from the identification of barriers to the creation of solutions. The project demonstrated that inclusive interpretation can be achieved through collaboration, creativity, and empathy. It also showed that inclusion depends not on advanced technology, but on human-centred design that respects the experiences and needs of its users.

6.2 Discussion: Reflections on Inclusive Design and Museum Practice

The findings from this research show that accessibility in museums is not simply about adding tools or technologies. It is about rethinking how museums communicate, how they share authority, and how they create spaces where all visitors can participate equally. The frameworks of New Museology, Inclusive Design, and the Social Model of Disability together provided a lens for understanding this process and for analysing how inclusive practice can be applied in real contexts.

New Museology calls for museums to move beyond their traditional roles as keepers of objects and to become active spaces for dialogue, participation, and social inclusion. This project reflects that shift. By transforming preserved artefacts into tactile replicas that could be handled, the study challenged the conventional idea that museum artefacts must remain behind glass. It demonstrated that interpretation can be participatory and multisensory without diminishing the cultural or scientific value of the objects. The process of reinterpreting the Victorian insect models created opportunities for visitors to engage directly with heritage that had previously been restricted to sighted audiences.

The Social Model of Disability also played an important role in shaping the project. It shifted attention away from impairment and towards the barriers that disable people in everyday environments. In this study, the barriers were not only physical but also sensory and institutional. The artefacts were inaccessible because they relied entirely on visual display and because the museum context had not considered non-visual forms of interpretation. By producing tactile replicas and multisensory interpretative tools, the project directly addressed these barriers. The findings show that accessibility is achieved when design removes environmental and attitudinal obstacles rather than attempting to fix the individual.

Inclusive Design provided the practical foundation for developing the tactile, Braille, and audio materials. Its core principle, designing for diversity by default, guided the creative process from start to finish. The tactile models were produced with consideration for comfort, legibility, and independent use. The bilingual audio and Braille labels extended this inclusivity further by recognising linguistic and cultural diversity. Together, these elements proved that inclusive design can operate successfully within limited resources and still produce outcomes that are functional, meaningful, and human centred.

Reflecting on the findings, it becomes clear that these frameworks are not separate theories but overlapping perspectives that reinforce one another. New Museology sets the cultural and institutional foundation by asking who museums are for and how they represent people. The Social Model of Disability identifies the barriers that prevent participation. Inclusive Design provides the tools to address those barriers through practical action. When applied together,

as this research has done, they create a strong basis for real inclusion in museum interpretation.

Another important reflection concerns the emotional and educational dimension of accessibility. Participants did not only gain information about the models; they also experienced the satisfaction of independent learning. The sessions showed that when visitors can explore freely, the sense of control and confidence contributes as much to engagement as the content itself. This aligns with New Museology's emphasis on dialogue and experience rather than display. It also affirms that inclusion should involve emotional and social participation, not just physical access.

Cultural relevance emerged as another key aspect of inclusive design. Although the tactile models were effective educational tools, one participant noted that the subject matter felt distant from their own experiences. This observation highlights an ongoing challenge for museums: to make inclusion meaningful, interpretation must also be culturally grounded. The models succeeded in breaking physical barriers but still carried the legacy of Western scientific representation. Integrating local narratives or artefacts that reflect community heritage would extend inclusion beyond access and towards representation.

The project also reinforces that inclusive design is a process rather than an outcome. It depends on iteration, reflection, and collaboration with users. The feedback from participants did not just evaluate the tools; it helped shape the understanding of what inclusion can mean. Their comments about tactile markers, spacing, and environmental cues provide small but powerful lessons for designers and curators. These insights demonstrate that even minor changes, when informed by user experience, can transform accessibility from a checklist into an evolving conversation between designers and audiences.

Finally, this discussion highlights how practice-led research contributes to the wider discourse on museum accessibility. By combining design work with direct engagement from users, the study bridges theory and practice. It shows that inclusive interpretation is most effective when it grows out of experimentation, testing, and listening to participants. The process aligns with the principles of New Museology by turning design into a participatory act and by positioning visitors as collaborators in the production of meaning.

In conclusion, this project shows that the path to inclusion lies in collaboration and continuous learning. Museums that adopt inclusive design approaches not only improve access for visually impaired visitors but also enrich the experience for all audiences. Accessibility, when understood as a form of dialogue, allows museums to move beyond the visual and to become spaces of shared understanding and connection.

6.3 Recommendations for Future Practice

The research led to several lessons that can be applied in real museum and educational spaces. Most of them came directly from what participants said and from what I observed during testing. Others grew from the design process itself. Together they point to simple but important ways to make access and participation stronger for people with visual impairments.

1. Support Independent Movement

One of the clearest lessons was that accessibility begins before the visitor reaches the object. P1 and P2 needed light help at the start, which showed that independence depends on how the whole space is organised, not just the design of the model. Museums should look at how people move through their spaces and how someone without sight might find their way. Tactile or textured paths, small floor markers, or even quiet sound cues could guide visitors toward a display. Independence starts with being able to move freely and to know where you are without having to ask for help.

2. Keep Tactile Design Simple and Clear

The models worked well because their shapes were easy to read through touch. The beetle head was smooth and distinct, while the spider had depth and texture that drew attention. These qualities made the models enjoyable to explore. Future projects should follow the same principle: keep the form simple enough to understand but still detailed enough to feel interesting. Overly complex textures can be confusing, while surfaces that are too plain can feel empty. Testing the design with users at each stage helps find that balance.

3. Combine Senses

Participants liked using both the Braille and the audio. It gave them choices. Some started with the Braille, others preferred to listen first. Having more than one option made the experience flexible. Museums should continue to build multisensory interpretation that brings touch, sound, and language together. Audio recordings should be short, clear, and easy to follow. The Braille should be close to the object, so visitors can move between the two without losing focus.

4. Make Space for Language and Culture

The isiZulu audio made a noticeable difference. Participants said it felt natural and easier to follow. This showed that inclusion is also about language. When museums include local languages, they open the experience to more people and show respect for the visitors' identities. In future projects, tactile displays could be combined with local stories or everyday examples that link the artefact to familiar experiences. This would make the learning not only accessible but also meaningful.

5. Involve Users Early

Working with visually impaired participants was one of the strongest parts of this study. Their feedback in the initial questionnaire helped shape the final design and improve the layout by understanding their previous experience with museum spaces and the use of tactile models. Future projects should involve users from the very beginning, not only at the testing stage. When people with lived experience help design a project, the results are always more practical and more relevant. Co-design workshops or short review sessions can reveal issues that designers might miss.

6. Train and Involve Staff

Accessibility also depends on people. Museum staff are often the first point of contact for visitors, so their understanding of inclusion matters as much as the design itself. Regular training sessions can help staff learn how to welcome and assist visitors with visual

impairments. More importantly, it builds confidence and empathy. Staff who understand why accessibility matters are more likely to maintain these practices in the long term.

7. Plan for Continuity

One challenge many museums face is keeping accessibility projects active once the funding or research ends. Accessibility should be built into everyday practice, not added later. This means planning budgets, staff time, and maintenance with inclusion in mind. Updating technology, replacing worn tactile labels, or checking that QR codes still work are small steps that make a big difference over time.

8. Keep Experimenting

This project showed that meaningful accessibility can be achieved with limited resources. A small team, affordable tools, and thoughtful design made a real impact. Museums should not wait for perfect conditions to begin. Small, well-documented projects can grow into larger ones over time. Experimenting and sharing what works builds collective knowledge and keeps inclusion moving forward.

The lessons from this project all come back to the same idea: inclusion is a process, not a product. It requires listening, collaboration, and patience. Every change, even a small one, can help remove a barrier and open new possibilities for learning and connection. The best results come when design is driven by empathy and when the people who use the space are part of the process.

6.4 Contribution to Knowledge

This study adds to the growing body of work on inclusive museum practice by showing how accessibility can be created through design that is simple, affordable, and human centred. While many discussions about inclusion in museums focus on policy or technology, this project contributes a practice-led example that demonstrates how inclusion can be achieved through creativity and collaboration.

One of the main contributions of this work is its demonstration that 3D scanning and printing can be used as practical tools for inclusion, not just for display or conservation. By reproducing the Victorian insect artefacts as tactile models, the study showed that digital tools can be adapted to support sensory learning and participation. The process turned inaccessible objects into multisensory experiences that allowed users to explore and learn independently. This work shows that technology becomes meaningful when it is guided by empathy and by the real needs of users.

The research also contributes new understanding about how bilingual and multisensory interpretation supports inclusion. The use of both English and isiZulu in the audio guides gave participants a sense of recognition and comfort that deepened their connection to the artefacts. This small but important detail demonstrates that accessibility is not only about physical access, but also about language, culture, and belonging.

Another contribution lies in how the study combined theory and practice. The research applied ideas from New Museology, Inclusive Design, and the Social Model of Disability to a real design process. It showed how these theories can move beyond discussion and into

application. The tactile models, Braille labels, and audio guides became physical evidence of how these frameworks can work together to remove barriers and create shared experiences.

The study also adds to practice-based design research by positioning co-design as a central method for inclusion. The participants were not passive subjects but active collaborators whose feedback shaped the final design. This approach contributes to an emerging model of accessibility where design grows from user experience rather than being imposed from above.

Finally, this research adds local insight to a global conversation. Much of the literature on museum accessibility comes from Europe or North America. This project, based in South Africa and focused on local languages and contexts, offers a perspective that is both regional and relevant to other parts of the Global South. It demonstrates that inclusive design does not depend on expensive infrastructure or large teams, but on creativity, respect, and the will to make change.

In summary, the study contributes new practical knowledge about how inclusive design can be integrated into museum interpretation. It provides a tested example of how tactile and audio tools can transform inaccessible displays into participatory experiences. It also contributes a methodological model that combines theory, design, and collaboration in a way that other institutions can adapt. Most importantly, it shows that inclusion is not a separate goal for museums but a way of working that makes culture, learning, and heritage accessible to everyone.

6.5 Closing Reflection

Completing this research has changed the way I think about both museums and design. At first, I saw inclusion mainly as a design challenge, something that could be fixed with tools or layout. Through this process, I came to understand that inclusion is about people and the willingness to listen and adapt.

Every part of the project taught me something new. Scanning and modelling the artefacts was a lesson in patience, and the testing sessions reminded me that accessibility grows through trial, feedback, and small improvements. Some stages were difficult, but the learning came from those difficulties.

The most rewarding moments were during the testing sessions. Watching participants explore the models, listening to their reactions, and seeing their independence gave meaning to the work. It showed that inclusion is not only practical but emotional. It is about confidence, curiosity, and feeling part of something.

Working in South Africa also shaped how I understood accessibility. The importance of language and cultural identity became clear when participants responded so positively to the isiZulu recordings. True inclusion must reflect local voices and lived experiences, not only remove barriers.

The tactile models, braille labels, and audio guides have now been installed in the Victorian insect section of the KwaZulu-Natal Museum. They will remain the research property of the University of KwaZulu-Natal, and my contribution as designer and researcher is acknowledged in the exhibition. Having the work installed in the museum feels rewarding.

Visitors can now interact with the models and the audio material directly, and the research has become part of a real exhibition where it can keep serving its purpose.



Figure 16: Tactile, Braille and Audio Display Installed in the KwaZulu-Natal Museum, 2025

This project has given me direction for the future. I hope to build on this work by focusing on spatial accessibility and independent navigation in future research. It confirmed that change begins with small, patient steps and with collaboration between designers, curators, and users. Real inclusion happens when museums and designers are willing to listen, test, and grow together.

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Appendices

Appendix A: Initial Research Questionnaire

Researcher Topic

Beyond the Glass: Enhancing Accessibility for Visually Impaired Visitors to Preserved Exhibits at the KwaZulu-Natal Museum

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Purpose of the Research

The aim of this research is to explore how museum artefacts can be made accessible to visually impaired visitors through tactile, audio, and Braille interpretation. The findings will help improve how museums like the KwaZulu-Natal Museum design inclusive experiences for everyone.

Voluntary Participation

Your participation in this study is completely voluntary. You may choose not to answer any question or withdraw at any time. Your responses will be anonymous unless you choose to share your contact details for follow-up participation.

Estimated Completion Time

This interview will take about 10–15 minutes to complete.

Confidentiality

All responses will be kept confidential and stored securely. Any personal information provided will only be used for research purposes and will not be shared outside the study team.

Ethical Approval

This study has been reviewed and approved by the University of KwaZulu-Natal Humanities and Social Sciences Research Ethics Committee.

Consent to Participate

Please confirm your consent before continuing:

I have read and understood the information above and voluntarily consent to participate in this study.

☐ Yes, I consent

Section A: Participant Information

1. What is your age range? (☐ 18–25 ☐ 26–35 ☐ 36–45 ☐ 46+)
2. What is your gender? (☐ Male ☐ Female ☐ Prefer not to say ☐ Other: _____)
3. What is your level of visual impairment? (☐ Totally blind ☐ Partially sighted ☐ Other: _____)
4. What is your preferred language of communication? (☐ English ☐ isiZulu ☐ Both ☐ Other: _____)
5. Have you visited the KwaZulu-Natal Museum before? (☐ Yes ☐ No)
6. If yes, how often? (☐ Once ☐ Occasionally ☐ Regularly)
7. If no, have you visited any other museum? (☐ Yes ☐ No)
If yes, please specify: _____

Section B: Experiences of Museum Visits

8. How would you describe your overall experience when visiting a museum?
9. What types of exhibits do you find most interesting or meaningful?
10. What challenges or barriers have you encountered when visiting museums or exhibitions?
11. Have you ever used audio guides, tactile models, or Braille labels in a museum? (☐ Yes ☐ No)
12. If yes, please describe your experience with them.

Section C: Accessibility and Expectations

13. What kinds of tools or features would make a museum more accessible for you?
14. How important is it for museums to provide descriptions in multiple languages such as isiZulu and English?
15. How confident do you feel navigating museum spaces independently? (☐ Very confident ☐ Somewhat confident ☐ Not confident)
16. What would make you feel more comfortable or included during a museum visit?

Section D: Willingness to Participate in the Testing Stage

17. Would you be interested in participating in the next stage of the study, which involves visiting the KwaZulu-Natal Museum to engage with tactile and audio prototypes? (☐ Yes ☐ No)

18. If yes, please provide your name and a preferred contact method (email or phone). (This information will be kept confidential and used only for research purposes.)

Name: _____

Contact: _____

Appendix B: Observation Sheet

This document is used to record observations during participant testing of tactile replicas at the Centre for Visual Art (CVA). Each participant will explore the artefacts individually, followed by a short post-experience questionnaire.

Participants	Time	Behavior Observed	Notes / Interpretation	Researcher Reflection
P1	14:50	Started with spider braille No problem using braille Needed help with audio due to total blindness Happy interacting with the model	Navigated the Braille text confidently and appeared to understand the tactile layout easily. The need for support with the audio device was linked to the level of visual impairment rather than difficulty with the technology itself. Positive affect suggests the model design encourages independent exploration once orientation is established.	The interaction showed that Braille placement and clarity work well. Audio activation steps could be simplified or explained verbally at the start of the session. P1's enthusiasm highlights the emotional value of tactile engagement for fully blind users and reinforces the importance of multisensory features working together smoothly.
P2	15:10	Need help using model due to total blindness Started with spider model and was happy with both models No problem using braille Needed help playing audio	Experience was positive once guided to the model and Braille label. Support was mainly needed for initial orientation and to locate the audio function. Once settled, P2 explored the replicas carefully and expressed enjoyment. This suggests that physical guidance at the beginning can significantly improve engagement for fully blind participants.	The session showed how critical first contact and orientation are to the visitor experience. A short introduction describing layout or QR placement before starting could improve independence. The participant's satisfaction despite needing assistance shows the potential of the tactile models to sustain interest when accessibility tools are properly introduced.

P3	15:30	No problem using the tactile models Wasn't fully interacting because the models doesn't culturally resonate with P3 Doesn't understand braille No problem using audio independently	Interaction demonstrates that physical access alone does not ensure engagement. While the tactile design and audio worked well, the limited cultural connection with the insect models reduced P3 interest and depth of interaction. This points to the need for interpretative content that relates objects to broader cultural or local narratives.	The experience emphasised that accessibility and relevance must go hand in hand. The participant's independence with the audio system was encouraging, showing that the technology functions well. However, the lack of emotional or cultural connection indicates the importance of including local storytelling or examples that resonate with South African contexts in future designs.
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Appendix C: Participant Post-Experience Questionnaire

P1

1. How would you describe your overall experience using the tactile models?

It was fantastic. I got to feel the models, the audio and Braille guidance provided background information on those said models

2. Was it easy for you to find and explore the models by yourself?

Not easy, but I was assisted by Paul (the researcher). Only then was it easy.

3. What part of the experience did you enjoy most?

Physical sensory experience - by feeling the object. Simple hand touches explained the models for me.

4. Was there anything that felt difficult, confusing, or unclear?

No

5. How did you find the audio or Braille guidance?

Was it helpful and easy to follow? Almost both are helpful. They were easy to follow. I understood the Zulu audio guidance much better than the English

6. If you could change or improve one thing about the models or layout, what would it be?

I would suggest placing the models and Braille labels a little closer together and adding a small tactile marker to help locate each part more easily without assistance. It would also help if there were simple tactile cues in the environment itself to support independent navigation before reaching the display.

7. Did the experience make you feel more interested in visiting museums or exploring other displays?

Yes

8. Do you have any other comments or suggestions?

Everything is good.

P2

1. How would you describe your overall experience using the tactile models?

The experience was good.

2. Was it easy for you to find and explore the models by yourself?

No, good with assistance

3. What part of the experience did you enjoy most?

When it was time to touch the models

4. Was there anything that felt difficult, confusing, or unclear?

No, Everything was clear

5. How did you find the audio or Braille guidance? Was it helpful and easy to follow?

Yes, it was very helpful a lot

6. If you could change or improve one thing about the models or layout, what would it be?

Nothing, Everything was good

7. Did the experience make you feel more interested in visiting museums or exploring other displays?

Yes.

8. Do you have any other comments or suggestions?

Yes, the museum must have more displays like this so that other visually impaired people can also experience and learn through touch.

P3

1. How would you describe your overall experience using the tactile models?

It was difficult to understand

2. Was it easy for you to find and explore the models by yourself?

Yes, I can explore the model myself

3. What part of the experience did you enjoy most?

I enjoyed the Zulu audio as it was easy for me to follow along

4. Was there anything that felt difficult, confusing, or unclear?

I was trying to understand the purpose of the artefacts, as they don't culturally resonate with me

5. How did you find the audio or Braille guidance?

Was it helpful and easy to follow? Audio was helpful, but I don't understand Braille

6. If you could change or improve one thing about the models or layout, what would it be?

The presentation was okay, but I think having more explanation about the background or meaning of the artefacts would help me connect with them better.

7. Did the experience make you feel more interested in visiting museums or exploring other displays?

Yes

8. Do you have any other comments or suggestions?

It would be good if future projects included more relatable models that connect to my culture or experiences, so that the tactile and audio elements feel even more meaningful.

Appendix D: Scripts for Audio Description and Braille

Audio Description Spider Model (English)

You are touching a 3D-printed half model of a spider, enlarged from a Victorian educational display. Start by finding the flat base. From here, move your hand upward to the main body. The front section is the head and thorax joined together. Behind it is the rounded abdomen. From the sides, you can feel five legs, each divided into small jointed parts that bend slightly. At the very front are two short feelers called pedipalps. This model lets you get closer to the spider than anyone could in the original display, inviting you to feel its form and imagine how it moves.

Audio Description Spider Model (isiZulu)

Uthinta imodeli eyenziwe nge-3D ebonisa uhhafu wesicabucabu, ekhuliswe kusukela kumfanekiso wokufundisa wesikhathi sika-Victorian. Qala ngokuthinta isisekelo esiyisicaba. Usuke lapho uye phezulu emzimbeni omkhulu. Ingxenywe engaphambili iyinhloko ehlanganiswe nomzimba ongaphambili, kanti ngemuva kukhona isisu esijikile. Eceleni, uzothinta imilenze emine ehlukeniswe yaba izingxenywe ezincane ezigoqekayo kancane. Phambili kukhona ama-pedipalps amancane, azizwa njengama-mpiko amafushane. Le modeli ikuvumela ukuba usondele esicabucabeni ngendlela okungenzekanga embukisweni wokuqala, ikumema ukuthi uzwe ukuma kwaso futhi ucabange indlela esinyakaza ngayo.

Braille Label (English)

Spider Model – Victorian Educational Display

Body divided into two parts; five legs and small sensory appendages (pedipalps) at the front. Replica created for tactile exploration.

Braille Label (isiZulu)

Imodeli Yesicabucabu – Umbukiso Wokufundisa Wesikhathi SaseVictoria

Umzimba uhlukaniswe izingxenywe ezimbili; imilenze eyisihlanu nezitho ezizwisisayo ngaphambili.

Imodeli yokuthinta nokufunda.

Audio Description Beetle Head Model (English)

This is a 3D-printed model of a beetle's head, enlarged from a nineteenth-century teaching display. Start at the smooth top curve; this is the beetle's head shield. Below it you will feel two large jaws or mandibles that curve inward. Behind the jaws are two small raised points marking where the antennae begin. The surface feels slightly uneven to show the hard texture of the beetle's outer shell. As you explore, imagine the tiny insect this model was based on, and how its shape tells the story of careful observation and curiosity.

Audio Description Beetle Head Model (isiZulu)

Lena yimodeli ye-3D ekhombisa ikhanda lenyonye, elikhuliswe kusukela emfanekisweni wokufundisa wekhulu le-19. Qala phezulu lapho uzothinta khona indawo egobile eshelelayo – lena yisihlangu sekhanda lenyonye. Ngaphansi kwaso uzothola amazinyo amabili amakhulu agobile ngaphakathi. Ngemuva kwala mazinywa kukhona amaphuzu amabili aphakanyisiwe lapho kuqala khona ama-antenna. Indawo ezungezile ithambekele kancane, ikhombisa ulwelwesi oluqinile lwangaphandle lwenyonye. Njengoba uhamba ngezandla zakho, cabanga ngalesi silwanyana esincane esisuselwa kuso lesi simo, nokuthi ukuma kwaso kukhuluma ngomsebenzi wokubuka ngokucophelela nokufuna ukuqonda.

Braille Label (English)

Beetle Head Model – Victorian Educational Display

Features include curved mandibles (jaws), antenna sockets, and textured surface for tactile recognition.

Braille Label (isiZulu)

Ikhanda Lenyonye – Umbukiso Wokufundisa Wesikhathi SaseVictoria

Linezindawo ezijiyile ezimaka amazipho nezimbobo zama-antenna; indawo enobuso obuthintwayo.

Appendix E: Full Coding Process

Introduction

This appendix presents the complete coding process used to analyse the qualitative data collected during the participant testing sessions. Data came from three sources: observation sheets, researcher reflections, and post-experience questionnaires. Each source offered a different perspective. Observation captured behaviour, reflection documented interpretation, and questionnaires recorded participants' own words.

The data were coded to identify repeating ideas and patterns that revealed how participants experienced the tactile replicas, Braille labels, and audio descriptions. The process followed the steps outlined in Chapter Four, moving from familiarisation and initial coding to the grouping of related ideas and development of final themes.

Coding Table

Data Source / Participant	Raw Data Extract (Evidence)	Initial Codes	Final Theme
P1 Observation	Needed help locating the table. Once guided, moved confidently and explored for several minutes.	Assistance at start; independence after orientation; environment needs cues.	Orientation and Independent Navigation
Researcher Reflection	Participants hesitated briefly before touching, showing uncertainty about where to begin.	Hesitation; unclear starting point; need for orientation.	Orientation and Independent Navigation
P2 Observation	Followed the sequence Braille → QR → model without instruction.	Logical order; intuitive layout; self-direction.	Orientation and Independent Navigation
P3 Observation	Reached the table alone but paused to assess layout before exploring.	Independent movement; spatial awareness.	Orientation and Independent Navigation
P1 Questionnaire	It would help to have small tactile markers or cues to find the model easily.	Tactile navigation aids; spatial orientation.	Orientation and Independent Navigation
Researcher Reflection	Accessibility begins before the object. Visitors need cues to find and position themselves.	Pre-object accessibility; environmental wayfinding.	Orientation and Independent Navigation
P2 Observation	Traced beetle head contours with both hands. Movements were steady and confident.	Comfortable scale; tactile legibility; confidence.	Tactile Clarity and Understanding
P1 Observation	Explored spider interior repeatedly, tracing inner surfaces and shapes.	Engagement through internal detail; clear tactile structure.	Tactile Clarity and Understanding

Data Source / Participant	Raw Data Extract (Evidence)	Initial Codes	Final Theme
P2 Questionnaire	Easy to follow the shape. I could imagine what it looks like.	Form comprehension; tactile imagination.	Tactile Clarity and Understanding
Researcher Reflection	The spider model's depth encouraged active exploration and learning by touch.	Depth enhances comprehension; tactile reconstruction effective.	Tactile Clarity and Understanding
P3 Questionnaire	The artefacts were interesting but not something I relate to personally.	Clear structure; limited personal connection.	Tactile Clarity and Understanding
Observation (General)	Participants' movements became smoother after a few minutes of interaction.	Learning through touch; growing familiarity.	Tactile Clarity and Understanding
Researcher Reflection	Confidence increased with exploration. Participants began mapping the models faster.	Building confidence; tactile learning process.	Tactile Clarity and Understanding
Observation (P2)	Used Braille first, then scanned QR code while listening attentively.	Sequential learning; independent exploration.	Audio and Braille Accessibility
Observation (P3)	Listened to isiZulu audio only. Nodded slightly while exploring.	Audio preference; comprehension through local language.	Audio and Braille Accessibility
P1 Questionnaire	Braille was easy to read and helped identify the artefact before audio.	Braille identification; logical sequence.	Audio and Braille Accessibility
P3 Questionnaire	IsiZulu audio made more sense than English.	Linguistic familiarity; cultural comfort.	Audio and Braille Accessibility
Researcher Reflection	Movements slowed while listening, following the narration closely.	Coordination of sound and touch; embodied learning.	Audio and Braille Accessibility
P2 Observation	Participant smiled while audio played, tracing in rhythm with the words.	Audio-touch synchrony; focused engagement.	Audio and Braille Accessibility
Observation (P1)	Smiled and said that touching made it real.	Emotional connection; authenticity through touch.	Engagement and Meaning
Observation (P2)	Repeated movements and appeared deeply focused.	Enjoyment; curiosity; sustained engagement.	Engagement and Meaning
Observation (P3)	Quiet, concentrated posture while listening.	Focus; reflective engagement.	Engagement and Meaning

Data Source / Participant	Raw Data Extract (Evidence)	Initial Codes	Final Theme
P2 Questionnaire	It was good. I liked touching and listening together.	Positive response; multisensory satisfaction.	Engagement and Meaning
P3 Questionnaire	Did not find it very meaningful.	Emotional distance; limited relevance.	Engagement and Meaning
Researcher Reflection	Engagement increased when participants were free to choose their pace.	Autonomy; self-direction; ownership of experience.	Engagement and Meaning
Observation (P1)	Needed help at first but smiled after finding the Braille label independently later.	Growing independence; confidence; satisfaction.	Engagement and Meaning
Observation (P2)	Asked if there could be more of these displays in other spaces.	Desire for expansion; positive engagement.	Suggestions and Design Implications
P3 Questionnaire	Would like more background information about what these objects represent.	Need for context; relevance to meaning.	Suggestions and Design Implications
P1 Questionnaire	Add tactile cues for easier finding. Bring Braille and models closer together.	Design refinement; user-led improvement.	Suggestions and Design Implications
Researcher Reflection	Accessibility should grow to include navigation and cultural meaning.	Continuous improvement; direction for future design.	Suggestions and Design Implications
Observation (General)	All participants adapted quickly once familiar with the layout.	Effective design; potential for replication.	Suggestions and Design Implications

Coding Process:

Familiarisation

All data from observation, reflection, and questionnaires were read repeatedly to identify recurring actions, comments, and reactions. Key points were marked to capture first impressions and patterns of behaviour.

Initial Coding

Phrases and short words were used to represent small but significant ideas in the data. For example, “needed help locating the table” became *assistance needed*, and “preferred isiZulu audio” became *language preference*.

Grouping of Codes

Similar codes across participants were merged. Codes like *hesitation* and *unclear start point* were grouped as *orientation difficulties*, while *Braille easy to read* and *logical order* were grouped under *interpretative clarity*.

Formation of Themes

These grouped codes were then organised into five overarching themes:

- Orientation and Independent Navigation
- Tactile Clarity and Understanding
- Audio and Braille Accessibility
- Engagement and Meaning
- Suggestions and Design Implications

Verification and Refinement

Each theme was checked against the raw data to ensure accuracy. Overlaps were reduced, and final themes were defined in relation to the research objectives and questions.

Definitions of Final Themes

Theme	Description
Orientation and Independent Navigation	Describes how participants located and approached the display, including levels of independence and need for environmental cues.
Tactile Clarity and Understanding	Focuses on how clearly the tactile models communicated form and structure through touch and how participants interpreted them.
Audio and Braille Accessibility	Examines how the audio descriptions and Braille labels complemented each other and supported understanding.
Engagement and Meaning	Captures participants' emotional and intellectual responses, including enjoyment, curiosity, and cultural relevance.
Suggestions and Design Implications	Brings together user feedback and researcher reflection on how to refine and expand inclusive interpretation strategies.

Interpretation

This appendix documents the complete path from raw qualitative data to the development of the five themes used in Chapter 5. Observation provided a record of physical behaviour, reflection offered the researcher's interpretative perspective, and questionnaires recorded direct participant voices.

The process of comparing these three sources produced patterns that were consistent across the dataset. Each theme was grounded in real actions and comments observed during the sessions. This coding process ensured that the final findings were credible, traceable, and aligned with the study's objectives.