

# Using AI to Enhance the Visitor Experience at Te Papa Museum



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**WPI**

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# Chapter 1: Introduction

A revolution in digital learning is shaping our approach to teaching, sharing and consuming information in the public educational space. Among these institutions, museums are uniquely positioned to leverage emerging AI technologies. Specifically, AI applications have the potential to enhance exhibition design and visitor interaction. These tools offer a fresh mechanism for attracting visitors and amplifying the scale and impact of exhibitions by making them more immersive. Nevertheless, research in AI museum applications must weigh both the feasibility and challenges of implementations on a case-by-case basis.

Te Papa Tongarewa, the national museum of Aotearoa New Zealand, has a mission to provide meaningful experiences to its visitors. The museum is a point of pride for Wellington and all of Aotearoa New Zealand, as the museum values the past to better the present and focus on the future, while prioritizing the multicultural values of Aotearoa New Zealand (Museum of New Zealand - Te Papa Tongarewa, n.d.). It has garnered a global audience, for its “scholarly” and “innovative” approach to education (Museum of New Zealand - Te Papa Tongarewa, n.d.). To remain on the cutting edge in museum technologies and continue to captivate visitors, Te Papa seeks an opportunity to harness the potential and the current enthusiasm for AI applications, particularly to explore potential implementations that make use of storytelling.

Society has just started to realize the range of practical applications for Artificial Intelligence in the present day – thus, experience with AI-enhanced programming is growing. As a tool, it offers ease of use, rapid information processing, and wide distribution. AI could greatly amplify visitor engagement. On the other hand, technical limitations and financial constraints could limit the effectiveness of utilizing AI in some settings. Budgets and available resources could limit the ability to implement certain AI technologies.

While AI-driven applications can serve as valuable tools, responsible implementation of AI in any use case also necessitates understanding public perceptions and even laws. At Te Papa, this means acknowledging visitor feedback, exploring ethical considerations, and ensuring that the application follows the museum’s standards to express and share the history and culture of

Aotearoa. There may be questions about data sovereignty for Māori and Pasifika stories. As noted: “for Māori, the desire for such autonomy is rooted in history,” and so careful research can ensure accordance with the museum's mission (Hao, 2022; Museum of New Zealand - Te Papa Tongarewa, n.d.). The goal of the project is to therefore advise Te Papa on the feasibility of AI in storytelling at the museum. We identified the following objectives to achieve our goal: (1) Explore the technical and cultural limitations and standards of AI, (2) Gauge Te Papa visitors’ perceptions of AI and interactivity, and (3) Assess methods of engagement in prospective platforms for AI implementation. We hope to provide Te Papa with recommendations that will lead to meaningful engagement and maintain the museum's adherence to multicultural principles.

# Chapter 2: Background

This chapter explores how AI has transformed approaches to creative education. It impacts the design of interactive platforms, visualizing data, and how museums enhance engagement with offerings such as exhibits and learning activities. Museums can leverage these new AI tools to potentially create more immersive experiences for visitors, facilitating novel and dynamic learning environments. This chapter presents the promise of AI, highlights concerns and controversies that might shape its use in an educational setting like Te Papa and discusses application opportunities.

## 2.1 The promise of AI

Artificial Intelligence is commonly understood as a field of ever-evolving software that can imitate human abilities such as learning, conversing, and creating. The type of AI seen most often today is General AI (Gen AI); Gen AI strives to “create complex original content—such as long-form text, high-quality images, [and] realistic video or audio” by drawing from a “simplified representation of [its] training data and then draw[ing] from that representation to create new work that’s similar, but not identical” (IBM, 2024). However, the concept of AI has been around since 1935 and only in the last decade has scientific innovation transitioned AI to human-level performance due to the growth of machine learning and deep learning (Copeland, 2024).

The relationship between data and AI is symbiotic. For example, some generative AI relies heavily on vast amounts of data to learn patterns and make predictions; thus, the more data that AI systems have access to, the more accurate, robust, and intelligent their predictions can be (Mucci, 2024). Applications of AI are becoming prolific, and its ability to analyze vast amounts of data make it an exciting tool at the cutting edge of learning and education. For that reason, AI has the potential to revolutionize the institutional learning experiences through the re-imagination of traditional storytelling and visitor immersion. With careful design and curating, AI can create meaningful stories using museum data, bringing narratives to life through visual

and multimedia techniques. The advancement of storytelling is a powerful opportunity for museums to strengthen connections between visitors and the exhibits. This approach to engagement can help visitors relate to the rich cultural and historical information, as “storytelling forges connections among people, and between people and ideas,” making it an effective tool for engaging diverse audiences and conveying complex topics (Boris, 2017). Additionally, Boris notes that it “...helps with learning because stories are easy to remember,” suggesting improvements to knowledge retention (Boris, 2017). Using AI for storytelling not only helps visitors become more engaged with the museum’s experiences, but it also adds a personalization component that further enriches learning.

## 2.2 Te Papa: A mission to engage, attract, and educate

Located on Wellington’s waterfront, Te Papa is a point of pride for Aotearoa New Zealand. Having reached 30 million visitors in 2019, Te Papa understands that their “success is built on [their] relationships with and ... ability to represent [their] community” (see Figure 2.1) (Museum of New Zealand - Te Papa Tongarewa, n.d.). Te Papa’s strategy prioritizes the *mana* of all communities, bicultural belonging, sovereignty, and biodiversity which guides their decisions and maintains an influential *Tiriti-based museum* (Museum of New Zealand - Te Papa Tongarewa, n.d.).



*Figure 2.1: Museum of New Zealand - Te Papa Tongarewa in Wellington, New Zealand.*  
(Museum of New Zealand - Te Papa Tongarewa, 2016)

As the national museum, Te Papa represents Aotearoa New Zealand, its people and culture across international audiences, making its messaging and operations of utmost importance to the people of Aotearoa New Zealand (Wellington NZ, n.d.). In hopes of supporting this mission, Te Papa has created an Audience and Insight Directorate that constantly prioritizes the audience throughout development of exhibits to create impactful visitor experiences (Museum of New Zealand - Te Papa Tongarewa, n.d.). This includes exploring cutting-edge technological solutions, such as AI.

## 2.3 Partners and stakeholders for responsible AI usage

Te Papa has brought artificial intelligence into the operations of the museum in recent years (Chumko, 2023). They proactively established an AI Guidance Group to prioritize exploration of generative AI applications and their influence (Watkins, 2024). The museum also acknowledges an ethical responsibility to provide a learning space that reflects their mission and the interests of the owners of the stories that the museum presents in its exhibitions. All operations at Te Papa, including those of the AI Guidance Group, must abide by the museum's mission-based framework, called "Te Rautaki o Te Papa" (Museum of New Zealand - Te Papa Tongarewa, n.d.).



Alongside advisory groups at Te Papa, the ethical representation of culture and identity is essential in a multicultural learning environment. For example, the Te Mana Raraunga (Māori Data Sovereignty Network) is an organization dedicated to the preservation of Māori data sovereignty in an increasingly technological world (Te Mana Raraunga, n.d.). Similarly, the Ministry of Pacific Peoples is dedicated to advising on topics and policy relating to Pacific peoples, including the nuances of data sovereignty, which Section 2.4 discusses (Ministry for Pacific Peoples, n.d.). Given that the Māori and Pasifika consider data to be a cultural treasure, their perspectives on protecting data and its usage are vital in developing a project that respects the diverse cultures of Aotearoa.

Finally, with the goal of enhancing visitor engagement and experience at Te Papa, the voice of museum visitors will be integral to project development and/or successful implementation. In the 2023-2024 fiscal year, Te Papa had roughly 1.2 million visitors, with approximately 590,000 of them being international visitors (Museum of New Zealand - Te Papa Tongarewa, 2024). This level of exposure amplifies the responsibility of the museum to be cautious when telling the multicultural story of Aotearoa through AI applications.

## 2.4 Learning from trends in visitor engagement

Museums have actively been exploring several techniques to boost engagement and/or learning. Unfortunately, there is no uniform answer as to which is the best. There are a variety of methods that museums have previously implemented or studied to improve the experiences they provide to their visitors. Emerging trends range across multiple devices that provide AI enhanced technologies such as apps, touch screen elements or immersive exhibitions that enable the visitor to feel as though they are directly participating in the model (Wen & Ma, 2024). This study will focus on how museums currently use mobile applications and interactive kiosks.

One way in which museums try to boost engagement and learning is through mobile applications that visitors can use on-the-go. The goal of this approach is for visitors to stay properly engaged and informed while observing exhibits. Museums have already implemented these applications in a more traditional way, or with an integrated game feature. One study that observed the effects of either approach is that of “Ask Dr. Discovery” (Nelson et al., 2020). This

application enabled museum visitors to ask questions about certain exhibits in hopes of helping them engage with and/or learn about them. In both versions of the app, the visitor interacts with the Dr. D character (Nelson et al., 2020). The traditional “Ask Mode” served as the baseline treatment where museum visitors could ask Dr. D pre-programmed questions about the exhibits (Nelson et al., 2020). The “Game Mode” was experimental and incorporated parts of the baseline application, but sent visitors on a mission with Dr. D to get him to his spaceship by asking several questions (Nelson et al., 2020). Analysis of pre- and post-surveys of 1539 participating visitors compared the effectiveness of both versions of the application. Ultimately, the “Game Mode” resulted in about two times more usage than the “Ask Mode” (Nelson et al., 2020). This shows that utilizing games can help engage visitors and encourage learning.

Another approach museums take to boost engagement and/or learning is to implement technologies such as kiosks and digitally linked audio guides (Pallud, 2017). According to the studies at the National Museum of the History of Immigration (NMHI) in France, digitally linked audio guides reduce the area for physical text needed to explain exhibits (Pallud, 2017). The aim is to combine mobility and interactivity (Pallud, 2017). Furthermore, interactive kiosks adopt a Q&A strategy to provide visitors with ample amounts of information (Pallud, 2017). Pallud studied how these technologies affected visitor experiences by performing tests, employing measurement models, and using other forms of statistical analysis. From this analysis, they determined that interactivity and ease-of-use aspects of these technologies boosted cognitive engagement and in turn enhanced learning (Pallud, 2017). In all, digital methods have consistently proven to be effective in boosting engagement and measurable learning for museum visitors. Although these methods are effective, incorporation of more advanced technologies, specifically in the realm of AI, prompt further discussion. It is important to recognize the functionality range of AI and concerns that arise from the use of it before considering any implementation.

## 2.5 Public perceptions and cautions about the use of AI

AI learns from training data and then analyzes it to create new content. However, this process raises ethical concerns about gaining training data and the authority of these AI predictions. Some AI models like large language models (LLMs) need hundreds of gigabytes of

data to make reasonable predictions. However, sourcing that much data is difficult, thus many creators result in using web-scraping or purchasing large amounts of data. Web scraping is the practice of using software to collect information from websites, journals, and other internet entities to then store internally on a database. However, web-scraping makes no distinction between work in the public domain and copyrighted work (Nature, 2024). This leads to AI work using copyrighted sources without proper citation or accreditation. Additionally, purchased data and scraped data can contain personal and sensitive information. Some models store and analyze this information like any other data points, creating the potential to facilitate “spear-phishing—the deliberate targeting of people for purposes of identity theft or fraud” (Miller, 2024). Lastly, AI is a human creation, meaning it could potentially reflect any biases present in its training data and algorithms.

By leveraging AI’s ability to analyze vast amounts of data and automate complex tasks, it has become an invaluable tool for enhancing productivity and improving user experience in industries and institutions. While there are significant concerns of data ownership and biased outcomes exist within AI, there are frameworks in place that AI-tool creators can adopt to mitigate these issues – developing new standards and models that are more equitable. For instance, following the EU’s policy on training data can boost credibility and mitigate stolen work. The policy requires developers to credit the works used to train their AI models to help with clarity and distinguish ownership (Nature, 2024). Additionally, equipping new AI models with Retrieval-Augmented Generation (RAG) framework can enable these technologies to “fill in” training data gaps by fetching information from outside sources allowing the model to gain more comprehensive data as well as cite papers that are relevant to its output (Merritt, 2023; Nature, 2024). Understanding the limitations of the use of AI in a museum environment is important to provide recommendations that are reasonable for Te Papa.

The government of Aotearoa New Zealand has established a legal framework for the use of AI. Stats NZ published the “Algorithm Charter for Aotearoa New Zealand” in July 2020, which is the major work that provides guidance to the government about the use of data-driven technologies. This charter assesses risks that could result from the use of complex algorithms with large data sets (Stats NZ Tatauranga Aotearoa, 2020). This may include predictive algorithms that AI software uses. Challenges arise from human and data biases, security

vulnerabilities, a lack of transparency about the use of algorithms, and issues involving data sovereignty. The Algorithm Charter addresses these challenges by suggesting that the use of algorithms should coincide with the Treaty of Waitangi, ensure a degree of human oversight to determine biases and unintended consequences, and have “plain English documentation of the algorithm” for transparency in regard to how the algorithm works and how one can use the algorithm (Stats NZ Tatauranga Aotearoa, 2020). Although the focus of the charter is not on artificial intelligence, complex algorithms are a major component in the functioning of AI systems. The charter indicates that the government of Aotearoa New Zealand is dedicated to the secure and transparent use of data-driven technologies that are consistent with diverse cultural perspectives.

As stated earlier, the Algorithm Charter has a commitment to the Treaty of Waitangi, which created the framework for the relationship between the indigenous peoples of Aotearoa New Zealand and the British Crown (Orange, 2012). The extension of this to the digital age is primarily through the concept of data sovereignty, which details that the use of a certain group’s data should be under the authority of the owning entity (Te Mana Raraunga, n.d.). Preserving this sovereignty is imperative since early examples of AI received public criticism for perpetuating dominant narratives and offensive stereotypes (IBM, 2023). Similarly to the government of Aotearoa New Zealand, Te Mana Raraunga has produced their own document describing how to govern the use of algorithms based on Māori principles. The perspective of Te Mana Raraunga derives from these six key Māori concepts: Rangatiritanga (authority), Whakapapa (relationships), Whanaungatang (obligations), Kotahitanga (collective benefits), Manaakitang (reciprocity), and Kaitiakitanga (guardianship). These principles articulate that the “Māori have the right to control the development, and use of an algorithm, including (but not limited to) motives, design, choice of inputs, interpretation of outputs, maintenance, management, and deployment” (Tikanga in Technology Research Team, 2023). This perspective on algorithms and data-driven technologies demonstrates the importance of cultural information to the Māori. Therefore, any use of Māori information in artificial intelligence algorithms or data sets must abide by Māori cultural principles.

Similar to the Maori, the Pasifika have their own perspective on data sovereignty. A report by the Ministry of Pacific Peoples (MPP), examines data collection through the lens of the

Kakala framework, which is a traditional Tongan weaving practice (Ministry of Pacific Peoples, 2023, p. 8). Utilizing data-related technology through this lens can lead to a better understanding of the Pasifika community and their perspective on cultural data in contrast to Western views. The MPP uses the Kakala framework to analyze Pacific peoples' data (Ministry of Pacific Peoples, 2023, p. 6). In the *toli* (data collection) stage, the MPP recognizes a lack of inclusion of Pasifika people in the accumulation of Pacific data. A similar lack of involvement occurs in the data methodologies and analysis stages. Therefore, Te Papa must abide by data sovereignty principles when dealing with data from Pasifika sources.

Since Te Papa is one of the main cultural centers of Aotearoa New Zealand, the use of data technologies at the museum should reflect the perceptions that New Zealanders have towards AI. In 2023, Verian – an independent research group – conducted a survey with 853 New Zealanders who know about artificial intelligence. It showed that 42% of respondents said they were “more concerned than excited” about AI, while 40% were “equally concerned and excited” (Matika, 2023). Only 11% of responders were “more excited than concerned,” indicating that most citizens, potential visitors, had some form of concern relating to the use of AI as recently as 2023 (Matika, 2023). Of those who were more or equally concerned, the major issues included malicious use of AI, a lack of regulation, unintended consequences, inaccurate information, and privacy (Matika, 2023). These concerns could be relevant in a museum environment if visitors share the same sentiment, especially given the technological capabilities at Te Papa. Thus, museums must consider and address privacy and accuracy concerns about the use of AI prior to implementation.

## 2.6 Learning from museum applications of AI

Integrating the newest technological developments and functioning at the cutting edge of innovation appears successful for museums in the past, peaking visitor interest via “on-the-go” digital media, digital guides and VR. The following assessment of recent implementations to harness the power of AI can provide insight to AI opportunities at Te Papa.

Still in development, ‘The Living Museum’, an online collection of 1.2 million objects from The British Museum, is one of the newest and largest innovations of museum-AI

implementations for its conversational capabilities. Jonathan Talmi, an independent AI engineer is implementing this AI exhibit unaffiliated with The British Museum (Museums and Heritage, 2024). The application uses some of the museum's open-source data, as per a Creative Commons license (Talmi, 2024). Currently, The British Museum has eight million artifacts accessible through the museum's online database (The British Museum, 2020). However, the collection is made more impactful to visitors through the application of AI. Instead of stagnant images and facts about the artifact, 'The Living Museum' uses AI to carry a fluid conversation between the artifact and the visitor, allowing the visitor to ask any question and suggesting points of interest. In addition, the system is receptive to natural language, creating an environment for accessible exploration through its understanding of common use descriptions (Museums and Heritage, 2024). Thus 'The Living Museum' provides a functional framework of AI usage for conversational interaction, artifact involvement, personalized experiences, and ease of exploration that benefits visitor learning (Talmi, 2024). This conversational AI usage may be a particularly useful opportunity for Te Papa, as it allows for interaction with artifacts on a deeper level without their physical presence as well as opening a possibility of storytelling through conversation.

Another change to The British Museum's traditional collection through AI implementation lies in data sourcing. The British Museum's collection presents information compiled from 250 years of museum content, ensuring online visitors receive credible content (The British Museum, n.d.). On the other hand, the AI 'Living Museum' draws upon knowledge of large language models to provide information in a conversational manner (Talmi, 2024). This raises the question of the reliability of the information distributed through the conversation with AI. The sourcing of information presented in conversation is unknown in this application, highlighting important factors to consider in determining feasibility of implementation at Te Papa: reliability and data sourcing.

On the cutting edge of STEM education and engagement with children, is NoRILLA, a mixed-reality AI exhibit that Carnegie Mellon University's faculty developed for museums and other educational settings (Children's Museum of Atlanta, 2021). NoRILLA utilizes tangible items such as blocks and earthquake tables, a virtual AI helper, and AI feedback based on users' physical interactions (see Figure 2.2) (Lacovara, 2024). During primary testing, researchers

found that this mixed reality system improved scientific understanding, engineering implementation, and amount of time spent at the exhibit while maintaining enjoyment for kids (Yannier et. al., 2022). NoRILLA demonstrates the versatility of using AI in conjunction with traditional learning methods such as tangible blocks. When implementing new digital tools, it is important to note that NoRILLA’s implementation shows that mixed reality systems lead to 5 times more learning than interactions solely with a screen, as explained by NoRILLA founder, Dr. Nesra Yannier (Children’s Museum of Atlanta, 2021).



*Figure 2.2: Children/parents interacting with the mixed-reality platform. (Yannier et. al., 2022)*

Te Papa may be able to implement a similar system to engage school groups and young visitors in a more educational experience than traditional museum methods. Particularly, NoRILLA’s usage of AI to follow the motion of the objects and users as they explore, could allow Te Papa to implement a system adaptable to each user and applicable to a wide array of audiences and exhibits. Furthermore, Te Papa can implement unique platforms following NoRILLA’s principles for improved learning. Specifically, as per NoRILLA’s success, exploring the teaching methods of “contrasting cases, self-explanation, predict-observe-explain, and real-time interactive feedback” could allow Te Papa to elevate its educational impact in its own unique way (Yannier et.al., 2022).

## 2.7 Summary

Innovation in artificial intelligence gives Te Papa the opportunity to expand the museum's storytelling abilities and enhance meaningful engagement. A core benefit of AI is its interactivity component, enabling industries to integrate personalization into existing operations by having this technology learn from its interaction with the user. It is important to address concerns from visitors and data owners with regard to the responsible use of information and AI to ensure representation and respect of these groups. Furthermore, using AI to achieve human-like conversational and mixed-reality interactivity could potentially enhance user connection and learning experience compared to traditional information display methods.



# Chapter 3: Methodology

The goal of this project is to advise Te Papa on the feasibility of AI in storytelling at the museum. In hopes of achieving this goal, we have identified the following objectives:

- 1) Explore the technical/cultural limitations and standards of AI.
- 2) Gauge Te Papa visitors' perceptions of AI and interactivity.
- 3) Assess methods of engagement in prospective platforms for AI implementation.

This chapter explores the proposed methods to fulfill these objectives. We will discuss the color-coded methods seen in Figure 3.1, as well as how these methods can help make effective recommendations for an AI implementation at Te Papa.

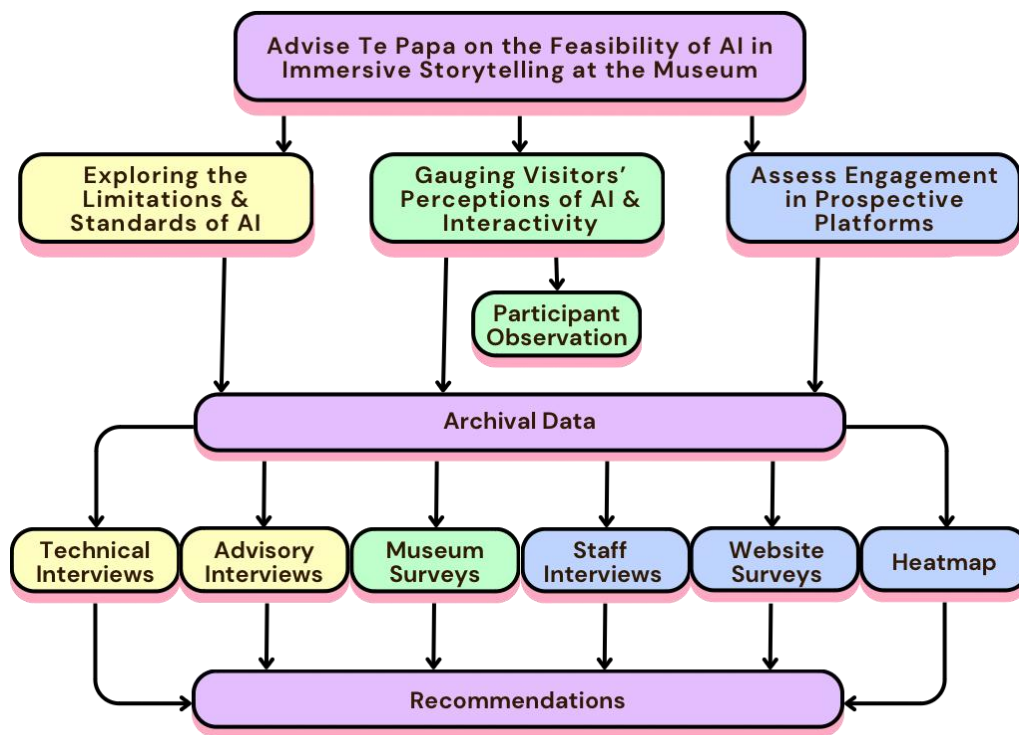


Figure 3.1: Flowchart depicting project goal, objectives, associated methods, and outcome.

### 3.1 Objective 1: Explore the limitations and standards of AI

The first objective is to explore the limitations and best practice standards of AI. To meet this objective, we will explore any archival data pertaining to prior implementations of AI at TePapa to provide a strong foundation. The extent of data archives and interviews with internal staff will be framed on-site. We will conduct snowball interviews with cultural groups, AI experts and/or technical staff at Te Papa. Interviews are designed to give insight on limitations regarding use of data, as well as on the technical limitations and museum standards for AI.

The first focus for this objective is data sovereignty topics concerning the Māori and Pasifika people of Aotearoa New Zealand, so it is important to understand their perspectives for our recommendations to maintain cultural respect. The plan is to conduct semi-structured and in-depth interviews with a few members of the Ngā Manu Atarau Directorate at Te Papa (Museum of New Zealand - Te Papa Tongarewa, n.d.). Members of this group represent Māori or Pasifika viewpoints, or would be able to speak from personal experience. We will provide information about our project and offer consent forms to clarify privacy concerns. The questions will focus on data sovereignty and representation, specifically about its relevance within the broader Māori and Pasifika communities. We will also ask questions that will inform the cultural boundaries for our recommendations or potential implementation(s). The interview guide can be found in Appendix B.

Regarding academic/industry experts and technical staff, we will reach out to Professor Jesse Pirini at Victoria University of Wellington for contacts to provide information about privacy concerns, bias, and recent discussions of AI. Additionally, the team of technical staff members from the museum will be able to guide us throughout our project. Conducting scheduled snowball interviews with these experts and external resources will gauge ethical boundaries and current standards that will impact Te Papa's direction. Snowball interviews are favorable as they allow us to contact experts who could contribute to our technical understanding of the project within a limited timeframe. We foresee ourselves conducting about 2-3 of these expert interviews. Our tentative interview questions are listed in Appendix B, and we will

improve them after our initial discussion with the Ngā Manu Atarau Directorate (Museum of New Zealand - Te Papa Tongarewa, n.d.).

To conduct these interviews properly, we must be able to communicate our interview questions clearly and respectfully (Harerimana et al., 2024). Emphasizing open communication, adopting a listening-heavy approach, asking refined questions, and establishing a sequence that will create a natural flow of responses is key (Harerimana et al., 2024). Two team members will conduct the interviews in a public or quiet museum space with an hour allotted for each interview. Our interviews will take place during the first three weeks of our project. This will ensure that these interviews go smoothly and are meaningful through a semi-structured approach.

## 3.2 Objective 2:

### Gauge visitor perceptions of AI and interactivity at Te Papa

The second objective will gauge visitor perceptions of AI and interactivity at Te Papa. We will address this objective by conducting participant observation, examining archival data, and surveying visitors on their perspectives.

The rationale of our participant observation study is to collect information that can only be observed by an active participant of the Te Papa-visitor experience (Price et. al, 2017). During our first week at the museum, we will engage with the visitor experience to understand how Te Papa currently uses AI in interaction with visitors, how the museum leverages storytelling, the visitors' takeaways, and their level of immersion. First, we will ask our partners at Te Papa to suggest specific exhibits to experience such that we observe the ones most relevant to the direction of our project, likely those pertaining to storytelling. While conducting our initial participation experience, we will record our own insights on aspects of Te Papa and AI that might inform later research and surveys (see Appendix A & D). Each team member will interact with the exhibits as a visitor would, particularly focusing on aspects of storytelling and any possible AI implementations. Depending on how many exhibits we wish to explore, we will either individually observe each exhibit or split into groups. We will take field notes about the experience in a journal. The format of these notes can be found in Appendix C.

From a meeting with our partner at TePapa, we learned that the museum has previously implemented AI and surveyed their visitors to better understand visitor expectations, engagement, and perceptions. Additionally, Te Papa’s Audience and Insight Directorate, along with the Collections and Research Directorate, collect auxiliary information on visitor opinions and outcomes of AI-implementations. We will interpret this data after completing our participant observation to ensure we do not bias our viewpoint. These surveys and auxiliary information serve as archival data for our study. The archival research study consists of determining data-analysis methods to identify trends in engagement and perceptions over the first 2 weeks of the project. It will also inform the design of targeted surveys for our study. Te Papa may use a specific survey structure or may have gaps in data concerning perceptions of AI used for storytelling. Our visitor surveys aim to fill in these gaps.

To gauge visitor perceptions, the surveys will be semi-structured and consist of both closed and open-ended questions (see Appendix D) The semi-structured approach provides a standardized list of questions but allows for some digression to gain deeper explorative data without a full-interview (Bullard, 2016). Closed questions make use of Likert scales to visualize and assess broad attitudes (e.g. from “Strongly Disagree” to “Strongly Agree”) towards AI, Te Papa’s interactivity, and Te Papa’s user engagement. Best practices involve including text anchors and incorporating numerical representation of responses (South et. al, 2002). Our scales for the attitudes are standardized to other common Likert scales (Brown, 2010). Surveys are available on both paper and through QR code. The first section on the survey is an informed consent form QR codes may be posted at the exit of every exhibit of interest (e.g. any digital and/or AI exhibits). For paper surveys, we will determine three exhibits of interest to study, per the suggestions of our partners at Te Papa. We will assign a team member to the exhibit’s exit with the 4th member stationed at the museum’s exit. We will collect samples on a voluntary, random basis by asking and handing every 10th visitor a survey, collecting them via a collection box. Moreover, other visitors are also free to fill out the survey whether they scan the QR code or request a paper survey. This surveying will end on [TBD] and a note of such a deadline will be included in online surveys. Additionally, team members may act as moderators to verbally guide a visitor through the survey and document their answers if they request help. We intend to analyze data from our surveys to assess visitor perception. On closed questions, we will use

quantitative data-analysis methods and on open-ended questions, we will use qualitative data-analysis methods. For quantitative data, we will use parametric tests to evaluate the average and median response along with visualization tools like graphs and charts. For qualitative data, we will group together and code similar responses for common themes and threads.

### 3.3 Objective 3:

#### Assess methods of engagement in prospective platforms

The third project objective will assess methods of engagement in various educational platforms at Te Papa. These platforms include both physical exhibits as well as Te Papa's websites, which includes the main museum website, the online collection database, as well as the guided tour website. Time permitting, we will use archival data to determine the exhibits with effective methods of engagement, based on visitor feedback and engagement analysis. In addition to archival data, we will conduct interviews with Te Papa's teams that manage these platforms. These interviews will differ from those in Objective 1 as we are going to provide visitor and expert feedback collected from Objectives 1 and 2 to the teams in charge of educational platforms. By doing this, we hope to make these development teams aware of potential concerns with the implementation of AI into their respective platforms. During these interviews, we hope to understand development principles for these platforms and what factors we must take into account for our implementation recommendations. Engagement is important to ensure the visitor is gaining a meaningful experience from the museum.

Holding two-person 1-hour interviews with the department heads at Te Papa will allow us to understand how platform management teams view the use of AI and how they could implement it into their respective educational platforms. We are aware of both physical platforms, such as exhibits, and virtual platforms, such as Te Papa's website, through communication with the project sponsor. To better understand physical platforms, we will interview the Head of Experience Design and Content, which is the creative team in charge of developing exhibitions. For digital platforms, we will interview the Head of Digital Channels, Adrian Kingston, and the team in charge of developing digital systems for Te Papa. Additionally, continuous communication with our sponsor, the Head of Audience Insights, Dr. Samuele De Stefani, will provide us with insight into how his team determines trends in engagement and the

decision-making process involved (Museum of New Zealand - Te Papa Tongarewa, n.d). We will contact each person individually to establish a location and time. During these interviews, we will ask questions relating to the creative and technical processes that the teams use to develop meaningful content on these platforms and how this development leads to storytelling opportunities. We will also ask questions relating to the team's experiences and opinions of AI so far. This will guide us in assessing how our recommendations should align with engagement methods and meet the capabilities of the teams in the museum. Finally, we will ask questions regarding expert and visitor feedback we received during Objectives 1 and 2 to understand how the museum can address these perspectives. An interview guide can be found in Appendix E.

In addition to our interview with the Head of Experience Design and Content, we hope to have time to conduct a heatmap in order to understand which exhibits at Te Papa are most popular and engaging with visitors. The heatmap may record "ant trail" data, dwell time data, or other patterns relevant to our study. Heat maps are particularly useful for visualizing spatial and behavioral data and thus, are used to assess the interactivity of different exhibits or even portions of exhibits within Te Papa (see Appendix F). The availability of technology and resources at the museum will determine our capability in performing a heat map. If Te Papa has the ability to track visitor movement, we can use this technology to monitor the holding power, which is the average time spent at that exhibit, as well as the attraction power, or number of people who stopped at the exhibit (Lanir et al., 2017). With these metrics, we can determine the relative density of specific exhibits and overlay that information over a map of Te Papa to visualize which exhibits, or even portions of exhibits, are popular. If we do not have visitor tracking technology available or time to conduct this study, we may have to rely on archival data of previously conducted heat maps as well as visitor surveys. This data will allow us to identify interactivity "hotspots," revealing commonalities between the most engaging exhibits and providing insight for us in recommending an engaging AI implemented exhibit.

To best assess engagement on virtual platforms, we will also conduct web intercept surveys. The primary virtual platform relevant to this project is Te Papa's website. Web intercept surveys are valuable for their ability to quickly and easily collect information from the preferred audience in real time via their interaction with the website. Specifically, we will utilize collapsible pop-up surveys for their ability to appear on screen upon a certain visitor's action and

allow visitors to reopen the survey (Khan, n.d.). In this way, we will customize the surveys to appear when interacting with pages on Te Papa’s website platforms, allowing us to collect the opinions of only website visitors capable of providing insight on their engagement experience within the investigated page. We will determine which online pages to investigate from our interviews with Adrian Kingston, as described above. However, an example survey can be viewed in Appendix G. These web intercept surveys will inform us on the effectiveness, interactivity, and learning experience of the online exhibits, highlighting focus areas to improve or maintain in our recommendation for AI implementation on the website.

### 3.4 Project Timeline

We determined this timeline by mapping the methods in Objectives 1, 2 and 3 with archival data playing a primary role for each objective, as outlined above. It is important to note that the timeline was created as an initial plan subject to change throughout the research process.

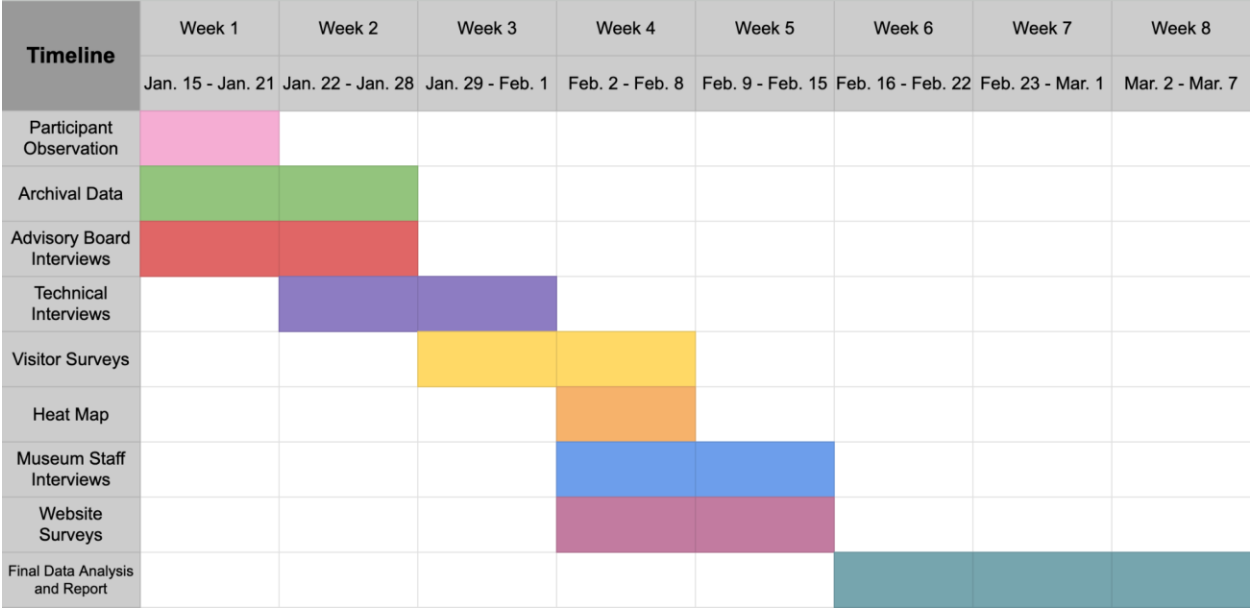


Figure 3.2: Gantt chart depicting our project timeline over eight weeks.

# Chapter 4: Conclusion

The feasibility assessment and recommendations of our project will support Te Papa’s current and future development in their mission to “meet the challenges of the future” through creation of meaningful visitor experiences (Museum of New Zealand - Te Papa Tongarewa, n.d.). This project can improve Te Papa’s ability to implement AI effectively and respectfully, an important and growing opportunity for educational outcomes. In addition, our proposed assessment supports the United Nations Sustainable Development Goal 9: Industry, Innovation and Infrastructure and Goal 4: Quality Education, as well as a global push to better understand the parameters of AI as a tool that serves development.

There are many considerations that will determine the value of implementing AI. Data sourcing and visitor perception will guide the standards of AI so as to be successful and respectful to all communities. Interviewing experts, technical advisors, and platform developers, as well as conducting surveys, and assessing engagement will generate a strong foundation for recommendations for TePapa. We look forward to our collaboration with Dr. Samuele DeStefani and the Museum of New Zealand Te Papa Tongarewa. We will further discuss our proposal, address any questions/suggestions, and begin work upon our arrival in January.



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# Appendices

## Appendix A: Consent

Here is a sample consent agreement that will be given to participants before any survey of interviews.

### A-1 Consent Form

#### **Informed Consent Agreement for Participation in a Research Study**

##### **Investigators and Contact Information**

Hello, we are a group of students from Worcester Polytechnic Institute in the United States conducting a project in collaboration with Te Papa Tongarewa. By completing this survey, you are consenting to participate in our research and helping us learn about your experience to inform Te Papa on the feasibility of AI in storytelling at the museum. You are free to respond to any level you feel comfortable disclosing.

- Investigator: Bailey Allmon | [beallmon@wpi.edu](mailto:beallmon@wpi.edu)
- Investigator: Klaudio Fusha | [kfusha@wpi.edu](mailto:kfusha@wpi.edu)
- Investigator: Ethan Shanbaum | [esshanbaum@wpi.edu](mailto:esshanbaum@wpi.edu)
- Investigator: Aditri Thakur | [athakur1@wpi.edu](mailto:athakur1@wpi.edu)

##### **Purpose**

The purpose of this study is to understand visitor perception of Artificial Intelligence (AI) and interactivity at Te Papa.

##### **Procedures**

This survey will ask you to reflect on your experience at Te Papa and your perceptions of AI.

##### **Record Keeping and Confidentiality**

Your responses will be anonymous. Although we may have a general sense of who completed the survey, we will not tie the data back to specific participants. We will share this information anonymously with our advisors for evaluation purposes. We will not look at any personal information (like email addresses or names) if it were to be collected.

This survey is entirely voluntary, and your consent is given freely. Any publication or presentation of the data will not identify you.

### **Additional Information**

If you have questions or would like more information about this research, please contact the investigators using the email addresses listed above. Once the project is completed, you can request to view the final results by emailing us.

### **Voluntary Participation**

Your participation in this research is voluntary. By completing this survey, you acknowledge that you have been informed about the study and consent to participate. As a matter of respect for your right to change your mind, you will have the opportunity to withdraw consent after completing the survey.

## Appendix B: Advisory and Technical Interviews

This appendix contains sample interview questions that we will ask the advisory group on Māori/Pasifika data concerns, as well as technical experts on AI.

### B-1 Advisory Group on Māori/Pasifika Data Sovereignty and General Concerns

1. How long have you been working at Te Papa?
2. What is your job title and area of expertise?
3. To what extent is your involvement with Māori and/or Pasifika communities?
  - a. If they are Māori: What iwi do you belong to?
4. How has Te Papa dealt with Māori/Pasifika data sovereignty issues in the past?
5. What are some of the current concerns the Māori and/or Pasifika communities have with AI implementations using their data?
  - a. Are there any particular issues that are unique to each community?
6. Do you know of any AI used by Māori and/or Pasifika communities? What do these look like and how were they implemented?
7. What is your perception on AI implementations with regards to language translation, conversational tools, virtual artifacts or people?
8. Do you have any advice for how we can involve the Māori and/or Pasifika communities in the process of coming up with potential AI implementations?

### B-2 Industry Experts and/or Museum Technical Staff

1. How long have you been in this industry?

- a. For Museum Technical Staff Member: How long have you been working at Te Papa?
2. What is your job title area of expertise in AI?
3. What are some of the main privacy and bias concerns regarding AI that you have encountered?
4. What are some of the directions AI has taken, either in projects you are personally involved in or those taking place at Te Papa?
  - a. Which have been successful or unsuccessful? How so? Why do you think that was the result?
5. Have you encountered any backlash or negative responses to AI implementations or other technological advancements? What were the reasons you perceive for these reactions?
6. What would it take to minimize bias and misinformation from an AI system? Is it possible to completely eliminate these things?

# Appendix C

This appendix contains a sample of our note-collecting format for our participant observation study in Objective 2. We will follow this standard for each exhibit we observe.

## C-1 Exhibit Note Sheet

Note Taker:

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Date: \_\_ / \_\_ / \_\_

Exhibit Name: \_\_\_\_\_

Location in Museum: \_\_\_\_\_

Exhibit Topic:

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What story does the exhibit tell?

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List any interactive components you identified at the exhibit:

- \_\_\_\_\_
- \_\_\_\_\_

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Does the exhibit use AI?                      Y/N

Does the exhibit use any data sets?      Y/N

If so, what data is used? \_\_\_\_\_

How immersed were you in the exhibit?

[ ]

[ ]

[ ]

Not Immersed

Somewhat Immersed

Very Immersed

How was the information presented? (select all that apply)

[ ] Text

[ ] Video

[ ] Images

[ ] Diagram/chart

[ ] Physical model

[ ] Museum staff

[ ] Website

Other Notes:

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## Appendix D: Visitor Surveys

This appendix contains sample questions for visitor surveys.

D-1 Paper Survey, handed to visitors after they exit an exhibit or the museum.

### A. Visitor Interaction with Te Papa Exhibits

How would you rate your overall experience with Te Papa's interactive exhibits?

(1 = Poor) (2 = Fair) (3 = Average) (4 = Good) (5 = Excellent)

What method of instructions were most useful for interactive exhibits? Please select all that apply.

(Audio) (Text) (Video)

Were the instructions for using interactive exhibits clear and easy to follow?

(Yes) (No) (Somewhat)

How effectively did the interactive exhibits enhance your understanding of the exhibit's content?

(1 = Not at All) (2 = Little) (3 = Somewhat) (4 = Much) (5 = A Great Deal)

Did you feel the interactive exhibits made your visit more engaging in comparison to traditional exhibits?

(Yes) (No) (Somewhat)

Which exhibit did you enjoy the most? Why?

(Exhibit A) (Exhibit B) (Exhibit C) (Exhibit D) (Exhibit E) (Exhibit F) (Other)

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What improvements would you suggest for Te Papa’s interactive exhibits to enhance your experience?

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**B. Visitor Perception of AI**

How familiar are you with Artificial Intelligence (AI)?

(1 = Not) (2 = Slightly) (3 = Somewhat) (4 = Familiar) (5 = Very)

What are your overall feelings about AI?

(Positive) (Neutral) (Negative)

How interested are you in experiencing storytelling exhibits enhanced by AI in museums?

(1 = Not) (2 = Slightly) (3 = Somewhat) (4 = Interested) (5 = Very)

How do you think AI could improve storytelling or narrative experiences within Te Papa?

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Do you have any concerns about using AI in museums? Please select all that apply.

(Data Sourcing) (Data Sovereignty) (Security) (Inaccuracy) (Malicious Use) (Other)

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Do you have any additional comments or suggestions?

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## Appendix E: Department Interviews

Interview Guide for museum staff responsible for engagement, and exhibit development on various platforms.

### E-1 - Museum Department Heads

1. How long have you been working at Te Papa?
2. What is the focus of your department?
3. How is your department structured?
4. What kind of technology/tools does your team use for development?
  - a. Do any of these technologies/tools use AI?
5. What is the general process for developing the platforms associated with your department?
6. What kind of data is your department typically working with?
  - a. Is this data owned by the museum or is it publically available?
7. How do the platforms you develop contribute to the storytelling at the museum?
  - a. What stories have your projects told?
8. What makes your platforms engaging and immersive?
  - a. Do you believe AI could be used to enhance this engagement or immersion?
9. Has your team ever used AI as a main component in any of your projects?
  - a. How was AI used for this project?
  - b. Were large data sets also used for this project?
10. During an interview with [technical/cultural expert], we discussed [topic] and they had mentioned [opinion/feedback/concern]. Do you agree with this?
  - a. How could the museum address this concern/feedback?
11. Some feedback we received from visitors about AI is [feedback from surveys]. Do you agree with this?
  - a. How could the museum address this feedback?

## Appendix F: Heat Map

Sample heat map of a museum. A similar heat map will be used to visualize visitor interaction.

### F-1 Heat Map



*Figure 3.3: Aggregate example view showing heatmap of attraction power at the museum. (Lanir et al., 2017)*

## Appendix G

We will ask questions in a collapsible pop-up web intercept survey to be utilized on Te Papa’s website. It is important to note that this survey is formatted electronically and likely displays one question at a time. Additionally, any question or portion of a question can be skipped by the respondent. These questions aim to measure engagement, learning outcomes, and the potential of AI or visitors’ interest in it. They may be modified to the specific interaction that triggers their pop-up.

### G-1 Sample Web Survey Questions

What exhibit page did you visit?

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Did you learn something new from this exhibit today?

(No) (Somewhat) (Yes)

Did you find this exhibit engaging? Why or why not?

(No) (Somewhat) (Yes)

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How interested are you in experiencing exhibits enhanced by AI online?

(1 = Not) (2 = Slightly) (3 = Somewhat) (4 = Interested) (5 = Very)

Would you prefer an interactive game on this webpage?

(No) (Somewhat) (Yes)

Did you have trouble navigating the exhibit?

(No) (Somewhat) (Yes)

Would a translation tool improve your experience with this online exhibit?

(No) (Somewhat) (Yes)

Do you think this exhibit was easy to understand? Why or why not?

(No) (Somewhat) (Yes)

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Please leave any additional comments or suggestions below:

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