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Visitor Expectations at Te Papa: Investigating the Space Where Museum and Visitor Expectations Meet

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VISITOR EXPECTATIONS AT TE PAPA

Investigating the Space Where Museum and Visitor Expectations Meet

Museum of New Zealand Te Papa Tongarewa

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ABSTRACT

The National Museum of New Zealand Te Papa Tongarewa sponsored this project in order to better understand how visitors respond to its Interactive Audience Engagement Devices (IAEDs). To achieve this, we selected three exhibits to study, and through interviews, surveys, observations, and video recordings, evaluated the devices' impact on visitor experience. Upon examination we recommend the museum add on screen instructions to their devices, look into making devices more accessible to their users, and make future devices incorporate aspects such as challenging their users, giving them a personal connection with the content, and providing multiple simultaneous interactions.

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EXECUTIVE SUMMARY

In the National Museum of New Zealand Te Papa Tongarewa, interactive devices are used as the primary method for delivering information in some exhibitions, and as a supplemental source of information in others. Te Papa was interested in seeing how these on-floor devices engaged and affected the users' experience. The goal of this project was, therefore, to assist the museum in gaining information about the users' interaction with the on-floor devices in the current exhibitions. Our research offers the museum useful information that will allow them to improve its design of interactive devices in the future.

In order to select three devices for our study, we toured the museum, looking at each interactive and took detailed notes. We then compiled these notes into a list of pros and cons for each. This list was then brought our team of sponsors and discussed the best options. After we had three devices to study, we looked to find out why they were chosen to convey the subject matter of the exhibition. To do this, we met with each respective curator. We conducted in-person interviews, focusing on the design process of exhibitions and the original intent of the interactive devices.

We then began our main stage of data collection. We sought to evaluate the visitor experience in order to assess the devices' impact. This objective was broken down into six sub-objectives that allowed us to understand many aspects of the interaction between the visitors and the devices in the museum. Each of the sub-objectives helped us to create specific survey questions that would be given to the visitors at the end of their interaction with the devices. Along with these post-visit surveys, we observed visitors in-person and via camera recordings. The in-person observations were meant to give us a view of the visitors while they were interacting with the device in order to note any interesting or surprising information that could be useful in our findings.

We chose to focus on the touch tables in *The Mixing Room* exhibition, the *Quake Safe Game* in the *Awesome Forces* exhibition, and the *Ngā Mōrehu: The Survivors* game in the *Slice of Heaven* exhibition. These devices were chosen because they represented variety of interactives that ranged in age, interface type, and content. We then conducted two interviews with key staff members of the museum, who had played an important role in the design and development of *The Mixing Room* and the *Slice of Heaven* exhibitions. From this, we learned about the complex design process of exhibitions. The project involves many departments and outside companies. We also learned that what the curators intend the visitors to take away from their experience is not always what they actually do. *The Mixing Room's* three touch tables are broken up into three themes: challenge, connection, and freedom, but visitors tend to not notice this and only visit one.

We broke up our third objective into six sub-objectives:

The first sub objective was to identify visitor background and expectations. For this, we sought to understand the visitors' background and the expectations of technology they brought with them. This sub-objective was explored using the survey and in-person observations. From this, some of our important findings were that the average visitor is proficient with technology and expects to be able to choose the information they look at. The average value for visitors' proficiency with technology across all exhibitions was 7.8 on a 1 to 9 scale. Additionally, the mode was 9, suggesting strongly that the majority of visitors were very proficient with technology. We found that visitors prefer to choose their own information because 60% of visitors preferred to get their news from the Internet, which allows users to curate their own information.

Our second sub-objective was to determine how the visual aspects of the exhibition are related to visitor-device interaction. This sub-objective looked at how the visitors were attracted to the device, whether that be because the device caught their eye or a friend called them over. This sub-objective also dealt with how many people in the exhibition chose to use the device. This sub-objective was completed using data from our in-person observations and the video recordings. We found that all of the interactive devices had surprisingly low use percentages. In a two-hour period, we recorded 296 people who walked through the *Quake Safe Game* with 18% interacting with the device, 279 who walked through *The Mixing Room* with 40% using the device, and 71% who walked through *The Survivors* game with 13% using the device.

The third sub-objective was to explore the connection between the devices' current ease of use and visitor suggested improvements. For this, our survey asked the visitors to rate the ease of use of the device and to provide feedback on what could make it easier to use. We also observed the visitors' interaction with the device to not whether they were using it correctly and their reactions while using it. This developed a couple of noteworthy findings. First, *The Survivors* game was the easiest to use with an average rating of 8.3 on a 1 to 9 scale with 9 being the easiest. *The Mixing Room* was in second place, with a rating of 7.3. The *Quake Safe Game* came in last with a rating of 6.4. We found that *The Mixing Room* and the *Quake Safe Game* had mixed reviews because of their interfaces were not what people expected; the *Quake Safe Game* had an old touch-screen interface and *The Mixing Room* used a technology that people were not used to. The most common response from visitors on how improve ease of use was to include better instructions on how to use the device.

The next sub-objective was to examine the engagement of the visitor with the device. This sub-objective dealt with the amount of time the visitor interacted with the device, how exploratory their

actions were, and their commitment to the interaction. We determined the amount of time the visitors used the device from our video recordings. We observed the visitors interacting with the device and classified each of them using the Exploratory Behavior Scale (EBS). This scale classifies each visitor as passive if they have limited interaction with the device, active if they use the device as it was intended, and exploratory if the user went above and beyond by applying repetition or variation to their actions. The commitment of the visitor was measured by proxy of whether the user was sitting or standing while using the device. We had one major finding about engagement. When we classified each of the users on the EBS, we noticed that *The Mixing Room* had the most passive users. We believe this to be because people could easily view the content without interacting with device themselves. The *Quake Safe Game* had the most active users because the clock prevented people from performing exploratory action. *The Survivors* had the highest amount of exploratory users because people developed a connection with their avatars, causing them to fully explore all the chances they could make in the game.

Measure visitor enjoyment of the device was our fifth sub-objective. The visitors' enjoyment was measured using the survey and our observations. On the survey we had a question asking what they found interesting about their interaction with the device. From our observations we noted the users' emotions and reactions while using the device. This showed us each of the devices had an attractive feature to it. *The Mixing Room*'s water effect proved to be fun for visitors to play with. With the *Quake Safe Game,* people enjoyed the challenging aspect of the time limit. *The Survivors* developed a personal connection with the user, allowing them to enjoy their experience more.

The final sub-objective was to understand key outcomes from visitor-device interaction. The key outcome that we looked at was the amount of knowledge the visitor took away from their interaction. This was done using survey questions about their knowledge before and after their interaction. We also asked about their preferred learning styles to see how the devices could best deliver their information. Our data on key outcomes produced many useful findings. The first was that all three of the devices taught their users about their content successfully. We also found, through our survey, that the most preferred learning style of the users was hands-on, while the second was visuals such as picture and video. Visitors also replied that reading was their least preferred learning style.

Some other highlights of the data included *The Survivors* game being rated the easiest device to use, having the highest number of exploratory users, and showing the highest percentage of positive emotions from its visitors. *The Mixing Room* had the most followers and had a higher percentage of people who sat during their interaction. The *Quake Safe Game* had the most active users and the highest amount of overall traffic.

From our findings we developed the following recommendations:

On-screen instructions: Confusion and misusing interfaces were a huge discovery from our data collection process. Visitors walking up to a device could not intuitively understand how to use the devices appropriately. Instructions must be a concern that is looked at during the initial planning stages of the device because they may not be able to be added later. Instructions should be placed on devices to explain what the objective of the game is and to explain how the device itself works. Not every device will need this explanation, especially when the device follows technology that most users are familiar with, such as a modern day touch screen. However, when looking at devices that are less common, such as *The Mixing Room* technology, it is always better to assume the users will be confused without any guidance and to take the measure to clear up any confusion that could occur.

Making devices more accessible: We saw at the *Quake Safe Game* that people were not able to interact with the device because it was being used by another visitor a majority of the time. In order to counteract this, there can be multiple screens or having games promoting groups working collaboratively. If neither of these suggestions were feasible for a future device, then it would be advisable to look carefully at the possible locations for the interactive. We believe that placing a device based on its type of interaction will help improve the visitor-interaction rate. Another way of looking at the problem of the accessibility of a device would be to supplement it in a way that allows users to play the game on other devices. If the museum looked into finding a way to standardize the software so that these games could run on mobile devices as well as the in-museum interactives, then people would be able to have access to museum content in more ways than ever before. Finally, having a restart button on devices that involve a long interaction such as the *Quake Safe Game* or *The Survivors* game would allow for people to experience all of the device's content from its beginning, the way it was intended.

Device maintenance must be a priority: Interactive devices cost a significant amount of money to implement. Therefore, they should be reliable for the visitors. Unfortunately, when a device is malfunctioning, however small, it can cause the visitors to become frustrated and leave. It is important to note that the museum has a system in place for dealing with malfunctioning technology. The museum's hosts either observe it or are alerted to the incident by visitors. It is unavoidable when dealing with interactives that problems will occur, but as long as they are handled in a timely manner, most of the visitors will not have to experience the bugs or glitches that can occur.

Meeting visitors' expectations of interactive technologies: Technology evolves at a very rapid pace in today's world. Along with these evolving technologies come guidelines for how devices are intended to be used. People expect devices to work a certain way, and when they do not, it makes things more

confusing and frustrating. If a museum is going to use a unique technology that most people are not accustomed to, then it needs to be clear to the visitors how the device will behave otherwise the interaction with the device will suffer. We recommend that when looking at future devices, the museum take time to look at the standards of devices.

Implementing interactive devices is a good strategy for meeting visitors' learning style expectations: We found that 60% of visitors who were surveyed preferred to get their news from the Internet. What we can extrapolate from this is that people have changed how they want to receive their information. Traditional ways of getting news, such as the newspaper only allowed readers to have access to the stories the newspaper chose to report on. This is much different than the Internet, where the almost unlimited content allows people to select their own stories to read about which puts them in control of the material. Interactive devices can provide this tailored experience just as the Internet does for all four types of learning styles we looked at. In addition, interactives allow for learning styles like reading and looking at images to be more flexible by allowing curators to swap in new material or modify current material digitally based on feedback for the exhibit. This shows that, regardless of the learning style, interactive devices are a good strategy for giving users the best experience with the material and letting them feel in control and empowered while they learn.

Most effective interactive device types: Each of the devices we looked at were effective interactive audience engagement devices. The *Quake Safe Game* can be commended for challenging its users in order to better engage them in the material. Interactive devices in the future should challenge their users, as it is a great way to get people involved and engaged with the material on the device by pushing them to be more active and interested. *The Mixing Room* was able to handle many different visitors at the same time. Through our observations we saw that many visitors traveled in groups, which meant that having a device that allowed everyone to interact at the same time is a huge accomplishment. Future devices should keep this in mind because there are many ways of solving the issue of multiple interactions. Finally, *The Survivors* game was able to use a person's connection to the material presented to make for a meaningful engagement. Personal connection makes the user care about what is happening on the screen, making reading text and looking at images a necessity for users rather than a chore. Giving people the power over the avatar's outcomes creates this connection because the only reason certain events or situations occur is because of the user's decisions. Future devices should look to achieve this personal connection with their users by making them question what they are reading and what decisions they are making, in order to keep them fully engaged.

AUTHORSHIP

Anthony Gallo was the primary author on the executive summary and conclusions. Despoina Giapoudzi contributed majorly to the introduction and findings and analysis sections. Thomas Grimshaw directed the formation of the executive summary and findings and analysis sections. Matthew Sabetta took the lead on the introduction, conclusion, and the appendices sections. The literature review and methodology sections were contributed to by all team members over the course of the fourteen weeks. Numerous revisions were done to all of the sections by the entire team.

Contents

Chapter 1. INTRODUCTION

The common mission for museums is "to collect, preserve, study, and interpret the cultural and natural heritage of man for the public" (King, 1980, p.1). The approaches to accomplishing such a mission have drastically evolved over time. The presentation of information has shifted from traditional static exhibitions to more visitor centric ones, containing new technologies and supplementary interactive devices. The use of printed text in front of a physical object has become antiquated. Museum curators, today, are making efforts to appeal to a variety of visitors by having exhibitions actively engage and interact with them. One of these efforts is the introduction of interactive devices, such as touch screen displays, that engage the visitors by providing supplemental information about the objects in the exhibition.

In designing an exhibition for a museum, a team of curators are responsible for creating an experience that establishes a meaningful connection with the visitor. As interactive devices become more popular, curators strive to have a better understanding of the impact they have on the visitors' experiences in order to make informed decisions about improving these devices (Rozan, 2013).

In The National Museum of New Zealand Te Papa Tongarewa, interactive devices are used as the primary method for delivering information in some exhibitions, and as a supplemental source of information in others. Te Papa is interested in seeing how these on-floor devices engage and affect the users' experience. In order to develop informed criteria for new interactive devices, Te Papa has asked us to analyze the visitors' expectations of the device, how they interact with it, and any unexpected outcomes of interacting with the device.

The goal of this project, therefore, was to assist the museum in gaining information about the users' interaction with the on-floor devices in the current exhibitions. To do this, we interviewed curators at the museum to better understand how current interactive devices were intended to achieve the exhibition objectives, observed visitors as they used interactive devices, and conducted surveys with visitors to assess their views of the device, and to identify improvements for interactive exhibitions to better reach the visitors. Our research, we hope, offered the museum useful information that will allow them to improve its design of interactive devices in the future.

Chapter 2. LITERATURE REVIEW

This chapter explores some of the key research and findings from previous studies that are relevant to interactive audience engagement devices and their role in a museum setting. The first section is about the changing role of museums and the evolution of their efforts to attract visitors. The next section discusses the expectations that visitors have when at a museum. The third section looks at the concepts of visitor interaction and engagement in the museum setting. The section after that introduces the concept of interactive devices and discusses recent technologies that can be implemented in a museum environment. The final section explains the background of Te Papa and the selected exhibits for this project.

2.1 The Changing Face of Museums

The purpose of a traditional museum has been presenting curated information about a select area such as art, history, or science. Museums used to be quiet, reserved places where exhibits were static objects that visitors studied and read information about from plaques. Think of a traditional art museum with paintings and plaques with information next to them. However, today many museums are quite different than they once were. As museums face the problem of keeping visitors engaged and excited, they are changing their exhibits to have more digital and engaging interaction with the visitor (Linge, 2006). Modern museums feature exhibits that the visitor interacts with, digital displays to give more knowledge about an area the visitor selects, and digitized collections that can be accessed from around the world and searched for specific information. Museums are trying to further engage the visitor and become a better source of learning rather than just a cultural refuge. There is a large marketing push by museums to attract visitors because, as information becomes more and more available on the Internet, the museum needs to develop new ways to engage the visitor that the Internet cannot match (Marty, 2006).

2.2 Visitor Expectations

The changing mission of the museums is driven, in part, by the change in what visitors expect from repositories of knowledge. In the age of the Internet, people are used to being able to search for specific information and getting as much or as little on a topic as they want. The traditional museum structure does not suit this desire because the information is preselected by the curator and the visitor can only dive as deep as the information on the plaques (Linge, 2006). This is driving museums to create exhibits that display only summary information to those with a casual interest in the topic, and more

detailed information to the keener visitor who wants more. Many visitors today are expecting personalized museum visits that allow for greater engagement with the exhibitions (Stock, 2007).

Along with the expectation of personalization, visitors have other, more general, expectations when they walk through the doors of a museum. These expectations set the criteria a good museum will strive to meet. One study found that people generally have five expectations for their visit: easiness and fun, cultural entertainment, personal identification, historical reminiscence, and escapism (Sheng, 2012). Each one of these may be more or less expected based on the type of museum. For example, a science museum may put less emphasis on historical reminiscence than a history museum would, or an art museum may choose to focus more on cultural entertainment than easiness and fun (Sheng, 2012). Another study found that expectations include metrics such as simplicity, duration, entertainment, collaboration, and education. These criteria encompass what a user will expect out of modern day devices when visiting a museum (Goncalves, 2012). The museum also benefits by knowing the demographics of its visitors because the expectations will vary based on age, gender, race, and other factors (Sheng, 2012). By understanding the type of museum desired and the demographics of its visitors, a museum can develop a good understanding of its visitor's expectations. Having a good sense of these expectations allows a museum to tailor its exhibitions to be more appealing and engaging.

The visitor's expectation can also be driven by the setting in which they are visiting the museum. If someone is visiting as an individual and is curious about an exhibition, they will have different expectations than a class would when visiting the museum on a school field trip. These different types of groups need to be considered when looking at audience engagement because each formation brings a specific dynamic that can have an influence over the group's overall engagement. For instance, a typical family dynamic often promotes an overall sense of learning. This is because the older generations of the family can share their knowledge of the exhibits with the younger generations. Consequently the younger members are encouraged to ask more questions and thus tend to learn more from their museum experience (Cone, 1978). Another example of group dynamics having an effect on the group's overall engagement is when students visit with a group of classmates. The students can then discuss and share their thoughts on the museum with their friends and be able to relate the material back to something they might have learned in class prior to going to the museum (Charitonos, 2012).

2.3 Visitor Interaction and Engagement

Often the terms interaction and engagement, are misunderstood and taken to mean the same thing. However, the words have two very distinct definitions. Audience engagement in a museum describes the connection the museum's visitor has with the exhibits; it is the action of capturing the

visitors' attention. Interaction is when an exhibit requires the visitor to actively participate in extracting information from it, essentially producing a minor or major change in the exhibit with his or her response (Bitgood, 1991). Audience engagement does not depend on interaction with the exhibit, however when interaction occurs the user is engaging with the device. Visitors first need to be attracted to an exhibit, and then engaged by it, before they decide to interact with it.

Audience engagement is an area in which more and more museums recognize the need for expansion and development, as well as the need to provide both educational and leisure opportunities for their audience. Hanna Cho, the Curator of Engagement and Dialogue at The Museum of Vancouver, states, "Audience engagement is a key component of a generational shift that is already underway and exemplified in every aspect of how workplaces, education, and other cultural sector agents are evolving. I think I see engagement becoming part of museum DNA" (Rozan, 2013, p.4). Allison Angsten, the Curator of Public Engagement at The Hammer Museum, shares a similar view with Cho, specifying that a focus on audience engagement would be achieved through research in psychological, economic and social factors, as well as the cooperation of various departments at the museum, such as education and marketing (Rozan, 2013).

In order to ensure the visitors' satisfaction, a museum has to better the quality of the visitor-exhibit interaction. Researchers have noted that there are certain features that can generate more effective interactive exhibits. A museum has to simultaneously develop well-thought objectives, further its knowledge of visitor-exhibit interaction, combine engineering with creative thinking, and become aware of the nature of its audience (Bitgood, 1991). According to Ciolfi, the use of physical objects is crucial in bridging the gap between the visitor and the digital experience. For example, a museum depicting a historic house setting can showcase everyday objects (e.g. quills, combs, books) that when touched to a phone unlock recorded audio messages of the people that (could have) used them. This union of physical and digital interaction brings the visitor closer to the exhibition, and the story behind it (Ciolfi, 2012). Implementing the use of familiar technologies, such as smart phones, allows the interactivity to be more familiar and welcoming to those who have such prior experience. The visitor then enjoys the exhibit more, as there is almost no learning curve, and thus extracting information happens at a smoother pace (Hakvoort, 2013).

Museums can also invite visitors to record their comments or the memories provoked by the exhibit. These recordings can then be shared with future visitors, allowing for personal connections among visitors from different timeframes. Even if the visitors' thoughts are simply recorded but not shared, it will still encourage them to be more engaged with the exhibit and more thoughtful about its

connections to them (Ciolfi, 2012). A visitor can also develop a connection to the exhibit, when it ignites personal memories (Armstrong, 2012). A historical exhibit may remind visitors of their childhood or stories their grandparents told them. When visitors develop a personal connection to an exhibit, they understand its purpose better (Armstrong, 2012). For example, when kids are interacting with an item from their parents' past, and their parents assist them in understanding it fully, they can share stories about how they used the exhibit in their everyday lives.

When museums strive for interactivity, they should be cautious of the way an exhibit approaches and engages the visitor. Complicated interactive exhibits that require overthinking from the users can tire the audience. Also, exaggerating the use of an exhibit can hinder the museum's desire to simultaneously teach and entertain its visitors; such excessive use can achieve maximum entertainment, but its educational features may not reach their full potential. For example, a child interacting with an amusing train exhibit might simply be playing with it, but not be able to grasp the actual information offered (Warren *et al.*, 2010).

As museums try to adapt to the broad range of their audience, they are starting to incorporate interactive exhibits that welcome physically impaired people. Specially designed exhibitions and tours give handicapped people the ability to picture the artifacts and their historical context. These innovations include touch tours, and touch and try-on exhibits, giving the handicapped the unique opportunity to touch or even try on specific artifacts. There is no limitation as to how far interactivity for physically impaired people can go; more and more art galleries are introducing AEB's (Art Education for the Blind) tactile representations to their audience. These are three-dimensional depictions of paintings, placed next to their originals, addressed to the visually impaired visitors. By touching the three-dimensional version, visitors can recreate an image of the painting in their mind (UNESCO, 1981. Hoskins, 2014).

2.4 Interactive Audience Engagement Devices

An interactive device is normally defined as a computer program that, in response to the user's actions or requests, presents choices to the user that will allow them to control or change the outcome of the program. People in today's society use interactive devices all the time. Some examples of these devices would be ATM machines, cell phones, tablets, etc. A more specific type of interactive device is one that relates directly to the technology used in present day museums. These devices, which are called interactive audience engagement devices, are computerized devices that are physically present in an exhibition, and require physical action by a human to activate. Audience engagement, in this context, is when the interactive device is able to hold the users' attention in a pleasing or appealing way. All

interactive devices have two main components, the computer program software and the physical device. The computer program is what handles the user's input to then update the display to show different pictures, change text, and much more. The physical device defines how the user will be giving input to the device, whether that be through a touch screen, motion tracking cameras, or other creative human computer interactions.

Making an exhibit more interactive for visitors helps to engage them and provide a better overall museum experience (Ciolfi, 2012). This is why there has been a vast amount of research done on the different types of engagement devices and how they can be used in a museum setting. An ideal interactive device will supplement the existing museum experience and provide extra engagement, but it should not structure or define the entirety of a visitor's experience (Ciolfi, 2012). Interactive audience engagement devices are able to accomplish this because, although they are not the entirety of the visitor experience, they do provide the ability to let the audience learn and remember more about the exhibitions they visit. Learning through interactive devices is achieved because the users have a more significant role in the exhibit (Ciolfi, 2012). The devices themselves help exhibitions convey more information to the users by being an extension of the actual exhibit. The user is able to control the device in order to select the information they want to know more about. Researchers have tested this claim of learning through interaction, such as when students visiting a museum were given an interactive quiz on the art they saw. The students who took the interactive quiz remembered more facts about the art compared to the students that only took a paper quiz (Mikalef, 2012).

To improve interactive devices, there must first be a solid understanding of problems associated with interactive devices. One such problem is the inability for these devices to adapt to different visitors. Although the audiences visiting a museum are very dynamic and have different interests, some disadvantages of older interactive devices is that they do not allow for changes in output based on a specific viewer (Schieck, 2012). To improve on this, user movement tracking allows the interactive devices to see how the visitor moves through the museum and how long they stay at each exhibit. This helps the software to generate better dynamic content that the user will then interact with on the devices (Schieck, 2012). This type of technology not only serves to improve interactive devices, but also allows for data to be collected and analyzed on how visitors move through a museum and what exhibits grab their attention the most. For example if users spend most of their time at a dinosaur exhibition and then move to the mammal exhibition, the interactive devices could generate information on the difference between the two to give users a better transition into the new exhibition.

When a visitor enters the room with an interactive audience engagement device, one of the most critical moments for the device's success is when the visitor becomes a user of the device (Lehn, 2007). A user is anyone interacting with the device in any way. The visitor may become a user unknowingly when they enter the field of a motion tracker. They may watch others use the device first or read the instructions before using it themselves. However, once the visitor becomes a user, that point is critical because it shapes the overall experience (Lehn, 2007).

After the device gains a user, serious challenges in keeping that user interested and engaged arise. If the device has too high a learning curve, it will exclude a large portion of visitors who do not have the patience to learn a complex interface. Another challenge with getting the user to first interact with the device is the method of interaction. Visitors may be reluctant to wave their hands around or run back and forth for a motion tracking device for fear of looking silly (Hakvoort, 2013). One of the other major challenges faced by interactive technologies is aligning the digital interpretation accurately with the user's actions. This is especially a challenge for technologies like motion trackers or virtual reality devices as even a short delay can throw off a user's connection to the digital environment.

The research above touches upon different attributes that make up a good interactive device. These metrics can be formulated down to visibility, feedback, structure, simplicity, learning, and entertainment. Through these metrics researchers have been able to break down the broad spectrum of interactive devices and make meaningful evaluations about how well they perform and affect the users' experience (Goncalves, 2012).

In recent years there have been numerous advances in interactive devices and their ability to connect users to varying content. Because museum technology is so broad, these new technologies are able to work their way into museums to be incorporated in exhibitions. These devices allow for new human-computer interactions inside the museum. One of these rising technologies is motion-detecting cameras. These cameras incorporate users' gestures as a way to interact with the software running on an interactive device. Researchers have found that motion tracking is an engaging medium for users because it allows the visitors to play a greater role in the interaction and the control over the device (Schieck, 2012). The advantage of this technology is that, because it has become widely used in other industries like video games, the technology is both cost effective and has a vast amount of support and developer tools, making it easy to integrate to a museum setting (Schieck, 2012).

Devices are useless unless there is high quality software running on them. Software is the bridge between the user and the device by allowing the users to create event-driven input to affect the program and produce the interaction through the device. Through software, users can extend their

interaction past the devices in front of exhibits, and into phones, tablets, and computers inside or outside the museum. An immersive software technology that has become prevalent in the past few years is virtual and augmented reality. This software allows for devices to produce content for an exhibit that allows for interaction that would never have been possible with the actual exhibit. An example of this is allowing three-dimensional models of old artifacts to be created and presented on devices. That way, an exhibit might host these artifacts, but also allow for the users to engage in an interaction with the exhibit by making them available in the virtual world. This improves both the in-museum experience by providing more information, and the online experience for those visiting the museum's online collection (Wojciechowski, 2004). Another example of the power of software is the ability to make it available to the audience on an interactive device they already own, such as a tablet or smartphone. By allowing software to be available for visitors on their devices, all exhibits in the museum can benefit from the extra interactions as long as the software has been maintained to work with the current exhibits present in the museum (Yiannoutsou, 2009). This software can range from mini-games based off exhibits to quizzes and surveys that the visitors can fill out while in the museum. Researchers can then use that data for analyzing the engagement of the user and exhibits (Charitonos, 2012).

Another important interactive device for a modern day museum visitor is social media. Museums are starting to use this tool to connect patrons and their experiences. Jerry Watkins, the director of the News and Media Research Center at the University of Canberra calls social media, "the heart of new learning" (Russo, 2009, p.13). These tools can create a sense of cooperation and personal expression, two aspects that can enhance learning. For example, the company ArtMob has created a smartphone app of the same name that allows users to upload self-recorded podcasts after their museum experience (Russo, 2009). The future users can then choose to listen to that podcast or record their own. Another example of this is a web page for visitors to share photos and comments on their visit. One of the first museums to implement this was the Brooklyn Museum, that's site became so successful that visitors began to use it to debate with each other on historical aspects of the museum. The museum also used this to its advantage by getting feedback on its exhibitions without making visitors go out of their way to fill out a survey (Russo, 2009).

2.5 Te Papa Background and Selected Exhibits

During the 1980's, due to the evolution of museums discussed earlier, the founders of Te Papa were looking to make a modern and visitor-centered national museum to replace the old one. "Museums have had to become more interactive and 'visitor centric' in order to survive. Where the value of a national archive ceases to be self-evident and where public institutions are forced to become

more cost effective, museums can no longer afford to regard themselves merely as repositories of heritage" (Niell, 2004,p.184).

Since its opening, the museum has had high numbers of visitation. From 2001 to 2009, the average visitation was 1.3 million per year, and the number continues to grow. In 2011, there were 1.5 million visitors (Davidson & Sibley, 2011). In fact, due to the museum, Wellington has become more of a tourist destination. Since the museum's opening, the city has seen increased tourism (Carey, 2013), which tends to peak when there is a special, limited time exhibition in the museum (Davidson & Sibley, 2011). For example, from 2007 to 2009, there was a large *Lord of the Ring*s exhibition that led to visitation well above the yearly average. Data collected by the Visitor Profile Interview, gives the museum insight into the demographics of its audience. Families and well-educated young adults make up the majority of Te Papa's visitation.

Te Papa has a clear vision of its mission and its plan for the future. The museum releases signed annual reports, as well as Statements of Intent in three-year timeframes. These documents are to be followed to the last detail, and state the nature, mission, and goals of the museum. Te Papa's vision can be encompassed in the motto: *E huri ngākau ana. E huri whakaaro ana. E huri oranga ana | Changing Hearts, Changing Minds, Changing Lives*. The museum desires to be a forum for change in the country; it desires to assist people in experiencing the world, sharing their ideas and perspectives, and then taking action in a logical and well-thought way. Part of its plan for the future includes improving on its current interactive exhibits. Te Papa has over 20 interactive exhibits throughout the institution, ranging from devices about war refugees to alien species in New Zealand.

Out of all the interactive exhibits in the museum, we consulted with Te Papa staff to select three devices to focus on for our study. These devices were *Ngā Mōrehu: the Survivors* game in the *Slice of Heaven* exhibition, the touch tables in *The Mixing Room* exhibition, and the *Quake Safe Game* in the *Awesome Forces* exhibition.

Slice of Heaven is one of the museum's long-term exhibitions that contains a collection of

Figure 1 Fight Like a Shark! Segment

objects, events, stories and people from the 20th century New Zealand. This exhibition includes the *Fight Like a Shark!* Segment (Figure 1), dedicated to the struggles of the Maori people during the 20th century. Inside the *Fight Like a Shark!* Segment there is the game *Ngā Mōrehu: The Survivors (*Figure 3*). The Survivors* is an interactive game that allows users to put themselves in the role of a 20th

century Maori citizen. The user first picks to either be a Maori boy or girl (Figure 2), and is then asked a

series of situational roleplaying questions that affect the outcome of the person's life by touching different options. The child eventually grows into an adult as the game progresses. Each option and outcome offers additional information via text on the time period. In this way, the user will learn as they are captivated by the game. In a study by Morris Hargreaves Mcintyre, it was found that

Figure 2 The Survivors touch screen

only about 19% of visitors to the *Fight Like a Shark!* Segment actually interacted with *The Survivors*. While the number who used the device was small, those who did were from all ages and found the

Figure 3 The Survivors Game

device very rewarding (MHM, 2011). In a separate, internal study, *The Survivors* was found to be a highlight of the entire *Slice of Heaven* exhibition. It is an interactive device that "delivered more reward for the effort that was put in." This is because with each choice the user makes, they are instantly rewarded with feedback and information. It also adds an emotional outcome, allowing visitors to make

connections to their own life while directing their Maori avatar (Te Papa, 2011). These aspects make the interactive device an appropriate choice to focus on for the study.

Another interactive exhibit in the museum is the *Quake Safe Game* in the *Awesome Forces* exhibition (Figure 4). *Awesome Forces* showcases the powerful forces on earth like volcanoes and earthquakes. The section of *Awesome Forces* that the game is in was sponsored by New Zealand's Earthquake Commission to educate people about the dangers of earthquakes and other natural disasters (Figure 5). The Earthquake Commission collects insurance taxes in order to establish a fund for natural disaster recovery, and sponsor this section to better educate people about the natural

disasters and preparation for them. The game is designed to teach people about how to secure objects in and around their homes to reduce damage during an earthquake. The game has three separate stages, the kitchen, the living room, and the outside of the house. Each stage contains different objects that need to be

Figure 4 The Quake Safe Game

Figure 5 EQC Segment

secured. For example, the fishbowl should be secured with the non-slip mat, and the foundation should be secured with the cross braces. The touch screen allows people to drag the different securing items onto the objects in each of the three stages. The users have to race against the clock to secure all the items before the earthquake hits. The users then get feedback on which ones they successfully secured and what should have been used on those they didn't. The device is tied into the rest of the section of the exhibition by surrounding wall panels talking about the different securing methods as well as an example of some secured objects (Figure 6).

Figure 6 The Quake Safe Game instructions

The final exhibition we decided to look at is *The Mixing Room: Stories from Young Refugees* in New Zealand (Figure 7). This exhibition shares the experiences of refugees through art, film, poetry, performance, and digital media. The main purpose of this exhibition was to portray ethnic and cultural diversity of the people of New Zealand, and the contributions they have made in New Zealand's society. *The Mixing Room* focuses mainly on contemporary stories of resettlement and, because it was a collaborative project, the Te Papa staff worked closely with the adolescents in New Zealand refugee communities to define what the refugees wanted to present in this exhibition. The exhibition area is made up of a hallway that's walls are covered by photographs showing the journeys of the refugees along with evocative quotes supplementing the images. Walking through the exhibition, visitors can see a timeline of different dates when refugees arrived in New Zealand on the floor. At the end of the hallway is a large screen that showcases different faces of refugees made from a collage of pictures and passports supplied by the refugees.

Figure 7 The Mixing Room entrance

The main exhibits for *The Mixing Room* are the interactive circular tables located in the middle of the exhibition (Figure 8). These tables are interactive audience engagement devices that use overhead projectors to

project the screen onto the tables. The projectors are accompanied by two Infrared sensors which detect motion over the tables so that visitors can hover their hand over buttons on the screen and the program will know they want to click that specific button.

Figure 8 The Mixing Room

The tables contain videos that were created by the refugees working with Te Papa to showcase their experience of coming to New Zealand (Figure 9). Along with videos, images and letters are also displayed showing the refugee's experiences. The tables are divided into four sections allowing for visitors to independently interact with the table at the same time. In the middle of the table are rotating bubbles with pictures of the refugees on them. When a visitor hovers their hand over one, the image changes to either a camera icon, a video icon, or a letter icon to give the user feedback on what type of material will be shown. Holding your hand over the bubble will select that material and display it in the section of the table where the hand had come from.

According to Hornecker's study conducted on the interactions between museum visitors and a

Figure 9 The Mixing Room table

multi-touch table, a set of hand gestures and general reactions was observed during the visitor-device interaction (Hornecker, 2008). The most frequent of these is using multi-fingered gestures and touching the screen without hesitation; this occurs because most visitors are not familiar with this specific touch table technology and are not aware of the fact that a simple placement of the hand or the finger directly above the targeted icon is sufficient to achieve interaction. Based on Hornecker's study, the visitors' behavior sometimes leads to undesired results in their interacting experience; one such behavior is when visitors accidentally choose a different icon from the one they were targeting. This can happen because the infrared sensors detect motion above the surface of the table, thus being less accurate than the more common resistive touchscreen surfaces, at times. Such situations can lead to confusion among users.

Chapter 3. METHODOLOGY

The goal of our project was to understand how visitors at Te Papa use the interactive audience engagement devices, and to assess if and in what ways these devices add value to the visitors' museum experience. By doing so, we were able to compare the visitors' perspectives on these devices to those of the museum curators. We then evaluated the visitor-device interactions and provided Te Papa with suggestions on the future development and implementation of interactive audience engagement devices. In order to achieve this goal, we developed the following research objectives:

1. Identify appropriate exhibitions for study
2. Understand the museum's intent when designing the devices
3. Evaluate the visitor experience in order to assess the devices' impact
   a. Identify visitor background and expectations
   b. Determine how the visual aspects of the exhibition are related to visitor-device interaction
   c. Explore the connection between the devices' current ease of use and visitor suggested improvements
   d. Examine the engagement of the visitor with the device
   e. Measure visitor enjoyment of the device
   f. Understand key outcomes from visitor-device interaction

3.1 OBJECTIVE 1: Identify appropriate exhibitions for study

We have become familiar with Te Papa's current exhibitions and specifically the interactive audience engagement devices as described in section five of the background chapter. The team visited all of the exhibitions in the museum in order to get a sense of the experience both with and without an interactive device. We also compared our interactions with the different devices we used. When we visited each exhibition, we took notes on our general impressions, feelings, and questions about the devices. We looked at whether each device could be a potential candidate for our research based on the device's location, whether it was a permanent exhibit or not, and whether the interaction seems interesting or unique compared to others in the museum. Newer exhibits were also weighed more heavily because the technology used in them is more recent.

As well as noting our general impressions, we evaluated the devices based on set criteria. These criteria were ease of use, entertainment provided, and the ability of the device to convey its information (Goncalves, 2012). After we visited the exhibitions, we used our experience, input from key staff at Te

Papa, and the information we gathered in the literature review to choose the three exhibitions in which to evaluate and observe visitor expectations and interactions.

3.2 OBJECTIVE 2: Understand the museums' intent when designing the devices

To understand why the museum has turned to interactive devices and what benefits it expects from the technology, we interviewed some of the curators from the museum who worked on the exhibitions we selected. While we would have preferred to interview the original creators of each device, some of the exhibitions were old enough that the original curators were no longer working with Te Papa. This was the case with the *Awesome Forces* exhibition and the *Fight Like a Shark!* Segment in the *Slice of Heaven* exhibition. In order to gain the insight we needed about *The Survivors* game we spoke to the lead curator for the whole exhibition who had partial knowledge on the development of the device, and who had worked with the devices since its creation. For *Awesome Forces*, we had to review design-stage papers for the exhibition to gain the insight we needed.

The interviews we conducted were semi-structured in nature to encourage the curator to discuss the questions in depth and to enable us to probe key issues. We covered three broad topics with our questions: general information about the curator's background at the museum, the reason the devices were added to the exhibitions, and their thoughts on the devices' impact. The interviews allowed us to gain insight into the broader context the interactive devices play a role in. They also illuminated how exhibitions are planned, the museum's expectations of these devices, and the reasons for their inclusion in the exhibition. The interview questions we asked the curators are located in Appendix C.

3.3 OBJECTIVE 3: Evaluate the visitor experience in order to assess the devices' impact

To evaluate the visitor's experience, we measured their interaction with the devices by looking at six sub-objectives from metrics identified in our literature review. These sub-objectives are to:

1. Identify visitor background and expectations
2. Determine how the visual aspects of the exhibition are related to visitor-device interaction
3. Explore the connection between the devices' current ease of use and visitor suggested improvements
4. Examine the engagement of the visitor with the device
5. Measure visitor enjoyment of the device
6. Understand key outcomes from visitor-device interaction

We explored these six sub-objectives using three methods. These methods were:

1. Visitor observations
2. Camera recordings
3. Post-visit surveys

For observations, our strategy was to have team members move through the exhibitions to directly observe how people use the devices. For this, it was important to master the art of inconspicuous observation. This was because we did not want to disturb the visitors and change the experience for them (Cone, 1978). Additionally, we had to always be perceived as visitors and not as representatives of the museum; to do this, our employee badges for the museum remained out of sight while we were in the exhibitions.

In order to familiarize ourselves with the observation process, we conducted preliminary observations before our main observation phase. These preliminary observations served to give all the group members a mutual understanding of the observation process. This meant that no matter who was observing, we would get similar results. The preliminary observations also gave us time to identify the best locations for the cameras to be mounted in the exhibitions.

We decided the best way to complete team observations at each exhibit was to have two teammates as designated observers that would rotate back and forth between observing and writing up detailed notes on their last observation. This way, each observer would be out of the exhibition long enough so that visitors would not suspect them of being observers. While the observers were in the exhibition observing a visitor, they took extensive notes on the visitor's interaction with the device. Examples of factors that were recorded are facial expressions, clicking frequency, the group they were with, and time of use. After the notes were taken on the interaction, the observer entered the information in a premade Google Form that can be seen in Appendix D. The Google Form automatically took this data and put it into a spreadsheet to easily view the data as a whole. It is important to note that the form did not contain the entire collection of data from our observations, but rather a way to quantify it. After we completed each observation, we added our thoughts and impressions of the observation.

The video recordings allowed us to observe the visitors interacting with the devices over a long period of time, revealing group size and the percentage of people that interacted with the device. The camera setup allowed us to do these more numeric measurements in a precise way, leaving our observation time for extracting more qualitative information out of the interaction. When we set up our video recordings we positioned the camera where it could see the interactive device as well as the

surrounding area. This gave us information on both the visitors' interaction with the device, and any group dynamics that arose around the devices. One of the conditions of entry to the museum is that visitors may be photographed and filmed for research purposes. As part of museum protocol, we notified Te Papa security and host staff of our observations so they were aware of our actions. We also posted signs outside of the exhibitions that said we were observing, so that visitors were aware that we were conducting research there.

We gathered information on the relationships between the visitor's motivations for visiting Te Papa, their background, and their experience with the devices through a survey. The survey was administered at the exit of the exhibition, so that we could survey visitors who had already experienced the exhibits. We targeted those who we had just observed using the devices, in order to gain as cohesive a picture of the users' interactions as possible. Each survey consisted of questions that helped us to extract the information we needed to achieve the objectives mentioned above. As a group, we were sensitive to the fact that some visitors were not comfortable with being surveyed or did not have the time to spare. No visitor was pressured into being surveyed if they did not want to be, and those who did were given the option to not answer any question they were uncomfortable with. See Appendix E for our example survey.

These three methods were necessary because we wanted to know both what the users did while interacting with the device, as well as what they thought about their experience. The post-visit survey was given to visitors to provide feedback on their experiences with the different interactive devices we were testing. The reason that we utilized three different visitor experience measurements was because we wanted comprehensive information. It also allowed us to triangulate our findings, with one method backing up the findings of another to gain rich, multifaceted data. Our observations of their interactions did not provide deep insight into their thought process, and our surveys alone would not have given a true picture of their interaction with the device, as any account given from memory would be biased. We used the two visual techniques, observations and camera recordings, because while the video provides objective recordings of the visitor's actions, it was from a stationary viewpoint. Team observations were mobile and allowed us to see the visitors' reactions in the room, as well as other factors that were not captured in a recording, such as interactions between visitors outside of the camera view.

We were aiming to collect 50 survey responses and observations for each exhibition: *Awesome Forces*, *The Mixing Room*, and *Slice of Heaven*. This number was selected because Te Papa has found this number to deliver statistically relevant results. We conducted the observations, video recordings, and

surveying over an eight-day period. Going into the eight-day period, we knew that these numbers were ambitious. Due to time constraints and malfunctions with *The Survivors* game, we only ended up collecting 20 surveys and 20 observations for this interactive. We managed to collect 41 surveys and 43 observations for *The Quake Safe Game*, and 40 surveys and 53 observations for *The Mixing Room*.

The analysis conducted on each sub-objective was then used to determine differences between the museum's intended impact of the interactive devices, and the actual impact it had on visitors. The data and analysis we collected was compiled into a comprehensive evaluation of the interactive devices and the museum's expectations for them. We then discussed the analysis of our data with museum officials in order to get their input on the future development of interactive devices in the museum. This input helped us develop our list of recommendations for future device development. We used the information we gathered to present a report of our findings to the museum officials.

3.2.1 Identify visitor background and expectations

One of the first things we wanted to measure was the visitors' background and their expectations when entering the museum. We were not only interested in seeking information about the visitors' thought process while using the devices, but also about their mindset when they first entered the museum. We needed to collect background information on the visitors. This was important because a person's background affects his or her expectations of the devices and the museum in general (Sheng, 2012). Along with their background, every person who entered Te Papa, or any museum, had a distinct reason for doing so (Sheng, 2012). This can range from seeking specific subject material to simply visiting out of boredom.

The visitors' background was recorded through both the survey and observations. When they took the survey, visitors were asked questions like their age, ethnicity, and whether they came in a group. This allowed us to see if any of their background correlated to their experience with the device. We also collected background information during the observation, recording rough age range and whether they were in a group.

In our observations, we looked at how the visitors initially tried to interact with the device. The visitors came with expectations of how the device would be operated, and that is how they first tried to interact with the device. If the technology was different than they had expected, then it could lead to usage issues and frustration. The survey further extracted the visitors' expectations regarding the museum and technology. This was done by asking questions about their reason for visiting, their preferred news source, and their familiarity with technology. We believed that avid smartphone users would expect the interactive devices to be as user-friendly and gratifying as their personal device. Such

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visitors would also be comfortable with using the graphical interfaces and would be more likely to quickly understand the use of a touchscreen interactive device. The opposite of this were users unfamiliar with such technology. Older generations who, perhaps, did not own this type of technology, may have had a harder time with this. We intended to learn about expectations of both users who were comfortable and uncomfortable with this technology and to formulate how we could make interactive devices user-friendly to both. We also asked whether this was the first time they were visiting Te Papa. We wanted to know this because if they had had previous encounters with the exhibitions and interactive devices then their expectations may have been altered.

The first step for analyzing our observations of the visitors' expectations was to take our detailed notes from the observations and code them to extract themes of their initial interaction. This allowed us to compare multiple and different observations to see if there were any overarching themes to people's initial interaction, such as instant understanding of the device, or confusion when first interacting. To analyze the data we had collected from the survey, we took a look at the trends that emerged from our questions on the visitor's background and expectations. We looked at information like the average proficiency with technology and the preferred source of news. This gave us a good understanding of the mindset of the average visitor when entering the museum. We were then able to compare these trends to how we observed people behaving with the devices through the codes. We looked at how age correlated to people's familiarity with technology and whether that corresponded with what we observed from their interactions. We analyzed these and other relationships in our data using the chi-squared test. We chose the chi-squared test because our data is primarily categorical and not normally distributed, preventing us from using other common statistical tests like the t-test. We calculated the independence level by using Excel's chitest function. We accepted any relationship that had an independence value of less than or equal to .05. The statistical analysis served to support the observational analysis that we made.

3.2.2 Determine how the visual aspects of the exhibition are related to visitor-device interaction

In a museum context, the visibility of an interactive audience engagement device is essential to its success because if the device does not attract visitors, then it is not efficiently distributing its information. Its position needs to encourage visitors to approach it and should use titles and labels that are appealing and facilitate the interaction (Goncalves, 2012). Exceptionally rated devices will need to provide a prompt interactive capability where the users will have no hesitation with using the device. Researchers say a device cannot be cluttered with distracting objects or unnecessary elements,

otherwise visitors will not be able to use the device effectively and it will detract from the visual appeal of the device (Goncalves, 2012).

The visibility of the devices was measured through the observations and video recordings. During our observations we recorded whether the visitor was an "instigator" or a "follower." Instigator, in this case, was someone who started the initial interaction with the device, while follower was someone who only interacted with the device because someone in their group started working with the device before them. It would be assumed that the number of instigators would be higher than followers in all devices because in order to be a follower a visitor would need to be part of a group. However, the higher a follower rate for a device, the better it would be able to appeal to certain types of visitors that might not be as exploratory as other visitors. A higher follower rate can also show that a device has a stronger ability to providing multiple users with an engaging experience. For example for a person to be categorized as a "follower" they would need to interact with the device after someone from their group had instigated the first interactions with the device. To do this, the original instigator had to either leave the device so that the next group member can could it, allow the next group user to cooperate in the interaction with the instigator, or provide multiple parts of the device allowing for more than one person to interact with it. One example was *The Mixing Room* tables, where four people could work independently on a single table. In addition, we used the video recordings to count the number of people who entered the exhibition and actually stopped at the interactive device.

To analyze the observations regarding the visibility of the device, we looked at the percentage of instigators versus followers. From the video observations we got percentages of people who used the device out of the total number of people. By looking at these percentages, the visibility of the interactive device became more quantifiable whether it was location, use of signs, attracting sounds or other methods that caught the user's attention. We also looked at the amount of time the *Quake Safe Game* spent open for use over a 30 minute period. This analysis gave us a different perspective on how often it was used because many of the people who did not use the device were unable to do so because the device was occupied. We were unable to do this measurement for *The Mixing Room* because the tables had many seats and never filled up entirely. For *The Survivors* game this analysis of the video was unnecessary as there was never a large enough crowd to prevent many people from using the device.

3.2.3 Explore the connection between the devices' current ease of use and visitor suggested improvements

Simplicity refers to the measure of ease of use of an interactive device. There are many factors that can contribute to simplicity such as lack of tips or guides for using the device, unexpected behaviors

by the visitors, and possible malfunctions that can occur (Goncalves, 2012). In our project, if a user went up to a device and was not provided with enough knowledge about how to begin the interaction, then they would become confused and frustrated rendering the device ineffective. In this scenario, the device would score poorly on simplicity.

The simplicity of the device was measured through our observations and the survey. In the survey we asked how easy the visitors found the device to use and whether they had any suggestions to make it easier. This allowed us to get the users' thoughts on the device's interface and ease of use. We also measured simplicity through our observations by looking at the users' reactions to the device. We were not interested in labeling exact or hidden emotions, rather ones that were more obvious. Examples of such emotions were frustration, confusion, excitement, and indifference. These were extracted from facial expressions, verbal comments, and other actions the user took. For instance, we labeled someone who "mis-clicked" the device many times and then walked away as "frustrated." We did not seek to extract the fine grain emotions from our observations because the surveys were used to understand the users' feelings when using the device.

To analyze the observations of device simplicity, we coded our observations of the user with themes related to the simplicity of the device. These themes gave us an idea of what a common interaction with the device entailed in terms of simplicity. One frequent example of this was the code "confused." If our observations showed any sign of the visitor being confused such as "mis-clicking" they would be given this code. The opposite of this is the code "competent with the technology" expressing that the visitor had no trouble understanding how to use the interface. These codes were counted against each other to see if the device was easy or complex to use on average. The open response questions regarding what could make the device easier to use were similarly coded and allowed us to see what improvements most people thought were necessary to make the device better. Lastly, another question on the survey asked the visitor how easy the device was to use on a scale from one to nine. A bar graph of the data showed us what the majority of visitors thought about each device based on this question. This rating was also used in our statistical analysis to see if it had a relationship with any of the other questions.

3.2.4 Examine the engagement of the visitor with the device

Visitor engagement is a measure of how involved a user gets with the device. Through our literature review we identified four different aspects of engagement. The first was the length of time the visitors used the device. The second was the visitors' commitment to the interaction. The third was their

actions while they were using them. And the final measure was the visitors' expressions and emotions while using the device.

Each of these signs of engagement was turned into metrics to be assessed for each device. The first and simplest metric was engagement time. Engagement time was the measure of how long a user interacted with a device. The longer a user was working on the device, along with a strong simplicity score, the better the device was able to keep the user engaged and interested in the content presented to them. While this metric was simple, both our research and curator interviews identified use-time as a good metric for engagement. The second metric was whether the user was sitting or standing while using the device. This metric served as a proxy for commitment because if the users sat when interacting, it meant that they felt they would spend enough time at the device to justify sitting. While visitors may have sat for other reasons than engagement, they were less likely to interact with the device in those cases. The third metric was the user's actions. Looking at how the user interacted with the device provided insight into their engagement with it. From our research outlined in the literature review, we found the EBS, or Exploratory Behavior Scale, to be a good metric (Van Schijndel, 2010). This scale labeled every user as "passive," "active," or "exploratory." Passive visitors simply watched someone else interact with the device or interacted briefly before leaving. Active visitors interacted with the device, using it for its intended purpose. Exploratory users went beyond active users in their interaction. They applied repetition and variation to their actions. For example they played through the device multiple times or they pressed all the buttons to see what they did. The final metric for engagement was the visitors' reactions to the device. The users' emotions when using the device gave a good idea as to whether they were fully engaged with the material. For instance, if the visitor was distraught and emotional after reading about the struggles of refugees in *The Mixing Room* they were probably fully engaged with the materials. We could also tell if they were staring into space or had looks of indifference while interacting with the device. It was also visible how absorbed in the material they were by how distracted they seemed by outside people. If the user kept looking around at other things they were probably not that engaged with the device, but if they kept looking at the content throughout their interaction, it meant that the device was probably holding their attention well.

Metrics of Engagement	Definition	Methods to Measure Metric
Engagement Time	The amount of time the visitor used the device	Video recordings
Sitting versus. Standing	Whether the user was sitting or standing while using the device (served as a proxy for commitment)	Observations
Exploratory Behavior Scale	A classification of the users' actions as passive, active, or exploratory	Observations
Visitor Reactions	The emotions the visitor displayed while using the device	Observations

Table 1 Engagement metrics

In order to measure the first metric, engagement time, we used the video recordings of the devices to be able to accurately measure the length of time each user spent at the device. Our observations gave us a look at the other three metrics: the users' commitment, their actions, and their emotions (Table 1). When conducting visitor observations, we looked at the visitors' behavior when they were interacting with the device such as whether they were sitting or standing. This was only applicable for *The Mixing Room* and *The Survivors*, but it was important to see how much the user was willing to commit to the interaction. We also categorized every user of the device using the EBS. Factors that we took into account when looking at this were things like whether they finished the game, how many times they played, how many stories they viewed, and whether they used all the features of the device. Finally, we extracted engagement information from the reactions the visitors showed when interacting with the device. We were looking for simple emotions like happiness or frustration with their interaction. While we were only looking for simple emotions, we were unable to determine every user's emotions because not everyone expresses emotion the same way.

The analysis for engagement was conducted by first finding the average engagement time for each device using the video recordings. This gave us a sense of how long each device could keep users engaged. The sitting versus standing metric was simply analyzed by taking the percentage of those who sat versus those who stood. The EBS was analyzed by seeing what percentage of people fell into each of the three categories. We also looked at relationships between the engagement level of the visitor such as sitting versus standing and the length of time they spent at the device. We ran statistical tests testing

the independence of many of the observations we made in order to find any behavior that was indicative of other behaviors. We did this by running chi-squared tests on our data.

3.2.5 Measure visitor enjoyment of the device

Entertainment is a device's ability to promote a fun and interesting experience for the visitors. It is becoming a more important metric for museums today as they compete with other leisure activities like going to the movies or visiting an amusement park. Visitors want to see new and interesting things at a museum that are aesthetically pleasing and allow for an overall better experience. A highly entertaining device will increase the user's level of engagement and time of use. We therefore used the time spent on the device as a clue of the user's level of engagement (Goncalves, 2012).

We used the survey and observation methods to explore the visitors' level of entertainment. For the survey, we asked how the device was interesting or not interesting. Interesting, for our purposes, was a stand-in for enjoyment because people found it easy to specify what they thought was interesting with their interaction. If the user found the device to be interesting, they likely thought it was enjoyable. We also observed users' reactions to see if they seemed excited or bored with the device. This had the same limitations as did the rest of the emotion-based observations, in that not everyone expresses emotion the same, so we were not be able to get reads from everyone we observed.

To analyze the survey results of enjoyment, we took the responses and looked at how many people said they found it interesting versus not interesting. This showed us whether the device was enjoyable for the users. To code the observations, we looked for similar occurrences. More specifically, visitors laughing or seeming to be excited while interacting, were coded as "fun/enjoyment." We also used the code "emotional" for any description of someone being distraught or moved by the subject matter. These occurrences were counted and compared to other devices.

3.2.6 Understand key outcomes from visitor-device interaction

"Change is pervasive in contemporary museums as they are shifting slowly from places of education towards places for learning, responding to the needs and interests of visitors" (Goncalves, 2012, p.63). One of the intentions of the museum is that visitors take something away from the exhibition. We looked at the impact the devices had on the visitors' experience and what they were able to take away in the form of knowledge and outlook on the material. Learning in a museum has become more about free choice for a user, allowing them to make the decisions about what they will pay attention to and when/how they will do so. Interactive devices need to stimulate the visitor to promote critical thinking and questioning on the facts and ideas being shown by the devices. Along with measuring how much the visitors learned from the devices, we also wanted to record their preferred

learning style to see how it matched up with the devices' delivery methods. Additionally, we learned from our curator interviews that an important part of an exhibition in museums is to help visitors create their own views and opinions on the subject matter. This makes changing their outlook an important aspect.

Visitor learning was measured using the survey. First we had a question regarding the visitors' preferred learning style. The survey asked the visitor to give an answer on a one to nine scale on how much they liked learning in the certain style. We then asked them to choose which one they liked the best and worst. This told us the average visitor's preferred learning style. While this information was limited by the fact that it was self-reported learning styles, it still gave us a good measure of what the visitors thought they wanted from a device. Next, we asked about how much knowledge they had on the topic of the device before and after they used it. The visitors rated themselves as having none, slight, moderate, high, or expert knowledge on the material both before and after they interacted with the device. This showed us how much they took away from the device. Lastly, in order to look at change of outlook, we used the question on *The Mixing Room* survey, "How did the exhibition change your views on refugees in New Zealand?" This showed us whether the Mixing Room tables had the desired effect of changing the visitors' views on refugees.

To analyze the key outcomes of the visitors' interactions we visualized the information in line graphs and pie charts. The preferred learning styles were visualized in pie charts, showing us which was the most common and which was the least. For how much the visitors learned, we created bar graphs with both the before and the after responses. The graphs allowed us to see if there was an increase, decrease or no shift in knowledge.

3.4 Timeline

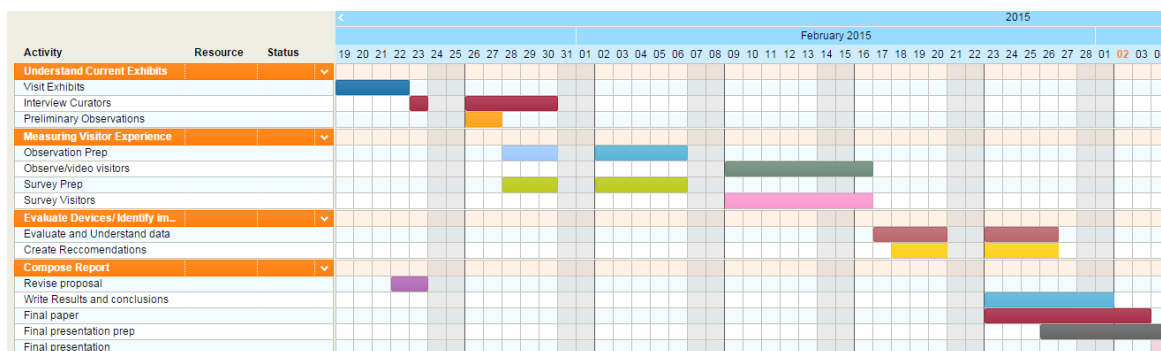This timeline shows the breakup of our methods over the eight weeks (Figure 10).

Figure 10 Timeline

Chapter 4. FINDINGS AND ANALYSIS

Our findings were separated by our objectives. For "Identify appropriate exhibitions for study," we took the pros and cons of all devices in the museum and chose three exhibits: *Quake Safe*, *The Mixing Room*, and *The Survivors*. For "Understand the museum's intent when designing the devices," we interviewed curators and audience engagement staff and learned valuable information on the stages of the creation process of an exhibition. We then began data collection for "Evaluate the visitor experience in order to assess the devices' impact" which took place over a week in the museum. For *The Survivors* we collected 20 surveys and 20 observations. We collected 41 surveys and 43 observations for *The Quake Safe Game*, and 40 surveys and 53 observations for *The Mixing Room*. *The Survivors* had considerably less data samples due to the device malfunctioning. We connected this data to hours of video footage to gain insight on visitor interactions and expectations for the device.

4.1 OBJECTIVE 1: Identify appropriate exhibitions for study

We selected *The Mixing Room*, *Quake Safe Game*, and *The Survivors* after going around the museum and weighing the pros and cons of using each interactive (Table 2), and then discussing them with museum staff. When doing so, we said that *The Mixing Room* and *Quake Safe Game* had the advantage of having high traffic and being highly visible. We found that they were educational, used by a wide age range, and had a high retention rate, meaning that people who started using them used them for a while. For *The Survivors*, we found that it would make a good device because it too was educational and had a high retention rate. The *Quake Safe Game* and *The Survivors* game also had disadvantages. The *Quake Safe Game* was older and confusing for some to use, and *The Survivors* game had low traffic and took a long time to play all the way through.

Devices	Pros	Cons
Quake Safe Game	● High traffic area ● Time Limit	● Old technology ● No seats
The Mixing Room	● Newer Technology ● Multiple Tables ● Four Unique areas per table ● Cooperation ability	● Low traffic area ● Table not functioning properly
The Survivors	● Up-to-date Touchscreen	● Low traffic area ● Lack of Cooperation

Table 2 Pros and Cons

After examining our notes on each exhibition, we were leaning towards studying *The Mixing Room* and *The Survivors*. However, we had not solidly identified a third device at that point. We then met with key staff at the museum who agreed with our first two choices. They suggested the *Quake Safe Game* because it was a slightly older interface. Even though we had listed this as a con, they believed it would provide a good comparison to the other exhibitions.

4.2 OBJECTIVE 2: Understand the museums' intent when designing the devices

In order to understand the original intent for the exhibitions and the devices in them and to develop survey questions that would provide us the desired feedback on visitor-device interaction, we interviewed a few of the museum's key staff members. The staff we interviewed had worked on creating the exhibitions. Unfortunately, we were unable to talk to the curators of the *Quake Safe Game* because they no longer worked at the museum. We were able to interview the head curators of *The Mixing Room* and the *Slice of Heaven* exhibition teams, and extracted the following findings.

We realized that creating a successful exhibition is a complex process involving numerous stages and diverse personnel. It involves working with many different departments of the museum (social, historical, financial, technological, etc.) to form the overall exhibition. For example, when asked for insight on why the museum chose *The Survivors* game to convey information on the lives of 20th century Maori, the lead curator of *Slice of Heaven* responded:

"I was lead curator so I had a team of four curators that I was working with and coordinating their work. So we had a specific Maori curator who was in charge of developing that content. I had an overview of that along with a creative director and an interpreter. Because we don't have the resources in house, we tend to contract out the development of a lot of our technology-based interactive."

Each of the exhibits needs to be created either by outside contractors or internally by the museum itself. *The Mixing Room* touch tables, for instance, were manufactured by an outside contractor based in Wellington. While the curators are experts on the materials going into the exhibitions, they do not have as much say as we expected over the development, functionality, and look of the interactive devices. Because developing an exhibition is such a large project, it is easy to see how the curators' original intent for the exhibition can easily be skewed by going through the creation process. Any initial idea can be modified or completely discarded to meet the needs of a new, more ideal design that will be welcomed by the visitors.

It does not pose a serious issue if the original intent of the curators does not come across to the visitors. Each visitor's museum experience is unique; they have the freedom to interpret each exhibition

however they want, giving them the potential to have a positive experience in ways the curators did not intend. The best way to see whether the curators' intent is coming across to the visitors is to conduct studies on exhibitions. For example, through our study of visitor-device interaction, we found that most visitors in *The Mixing Room* did not notice that each of the touch tables had carvings of the words Connection, Freedom or Challenge on it, and even when viewing the stories they were still unable to deduce the theme of each table. Even though this was a very creative design idea, it did not play a major role in conveying the refugees' experiences to the visitors. For *The Survivors*, the main concept for the *Slice of Heaven* exhibition is explained in an introductory panel. The panel was actually located on the back side of a column and most people did not see it. For example, when asked about the main concept, the curator said "The introductory panel, I do not know if you've seen it, gives you the guts of it. The idea was to show four areas of major... social change in New Zealand over that century." This means that most visitors could potentially be going through the exhibition without knowing what links it all together.

However many changes the exhibition goes through in the design stage, it is important for the curators to decide how much they want to meet audience expectations. Sometimes they might even need to disregard feedback in order to keep the integrity of the exhibition. For example, the curators of the *Slice of Heaven* were responsible for creating a lively exhibition that would depict 20th century New Zealand, with all its struggles and wonders. When developing the exhibition, the curators ran focus groups to find out what they would like to see in this particular exhibition. The curator said, "... we're not going to put a 1930 earthquake or the Wahine Disaster in there. They're just outside the scope of the exhibition as it is not about natural disasters." Because this expectation did not fit with the theme of the exhibition, the curators had to ignore this suggestion.

4.3 OBJECTIVE 3: Evaluate the visitor experience in order to assess the devices' impact

4.3.1 Identify Expectations and Background

From our analysis of expectations we found that the visitors expected technology in their everyday lives, including their museum visits. Most visitors are technologically adept and the majority enjoy reading information from a screen rather than regular text. This is shown by the proficiency with technology that we found in our data (Figure 11). The average value for visitors' proficiency with technology across all exhibitions was 7.8 on a 1 to 9 scale. Additionally, the mode was 9, suggesting strongly that the majority of visitors are very proficient with technology. Along with being technologically proficient, visitors are already used to reading information from interactive devices. With
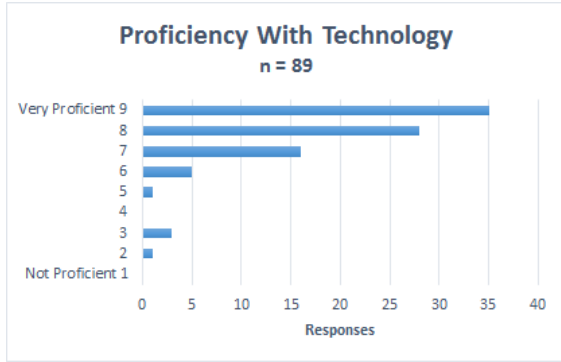
Figure 11 Proficiency with technology

60% of visitors preferring to get their news from the Internet, they are used to interacting with electronic sources of information (**Error! Reference source not ound.**)Figure 12 Preferred news source. It also shows that they have an expectation of being able to secure information according to their preferences. After the Internet, the second most common source of news was TV. This, too, shows that the users did not just want to be reading text from a static source; they wanted dynamic content that engaged them further. Only 13% of people said that they preferred the newspaper as their source of news. This, along with the single response stating radio as the preferred source, shows that people's preferences on how to get their news is evolving along with technology.
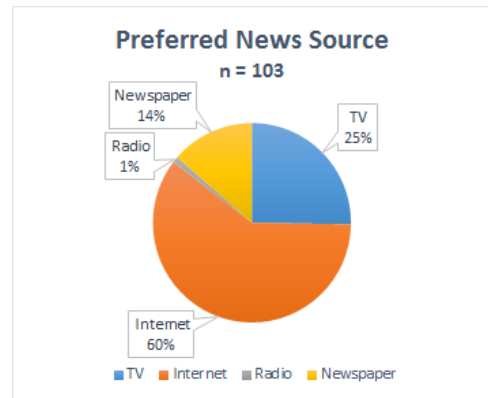

Figure 12 Preferred news source

The fact that the majority of users were technically proficient shows that using interactive devices is not out of reach for the visitors of Te Papa. In addition, visitors are expecting to be able to curate their own experience by selecting which information they want to view. Interactive devices provide this ability to the users, so providing them in the museum is a necessity. Without these devices, museums would be unable to meet these expectations and thus be unable to maximize the visitor experience.
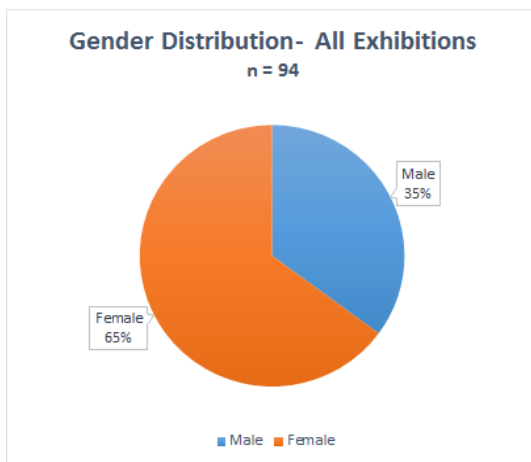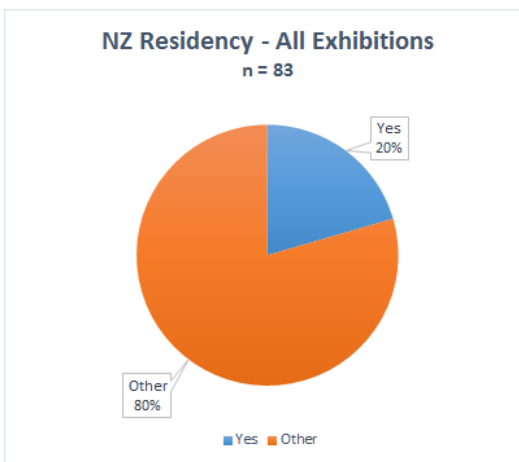

Figure 14 Gender distribution

Figure 13 NZ residency

28

From the background information collected from the surveys, we managed to determine the demographics of the visitors that we surveyed. We found that across all the exhibitions the majority of visitors were females (Figure 14), and not New Zealand residents (Figure 13). The majority of people that we surveyed were tourists from Europe.
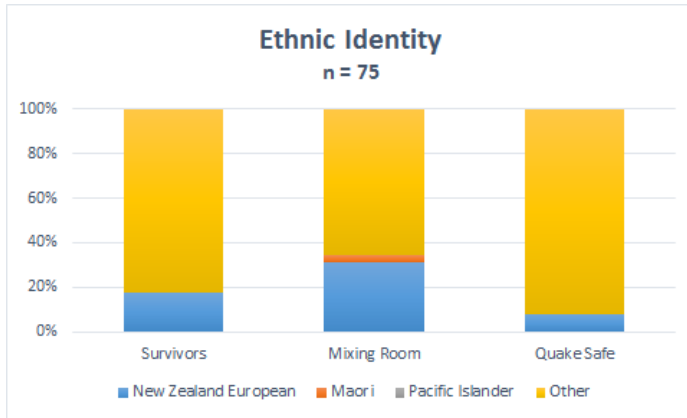

Figure 15 Ethnic identity

For each individual exhibition we found that the vast majority of visitors self-identified as something other than NZ-European, Maori, or Pacific Islander (Figure 15). We only received a single Maori response, which was in *The Mixing Room*. We also found that *The Mixing Room* had a much higher proportion of locals in it, with 10 people identifying as NZ-European versus the 2 and 3 in *Awesome Forces* and *Slice of Heaven,* respectively. The most common age range was 20-24 across all the exhibitions (Figure 16). Both *The Mixing Room* and *Quake Safe* had a good range of ages due to the higher traffic in those exhibitions, and the larger sample size collected.

We found that the age of the group and the size of the group were related. Groups with children in them tended to be larger, sizes of 3+, and elderly groups tended to be no more than two people. The most common groups of one were young adults. This relationship was seen in our observations and backed by the statistical analysis using chi-squared which had a value of 0.005.
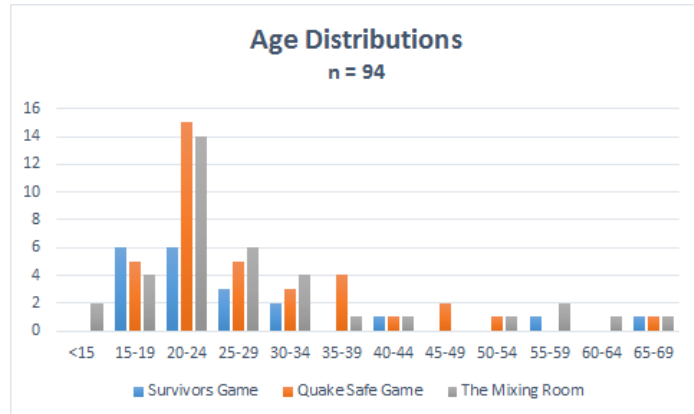

Figure 16 Age distributions

4.3.2 Determine how the visual aspects of the exhibition affect visitor-device interaction

The *Quake Safe Game* is located on the museum's second level, in the highest visitor traffic area of the entire museum. The actual device is located at the end of the exhibition by the exit. This makes it easy for visitors to get a glimpse of the machine on their way out or see others that are enjoying the game, possibly enticing them to want to play it even more (Figure 17). Our observations showed that the *Quake Safe Game* is in a good location in the exhibition with most people that pass by acknowledging the device and playing it, if it is not

Figure 17 Quake Safe Game position

already occupied. However, from Table 3 we can see that out of 296 visitors who passed through the exhibition in a randomly selected two-hour period, only 18% of them stopped to interact with the *Quake Safe Game*. Although this number seems very low for a device that appears to be in a very highly visited area, with more analysis we have found that the number of people walking through the exhibition acted as a bottleneck for this device. With a large number of people walking through this area and only the single interactive to play the *Quake Safe Game*, most of the visitors that could have potentially used the device never got the chance because it was occupied more often than not. When looking at the video observations, we saw that the device was only available for approximately 5 minutes and 23 seconds over a 30-minute time span. This means that any given visitor who walked through the area at that time would only have an 18% chance of the device being open and ready for them to use. Although the device had no problems attracting people to interact with it, many people missed the chance to use the device because so many people were walking through that area.

Visitors' Traveling Through *Quake Safe Game* Area	
Visitors who interacted	Visitors who did not interact
53	243
18%	82%

Table 3 Quake Safe Game usage

The *Mixing Room*, which is located on the fourth floor, sees less traffic on any given day than the *Awesome Forces* exhibition. However, since the tables are so big and prominently located in the middle

of the room, it is very hard to miss them. We were surprised to observe many people that walked through the exhibition only viewing the text and images on the walls or completely disregarding the exhibition all together. As seen in Table 4 below, out of 279 people passing through the exhibition in a two-hour period, 40% of the visitors interacted with the tables.

Visitors' Traveling Through *The Mixing Room* Area	
Visitors who interacted	Visitors who did not interact
111	168
40%	60%

Table 4 The Mixing Room usage

Although this number is higher than the *Quake Safe Game*, we were still shocked to see that 60% of people did not use any of the three tables that were the centerpiece of the entire exhibition. Our observations revealed one possible reason for this low number. The curator's original intent for this exhibition was to make it lively and upbeat. The exhibition celebrated different refugees who were able

Figure 18 The Mixing Room pictures

to make it to New Zealand and start their lives afresh with their new freedom. However, the environment of the exhibition did not promote this type of feeling. Instead, the exhibition was dimly lit in order to allow the projections to show up on the tables. Because of this, people usually came into the exhibition thinking they needed to be quiet and began reading the material on the walls. The material on the walls started with very negative images and text describing what refugees had lost through their life journey, with the images and text near the end turning positive to what the refugees had gained from coming to New Zealand, as seen in Figure 18.

When people began reading this material, we observed that many were saddened by the tragedies related to refugees even to the point where they became emotional after reading the information. It is easy to see why, when someone is in this type of state in an exhibition, they might not want to try out interesting new technology that is right in front of them.

Finally, *The Survivors* game was located inside of the *Fight Like a Shark!* Segment inside the *Slice of Heaven* exhibition. Because this segment is located in the back part of the exhibition, the traffic around it is not as high as in some of the other areas of the museum. For instance, in the two-hour time period we chose to review for the exhibit, there were only 71 individuals that entered the *Fight Like a Shark!* Segment (Table 5). The *Slice of Heaven* exhibition is also maze-like (Figure 19),

Figure 19 Slice of Heaven layout

making it difficult for visitors to make their way back to where *Fight Like a Shark!* is located. The device is also difficult to see because it faces away from the wall in a corner (Figure 21).

Visitors' Traveling Through The Survivors Area	
Visitors who interacted	Visitors who did not interact
9	62
13%	87%

Table 5 The Survivors usage

Figure 21 The Survivors visibility

The video recordings that were taken of *The Mixing Room* showed the low traffic of the *Fight Like a Shark!* Segment. The video, as seen in (Figure 20), captured the device along with the area around the device. From looking at the video, we took two hours of the recordings and measured that 13% of people that walked through the segment actually

interacted with the device. The other 87% completely disregarded the device or when they did notice it, did not find it intriguing enough to make the commitment to interact with it. This is similar to our research done on *The Survivors* game which said, in a study by Morris Hargreaves Mcintyre, that only about 19% of visitors to the

Figure 20 The Survivors camera position

Fight Like a Shark! Segment actually interacted with *The Survivors* (MHM, 2011). Our number was slightly lower than in the other study. However, we assumed that if we were able to have observed *The Survivors* on a weekend, we would have had more traffic and potentially more people interacting with the device.

For each of the devices, we looked carefully at the instigator versus follower question to see what could be extracted from the data. As seen from Figure 22, the instigator was the most common user at every device. This was because for every follower, there was an instigator who began the interaction with the device first. The other reason was that followers usually occurred only when they were part of a group. *The Mixing Room* allowed for the most 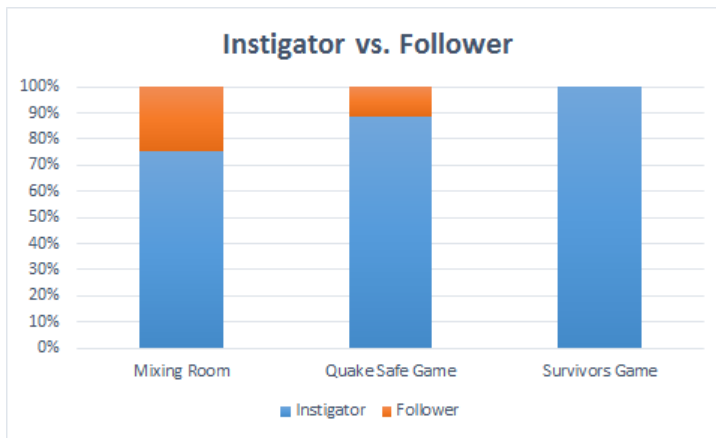followers because the tables have multiple spots and anyone who is attracted by some other user could immediately start their own interaction rather than joining someone else's or waiting their turn. The high traffic in *Awesome Forces* encouraged followers at *Quake Safe* because when the device was in use, it made it seem more attractive and people waited to get their chance at the device. In *Fight Like a Shark!,* there were no followers because the low traffic prevented lines from forming and the long play-through time discouraged anyone who could have been a follower from actually playing through, once the instigator visitor completed their game. While all three of the instigator versus follower charts can be compared to each other to draw conclusions, there is an inherent bias in the exact percentage of instigators versus followers. This is because we were targeting those who used the device for observation. This meant that with only one observer in the exhibition at a time, we were more likely to start observing the first person to walk up to the device rather than any followers. This means that while there are no followers reflected in our data, we know there were followers who played *The Survivors*. Even with this bias, this data is still credible. We understood the data would be favored towards instigators regardless. However, the way we look at the followers' data is by comparing the percentages across the three devices.

Figure 22 Instigator vs. follower

4.3.3 Explore the connection between the devices' current ease of use and visitor suggested improvements

As seen from the graphs, the majority of visitors reported that the devices were relatively easy to use, with the bulk of responses between 6 and 9 (nine being the easiest). In particular, the responses give an average level of easiness of 6.4 for the *Quake Safe Game (*Figure 23*)*. The device seemed the most difficult for visitors because of the fact that no one was able to find the directions that explained how to play the game. The
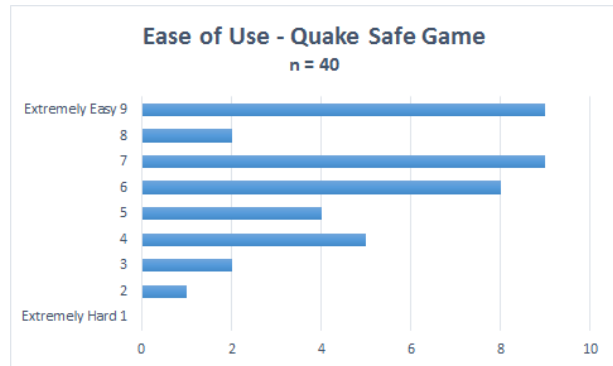
Ease of Use - Quake Safe Game
n = 40

Figure 23 Ease of use - Quake Safe Game

directions were directly behind the device on the wall. However, once people started to engage with a device, we noticed that they normally gave the screen their full attention. This meant instructions on the wall would go easily missed until the visitors completed their interaction and looked up to see them. Some of our observations showed people pointing at the directions after interacting with the device, showing that they finally found the instructions, even though it was too late and they had learned to play the game without them.

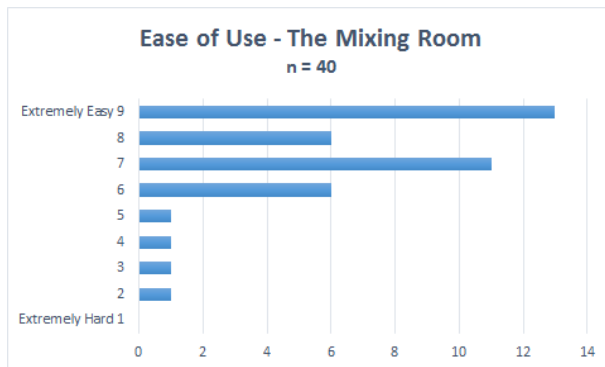*The Mixing Room* tables had an average ease of use score of 7.3 (Figure 24). With *The Mixing Room*, we saw multiple guests trying to operate the table the incorrect way. For example, many visitors were seen trying to use the table as a traditional touch screen. They were trying to drag and drop items by physically dragging their finger across the screen. They did not understand that the table was operated by simply hovering a hand over the object to be selected. This is further reinforced in *The Mixing Room*'s observation graph in Appendix F,

Ease of Use - The Mixing Room
n = 40

Figure 24 Ease of use - The Mixing Room

which shows that two prominent coded occurrences were "confusion" and "misuse of technology." This shows how many people did not understand the device initially.

The Survivors game had an average ease of use score of 8.3 (Figure 25). It seemed to be the easiest for people to use, seeing that the game only needed people to press one of the two choices that were proposed to them. These buttons were large and read "Choice 1" and "Choice 2" in big text. Not

only this, but *The Survivors* had the most reliable touch screen. As previously stated, *Quake Safe* ran on older software while *The Mixing Room* interface is unusual and initially confusing. *The Survivors* had the benefit of having new software and also a traditional touch screen, very similar to visitors who use today's technology. The device, however, did not have on-screen instructions similar to the others.
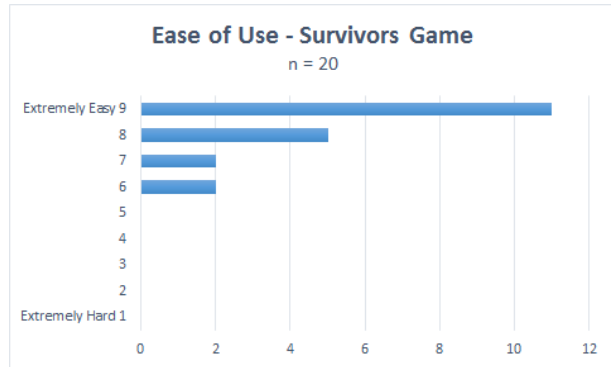

Figure 25 Ease of use - Survivors Game

When asked what could make this device easier to use, multiple visitors called for a "how-to" guide on all three of the devices. It seemed that our observations and the feedback from the surveys were very similar, showing that people who had trouble using the devices would have had a much easier time interacting if the devices had better instructions that were more visible. When looking at the *Quake Safe* observation graph, it is seen that the most common code from the observations was "confusion." We saw many people who did not understand completely how to play the game until a round or two into it. Many people learned by doing, rather than by reading the instructions on the wall in front of them. The *Quake Safe Game* also had survey responses that discussed the touch screen of the device. Users explained that moving left and right in the game seemed difficult and slow using the on screen arrows. If the interface followed normal expectations of a touch screen device, it would allow the user to drag a finger left or right in the house to simulate turning in the game.

In *The Mixing Room,* visitors responded saying the tables were too sensitive, causing confusion and frustration with their interactions. We attribute two possible meanings to the word sensitive: either the sensors detected even their slightest motions and changed their choices accidentally, or that the infrared sensors malfunctioned, something that occurred very often and caused the system to select stories randomly about every other minute. This type of behavior made it difficult for visitors to control the table and caused their interactions with the device to be cut short. Another main comment about ease of use dealt with *The Mixing Room*'s table speakers. Visitors wanted the speakers to be turned up because the device was difficult to understand with the low audio.

The Survivors had a small number of responses on how to make it easier to use. Our observations showed that because it was a traditional touch screen, people using the game could easily pick up how to navigate through the game without any problems. The only major ease of use suggestion was people specifically asking for more instructions.

4.3.4 Examine the engagement of the visitor with the device

The engagement time of the three devices showed us how involved the users were while interacting with the device. The most interesting finding from these numbers was the difference between what visitors reported and actual use time of the device. The interactive device that had the most accurate self-reporting was the *Quake Safe Game*. The average reported time was only a minute longer than the average actual use time. This is probably due to the fact that the game is timed, so users are very aware of the amount of time they spend at the device. *The Survivors* had a slightly larger gap, of two minutes, between self-reported and actual use time. Finally *The Mixing Room* had the largest gap of five minutes. This was likely because people thought that the videos they were watching were longer than they actually were. The fact that, for all of the devices, the average self-reported was longer than the actual time showed that they were engaging the visitors well enough for them to forget about the time they were spending.

The charts below represent the Exploratory Behavior Scale (EBS) of the visitors in each exhibition. They categorize the visitors' behavior into active, passive, or exploratory when interacting with each device. The three behaviors that make up the Exploratory Behavior Scale helped us to relate users' interactions to how engaged they were. Museums should always strive to have a majority of their visitors in the active or exploratory range. This is because the passive category only refers to people who did not interact with the device. One of our statistical findings presented a relationship between EBS and the engagement time, as well as whether the user completed the game or not. The chi-squared values of each were 6.36e-18 and .014, respectively.

While these relationships are statistically significant, we were not surprised that these relationships exist because when classifying visitors using EBS we used engagement time and whether they completed the game as factors.

Looking at Figure 26, we saw that only 5% of the users were passive. This was because the area where you could sit and play the game was small, not allowing for passive viewers. Another factor that contributed to a low passive percentage was that the game involved

Figure 26 EBS - Survivors Game

decision-making. This meant that most people were consistently making conscious choices to complete the game. *The Survivors* also had the highest exploratory user percentage at 35%. Through our
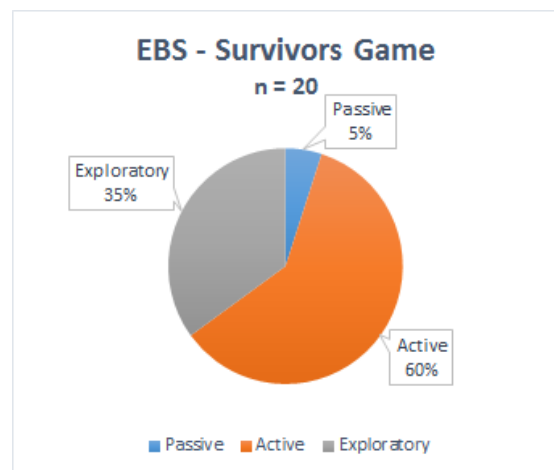
observations, we found that many of the visitors became so engaged in the game that they were taking the time to read all of the text on the screen and think about which choice they would want to select. Eventually, the users would select a decision. After reading the outcome, they would occasionally press the back button in order to review the alternative outcomes. The exploratory percentage also included people that realized there were multiple endings to the game, and played through again to view all the possible outcomes.

The *Quake Safe Game* saw the largest percentage of active users at 77% (Figure 27). We attributed this to the nature of the *Quake Safe Game*. Each level of the game was on a timer, which meant that anyone using the device would feel the pressure to try and complete the game before time ran out. People were less frequently passive while interacting because the time limit demands active engagement. However, the pressure of the clock kept people from exploring or taking their time while interacting with the device. The 14% of visitors that were exploratory, were a result of people who truly wanted to understand how to play the game and wanted to do as well as possible. These visitors played through the game multiple times in order to improve on their previous

Figure 27 EBS - Quake Safe Game

scores. The repetition made these users exploratory because they were able to go beyond their initial game and really understand which items needed to be secured with what.
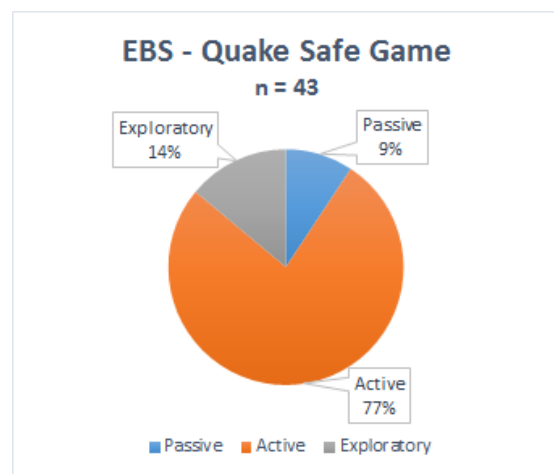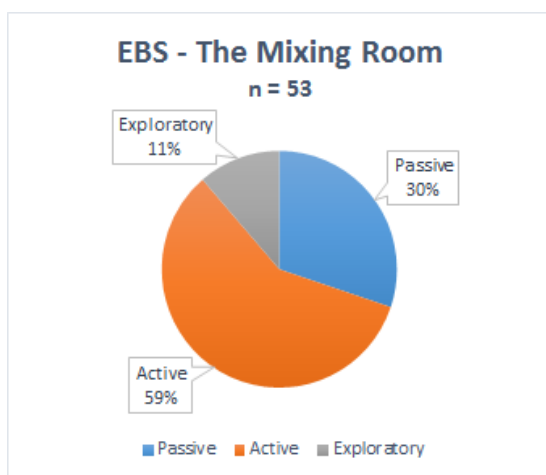

Figure 28 EBS - The Mixing Room

The *Mixing Room* had a large number of active users, which is understandable seeing as it was a hands-on device that always had a part of the table unoccupied, so a visitor could begin interacting with it (Figure 28). The percentage of passive users was the highest in *The Mixing Room* out of all three of the devices. This can be attributed to the type of material that was on the table. If a group of two or more began to use the device, it was common for one person to select a video from the table and for the rest of the group to passively watch it without actually interacting directly.

The other reason the number of passive users was high was because if a video was already playing on a table and the original active user had left before it finished, then visitors would watch the video and then move on without having interacted with the table. This also became more common because of a malfunctioning table that would select stories to play on its own.

To evaluate engagement, we also counted the number of people that chose to sit or stand when interacting with each device. The *Quake Safe Game* was the only device that was not given an option of sitting or standing because the game could only be played from the standing position. On the other hand, *The Mixing Room* interactive and *The Survivors* game offered the option to sit while using the device. In *The Mixing Room,* we saw a large percentage of people standing when they used the device (**Error! Reference source not found.**). We ttributed this to a number of factors including uncomfortable seating, as well as ease of screen viewing and interaction from a standing position. However, when it came to engagement, we saw that when a user sat down at the device, they were

Figure 30 Sitting vs. standing - The Mixing Room

more committed to the interaction and would normally spend more time watching the videos. We found that there was a significant relationship between whether or not they sat down and engagement time. We got a chi-test result of 3.87e-5 meaning that the relationship between sitting and longer use time is very strong. This result backed up our research showing that sitting was a proxy for commitment. People that were standing had an easier ability to walk away from a device at any time because they did not have to stand back up to continue on. *The Survivors* saw more people sitting then standing (**Error!**

eference source not found.). One potential reason for this was because there were two seats located directly in front of the device, making it difficult to interact with the device from a standing position without moving the chairs out of the way. Through our video observations, we also noticed that people would start by standing at the device and, if the device held their interest for the first few moments, they would move to a sitting position in
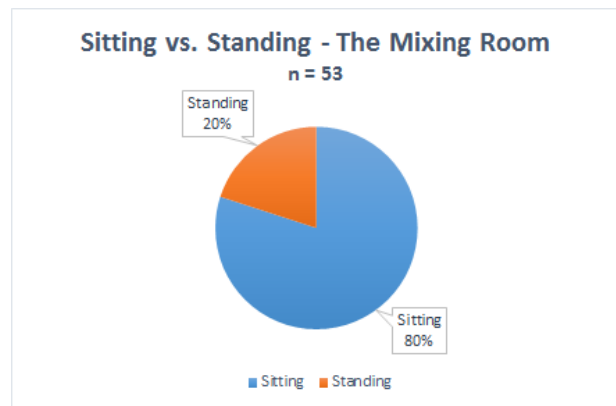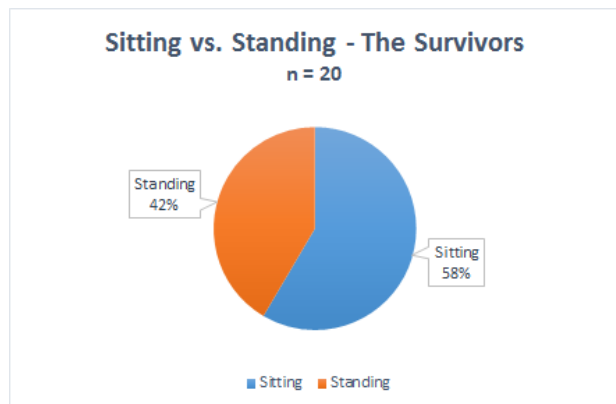

Figure 29 Sitting vs. standing - The Survivors

order to continue the interaction. If the device did not interest them, they would walk away. It seemed that there was a critical point when a person decided whether the device was worth interacting with; this decision could be seen when visitors made this transition to sitting down at the device.

There were some people who sat at the devices without interacting with them, but they were not counted in our data as we were only observing the users of the devices. While one would expect some people, like the elderly, to sit at the devices simply to sit, we found that there was actually a relationship, with a chi-squared value of .0086, showing that younger people who interacted with the device tended to sit more often than older users. This shows that the elderly users were not as willing to commit the time to the device, as they may have been unfamiliar with the technology. Another finding was that those who sat were more likely to be classified as active or exploratory. We found that this had a chi-squared value of 0.0009, showing that this relationship is very strong.

By looking at *The Mixing Room* observation code graph (located in Appendix F), it is evident that one of the biggest themes was visitors "playing with technology." More specifically, they were playing with the water effects on the table. Some visitors used this as a segue into their interaction, while others were only interested in this effect and then left. This effect, though interesting, is potentially a distraction to the device. *The Mixing Room* also had the largest number of occurrences we coded as "no engagement." As seen in Table 6 in Appendix F, this code referred to when someone stopped at the device, but had no significant interaction with it. This may also be traced back to the water effect, as many of these occurrences happened when someone started playing with it. The effect was good at attracting people to the device; however, it did not actually promote engaging interaction with the tables. Playing with the technology did not always lead to interacting with the material and many times we saw visitors completely disregard the content on the tables entirely, even after playing around with the technology. Of the people who were engaged by the subject matter of the device, it can be seen in the graph that many viewed multiple stories. This is a positive for the device, as it means that they were interested enough to invest their time in more than one document, picture, or video.

In terms of our coded observations, the *Quake Safe Game (*Figure 40*)* was very successful at having groups of people, such as families, work together, coded as "group interaction/cooperation." We observed parents instructing their children on how to interact with the game. This way, the important information presented in the game could be given to a large group instead of one person at a time. We also observed a large amount of "incomplete games." We noticed many people only played one round out of three. Perhaps this was because they thought the game was over after that. This could be clarified with "on-screen" instructions.

The Survivors observation graph (Figure 41), shows that out of all observations, the interactive had the highest ratio of visitors engaged in the material to visitors who interacted with it. We noticed that game was very successful at engaging visitors. Further proof of this can be seen in the graph, where the game also has a high number of visitors who played it more than once. They became so invested in the game that they wanted to play through again to see what different outcomes they could make for their avatar. It was also noted in the graph that it was predominantly females who played through *The Survivors* as a female character. This sense of identification and personalization could be another factor that makes the game so appealing and engaging. It can also be seen that some females played as a male avatar. Most of the time this happened when a female played through the game twice. Picking a male was their way of exploring different outcomes in the game.

4.3.5 Measure visitor enjoyment of the device

Visitor enjoyment looked at the entertainment, fun, and interest that the visitors were able to take away from using the devices. To get this information indirectly, we formed question twelve that asked in what way were the devices interesting or not interesting to use.

The *Quake Safe Game* was praised for teaching the important subject of preparing a house for an earthquake in a fun and challenging way. Many respondents thought the device was interesting and helped them learn more about earthquake safety when securing a house, which many of them admitted they had never thought about before. The respondents particularly enjoyed the end of the game when the earthquake begins and the user sees how well they did in "quake-safing" their house. Sound effects of an earthquake and things crushing around the house were reported to make this ending even more entertaining.

The Mixing Room-specific survey responses included people who enjoyed the variety of stories and videos displayed on the touch tables. Many visitors only mentioned the water effect in their comments. This was a positive because the water effect entertained the visitors, but many never interacted beyond that. Another response that came up frequently was the fact that people had difficulty hearing the stories, something that made the videos less interesting.

For *The Survivors*, visitors praised the role-playing interactive aspect of the game. They enjoyed that they learned while making choices that led to different outcomes in their avatar's life and that even one decision could change the entire storyline. One visitor wrote, "It was very interesting because it allowed me to learn about the struggles of the Maori people in an interactive way. I was very involved as I was required to make decisions." The responses were all positive which showed that people really enjoyed their interaction with the game.

Our observational notes provided some more thorough explanations for the survey responses. A mix of emotions appeared to have taken place during each interaction. For the *Quake Safe Game*, the desired reactions of the visitors (Excited, Interested, Amused, Curious) came out to 55%, whereas the undesired ones (Indifferent, Confused, Frustrated) amounted to 45% (Figure 32). Looking at the detailed
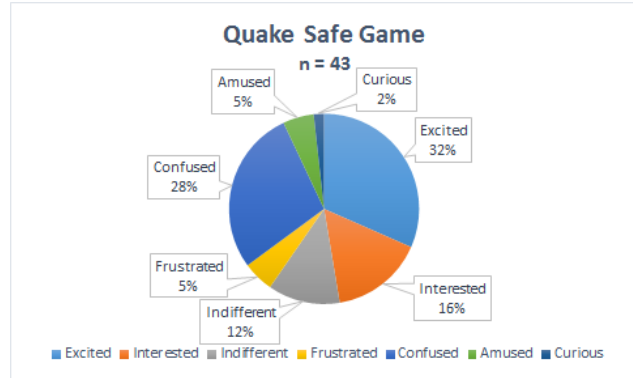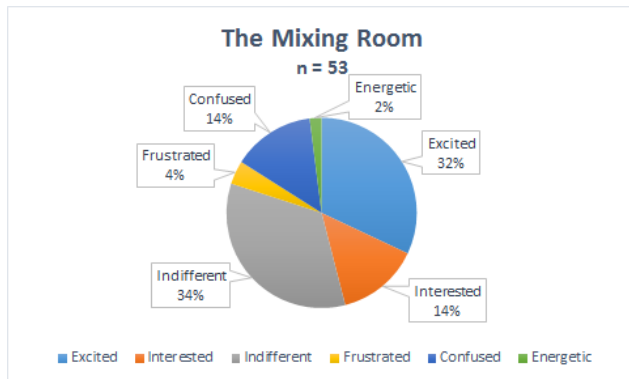

Figure 32 Reactions - Quake Safe Game

descriptions on our observations gave us a more clear justification for the very positive reactions in the surveys. Many of the reasons for the confusion or frustration dealt with being unable to understand the controls for the game. People would place the securing mechanisms on the objects and furniture with confusion and haste. Then, during the earthquake, when certain items fell over they would become frustrated and wonder why they were wrong, as they truly thought that the items they used to secure the house were in the correct

Figure 31 Reactions - The Mixing Room

places. On the other hand, the people that managed to learn how to play the game quickly seemed excited when they would get a high score in the game.

The Mixing Room had visitors with a number of different emotions ranging from excitement to frustration. The museum's desired reactions (Excited, Interested, Energetic) reached a percentage of 41% (Figure 31). This means that close to half of the users seemed to have a positive response to using the tables. The undesired emotions (Confused, Frustrated, Indifferent) totaled 44% of the reactions. We attributed most of these negative reactions to the malfunctions with the device, lack of instructions, and the unique type of technology that most people
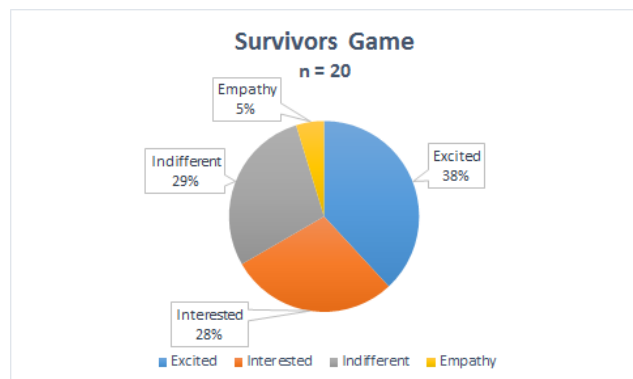

Figure 33 Reactions - Survivors Game

had never interacted with before. The overwhelming number of unsatisfied experiences shows that the different aspects which cause negative reactions can have a serious effect on a visitor's satisfaction and overall enjoyment with an exhibition.

For *The Survivors*, our observations revealed 38% in excitement and 29% in interest, totaling in 67% of positive reactions (Figure 33). Additionally, *The Survivors* observation code graph in Appendix F shows that the interactive had the highest ratio of visitors who became emotional due to the content, even more so than *The Mixing Room*. This may be because it put the visitor in the shoes of the avatar which allowed for a more personal connection.

4.3.6. Understand key outcomes from visitor-device interaction

The first finding about the visitors' learning was the discovery of the preferred learning styles. We found that most people learn best from an exhibit like an interactive device because it is a hands-on experience that involves visual material including photos and films. This is backed up by our data showing that kinesthetic was the most preferred learning style, followed by visual learning, as shown in Figure 34. We also found that visitors may not learn as much from traditional museum exhibits because the least preferred learning style was reading exhibition text and labels (Figure 35). On the other hand, interactive devices incorporate all learning styles, emphasizing hands-on operation and visual material. Thus, Te Papa's move to incorporate interactive devices into exhibitions is reflected in how visitors wish to learn.

We found that after their interaction with the devices, most visitors reported gaining knowledge of the material that they did not have before the interaction. For instance, in the *Quake*
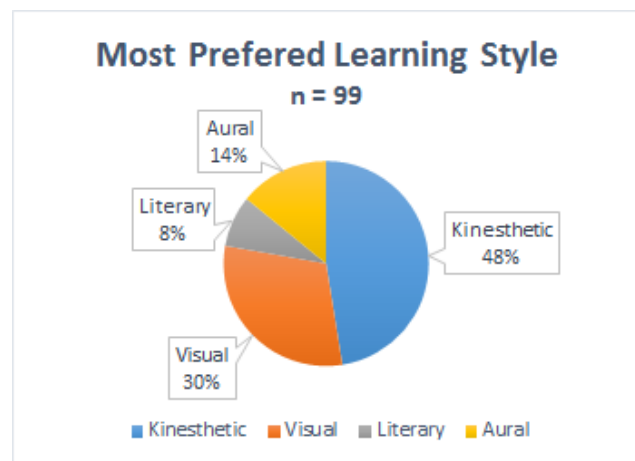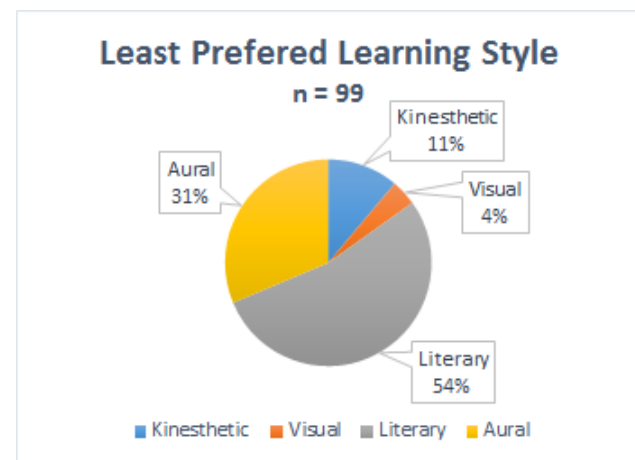

Figure 34 Most preferred learning style

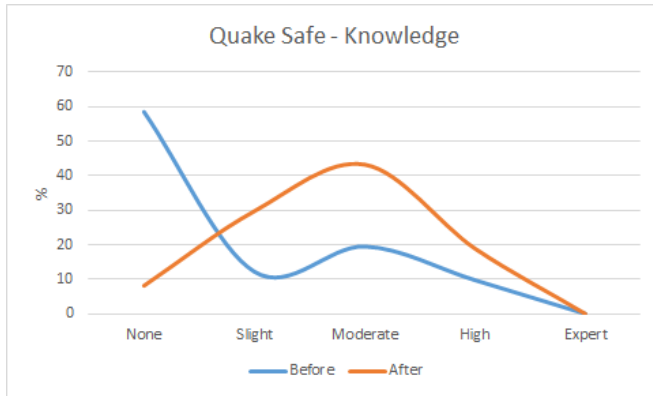*Figure 35 Least preferred learning style*

Figure 36 Knowledge - Quake Safe

Figure 37 Knowledge - Mixing Room

Figure 38 Knowledge - The Survivors

Safe Game, you can see that before interacting with the device most people had no knowledge of the material and thus the distribution is skewed left (Figure 36). But after interacting with the device, most people had moderate knowledge and the distribution was relatively normal. Another finding was that the *Quake Safe Game* had the largest shift in mode knowledge, shifting from "none" to "moderate." This showed that the device met the museum's intention of educating people about securing items for an earthquake. This is one indicator that *The Quake Safe Game* is fulfilling its objectives in the exhibition.

We found that visitors who came out of

The Mixing Room had learned about the refugees in New Zealand. This was evident by the rightward shift in Figure 37. The distribution goes from being skewed left to being relatively normal. As with the *Quake Safe Game*, the interactive tables in *The Mixing Room* are shown to be meeting at least one of the intended goals of the exhibition.

The Survivors game had the smallest shift in learning (Figure 38). The most common knowledge, both before and after, was "moderate" knowledge of the struggle of the Maori in the 20th century. However, while the mode did not change, there was a small shift from skewed left to normal distribution. This showed that there was still an increase in knowledge from before to after using the device.

The fact that all the devices showed a shift right from before to after, suggests that the visitors were learning from their interactions. It also means that personal viewing and hands-on experience with

the device satisfied what the visitors were looking for. It was also interesting to note that not a single person put "Expert" for before or after their interaction. This may be indicative of the fact that people do not come to museums to become experts in certain subjects.

Chapter 5. CONCLUSIONS AND RECOMMENDATIONS

In an effort to better the visitor-device interaction in the museum space, we have evaluated the visitors' behavior when using the interactive audience engagement devices of *The Mixing Room*, the *Slice of Heaven*, and *The Awesome Forces* exhibitions in Te Papa. In a time-span of 14 weeks, we examined research papers related to interactive devices and became familiar with the environment of Te Papa. We then conducted interviews with the key staff that worked on two of the exhibitions, video recordings of the flow around the interactive devices of the three exhibitions, as well as post-visit surveys and inconspicuous observations of the visitors' interacting experience.

The goal of this project was to evaluate Te Papa's interactive technologies and the devices' engagement with visitors to provide recommendations that might bridge the gap between the current interactive exhibits and visitor expectations. By studying these three interactive audience engagement devices at the museum, we have gained a better understanding of this relationship. We believe that our conclusions have implications for not only these three interactive devices but also for other current and future devices at the museum.

1. **On-screen instructions:** Confusion and misusing interfaces were an important finding from our data collection process. Visitors walking up to a device could not intuitively understand how to use them appropriately. *The Mixing Room* touch tables were an example of this, as many people tried to use the tables' surfaces as traditional touch screens instead of hovering their hand over them. This finding directly corresponded with our background research on *The Mixing Room* which said, "The most frequent of these is using multi-fingered gestures and touching the screen without hesitation; this occurs because most visitors are not familiar with this specific touch table technology and are not aware of the fact that a simple placement of the hand or the finger directly above the targeted icon is sufficient to achieve interaction" (Hornecker, 2008). The *Quake Safe Game*, on the other hand, had instructions on the wall in front of it that most users ignored. Our observations showed that less than 5 out of the 42 observed found the directions on the wall at any point during their interaction. Most of the time the people who did find the directions had already begun playing, so the directions did not provide them with the information needed. Visitor feedback from our surveys told us that a solution to this is on-screen instructions before the user begins to interact. This allows for a more efficient and rewarding interaction for the visitors.

   For *The Mixing Room*, a simple text label saying, "Hover hand to choose a story" would have cleared up initial interaction for many of the visitors. A direct quote from one of our survey

responses said "Didn't realize it was projected down. I thought it was a touch screen." This was because the concept of hovering a hand over the screen was not the expectation users had for using the device. In the *Quake Safe Game*, if there were information on screen addressing that the radar in the bottom left showed where the different items in the house were that needed to be secured, people would be able to understand how to play the game much quicker. *The Survivors* on-screen instructions were sufficient because the interaction with the screen was very basic and expected. However, we still had survey responses asking for better instructions so that they did not have to understand how the game worked by playing through it.

Current on-floor devices have no ability to modify their software in order to add on-screen instructions. This means that instructions must be a concern that is looked at during the initial planning stages of the device. Instructions should be placed on devices for one of two reasons. The first is explaining game instructions so that visitors understand what the objective of the game is and how they can achieve that objective. The second reason is to explain how the device itself works. This explanation extends to all interactive devices not just games. Not every device will need this explanation especially when the device follows technology that most users are familiar with, such as a modern day touch screens. However when looking at devices that are less common, such as *The Mixing Room*'s technology, it is always safer to assume the users will be confused without guidance and to take the measure to clear up any confusion that could occur.

2. **Making devices more accessible:** Of the three devices we looked at, The *Quake Safe Game* was located in the highest traffic area. Due to this, there was almost always a user interacting with it. While this speaks to the success of the device, it was also keeping a large portion of visitors from having the same experience. There were only 18% of visitors who actually interacted with the device, out of everyone who walked through the exhibition. This can be attributed to the length of the game, along with the fact that there was only one screen to interact with.

There are a few ways to counteract this. First, there can be multiple screens. *The Mixing Room* has three interactive tables with four user consoles each. Even during its peak hours, visitors were not blocked from use. If they were, the wait time was relatively short. Of course this is only feasible if the budget and space required for multiple devices is present for an exhibit. Second, the game could be more cooperatively based. Games promoting groups working together will allow for multiple users to contribute to the interaction with the device rather than having to wait for the current user to finish their turn. Cooperation works well

among groups because no one has to be left out of the experience, although with this recommendation a device will lose its ability for personal connection, something we saw to be very successful in *The Survivors* game. If neither of these suggestions were feasible for a future device, then it would be advisable to look carefully at the possible locations for the device. Placing a device based on its type of interaction will help improve the visitor-interaction rate. For example, when dealing with a single player game that has a small screen and does not allow for much cooperation, it would be advisable to find an area of the exhibit that did not see as high a flow-through as we saw in the *Quake Safe Game* area. If an exhibit is highly populated, then it might mean that instead of looking at where to place the device, the museum should look into whether this type of device is the best fit for the specific exhibition. Devices that involve cooperation or have an ability to host multiple interactions, should try to be located in higher traffic areas in order to supply the device with the amount of visitors it was intended for.

Another way of looking at the problem of accessibility of a device would be to supplement it in a way that allows users to play the game on other devices. Imagine if someone was using the *Quake Safe Game* and there was a queue waiting to play. If the *Quake Safe Game* was available online or as a mobile application, then a visitor could walk up to the exhibit area, scan a QR code on the wall, and begin playing the game on their own tablet or phone. This would also allow people who enjoyed the game or wanted to play it more, even after they left the museum, to still have access to it and the information it provides. *The Survivors* game is already a Flash application available on Te Papa's website along with other *Slice of Heaven* interactives. If the museum looked into finding a way to standardize the software so that these games could run on mobile devices, as well as the in-museum interactives, then people would be able to have access to museum content in more ways than ever before.

Finally, looking at the accessibility of a device's content, we can see some improvements that will also help to increase the visitors' experience with the device. The only time that the *Quake Safe Game* was not in use totaled about 5 minutes in a 30-minute period. During this time, we noticed people walking up to the device and seeing that it was still in the middle of a game that a previous user had left when exiting their interaction. This deterred people from wanting to interact with the device because they wanted to start their interaction from the beginning. Having a restart button on devices that involve a long interaction such as the *Quake Safe Game* or *The Survivors* game would allow for people to experience all of the device's content the way it was intended to be. *The Mixing Room* has the ability to exit out of the videos

that are currently on the screen which we observed people using frequently so that they could then choose the story they preferred to hear.

3. **Device maintenance must be a priority:** Interactive devices cost a significant amount of money to implement. In order to make this investment worth the museum's money, they should be reliable. During our observations, we noticed a few malfunctions of the devices. The most prominent one was in *The Mixing Room*. A glitch with the infrared camera caused the table to self-select items over and over, making user interaction nearly impossible. Another malfunction occurred on *The Survivors* interactive, which was completely shut down during a weekend span. The *Quake Safe Game* also had a minor interruption; a few times, we noticed a Windows genuine error message pop up over the game alerting the user to the issue.

Unfortunately, when a device has a malfunction however small, it can disrupt the engagement and interaction visitors have with the device. For *The Mixing Room*, visitors did not always understand that the device was malfunctioning. As first time users, it is very possible that they thought the machine was acting as it was supposed to. Visitors would try to read or watch the story selected, but then be interrupted by a newly selected story. In most instances, this would happen a few times before the visitor became frustrated and walked away from the device, therefore ending any engagement. This became even more of a factor during peak hours for the device when the other consoles for tables were most likely taken up. As for the *Quake Safe Game*, when visitors saw the grey error message, being a familiar sign of a problem for computer users, they usually left the game immediately. While the error message would go away with a simple touch, visitors did not care to try.

It is important to note that the museum does have a system in place for dealing with malfunctioning technology. Either hosts observe it, or are alerted to the incident by a visitor. It is then logged and the device is repaired. However, it is now clear that visitors cannot be relied on to point out the problem. Out of all the visitors we observed trying to interact with the malfunctioning tables, none attempted to alert a host that there was a malfunction. What we suggest is to educate all hosts on how the devices work. This will allow them to detect problems faster than when relying on the public. Some of the malfunctions with the device can be small or hard to detect, such as *The Mixing Room* issue, but even the smallest problem can detract from the visitors' experience. It is unavoidable when dealing with interactives that problems will occur, but as long as they are handled in a timely manner then most of the visitors will never have to experience any of the bugs or glitches that can occur.

4. **Meeting visitors' expectations of interactive technologies:** Technology evolves at a very rapid pace in today's world. Along with these evolving technologies come guidelines for how devices are intended to be used. When looking at the *Quake Safe Game*, we saw many people confused and frustrated with using the device. This was because it was difficult for the user to move around the in-game room and look for items to secure. The software used arrows to slowly move back and forth across the room, causing frustration especially with the game being timed and the player under pressure. If the game software followed generic guidelines for a touch screen device, then there would be no need for arrows. The touch screen technology is more than capable of completing this motion without the need for on-screen buttons. The device could have let you drag a finger on the screen left and right to look around the room. The only reason this device does not behave this way right now is because it is running on an outdated touchscreen from before gestures became standard. People expect devices to work a certain way, and when they don't, it makes things more confusing and frustrating. Another instance of this was on *The Mixing Room* tables. As stated before, people assumed the device was a touch screen and began using the device incorrectly because that's how they expected it to work. If a museum is going to use a unique technology that few people are accustomed to, then it needs to be clear to the visitors how the device will behave, otherwise interaction with the device will suffer.

      We understand that because of the amount of time it takes to create an exhibition, it is very likely that the interactives that come with it will be outdated if not immediately, then within a few years or so. We recommend that when looking at future devices, the museum take time to look the standards of devices and whether they are predicted to hold in upcoming years. It is ok to have devices that become outdated or do not have a typical interface, but it means that the museum must invest the time to make sure its visitors are provided with the information needed to understand the interaction, whether that be through instructions as mentioned previously or through other means.

5. **Implementing interactive devices is a good strategy for meeting visitors' learning style expectations:** In our surveys, we looked to learn more about visitor expectations of interactive devices through their preferred learning style. Our data showed that visitors liked hands-on learning the most. The second highest method was visuals such as pictures and video. This information was biased because the surveys were conducted on people that had already chosen to use an interactive device. Regardless of the bias, we understand that these methods along

with "reading text and labels" and "having things being explained" are also important methods of conveying information that many visitors may prefer.

To conclude anything from this data we also have to take a look at the survey question "How do you prefer to get your news?" We found that 60% of visitors who were surveyed preferred to get their news from the Internet. What we can extrapolate from this is that people have changed how they want to receive their information. Traditional ways of getting news, such as the newspaper only allowed readers to have access to the stories the newspaper chose to report on. This is much different than the Internet, where the almost unlimited content allows people to select their own stories to read about which puts them in control of the material. Interactive devices can provide this tailored experience just as the Internet does for all four types of learning styles we looked at. Even with the curators selecting the content that is placed on the devices, the devices give the visitors the feeling that they are in control of the material and can select whichever pictures, text, or audio stories they choose. In addition, interactives allow for learning styles like reading and looking at images, to be more flexible, by allowing curators to swap in new material or modify current material digitally, based on feedback on the exhibit. As we discovered in our background, the audiences visiting a museum are very dynamic and have different interests. Some disadvantages of older interactives is that they do not satisfy all audiences because they cannot change their output based on a specific viewer (Schieck, 2012). However, with new interactive technologies, this becomes possible to do. This shows that regardless of the learning style, interactive devices are a good strategy for giving users the best experience with the material and letting them feel in control and empowered while they learn.

6. **Most effective interactive device types:** All of the devices we looked at were effective interactive audience engagement devices. We observed and heard from many respondents how much they enjoyed each of the different devices and that they helped to teach, entertain, and excite the visitors in their own ways. It is too difficult to select which device would be considered the most effective interactive because each of the devices had their own strengths and weaknesses. However, we can look at what worked for each device and how these different aspects can be incorporated into future interactives.

The *Quake Safe Game* can be commended for making a challenging game into something that could be fun for an entire family. Even with the game being difficult, and on a timer to promote even more pressure, families were able to work together to pass down the

information on how to play the game. Because of this group dynamic, even small children were able to enjoy the game and express excitement at the end when the immediate feedback showed which items in the game they were able to secure. Challenging the user is what makes the *Quake Safe Game* so successful. Interactive devices in the future should challenge their users, as it is a great way to get people involved and engaged with the material, by pushing them to be more active and interested. People of all ages enjoy being challenged and by adding this aspect to future interactive devices, users will want to stand up to the challenge and test their ability to beat or complete the tasks at hand. Not all devices will be a good fit for challenging their users, but when possible, especially in games, it is a great way to promote immersive engagement.

The Mixing Room was able to handle many different visitors at the same time. Through our observations we saw that many visitors traveled in groups, which meant that having a device that allowed everyone to interact at the same time is a huge accomplishment. *The Mixing Room* tables used an interesting technology that had many people playing with the device, however this technology did not supplement the content well. Instead, people got entranced in the device mechanics, which took away from their engagement with the material. Therefore, the technology is not what is commended here, but instead it is the device's ability to provide multiple engaging experiences simultaneously. Future devices should keep this in mind because there are many ways of solving the issue of multiple interactions. As stated earlier, devices can offer multiple screens, allow the device to be found online or on mobile devices, or involve an aspect of cooperation that will give multiple people in a group the opportunity to interact.

Finally, *The Survivors* was able to use a person's connection to the material presented to make a meaningful engagement. Personal connection makes the user care about what is going on on the screen, making reading text and looking at images a necessity for users rather than a chore. In *The Survivors* game this personal connection was achieved through having an avatar in which you decide their fate through different life decisions. Giving people the power over the avatar's outcomes creates this connection because the only reason certain events or situations occur is because of the user's decisions. This relates back to what we previously said about allowing people to be in control of the material rather than just presenting it to them. Future devices should look to achieve this personal connection with its users by making them question what they are reading and what decisions they are making, in order to keep them fully engaged.

While these conclusions have been carefully formulated from our findings, there are some limitations to the research we conducted. First of all, we did not have enough surveys and observations to be statistically relevant, so a future study aiming to collect more data would be useful. Another limitation was that the fact that visitors were self-reporting knowledge and preferred learning style. This is an issue because visitors may not always report truthfully, leading to a bias in our data. Another limitation of our study was that the surveys we collected were targeted at only those who interacted with the devices. This caused a bias in our data towards the type of people who were already likely to use the devices. While this bias did exist, we took that into account when formulating our conclusions. If we were to do this project again, we would likely try to spend more time conducting the observations and surveys in order to get more numbers. We would also try to survey those who did not interact with the devices, in order to get their thoughts on the interactive technology. We would also explore more about the software companies that made these devices and the reason that they picked certain interfaces, for example The *Mixing Room* touch tables. We would look into whether this was a conscious decision due to the subject matter or design of the exhibition in general. Unfortunately, our timeline did not allow for these extra interviews. Future studies could look deeper into exactly what new technologies visitors would like to see in the museum by conducting focus groups. Another future topic could be looking at reexamining the museum after a subset of our recommendations has been used to create new devices. This would see whether our recommendations did indeed meet the visitors' expectations and improve their experience.

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APPENDIX A: History of Te Papa Tongarewa

Since the early 20th century, the government of New Zealand has sought to create a national museum that captures the culture of the nation and that could hold a collection of artifacts. The first iteration of this was the Dominion Museum, which opened in 1906 (Tramposch, 2007). As years past, the museum began to experience problems. Most pertinent was the extreme drop in visitation partnered with the vastly growing collection of artifacts that the building was too small to house. In the 1980's, the government ultimately decided that something had to be done about this. Plans began for a, "state of the art" museum to house the nation's artifacts, as well symbolize the pride and culture of New Zealand (Tramposch, 2007).

Two rising trends of the time period further persuaded government officials create a new national Museum: Biculturalism and Nationalism. In 1840, the Treaty of Waitangi was signed between the British Empire and the indigenous Maori people of New Zealand. The treaty gave the Maori back the land they owned and allowed them to continue their industries while the British governed the nation. However, in the following years, the Maori felt this treaty was grossly ignored by parliament and citizens alike (Harre, 1962). In the late 20th century, however, this began to change when biculturalism became very important to the nation (Tramposch, 2007). The nation also began to have a growing sense of nationalism since gaining its independence from Britain. In 1996, the Constitution Act was signed, declaring New Zealand independent (Keith, 1992). Prime Minister of New Zealand at the time, Sir Wallace Rowing, stated that in the new national museum, "The very soul of the nation will be exposed" (Tramposch, 2007).

In 1992, the museum was finally named "Te Papa Tongarewa" which is Maori for "Collection of Treasures" (Tramposch, 2007). The official mission of the museum was to be bicultural, customer focused, Matauranga, and commercially positive. Matauranga, is a Maori principle meaning wisdom. It includes their beliefs on environmentalism, biology, and other subjects (Tramposch, 2007).

When the museum was created the government agreed to fund 75 percent of the project, while the other 25 percent needed to be collected by the museum itself. (Tramposch, 2007) The museum building took four years to complete. It weighs 64,000 tons and includes 36,000 square meters of concrete. The structure sits on 150 shock absorbers to protect the building from earthquake movement. The land is owned by the museum and they also lease part of the waterfront on the northeastern boundaries. The actual design of the building was created by Ivan Merscep, a native New Zealand

architect. Merscep chose an abstract modern style for the building that includes both many curves and geometric protrusions.

In order to incorporate the ideal of biculturalism, the museum has put other programs into effect besides the shows and exhibitions. For example, many Maori are employed in the institution. Other employees are offered Maori language lessons in order to better understand and explain the culture to the visitors. Also, each official meeting in the museum is begun with a Maori blessing, an important tradition of the people (Tramposch, 2007). While these programs have been seen as a positive move by the museum they have also created some challenges. The museum has counteracted this by making it mandatory for each exhibition to get input from both Pakeha and Maori experts in order to gain the blessing of each party. The museum also embraces the Maori rituals in the creation of the exhibitions. The Maori elders may bless the exhibition before it opens, or perform a cleansing of an artifact that has a controversial history before it goes on display" (Ross, 2013).

Since its opening, the museum has seen tremendous visitation numbers. From 2001 to 2009, the average visitation was 1.3 million per year, and the number continues to grow. In 2011, there were 1.5 million visitors (Davidson & Sibley, 2011). In fact, due to the museum, Wellington has become more of a tourist destination. Since its opening, the city has seen increased visitation (Carey, 2013), which tends to peak when there is a special, limited time exhibition in the museum (Davidson & Sibley, 2011). For example, from 2007 to 2009, there was a large *Lord of the Ring*s exhibition which led to visitation well above the yearly average. Data collected by the Visitor Profile Interview, or VPI, gives the museum insight into the demographics of its audience. Families and well educated individuals make up the majority of Te Papa's visitation.

Te Papa has a clear vision of its mission and its plan for the future. The museum releases signed annual reports, as well as Statements of Intent in three-year timeframes. These documents are to be followed to the last detail, and state the nature, mission, and goals of the museum. Te Papa's vision can be encompassed in the motto: *E huri ngākau ana. E huri whakaaro ana. E huri oranga ana | Changing Hearts, Changing Minds, Changing Lives*. The museum desires to be a forum for change in the country; it desires to assist people in experiencing the world, sharing their ideas and perspectives, and then taking action in a logical and well-thought out way.

The plans of the museum for the upcoming years include the creation of the *National Centre of Collections, Exhibitions and Learning* in Manukau, Auckland. Since the museum has the policy to always

connect the people and reach out to them, it sees Manukau as the ideal location to expand, as Auckland is the largest city in New Zealand. The National Centre will host some of the national collections currently housed at Te Papa. This offers the New Zealand people more opportunities to access and experience its treasures, and witness their heritage. It also gives Te Papa the ability to ensure the structural safety of its growing collections. This institution will be better suited for the country's most valuable objects, as Wellington is a more prone to earthquakes area than the southern city of Auckland.

The museum also aims to improve its interactivity, and it is currently working on updating its online database, and providing digital tours. In Te Papa's own words, the goal is to create more "innovative, engaging, and targeted learning experiences that challenge and empower all audiences" (Te Papa, 2014). The digital priorities of the museum include the increase of digital access to more of its collections, the development of more engaging digital programs and experiences, the establishment of the digital collections as a resource of education, research, personal enrichment and creativity, the expansion of its mobile channels to a broader reach, as well as the creation of new ways of adapting and engaging to the new technologies for its physical visitors (Te Papa, 2014).

APPENDIX B: Observational Studies

Observational studies are a common way for museums to extract qualitative data from visitors' experiences without intruding on their visit to the museum. Observations involve collecting data through watching visitors at specific exhibits or parts of an exhibition. This type of data collecting is helpful when wanting to look at specific audiences like families or school groups. Observational studies have data that is easy to collect, collate, analyze, and report however they can be limited as they do not give an overall picture of the visitors' use of an exhibition (Kelly, 2009).

In an observational study, points of interest to focus on when viewing visitors include: the total time they spend at the exhibit, pathways/visitor flow, demographic data, whether the visitors are getting the key concepts, coverage of the exhibit, attracting/holding power, whether the exhibits are used as designed/intended, and design feedback. The goal of gathering this information is to gain a better understanding about the visitors' behavior, experiences and what they learned from the exhibition. The information can then help with making changes to the floor exhibits or future exhibits whether that be through adding signs to increase visibility, fixing interactive devices, or pointing at the need for further research (Kelly, 2009).

When conducting an observational study it is important to look at the necessary planning. Preparation involves understanding the floor plan, having a database setup for managing the data recorded, photographs to support the data, and any items needed for the study such as a stopwatch to keep track of time. This might also include setting up notices that will alert visitors to a study being conducted. Another part of the preparation to consider is the event that the researchers are caught by the visitors and will need to have an explanation prepared for their actions. Another key aspect of the study to look at is consistency between visitor to visitor and researcher to researcher if more than one are conducting the study. Consistency will need to be decided on things like the boundaries of the exhibit space and where the "line" of entering and exiting will be marked. Another will be how the observers will be reading behavior and how these emotions will be categorized in a consistent way (Kelly, 2009). Consistency can also be an issue when looking at the time and day of the sampling. A good way for getting sample would be to take samples from different days at different times to capture the overall population of visitors. Finally looking at budget and time will drastically change the observational study. Studies working on a short time frame will have to make the best of their time even if that means not getting the quantity of observations they would wish for. Budget will change how the observation is conducted. If the researchers can purchase and setup multiple cameras, they might have more rich data and be able to capture things that were not as apparent when observing only from one point of view. If

the budget is low then the quality of the data could suffer by not having the equipment needed to conduct the study properly.

The Exploratory Behavior Scale is a way of measuring the type of engagement a visitor has with an exhibit or specific device based on their interactions. The scale is broken up into three specific categories that define a visitor's behavior as: Passive contact, Active manipulation, and Exploratory behavior. Passive contact is the lowest form of engagement which is defined by the visitor who is not physically interacting with an exhibit or device but rather viewing someone else who is making the active interaction. Active manipulation is when the visitor interacts with an exhibit or device by physically playing an active role and giving the exhibit their full attention. Exploratory Behavior is the highest level on the scale and is defined as actively and attentively using the exhibit or device but go above and beyond regular active manipulation by showing repetition of actions with the exhibit or variation. An example of this would be a visitor using an interactive device that consisted of a game. An active manipulation visitor might play the game but the exploratory behavior visitor might play the game multiple times and see what ways they could take different paths in the game or try playing it differently than before (Van Schijndel, 2010).

APPENDIX C: Te Papa curator interview questions

General Questions:

- What exhibitions have you helped create here in Te Papa?
- Why do you think Te Papa is trying to learn more about the expectations the visitor brings to the museum?
- What do you hope visitors will take away from_____ exhibition?
- What do you see as critical to creating a meaningful experience?
- How do you measure the success of an exhibition?

Intended objectives:

- Why was an interactive device chosen for this specific subject in the exhibition?
- Was this device aimed at any specific audience?
- What was the goal of adding these devices?

Outcomes:

- From what you have seen of the exhibition now it has opened, did the devices supplement or detract from the goal of the exhibition?
- Why do you feel the devices had this impact?

APPENDIX D: Google Observations Form

Edit this form

Observations
* Required

Gender *
○ Male
○ Female

Age Range *
○ Child
○ Teenager
○ Young Adult
○ Middle Aged
○ Old Adult

Instigator Or Follower *
If they are the initial starter or join in after
○ Instigator
○ Follower

Group vs single *
○ 1 Person
○ 2 People
○ 3 people
○ 4 people
○ 5 or more people

Sit vs Stand *
○ Sitting
○ Standing
○ Other: [_____]

General Emotions
☐ Confused
☐ Frustrated
☐ Excited

☐ Indifferent

☐ Other: [   ]

Game Completed *

○ True

○ False

○ N/A

Exploratory Behavior Scale *

Passive: Watching the interaction Active: Interacting directly Exploratory: Is active and applies repetition or variation to actions

○ Passive

○ Active

○ Exploratory

Time Spent *

○ 0-30 seconds

○ 30 seconds - 2 minutes

○ 2 - 5 minutes

○ 5+ minutes

Notes

[   ]

Who's submitting *

○ Anthony

○ Despoina

○ Matt

○ Thomas

[Submit]

Never submit passwords through Google Forms.

APPENDIX E: Post-use survey on experience of interaction:

The Mixing Room Survey

WPI

1. What was your ONE main reason for visiting Te Papa today?

_____

_____

_____

2. On a scale of 1-9, rate the following statements on how strongly you agree or disagree when visiting museum exhibitions:

A. I like to touch and feel objects.

1 2 3 4 5 6 7 8 9
Strongly Disagree   Strongly Agree

B. I like to look at photos, images, and films.

1 2 3 4 5 6 7 8 9
Strongly Disagree   Strongly Agree

C. I like to read exhibition text and labels.

1 2 3 4 5 6 7 8 9
Strongly Disagree   Strongly Agree

D. I like to listen to things being explained.

1 2 3 4 5 6 7 8 9
Strongly Disagree   Strongly Agree

3. Which one of the options do you most prefer?

A   B   C   D

4. Which one of the options do you least prefer?

A   B   C   D

Interviewer: A D M T   Date: Time:

5. How do you prefer to get your news?
☐Internet   ☐Newspaper
☐TV   ☐Other: _____

6. On a scale of 1-9, how proficient do you feel you are with using modern day technology such tablets and touch screens?

1 2 3 4 5 6 7 8 9
Not Proficient   Very Proficient

7. Is this your first visit to The Mixing Room?

☐ YES   ☐ NO

8. How much knowledge did you have about refugees in New Zealand, before visiting The Mixing Room?

☐ None ☐ Slight ☐ Moderate ☐ High ☐ Expert

9. About how much time do you estimate you spent using the Mixing Room Tables?

_____

10. On a scale of 1-9, how easy did you find it to use The Mixing Room tables?

1 2 3 4 5 6 7 8 9
Extremely Difficult   Extremely Easy

11. What could have made the devices easier to use?

_____

_____

_____

Survey Number: Input ☐

The Mixing Room Survey

12. In what way were The Mixing Room tables interesting or not interesting to use?

_____

_____

13. On scale of 1-9, how confident would you feel teaching someone about what you learned from The Mixing Room?

1 2 3 4 5 6 7 8 9
Not Confident   Extremely Confident

14. In what way has the information displayed on the devices affected your views on refugees?

_____

_____

15. How many stories did you view on the interactive tables?

_____

16. How much knowledge do you have now about refugees in New Zealand, after visiting The Mixing Room?

□ None □ Slight □ Moderate □ High □ Expert

17. Who are you visiting Te Papa with today?
□ Alone
□ With my partner/spouse
□ With an organized group
□ With (a) friend(s)
□ With a family member or family group
□ With friends _and_ family
□ With an educational group
□ Other (please describe) :_____

18. Your Age

□ <15	□15-19	□20-24	□25-29	□30-34
□35-39	□40-44	□45-49	□50-54	□55-59
□60-64	□65-69	□70-74	□75-79	□≥80

19. Gender: □ Male □ Female

20. Are you a New Zealand resident?

□ YES □ NO (Please Specify) _____

21. Do you identify as:
□ New Zealand European □ Maori
□Pacific Islander   □ Other_____

If you have any other comments on The Mixing Room please leave them here.
_____
_____
_____
_____

The Quake Safe Survey

1. **What was your ONE main reason for visiting Te Papa today?**

   _____

   _____

   _____

2. **On a scale of 1-9, rate the following statements on how strongly you agree or disagree when visiting museum exhibitions:**

   A. I like to touch and feel objects.

   1 2 3 4 5 6 7 8 9
   Strongly Disagree   Strongly Agree

   B. I like to look at photos, images, and films.

   1 2 3 4 5 6 7 8 9
   Strongly Disagree   Strongly Agree

   C. I like to read exhibition text and labels.

   1 2 3 4 5 6 7 8 9
   Strongly Disagree   Strongly Agree

   D. I like to listen to things being explained.

   1 2 3 4 5 6 7 8 9
   Strongly Disagree   Strongly Agree

3. **Which one of the options do you <u>most prefer</u>?**

   A   B   C   D

4. **Which one of the options do you <u>least prefer</u>?**

   A   B   C   D

   Interviewer: A D M T   Date: Time:

5. **How do you prefer to get your news?**
   □Internet   □Newspaper
   □TV   □Other: _____

6. **On a scale of 1-9, how proficient do you feel you are with using modern day technology such tablets and touch screens?**

   1 2 3 4 5 6 7 8 9
   Not Proficient   Very Proficient

7. **Is this your first visit to the Awesome Forces Exhibition?**

   □ YES   □ NO

8. **How much knowledge did you have about securing items in and around your home, before visiting the Awesome Forces Exhibition?**

   □ None   □ Slight   □ Moderate   □ High   □ Expert

9. **About how much time do you estimate you spent at The Quake Safe Game?**

   _____

10. **On a scale of 1-9, how easy did you find it to use The Quake Safe Game?**

    1 2 3 4 5 6 7 8 9
    Extremely Difficult   Extremely Easy

11. **What could have made the device easier to use?**

    _____

    _____

    _____

    Survey Number: Input □

The Quake Safe Survey

12. In what way was The Quake Safe Game interesting or not interesting to use?

_____

_____

_____

13. On scale of 1-9, how confident would you feel teaching someone about what you learned from The Quake Safe Game?

<div align="center">

1　2　3　4　5　6　7　8　9

Not Confident　　　　　Extremely Confident

</div>

14. Did you play through the entire game?

□ YES　　　□ YES, more than once　　□ NO

15. How much knowledge do you have now about securing items in and around your home, after visiting the Awesome Forces exhibition?

□ None　□ Slight　□ Moderate　□ High　□ Expert

16. Who are you visiting Te Papa with today?
　□ Alone
　□ With my partner/spouse
　□ With an organized group
　□ With (a) friend(s)
　□ With a family member or family group
　□ With friends _and_ family
　□ With an educational group
　□ Other (please describe) :_____

17. Your Age

□ <15	□15-19	□20-24	□25-29	□30-34
□35-39	□40-44	□45-49	□50-54	□55-59
□60-64	□65-69	□70-74	□75-79	□≥80

18. Gender:　□ Male　□ Female

19. Are you a New Zealand resident?

□ YES　□ NO (Please Specify) _____

20. Do you identify as:
　□ New Zealand European　□ Maori
　□Pacific Islander　　　　□ Other_____

If you have any other comments on the Quake Safe Game please leave them here.

_____

_____

_____

_____

_____

_____

The Survivors Survey

WPI

1. **What was your ONE main reason for visiting Te Papa today?**

   _____

   _____

   _____

2. **On a scale of 1-9, rate the following statements on how strongly you agree or disagree when visiting museum exhibitions:**

   A. I like to touch and feel objects.

   1 2 3 4 5 6 7 8 9
   Strongly Disagree   Strongly Agree

   B. I like to look at photos, images, and films.

   1 2 3 4 5 6 7 8 9
   Strongly Disagree   Strongly Agree

   C. I like to read exhibition text and labels.

   1 2 3 4 5 6 7 8 9
   Strongly Disagree   Strongly Agree

   D. I like to listen to things being explained.

   1 2 3 4 5 6 7 8 9
   Strongly Disagree   Strongly Agree

3. **Which one of the options do you most prefer?**

   A   B   C   D

4. **Which one of the options do you least prefer?**

   A   B   C   D

   Interviewer: A D M T   Date: Time:

5. **How do you prefer to get your news?**
   □Internet   □Newspaper
   □TV   □Other: _____

6. **On a scale of 1-9, how proficient do you feel you are with using modern day technology such tablets and touch screens?**

   1 2 3 4 5 6 7 8 9
   Not Proficient   Very Proficient

7. **Is this your first visit to the Fight Like a Shark! Segment?**

   □ YES   □ NO

8. **How much knowledge did you have about the struggle of Maori in the 20th century, before visiting the Fight Like a Shark segment?**

   □ None □ Slight □ Moderate □ High □ Expert

9. **About how much time do you estimate you spent at The Survivors Game?**

   _____

10. **On a scale of 1-9, how easy did you find it to use The Survivors Game?**

    1 2 3 4 5 6 7 8 9
    Extremely Difficult   Extremely Easy

11. **What could have made the device easier to use?**

    _____

    _____

    _____

    Survey Number: Input □

68

The Survivors Survey

12. In what way was The Survivors Game interesting or not interesting to use?

_____

_____

_____

13. On scale of 1-9, how confident would you feel teaching someone about what you learned from The Survivors Game?

1 2 3 4 5 6 7 8 9
Not Confident   Extremely Confident

14. Did you play through the entire game?

□ YES   □ YES, more than once   □ NO

15. How much knowledge do you have now about the struggle of Maori in the 20th century, after visiting the Fight Like a Shark exhibition?

□ None □ Slight □ Moderate □ High □ Expert

16. Who are you visiting Te Papa with today?
□ Alone
□ With my partner/spouse
□ With an organized group
□ With (a) friend(s)
□ With a family member or family group
□ With friends *and* family
□ With an educational group
□ Other (please describe) :_____

17. Your Age

□ <15	□15-19	□20-24	□25-29	□30-34
□35-39	□40-44	□45-49	□50-54	□55-59
□60-64	□65-69	□70-74	□75-79	□≥80

18. Gender: □ Male □ Female

19. Are you a New Zealand resident?

□ YES   □ NO (Please Specify) _____

20. Do you identify as:
□ New Zealand European   □ Maori
□Pacific Islander   □ Other_____

If you have any other comments on the Survivors Game please leave them here.

_____

_____

_____

_____

_____

_____

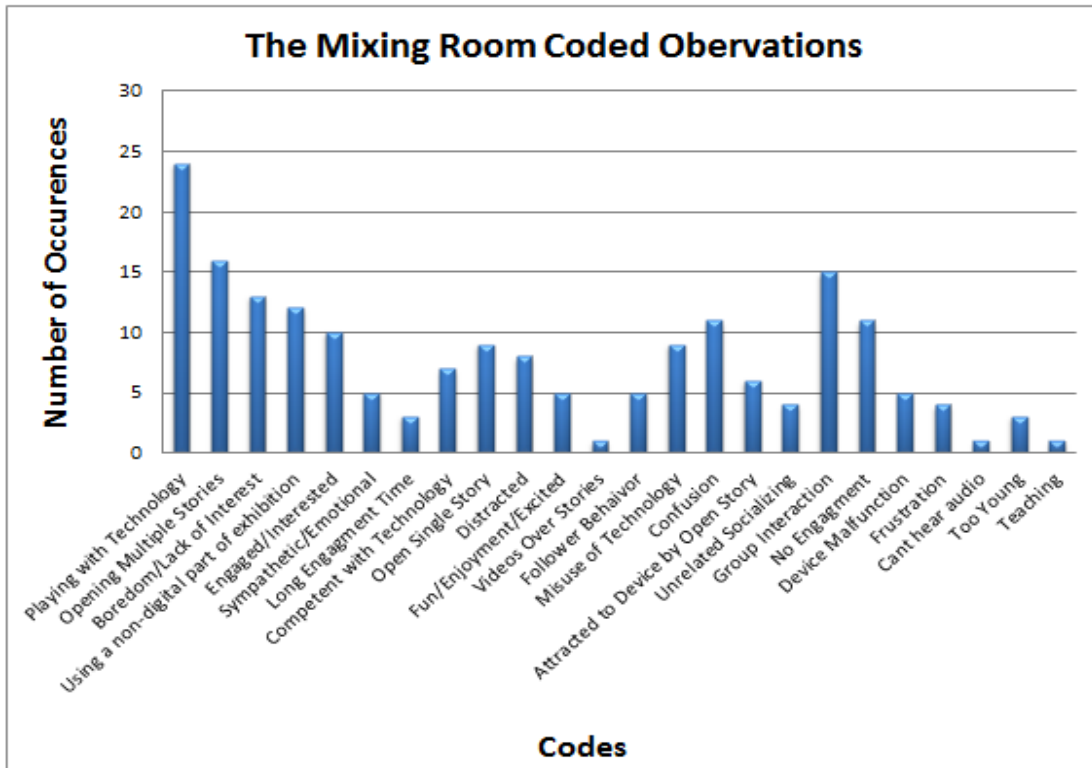# APPENDIX F: Observation Codes Defined and Graphs
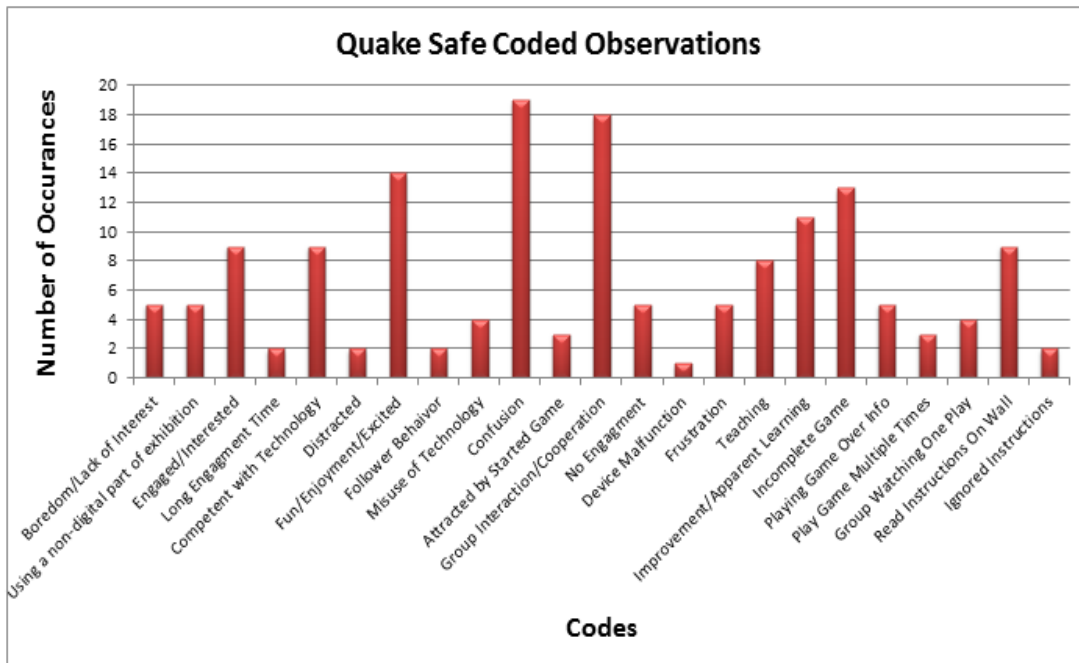

Figure 39 The Mixing Room coded observations

Figure 40 Quake Safe coded observations
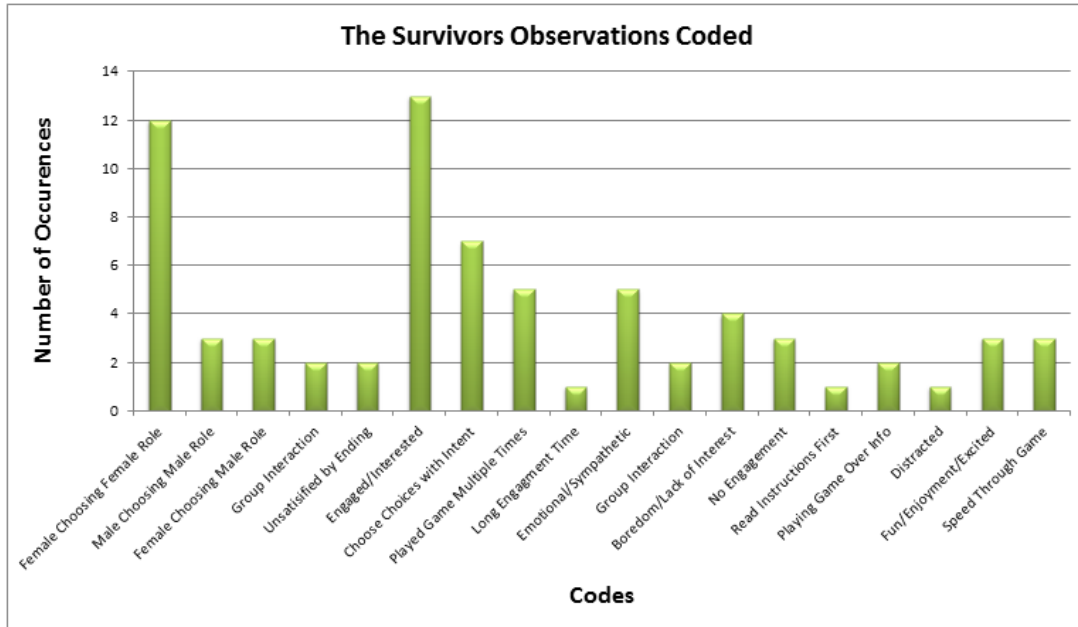
Figure 41 The Survivors observations coded

Code	Interactive Device(s) Code is Relevant To	Meaning
Playing with Technology	The Mixing Room	Visitors play with interface such as water effects instead of actually using the device for its purpose
Opening Multiple Stories	The Mixing Room	Visitors use the device to open more than document, picture, or video during their interaction
Boredom/Lack of Interest	All	Visitors show visible or audible signs of boredom such as facial expressions or leaving early
Using a non-digital Part of Exhibition	The Mixing Room, Quake Safe	Visitors pay attention to an exhibit that is not the interactive device in the exhibition space

Engaged/Interested	All	Visitors are actively using the device and seem interested by their uninterrupted attention
Sympathetic/Emotional	The Mixing Room, Quake Safe	Visitors show visible or audible emotional reactions to the subject matter such as tears or expressing their thoughts
Long Engagement Time	All	Visitors use the device for a long period of time (more than five minutes)
Competent with Technology	All	The visitor instantly knows how to use the device when they approach it
Open Single Story	The Mixing Room	Visitors only look at one document, picture, or video in the Mixing Room
Distracted	All	Visitors' interactions are interrupted by something other than the device such as a cellphone or other visitor
Fun/Enjoyment/Excited	All	Visitors show audible or visible signs of enjoying their interaction and having fun such as laughing and smiling
Video over Stories	The Mixing Room	Visitors pick only videos in the Mixing Room and show no interest in text based documents
Follower Behavior	All	A visitor only starts interacting with a device because they follow someone else in their group to it

Misuse of Technology	All	Visitors try to interact with the device in an incorrect way such as using the Mixing Room Tables as traditional touch screens
Confusion	All	Visitors show audible or visible signs of confusion while interacting such as repeatedly misusing the technology or failing a game multiple times
Attracted by Open Story	The Mixing Room	Visitors are attracted to the Mixing Room tables because a story is already playing when they get there
Unrelated Socialization	All	Visitors in a group communicate with each other while at the device about unrelated subject matter
Group Interaction/Cooperation	All	A group of visitors interact with the device together or even cooperatively to complete a task
No Engagement	All	A visitor stops at a device and has little to no interaction with it. They may press one button and move on or only want to sit
Device Malfunction	All	A malfunction of the interactive device causes an interruption in the visitors' interaction with it
Frustration	All	Visitors show audible or visible signs of becoming frustrated with the device such as leaving after they cannot understand the interface

Cannot Hear Audio	The Mixing Room	Visitors express that cannot hear the audio playing out of the Mixing Room Tables
Too Young	All	Visitors are too young to properly interact with the device such as not yet knowing how to read
Teaching	All	A visitor such as a parent teaches another visitor how to properly interact with the device
Attracted by Started Game	Quake Safe	A visitor is attracted to interact with the device because a game is already started instead of the title screen showing
Improvement/Apparent Learning	Quake Safe	As visitors play through the three levels of Quake Safe, their score improves, suggesting they have learned from their last attempt
Incomplete Game	Quake Safe, The Survivors	Visitors do not complete a full game. For Quake Safe, this means all three levels
Playing Game Over Info	Quake Safe, The Survivors	Visitors show signs of caring more about getting through the game than learning the subject matter such as rushing and not reading text
Play Game Multiple Times	Quake Safe, The Survivors	Visitors play through the entire game more than once
Group Watching One Play	Quake Safe	A group of visitors are in front of a device but only one of them is interacting with it
Read Instructions on Wall	Quake Safe	Visitors pay attention to the game instruction on the wall for Quake Safe

Ignored Instructions	Quake Safe	Visitors do not look at the wall instructions for Quake Safe
Female Choosing Female Role	The Survivors	A female visitor chooses to play as a female avatar in the Survivors Game
Male Choosing Male Role	The Survivors	A male visitor chooses to play as a male avatar in the Survivors Game
Female Choosing Male Role	The Survivors	A female visitor chooses to play as a male avatar in the Survivors Game
Unsatisfied by Ending	The Survivors	The visitor shows signs audibly or visibly of being
Choose Choices with Intent	The Survivors	Visitors take an extended time to read text and make a decision while playing the Survivors Game
Read In-Game Instructions	The Survivors	Visitors take time at the title screen to read the instruction for the Survivors Game
Speed through Game	The Survivors	Visitors ignore and text and run through the Survivors Game fast

Table 6 Code definitions