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Dynamize CERES: Bringing Activities to a Community Environment Park

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Abstract

CERES Community Environment Park in Melbourne is a leader in environmental practice in Australia, but it offers no interactive activities for visitors. In order to add fun family activities to the park, we conducted surveys on visitors, interviews with CERES employees and local experts, observations of park visitors, and playtesting of our activities. Our final deliverables included seven activities based in the CERES Chook app, data on high-traffic park areas, and recommendations for improving both the app and the park as a whole.

Executive Summary

The CERES Environmental Park in Melbourne is an international leader in community and environmental practice, an eleven-acre eco-oasis visited by over 400,000 people each year. The site features a large number of cutting-edge green technologies that can be experienced through a variety of immersive activities. Unfortunately, all current activities require staff supervision and so cannot be used by casual park visitors.

CERES began the effort to engage more with visitors through its recently launched Chook mobile application, which provides visitors with information about different aspects of the park. However, because the app is not interactive, CERES leaders needed a way to take this engagement a step further. Their long-term goal was to use this additional engagement to make the park more appealing as a destination for families with young children and ultimately attract a wider audience. The goal of our project was then to develop a set of fun family activities that will attract new visitors to CERES and allow them to interact and engage with the park.

Bringing Interactive Activities to CERES

We developed four primary objectives that would aid us in gathering the information needed to develop these fun family activities:

1. Gauge the interest level for family activities among visitors
2. Identify Activity Guidelines, consisting of both activity Design Criteria to serve as minimum requirements, and weighted Evaluation Factors to allow us to rank different activity ideas
3. Selecting the optimal locations in the park to place activities
4. Testing the success of the activities to provide a roadmap to CERES for future work.

In order to gauge interest levels for new activities among visitors, we surveyed families using the CERES Facebook page and monthly newsletter. The results of this survey showed overwhelmingly positive feedback, with over 95% of respondents saying they found the addition of family activities appealing. The survey also revealed that visitors who visit the park infrequently are interested in activities that would guide them while exploring the park.

To create our activity guidelines, we interviewed with the curator of the exhibits at the Scienceworks museum, an RMIT Ph.D candidate, and multiple CERES educators and management staff. We used these interviews to identify a list of design criteria an activity at CERES must satisfy. These minimum requirements include: can be played with two people, appropriate for children age 3 to 9, meets the park's safety requirements, is fun, and has some educational value. These criteria were used to filter possible activity ideas to create an initial long list.

We then used our interviews to decide upon five factors with which to evaluate activities, in order of importance: safety, fun, robustness, values, and education. By weighting these factors and then assigning each activity a score for each factor, we were able to rank the activities in our long list. After discussions with our project sponsors, we used these rankings to decide upon a short list of seven activities to implement:

1. Tree Hugging: An activity where one player has to identify a tree they hugged while they were blindfolded
2. Age of Trees: Participants hug a tree to determine the tree's age
3. Sounds of CERES: Visitors guess what different sounds are that they hear on the app

4. Past and Present of CERES: Visitors compare old photos of CERES to what it looks like today
5. Aboriginal Hand Talk Charades: Participants try to explain the meaning of Aboriginal hand signs using charades.
6. Art Scavenger Hunt: A scavenger hunt of different pieces of art that are around the park
7. Weather Rock: A humorous display that has the user feel a rock to determine the weather

To determine the ideal locations to place these seven activities around the park, we began with input from our survey and interviews. We then determined the usage of the various park entrances to gain a more complete picture of visitor traffic. Finally, we observed visitors and applied data mining techniques to determine which areas of the park were high-traffic hotspots. These combined methods gave us a multidimensional view of ideal activity locations and allowed us to then publish the activities with their instructions and selected location into the Chook app.

The final step in our project was playtesting both our activities and the Chook app. We used visiting families to obtain specific ratings and improvement areas for each activity, and fellow WPI students to explore the park in the mindset of tourists and discover our activities organically. This provided us with actionable feedback on several activities, the Chook app interface, and the park itself.

Deliverables and Conclusions

Based on our findings gathered from our research, interviews, and playtesting, we have produced the following list of recommendations.

We recommend that CERES continues to add new activities to the park, including the two additional activities we planned, the Garden Scavenger Hunt and Sliding Riddle Puzzle.

The playtest participants overall showed immense enthusiasm for our activities, remarking that they would return to CERES again to pursue the activities and possibly bring friends as well. This success has led us to recommend that CERES continues to develop and add new activities to the park.

We recommend that CERES uses these Guidelines for activity design and evaluation to continually assess and improve existing and new activities.

After rescoring our activities based on playtesting feedback, we found that each one scored higher than originally scored. This outcome suggests that our two-step process – filtering activities with the Design Criteria, then evaluating with the Evaluation Factors – provided CERES with well-chosen activities to develop and place throughout the park.

We recommend that CERES takes our location data into account when planning future installations or modifications to the park and that it continue to use our methods in the future to re-evaluate conditions as the park evolves.

By recording usage of the park's seven different entrances, we were able to conclude that the Main Entrance accounts for approximately half of all traffic into the park**.** Also, our high-traffic location observation method demonstrated that while the PlaySpace is very highly trafficked, the Energy Park receives very little attention from visitors.

We recommend that CERES works with the Chook app developers to make its interface easier to navigate.

During playtesting, we received consistent feedback that the Chook app interface requires improvement. Several features of the app such as the Interactive Map and Activity Collection proved very difficult to find. We strongly recommend that CERES works with the Chook app developer to streamline the interface.

We recommend that CERES increases usage of the Chook app through signage.

Currently, the Chook app is severely underused, with an average of only one or two uses per week, and less than 100 total downloads. In order to increase visitor usage of the Chook app, we recommend that CERES place signs promoting the app around the Main Entrance, Visitor Center, and other highly trafficked areas around the park.

We recommend that CERES makes the park more attractive to new visitors by making the park easier to navigate through increased signage. We also recommend that CERES adds a trivia-based scavenger hunt activity, filling the role of a self-guided tour to be used by new visitors and tourists.

Although our WPI student playtesters gave many positive comments about the general atmosphere of CERES and its appeal as a tourist location, they universally found it difficult to navigate the park. To encourage increased tourist attendance, we recommend that as a first step, CERES increase signage around the park pointing to the major attractions.

Significance

Our project resulted in both functional activities and research-supported recommendations which will have tangible benefits for CERES. After we conducted research establishing that visiting families find the idea of additional activities at the park very appealing, we were able to use the combined knowledge of many of the on-site staff and educators to create a comprehensive set of guidelines for activity creation and evaluation. Using these guidelines, we created seven complete activities that each received extremely positive feedback from visiting family playtesters. We also produced data useful to park management on the characteristics of visiting families, usage of the various entrances, and the park's location hotspots. Finally, we were able to use our research and playtesting to make several recommendations to CERES to further improve both the Chook app and the park itself. These combined deliverables will greatly aid CERES in the future by ultimately allowing it to expand its audience.

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Chapter 1: Introduction

Melbourne's Center for Education and Research in Environmental Strategies (CERES) is an international leader in community and environmental practice, a vibrant and culturally diverse 11-acre eco-oasis visited by over 400,000 people each year. The site features a large number of cutting-edge green technologies that can be experienced through a variety of immersive activities including school excursion programs, adult classes, and corporate volunteer groups. These combined programs have made CERES Australia's largest provider of environmental education. But despite the park's impressive offerings, its interactive activities for visitors are limited to those requiring staff supervision.

As a first step toward removing this limitation, CERES launched the Chook mobile application in October 2015, which provides visitors detailed information about different aspects of CERES based on its location within the park. However, because the app does not support interactive features, CERES leaders needed a way to take this engagement a step further. Their long-term goal was an innovative, interactive, and fun solution to engage visitors with the higher concepts and values of the park, to make the park more appealing as a destination for families with young children, and ultimately to attract a wider audience. The immediate challenge was to combine the ubiquitous power of the Chook app with the multitude of inspirational features within the park.

After determining that the addition of family activities would be a good fit for CERES, our specific project goal became the development of a set of fun activities that will attract families to CERES and allow them to interact and engage with the park. Meeting this project goal required gauging interest level for family activities at CERES across different kinds of visitors, identifying the specific design criteria and evaluation factors for activities at CERES, selecting optimal locations in the park to place activities, and testing the success of the activities we designed.

Our work has provided CERES with seven complete activities, as well as a set of detailed activity design and evaluation guidelines to enable easy addition of new activities. Additionally, our development efforts produced useful findings on visitor characteristics, entrance usage, and location hotspots, which will support current park management in planning future operations. Our final set of recommendations to CERES included suggestions for improvements to the park, modifications to the Chook app, methods for increasing app usage among visitors, and potential ideas for future exploration regarding increasing park appeal to tourists.

Chapter 2: Background

Today, Australia faces a variety of serious sustainability challenges including water scarcity, renewable energy, loss of biodiversity, and ozone layer depletion (Hobday, 2014). Unfortunately, when environmental activists attempt to encourage sustainable behavior, they consistently experience difficulty in engaging their audience (Malykhina, 2014). This has led the Centre for Education and Research in Environmental Strategies (CERES), a community environment park and sustainability center in Melbourne, to investigate the use of interactive activities to expand its impact.

In this chapter, we will discuss CERES Environment Park and its work to promote sustainability, why it is interested in interactive activities for families, the characteristics that effective activities should possess, examples of relevant activities at other parks and museums, and the knowledge gap which our team examined.

2.1 CERES Community Environment Park

CERES was established in 1982 and is located on 11 acres along the Merri Creek in East Brunswick in Melbourne. The land is the historic home of the Aboriginal Wurundjeri people, but following the Victorian gold rush, was turned into a blue stone quarry and then landfill. CERES acquired the land in 1982, rehabilitated it, and converted it into a community environment park that is known by 25% of Victoria's residents and visited by over 400,000 people every year (CERES 2014).

2.1.1 CERES Mission and Message

The mission of CERES is to be "a place for community-based learning and action to create environmentally beneficial, socially just, economically satisfying, culturally enriching and spiritually nurturing ways of living together" (CERES, 2015). The organization aims to combat Australia's environmental problems by leading people towards environmentally sustainable lifestyle choices, not through indoctrination or a political agenda, but by stimulating thought and discussion (Ian, 2015). Indeed, one of the special qualities of the park is its ability to signify a wide range of ideas (Sieta, 2015). A recent survey of CERES members asked respondents what they loved most about it, and the world cloud in Figure 2.1.1-1 shows their diverse responses. It captures the community oriented values of the park.

Figure 2.1.1-1: "What do you love most about CERES?" Word Cloud

2.1.2 Park Overview

The 11 acres of CERES park is comprised of many different buildings and attractions that teach about sustainable ways of living, as shown in Figure 2.1.2-1.

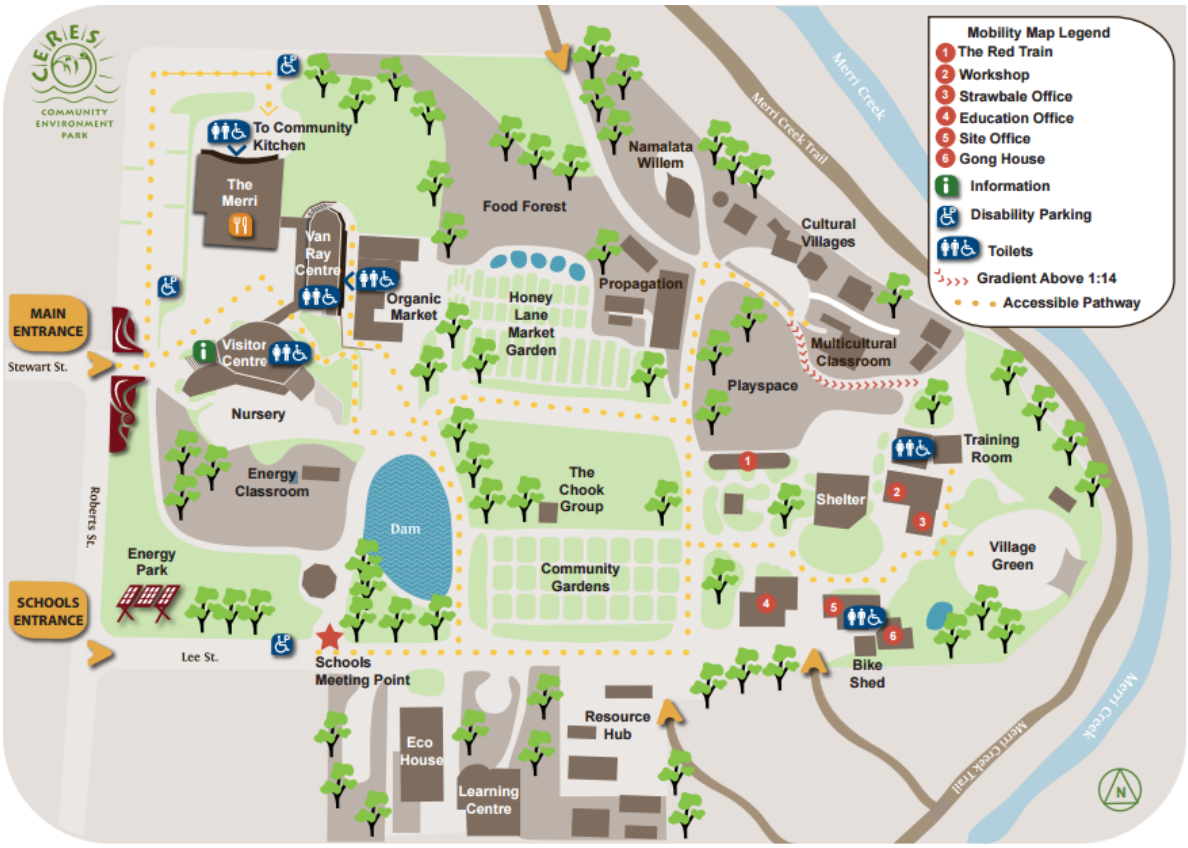

Figure 2.1.2-1: Map of CERES

The first areas that one would encounter when entering CERES are the Merri Table, Organic Market, and the Nursery. These are commercial areas that are highly frequented by visitors; they may stop at Merri Table for lunch or coffee, buy food at the Organic Market, or purchase plants at the Nursery.

Another popular attraction of CERES is its gardens. Honey Lane Market Garden is used to produce some of the produce that is sold in the Organic Market. The gardens are also used for educational purposes to teach people about sustainable urban gardening. The other gardens on site are the Community Gardens where people can grow their own produce to use.

Another focus of CERES park is its commitment to green energy resources. The energy park contains many examples of reusable energy sources including: solar panels, solar heating display, wind turbines, hydroelectric display, and a wind powered water pump. One way CERES demonstrates the usefulness of renewable energy sources is through its Eco-House. The Eco-House uses environmentally sustainable ways of heating, lighting, and insulating the house.

CERES also offers a Playspace, an area geared towards children having fun. This may not be like the regular playground you are used to; there are no swings, or monkey bars or jungle gyms. This area is focused on imaginative play for the children and has a sandbox, an adobe hut, a lookout tree fort, and a bamboo structure for children to play on.

The way CERES uses signage all these different parts of the park to teach people about sustainability. There are signs at different areas part of the park to explain the sustainable attractions are and how they are used. These signs are one of the ways people can be educated about sustainable ways of living while at CERES.

2.1.3 CERES Education

CERES' primary form of education is through its excursion and incursion programs with a combined reach of 69,000 students (CERES 2014). The incursion program involves CERES educators visiting a school to teach them about sustainability topics, and excursion programs involve students who are brought to CERES to learn while they are at the park through various hands-on activities led by CERES educators. There are over 70 programs and activities that CERES offers. These activities span the six subject areas shown in Figure 2.

Figure 2.1.3-1: Areas of study for excursion programs (CERES, 2015)

When students arrive at the park, they begin with a short introduction to the topic they are learning by their instructor. The instructors then lead the students through a short interactive activity before the program concludes with a summary and key takeaways for the students to think about. Most of the activities that occur, especially those involving specialized equipment, must be monitored and directed by an instructor.

One example of an activity that CERES offers is the "Merri Creek Walk" that is targeted towards primary school children. The activity consists of a tour along the Merri Creek by an excursion instructor who teaches about the importance of avoiding pollution. The excursion activity also engages the students by using a pick up tool to pick up litter along the creek. This activity follows the principles of experiential learning with the excursion teacher facilitating an activity and providing thought provoking questions to the children.

Another excursion activity is "Where Food Comes From" that aims to teach children about where the food they eat comes from. This program takes the concept of food and where it comes from and makes it fun for students to learn. This program is interactive and stimulates the students to think about what they are doing. One part of this activity is giving the students different plastic pieces of food and they have to tell the class what is and where it came from, whether it is from a cow, chicken, goat, or pig. The children are excited because they get to touch and hold something while they still have to think critically about what they are holding and where it came from.

A third activity is called "Netting", in which students learn to identify the quality of the water in the park's dam. This program is a way to get the students discussing and thinking about water and how it connects to the environment around it. The students break up into groups of three and use nets to identify organisms that are living in the dam. Only a certain quality of water will allow organisms to live in it and the students try to discuss the quality of the water and come up with an answer amongst themselves. Having the children collaborate enhances their critical thinking on the subjects that they are studying (Gokhale 1995).

CERES also uses a sustainability education model with 5 branches; understanding, transferability, experience, empowerment and values. Each of these five branches brings different elements to the lessons. Understanding brings scientific facts and knowledge into its programs. Transferability makes it so that each lesson can be applied to multiple areas in life. Experience gives people the opportunity to get in touch with the outdoors and sustainability. Empowerment motivates to change the future and be more sustainable. Values that the programs try and promote deal with respecting future generations (Figure 2.1.3-2).

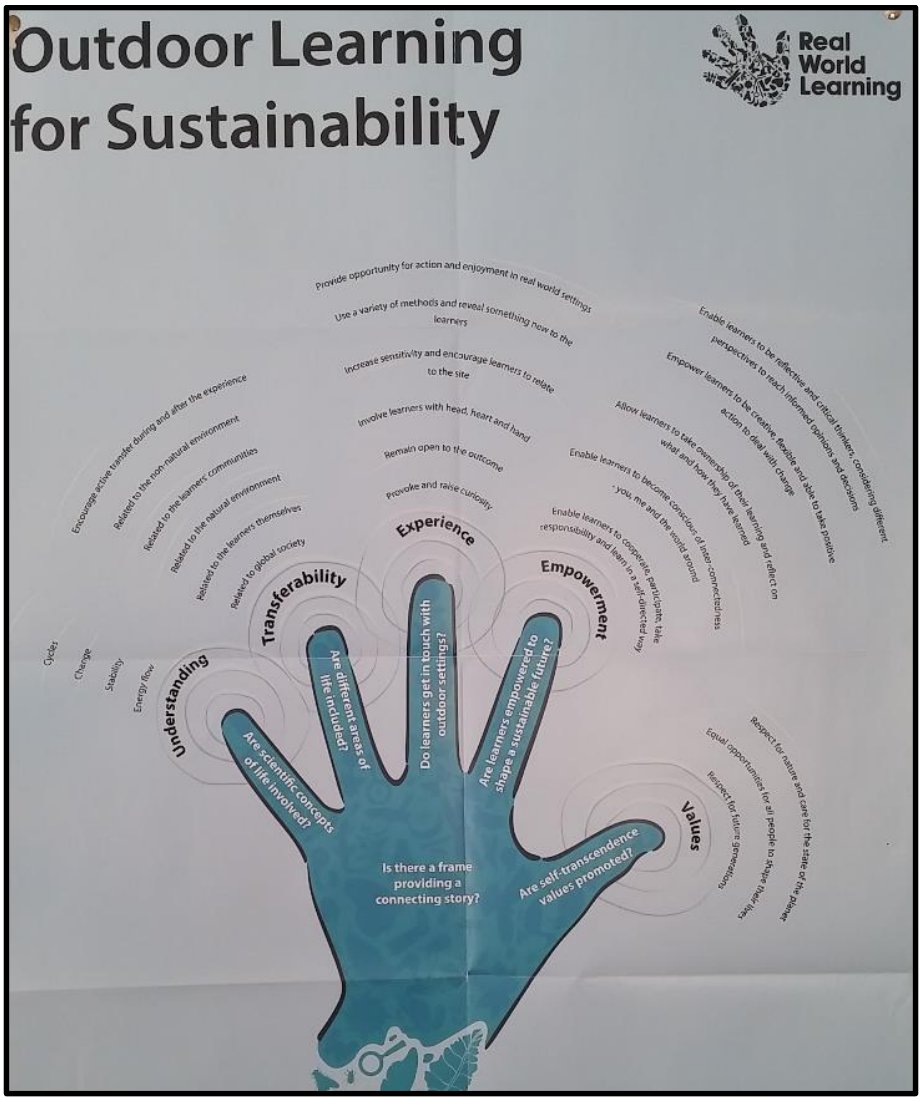

Figure 2.1.3-2: Outdoor Learning for Sustainability

2.1.4 Family Activities at CERES

Although CERES is expansive and contains many attractions, most of the activities are designed for large supervised programs such as the excursions (Sieta, 2015). Thus, outside of the Playspace, there are very few interactive activities suitable for visiting families with young children, the demographic this project targeted (Survey Data, 2015). Such family centered activities could appeal to some of the 386,000 people that visit CERES in a year (CERES 2014).

One way that CERES has tried to give everyday visitors more knowledge about the park is through its new app, the Chook. The app provides more in-depth information and history on many of the attractions at CERES. However, it still lacks the hands-on element that the excursion programs have. Also the app does not have a large user base with only an average of one user a day (Chook Statistics, 2015). To give visitors of the park an experience that is closer to that of the excursions, CERES is interested in creating family-friendly, interactive activities in which visitors can participate without the direction of an excursion teacher.

2.2 Activity Design Principles

Any interactive activity created by CERES should infuse principles of education and engagement. Ways in, which CERES can make more educational and engaging activities are explained in the section below.

2.2.1 Experiential Learning

A first step to reducing environmental problems is to educate people about the issues that are problematic (Kolb 2014) and one of the best ways to do this is through experiential learning. Knowledge can be defined as a process of using and testing information learned continuously through experience (Kolb, 2014). This process is a cycle (depicted in Figure 1) that consists of concrete experiences, observations and reflections, foundation of abstract concepts, and testing implications of new concepts (Dieleman & Huisingh, 2006).

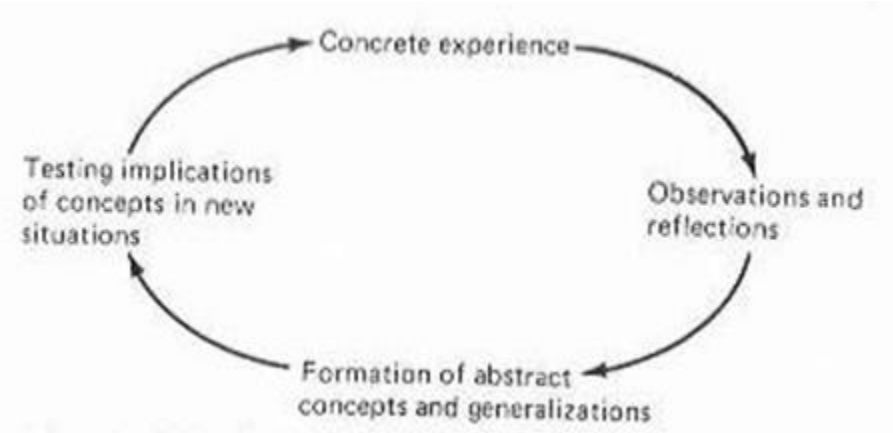

Figure 2.2.1-1: Kolb's Cycle of Experiential Learning (Kolb 2014)

CERES excursion activities are able to illustrate the cycle of experiential learning. Concrete experiences are students participating in an activity such as sorting food into the correct bin or taking a walk along the Merri Creek. The second step, observations and reflections, occur when the excursion instructor explains concepts to them and poses questions. Abstract concepts are formed as students recognize what they learned at their activities around the park. Finally, students test implications of concepts in new situations when they try to apply what they learned from the CERES excursion in their daily lives (Dieleman & Huisingh, 2006).

This cycle of experiential learning is a way for people to learn about environmental issues in a hands-on fashion. The hands-on approach to learning has been shown to increase knowledge transfer and the ability to transfer knowledge to different subjects (Kolb 2014; Wurdinger & Bezon, 2009) CERES Community Environment Park is one organization that uses this approach to teach people.

2.2.2 How do People Learn From Interactive Activities?

There are many ways interactive activities can be used to teach effectively. One way is to design an activity that is both engaging and enjoyable because those two characteristics facilitate learning. In order to make an activity enjoyable and engaging, it has to incorporate certain elements. One noteworthy element of learning is riddles, because they stress the development of knowledge

and skills throughout the task (Rubino, 2015). Another one is to present challenges. Successfully incorporating a challenge into an activity requires a clear goal, the ability to inform the player of their progress to completion, and uncertainty on whether the goal is reachable. For instance, time limitations introduce a win lose scenario, which drives people to learn from the activities. According to B.F. Skinner, repetition due to failure leads to more in depth learning (Ebner, 2005). Lastly it has been found that with cooperation vs competition, cooperation is better in facilitating learning (Rodger, 1988). These are all valid elements to make people learn from activities.

2.2.3 Children's Attention Span

There is a small positive correlation between the attention span of primary school children and their age (Schmitt, 1999). Several empirical rules describe this correlation and their results vary. On the low end:

Attention span = Chronological age + 1

This implies, a 7-year old has an attention span of about 8 minutes. Other rules yield estimates of greater attention span for a given age.

Attention span = 3 * Chronological Age

This implies that a 6-year old has an attention span of about 18 minutes (Schmitt, 1999).

However, age is not the only indicator of attention span . A significant factor affecting the attention span is how interesting an activity is to the participant. According to Kate Phillips, who is the senior exhibit curator at ScienceWorks in Melbourne, the level of attention given to an activity as well as the interest level of other activities located close by affects the attention span of the children. Specifically, if an activity is interesting and there is no other really interesting activity in the vicinity, the attention span is expected to be long. However, if there are many interesting activities the attention span is split between them because the participant would like to try all activities. Hence, activity design parameter should consider spacing between activities.

2.2.4 Interactive Activities' Effectiveness in Increasing Engagement

Interactive activities such as multimedia guides are known to better engage participants compared to standard activities, such as drawing (Hauenschild, 1998). Studies have shown multimedia guides keep visitors in museums longer because they are more engaged with the exhibits (Rubino, 2015). There are many strategies to use when designing interactive activities. One strategy is to present the player with a challenge, which will keep them motivated and invested in the game until they overcome it, two ways of presenting a challenge is to have variable difficulty level or to introduce competition (Ebner, 2005, Malone, 1980). Another strategy for engagement is to induce the so-called flow experience, an optimal state in which people are so engaged in an activity that nothing else seems to matter. This flow experience is made possible when challenges aline with the main goal of an activity. There are some pitfalls that have to be avoided when making an activity. One example is the complexity of the task and challenge; it can't be too easy or too hard or the activity will lose the person's attention (Kiili, 2005).

2.3 Case Studies

In order to effectively design our activities at CERES, we examined how other organizations are using games to help people learn and engage with their organizations. Here are case studies of games and activities from which we can extract relevent design information.

2.3.1 Palazzo Madama - Museo Civico d'Arte Antica

Museo Civico d'Arte Antica has a location-based mobile game called "Gossip at Palace", which was used in the Palazzo Madama museum in Torino, Italy. The learning objectives set out by the museum were to help the visitors understand the characters, traditions and events that defined the palace in the 18th century. To accomplish these objective, the following design goals were put in place:

- provide a story as a basis of the game tasks
- implement role-playing to enhance visitors' emotional engagement
- provide contextual clues linked to specific places; integrate microgames challenging visitors' skills
- integrate rewards with exploration and tasks to enhance visitors' motivation
- balance two conflicting elements, such as competition and knowledge acquisition

The results of this case study on the "Gossip at Palace" game show that across all age ranges there is a general appeal of the activity and that the activity achieves the learning objectives of the museum curators. Furthermore, the game verified that points and badges create an intrinsic reward system that motivates people to continue playing. Also the dialogue between the characters in the game was well received, because it made the arduous task of reading entertaining, which was an unexpected finding. On the downside, a careful consideration of the art style of the game is still required, since some adults thought the game looked too childish. Also, play time has to be reconsidered since there was a large number of players who did not complete the game because it was too long (Rubino, 2015).

There are several of conclusions we can draw from "Gossip at Palace". First, a story-based learning game is one way we can help people learn very basic concepts. Second, the inclusion of a reward system incentivizes people to play the game longer. Finally, we need to choose an appropriate art style for our audience.

2.3.2 Internal Force Masters

Internal Force Masters is a web based game used throughout North America and Europe to teach civil engineers about internal forces. The goal of the developers was to create an online computer game that is fun and motivating. To achieve this goal certain design principles were implemented, which are the following:

- The target group must identify with the contents of the game
- A lose–win situation has to be implemented for higher motivation
- Difficult time limits should induce the learner to play again and again, which causes more in depth learning
- Make the difficulty adjustable, which may help motivate players

The first conclusion was that the game was noticeably more enjoyable than expected. Given that game-based learning is equally or more effective compared to traditional learning (Ebner, 2005), the fact that the game is more enjoyable renders it a superior choice. Furthermore, it was shown that introducing a high score list and difficult time limits motivated people to play more than once, since 98% played the game at least twice. Lastly, incidental learning was achieved through the game, which is learning that occurs when one does not play the game with the intention to learn, but still learns (Ebner, 2005).

There are several points we can take away from this case study. Game based learning is an effective way of inducing learning. Additionally, motivating people to play can be done through difficult time limits that cause a win lose scenario and a competitive score board where people can aspire to put their names on.

2.3.3 DUMP Awards

DUMP (Damaging and Useless Materials from Packaging) awards are real-life annual awards designed by Environment Victoria, a leading Australian environmental group to the company that sells products with ridiculous amounts of packaging. Awards are also given to products that have recyclable parts to their packaging.

The CERES Education staff created the DUMP awards activity based on the real-life awards. It is intended for grades 5 and 6 and the mission is to award the worst and the best packaging within a given set of products. Children are asked to count the number of pieces of packaging for each product and write down their results. Then, they need to rank the products from worst to best. The worst product receives the DUMP award.

Although this activity does promote sustainability and learning on recycling and proper packaging, it was unsuccessful due to two main reasons. Children did not particularly like it because the pictures of the birds drawn on the instructions sheet rendered the activity more childish, thus not appropriate for the intended 10-12 year old children. The CERES educators also realized that the activity went against CERES values since it was paper based, therefore contradicting CERES efforts to limit waste. Hence, when creating activities the above mistakes should be avoided.

2.3.4 Kingfisher Trail

The return of the kingfisher bird is a symbolic story for CERES. The Sacred Kingfisher left the Merri Creek area after it had been polluted and did not return until CERES and the community began to rehabilitate the area. CERES cares for the Kingfisher and a visitor can find many depictions of this bird around the park. A few such depictions of this bird can be found along the Kingfisher trail.

The Kingfisher trail is a series of five signs spread throughout the park that are meant to teach people about the Kingfisher. These signs answer questions such as: where does the kingfisher live, what does sounds do they make, what do they eat, and why are they important to CERES. A problem that this activity encountered was that a visitor had to specifically ask for a handout from the visitor center. Visitors did not know to ask for this sheet and thus they were never used. The signs are still standing but visitors do not traverse the trail because, the typical visitor does not often stop by the visitor center (Sieta 2015).

Chapter 3: Methodology

The goal of our project was to develop a set of fun family activities that will attract new visitors to CERES and allow them to interact and engage with the park. In order to achieve this goal, we have developed the following research objectives:

1. Gauge interest level for additional family activities among different kinds of visitors
2. Identify activity design criteria and evaluation factors and weight the evaluation factors
3. Select optimal locations in the park to place activities
4. Test the success of the activities to provide a roadmap to CERES for future work

In this chapter, we describe the methods we utilized for each of our four objectives.

3.1 Objective 1: Gauge Interest Levels

Our first objective was to gauge the interest levels among different kinds of CERES visitors for interactive and engaging family activities. Because the questions that were trying to be answered by this are primarily quantitative statistics, we chose surveys as our data collection method (Couper, 2001).

These surveys were distributed through the organization's monthly newsletter and Facebook page, which had been previously demonstrated to produce excellent results (Beckwith, 2015). The number of newsletter recipients was estimated at 8,000-10,000 (Infographic, 2014). The number of Facebook recipients was estimated at 3,000-5,000, based on the 35,000 CERES page likes and studies stating that the average Facebook post reaches 9-16% of people who like a Facebook page (Cohen, 2015). Although there was a potential for overlap between the two groups of recipients, IP address recording was used to recognize if multiple survey responses arrived from the same computer (Qualtrics, 2015).

Although we originally considered including additional surveys conducted with park visitors, we later concluded that such additional research was unneeded given the low variation of results obtained through our newsletter/Facebook survey.

3.1.1 Surveying Families with Primary School Children

In order to filter survey responses to members of the target audience (families with young children), we included a preamble with our survey that asked only parents or caretakers of children in primary school to complete it. We used sponsor feedback to refine its structure and content, in particular by limiting it to six questions (plus an additional contact request at the end). The specific information we sought to obtain from each survey respondent included:

1. Frequency of visits to CERES
2. Primary locations visited
3. Average visit duration
4. Number of children in typical group
5. If additional activities would appeal to them, and why/why not
6. If structured tours/guides would appeal to them, and why/why not

7. Willingness to return for playtesting

Topics 1-4 primarily served to weight responses to Topics 5-6 for cross-tabulation and regression analysis, as we anticipated that visitors' interest in activities would vary across those variables (Dillman, 2000).

The complete survey may be found in Appendix A.

3.2 Objective 2: Identify Activity Design Criteria and Evaluation Factors

After gauging visitor interest in activities, we needed to determine the guidelines which would be used to develop our initial list of activities. We divided these activity guidelines into **design criteria** and **evaluation factors**. The design criteria served as a set of minimum requirements used to filter our brainstormed ideas into an initial long list. We then weighted each evaluation factor by importance and assigned each activity a score for each factor, allowing us to rank the activities. After discussions with our project sponsors, we used these rankings to decide upon a short list of seven activities to implement (described in Section 4.2).

To identify the design criteria, we first familiarized ourselves with the culture and mission of CERES, and learned firsthand about its exhibits and programs. This included having informal conversations with staff and volunteers, meeting with our sponsors, exploring the park, testing the Chook app (described in Chapter 2: Background), sitting in on excursion programs, and viewing informational material only available on-site. The design criteria we decided upon were:

- Age Range required for the activity
- Education
- Fun
- Number of People required for the activity
- Robustness
- Safety
- Values and Message

Two additional criteria that we considered to a lesser extent during the process of identifying design criteria were **cost** and **sponsor appeal**. Regarding cost, our sponsor did not want it to be a limitation causing us not to pursue an otherwise good activity idea. Sponsor appeal was moderately considered in creating activities because it would be the sponsors themselves who would be using our criteria in the future.

Distinguishing between the design criteria and the evaluation factors is important. The number of people and age range required for our activities are only considered in the design part of our activities. They were not used to evaluate the activities because we considered them irrelevant to how effective our activities are. On the other hand, safety, fun, robustness, values and education were indeed used as evaluation factors because the effectiveness of our activities is directly linked to how well they do according to these factors. The evaluation factors are:

- Education
- Fun

- Robustness
- Safety
- Values and Message

Subsequently, we needed to determine the relative importance of each of these five factors, in order to produce a weighted matrix for evaluating possible activities. Because the design criteria and evaluation factors required delving into more depth than we deemed appropriate for a simple survey (Dillman, 2000), we chose to conduct semi-structured interviews, which allowed us to address each key topic while still allowing new ideas and themes to be probed by follow-up questions (Turner, 2010). The three groups of people we interviewed were CERES staff members, CERES excursion teachers, and industry professionals who are experts on activity design . Although we also considered interviewing chaperones for the excursion program student groups, the structure of the programs left very little time available to the chaperones for any such extended conversations. (See Section 4.3 for analysis and weighting results.)

After discussing with our sponsors and analyzing a list of CERES employees and volunteers, we were able to identify six staff members and four excursion teachers with relevant experience. Our sponsors also recommended two local experts in activity design (from RMIT University and Museum Victoria).

3.2.1 Interviews with CERES Staff

To establish a solid foundation of knowledge about CERES and its values, we began our interviews with six staff with administrative and educational roles. The staff we interviewed were the following:

- Shane- Excursion Manager
- Nick- Site Manager
- Jane- Outreach Educator
- Lorna- Adult Education Manager
- Belinda- Site Gardener
- Sieta- Communications Manager

These different backgrounds were able to to give us multiple insights into the different design criteria and evaluation factors including: safety, fun, robustness, education, values, and activity placement. The specific topics we addressed included:

- Any issues/obstacles for us to consider from a park management perspective when designing, building, installing, and maintaining our activities
- Values and message of the park, and its separate parts (as defined by the site map)
- The importance of fun versus education
- Potential locations to place activities
- Personal ideas for activities

The complete framework of topics and questions may be found in Appendix B.

3.2.2 Interviews with CERES Excursion Teachers

Since the four CERES excursion teachers we interviewed work directly with children in the park by leading interactive activities, their insight was extremely relevant to our project. The specific topics we addressed included:

- What messages/values they try to convey through the different activities they teach
- The importance of fun versus education
- Which kinds of activities children seem most engaged with
- How teaching/activity design has to vary across age groups
- Any existing programs/activities that could be scaled down to be suitable for visitors
- Personal ideas for activities

The complete framework of topics and questions may be found in Appendix B.

3.2.3 Interviews with Industry Professionals

To gain general theory and knowledge on how to design superior interactive activities, we interviewed two experts outside of CERES: Lauren Ferro, a Ph.D candidate at RMIT University, and Kate Phillips, an exhibit curator from the Scienceworks museum in Melbourne.

Lauren Ferro has done a large amount of research into the design of videogames, specifically on how different personality types and gameplay habits correlate with enjoyment of a new game. The specific topics we addressed with her included:

- Foundations for gamification and the difficulty of intrinsic motivation
- Existing examples of large activities tailored to children/adolescents
- Examples of game mechanics which are exceptionally popular/well-received
- Potential obstacles we should avoid when designing our activities
- How children interact with technology
- Feedback on our preliminary activity ideas

Kate Phillips has a great deal of experience designing interactive museum exhibits for a wide variety of ages, and has specifically worked on several exhibits which have sustainability themes. The topics that we addressed with her included:

- What kind of exhibits/activities keep children engaged
- Which exhibits children find most fun, and why
- The process used for creating an exhibit for children
- What differences arise among the different age ranges
- The importance of an underlying theme throughout all activities
- The balance of education and fun
- How to best engage parents

- Specific game ideas that may work for CERES
- The proper methods for playtesting

The complete framework of topics and questions for both interviews may be found in Appendix D.

3.3 Objective 3: Select Locations to Place Activities

After weighting the design factors for CERES activities, the next step was to select the optimal locations to place the activities. The two key elements we had to balance were ensuring that the activities were placed in a visible and high-traffic area, while still encouraging visitors to explore various parts of the park (Glick, 2015). Additionally, the activities could not be positioned in a way that caused congestion on the paths, particularly in areas used as central meeting points for the excursion programs (Shane, 2015). To accomplish this, we combined survey and interview feedback (described in Section 3.2), visitor entrance monitoring, and observation of visitors. Since CERES had no previous data on this topic, the information we produced was useful to the park managers as an independent deliverable (Glick, 2015).

3.3.1 Distribution of Entrance Usage

The CERES park has seven different entrances spread in all directions: Main, Main Energy Park, Energy Park, Lee Street, Flood Path, Bike Shed, and Creek. Although park staff have observed that many visitors use the alternative paths as opposed to the Main Entrance, the exact proportions were not known (Shane, 2015). Obtaining an empirical distribution of entrance usage allowed us to more fully understand visitor movement around the park, and thus, how they will be most likely to encounter one of our activities.

Figure 3.3.1-1: Entrances to CERES (Google Maps, 2015)

To collect this data, our team members positioned ourselves in locations capable of viewing each of the exits. Because the Main/Main Energy, Energy/Lee St., and Flood/Bike entrances were very close to each other, it was possible to cover all seven with only four team members. On two Saturdays during peak park usage hours (10:30-12:30), we recorded the number of visitors entering and exiting from each entrance, as well as whether the visitors were adults or children.

3.3.2 Hotspot Identification

To determine what locations are central hotspots for visitors to CERES, we developed a method of visitor observation which was a less time-intensive alternative to individual visitor tracking. Each team member was placed at a location with high visibility of the surrounding area, with a copy of the map of CERES on their laptop. At regular intervals of two minutes, the locations of all visitors in the area were marked as red pixels on the CERES map. On a Saturday, one of the busiest days of the park, we observed visitors between 1:30 and 2:30. Based on the average number of visitors to CERES, we determined that an observation time of one hour would be sufficient to generate the needed data, especially given that the selected time interval does not lack traffic. This process generated a point cloud of visitor locations throughout the park, which could then later be analyzed using data mining techniques.

3.3.3 Combination of Location Selection Methods

In order to select locations for our activities that were as close to optimal as possible, we combined the methods of interviews, entrance usage distribution and hotspot identification.

Specifically, the entrance usage distribution provided us with an idea of which entrances and areas of CERES would benefit the most from our activities. Then, the hotspot identification informed us of places in the park where visitors tend to congregate. An appropriate location may have been one which was suggested both by the hotspot identification and by the entrance usage of the park. However, if that location was deemed to be inadvisable for placing an activity by our interviewees, then we would not hesitate to reject it. On the other hand, if a location was suggested by all methods then we would seriously consider it.

3.4 Objective 4: Test the Success of the Activities and Chook App

A clear set of evaluation criteria for the activities we produced was needed to assess the success of the activities. For playtesting we determined that the best way to get feedback on our activities was to have families play the activities. The testing of these activities followed the formative evaluation design used by museums and other informal educational settings (Diamond, 2009). Three families, one family with a two year old, one family with a four year old, and one family with a six, eight, and ten year old, were playtested. These families were survey respondents who replied that they were willing to come to CERES to playtest the activities. The age of the children was slightly lower than the demographic of six to twelve years old that was originally selected, but it gave a range of children's ages that could be tested. All families were a mother with her children. The families were led to each activity and asked to play the activities.

After conducting some controlled playtests to provide initial feedback, we had fellow IQP student volunteers tour the park. These volunteers were being used to test the usability of CERES Chook application, the noticeability of the created activities, and overall feedback of the park.

3.4.1 Playtest

The use of a playtest allowed us to catch design flaws in our activities before they were publicly released. Respondents from our online survey were used as participants. The disadvantage of a playtest was that instead of discovering the activities and deciding to use them (or not use them) organically, participants were getting introduced to the game by our group. Thus, we were not able to make effective observations on whether the participants noticed the game in the first place.

For the playtest, participants were asked to download the Chook application onto their phone before coming to the park. Once arrived at the park the participant would be informed of the purpose of our project and shown to the area of selected activity we were in the process of testing. Once at the activity area, we would inform the participant of the name of the activity that they were meant to playtest. The participant would then have to find and test the activity on their own. We were nearby in the event that the user was unable to test the activity but otherwise did not interfere with the participant. The participants were given as much time as they wanted at each activity. After they were given the opportunity to use all the activities (during which we were making observations), we verbally surveyed each participant to obtain their feedback. Using previously established literature on evaluating museum exhibits we developed questions to ask the participants (Diamond 2009). Questions the playtest addressed include:

- How fun was the activity?

- General comments and improvements for each of the activities.
- Did any of the activities have CERES values that were apparent to you?
- Did any of the activities have educational activities that were apparent to you.
- Would you recommend the activities to a friend?
- Was the app easy to use and understand?

Results from playtesting were then used to improve activities and provide feedback for other activities. The complete set of observational guidelines and survey questions may be found in Appendix G.

3.4.2 Surveying Tourists of the Park

After the activities were playtested, fellow IQP student volunteers came to the park to give feedback on the park itself, the Chook app, and our activities. There were two groups of five students each who came to the park at different times. The first group began exploring at 10:00 and the second group began exploring at 11:30. None of the students had previously been to the park before, but they were asked to download the Chook app before arriving at CERES. The students were brought to the front entrance of the park and asked to use the app and explore the park for as long as they would like. We didn't want to influence or bias the groups as they explored the park and thus did not follow them as they explored the park.

After the groups had finished exploring they were surveyed together as a group. The reason for being surveyed as a group was because they explored the park together as a group. The survey covered topics that included:

- What areas of the park did the group visit?
- What did they enjoy about the park?
- What did they dislike or think could be improved about the park?
- If given the chance to visit on your own would you?
- How useful was the app in exploring the park?
- Suggestions on how the app could be improved.
- Did you find any of the activities around the park?
- Did you play any of the activities around the park?

The complete set of observational guidelines and survey questions may be found in Appendix G.

Chapter 4: Findings

After analyzing the data collected through our family surveys and interviews with CERES staff and outside professionals, we were able to develop preliminary findings. Our survey led us to discover that families who visited the park found the idea of interactive activities very appealing. We then went on to developing activities that we would be able to test for the park.

Through our work at CERES, we made several discoveries about which activities out of all our activity ideas would be the most beneficial to the park. Following a clear process for developing activities (Figure 4-1), we narrowed down our initial list to ultimately fully develop several activities. Our findings demonstrate all activity design criteria and evaluations factors, as well as limitations which affected our activity selection and development.

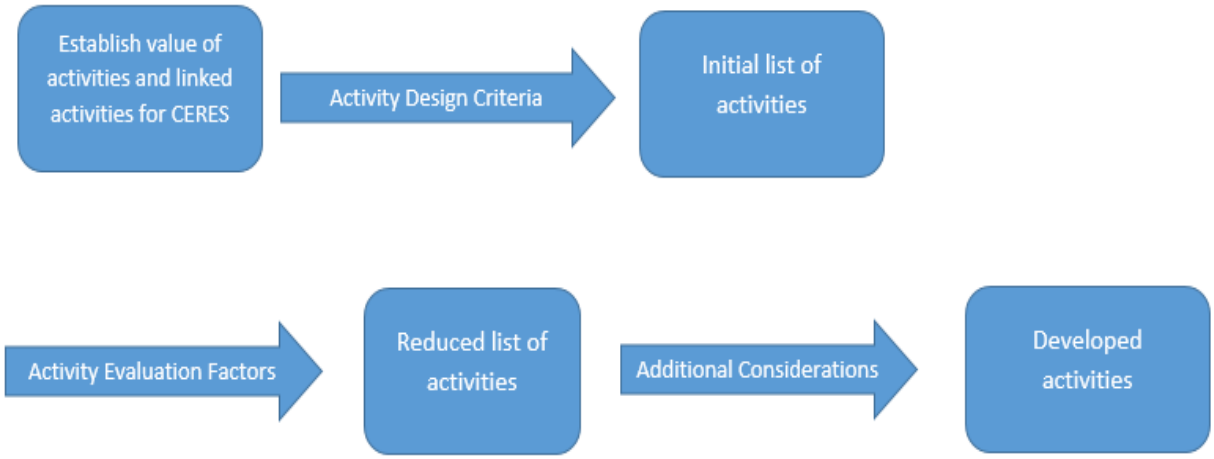

Figure 4-1: Activity Development Flowchart

Finally, after developing these activities and testing them through visitor interactions, we had a set of completed activities. The testing was not only used to refine the activities but was also used to discover areas of improvement for both CERES Chook application and the park itself. Providing CERES with these findings will help the community of the park better understand how visitors interact with the park and improve the visitors' experience.

4.1 Appeal of Family Activities and Linked Activities

The first step in our project was ascertaining that interactive activities are appealing to families, our target demographic. We needed to be certain that interactive activities would contribute to a positive experience for families at CERES.

Initially, we found out that family activities were appealing to families visiting the park. The responses to our Facebook and newsletter surveys and the open-answer feedback indicated that the majority of visitors thought that adding activities to the park would improve their experience at CERES (Figure 4.1-1).

Secondly, our survey's open response questions revealed a trend between familiarity with the park and linked activities. Linked activities promote guided exploration of the park, such as scavenger hunts, which can be appealing to visiting families that are new to the park. The majority of our survey respondents visit CERES on a monthly basis (Figure 4.1-2) and they found linked activities appealing in the open-answer feedback. On the other hand, visitors who found the idea of linked activities unappealing described themselves as being more familiar with the park.

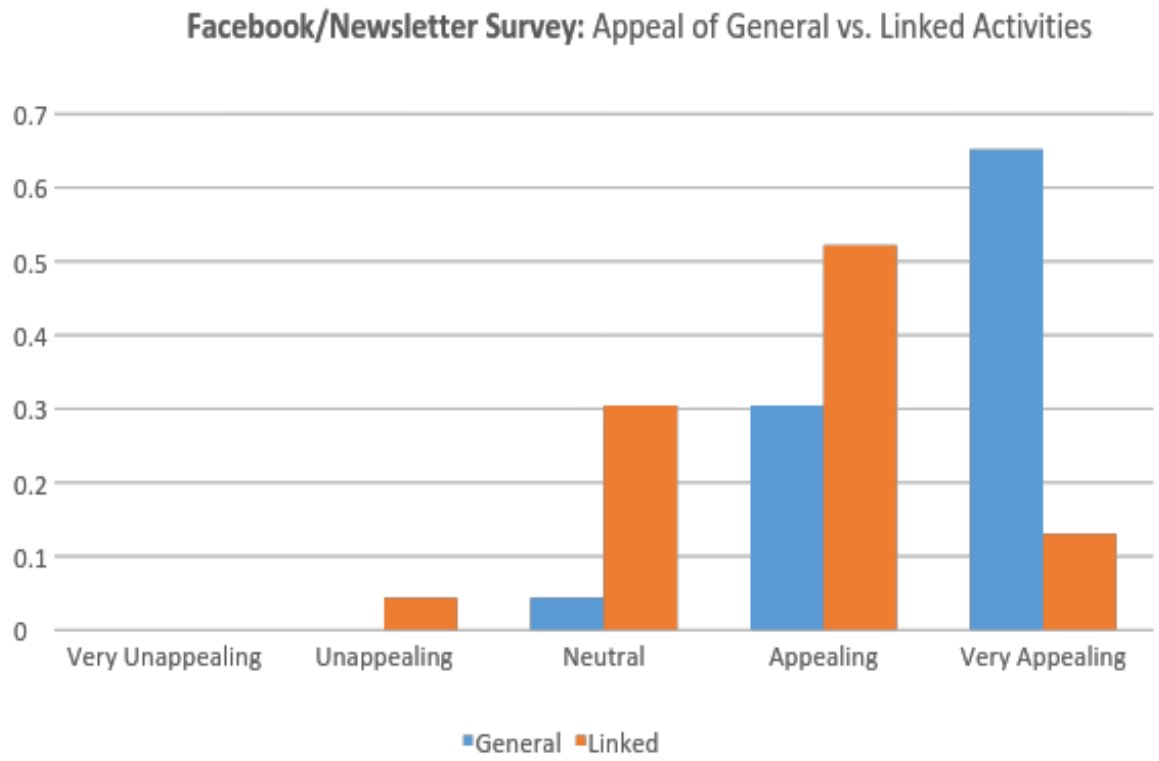

Figure 4.1-1: Bar graph showing the appeal of general and linked activities to respondents of our Facebook and CERES Newsletter Survey

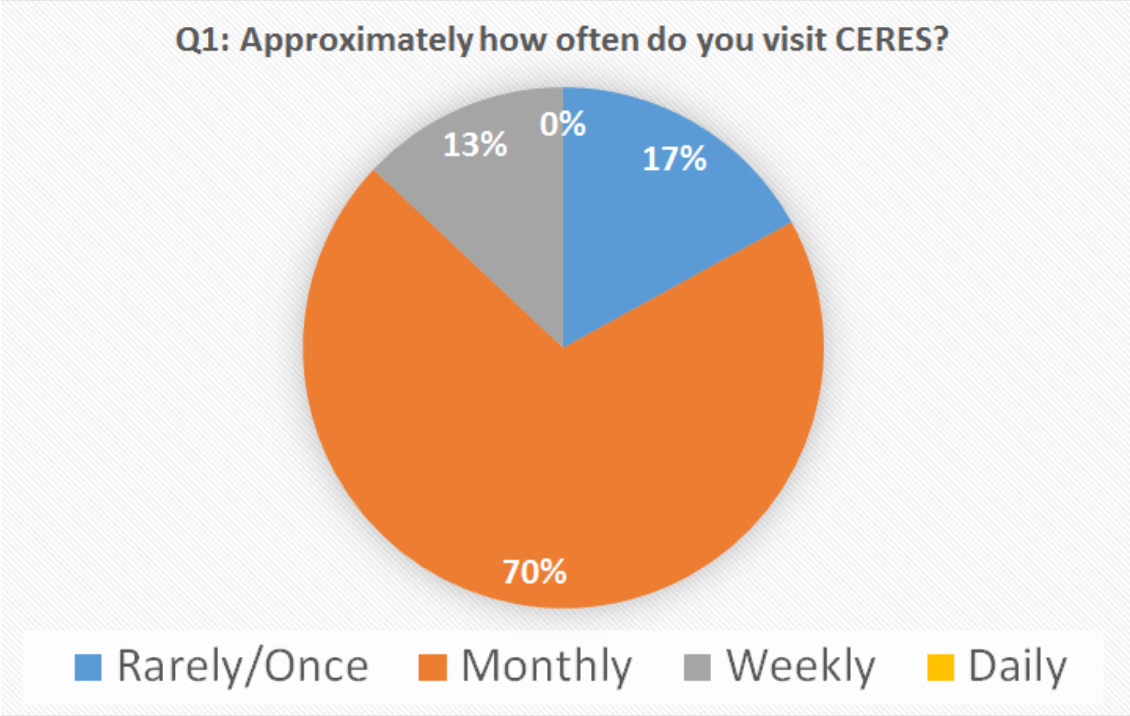

Figure 4.1-2: Pie Chart depicting the Frequency of Visits to CERES

4.2 Activity Design Criteria

Having established that family activities and linked activities have value for CERES, our team combined insights from the survey, interviews with CERES educators and professionals outside CERES, and research literature to determine activity design criteria. These criteria were essentially minimum requirements which had to be met by the ideas we produced through brainstorming in order for us to include them in our initial list of activities. The reason they were chosen was that multiple people mentioned them throughout our interviews.

One of these criteria was the **number of people** required for the activity. We thought it was a good idea to create activities which required two players, because the average group size (shown by figure 4.2-1) shows that most people visit CERES with either one preschool aged child or one primary school aged child. In the open-answer section of our survey parents expressed their desire to have activities which allow them to play with their children meaning they have to be designed for more than one user.

Another criterion we considered was the **age range** required to complete the activity. We found out that our activities should be designed for children from 3 to 9 years old, as opposed to 6 to 12 which we initially considered. The primary piece of evidence for this was derived from the entry and exit monitoring we conducted, the results of which we explain in section 4.4. Also from figure 4.2-1 the amount of people who entered the park with preschool aged children out numbered that of people with primary school aged children. Along with age range we had to consider the complexity of the activities, which was an important piece of information we got from our interviews with CERES educators.

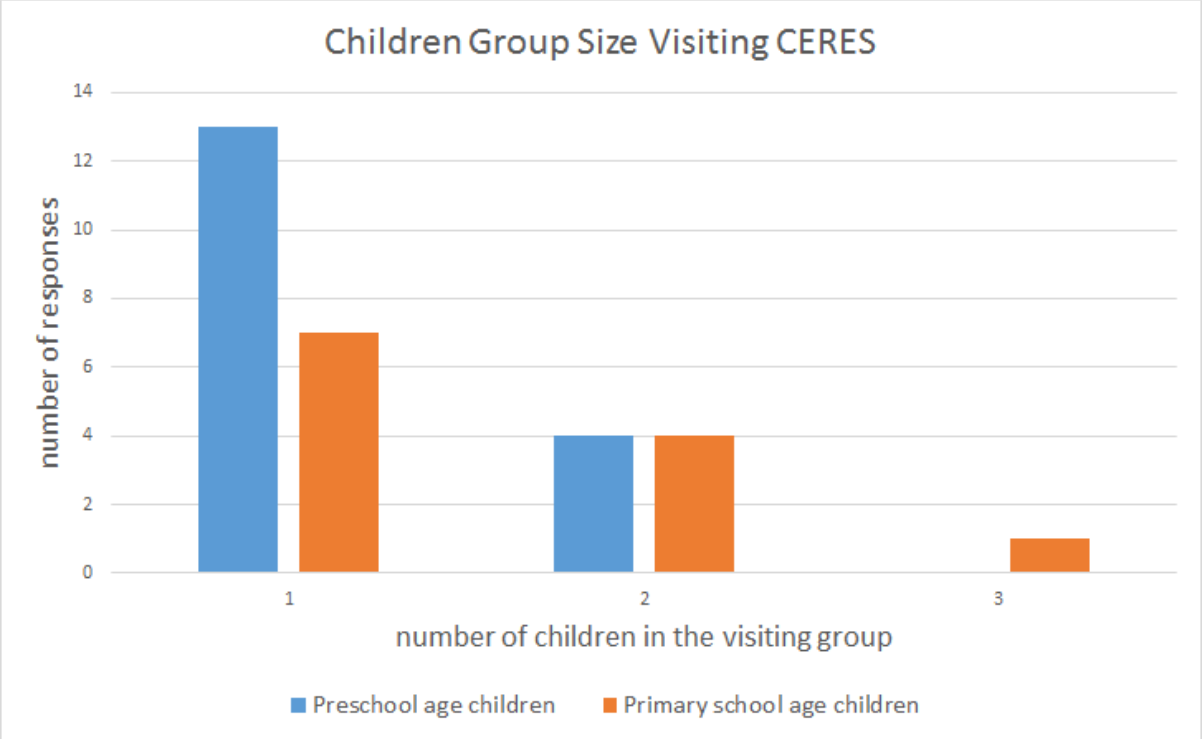

Figure 4.2-1: How many children are in visiting groups

Safety was one of the most important criterion that was touched on during interviews. We realized that safety is essential and this was emphasized by the CERES site manager in our interview with him. He pointed out that it is not only important to him, but also to CERES as an organization. CERES rates the safety of everything made on site according to its safety manual. Therefore, activity ideas which came up during team brainstorming sessions but failed to comply with the manual rules did not make it to our initial list.

The primary purpose of the activities is to make the experience of visitors at CERES more **fun**. Thus, creating entertaining activities was perceived to be an important design criterion both by our team and by all CERES staff during their interviews. The interviews yielded many results of what children found fun and the most common response was that children enjoyed tactile activities. Every activity on our initial list was designed to have some element that children found entertaining.

Finally, we designed the activities to be **educational**. Regardless of the degree to which each activity achieves that, all activities we initially considered incorporated educational elements so that visitors learn something about the park, the environment or the aboriginal culture.

Along with the design criteria, we learned from staff interviews to avoid activities which replicate those of the excursion programs that CERES is running. We also had to avoid conveying any negative messages to children, which can be easily done while trying to teach about sustainability.

Beginning with a brainstormed list of activities), we eliminate those that failed to satisfy all of the activity design criteria listed in section 3.2. Successful activities are listed in 4.2-1, where they are sorted by category of activity.":

Table 4.2-1: Initial list of activities

Category	Activity
Classic	Sliding Riddle Puzzle
	Kingfisher Puzzle
Observational	Picture Frame Tripod
	Weather Rock
	Sounds of CERES
Hands On	Bin Games
	Tree-Hugging
	Tree-Hugging Age of Trees
	Aboriginal Hand Talk Charades
	Musical Objects
Building	Giant Jenga
	Block-Building Challenge
Scavenger Hunt	Garden Scavenger Hunt
	Find the Kingfisher Scavenger Hunt
	Art Scavenger Hunt
	Aerial Picture Hunt
	Seven Wonders of CERES
Electronic	Turn off the Lights
	Lightbulb Bicycle

4.2.1 Classic

Classic was chosen as a category because these were simple game ideas that most people would understand what they are.

1. Sliding Riddle Puzzle
    a. Large Puzzle where children are given a riddle and the answer to that riddle will be a picture that they create by rearranging tiles.
2. Kingfisher Puzzle
    a. A small puzzle that depicts the Kingfisher habitat and has the story of the Kingfisher returning to CERES on it.

4.2.2 Observational

The observational category was created because it focuses on activities that are more about observing than interacting.

3. CERES in a Picture
    a. There is a frame that visitors can look through to see a great view of CERES. On the app there will be an old photo of CERES that they can compare to what CERES looks like now.
4. Weather rock
    a. Humorous weather forecast display to read on the app. Rock is warm it is sunny, Rock is wet it is raining etc.
5. Sounds of CERES
    a. Visitor uses the app to play sounds of birds/animals from around the park.. The players then tries to guess what made each sound.

4.2.3 Hands on

The hands-on category was created because having interactive activities was the original goal of the project and thus it was crucial to have a category dedicated to interactive activities.

6. Bin Games
    a. There are three different bins: Rubbish, Recycle, and Compost and the visitors are given different objects and they have to decide what correct bin the objects go into
7. Tree-Hugging
    a. Player 2 has to close their eyes in the middle of an area with many trees, and Player 1 spins them around and leads them to a tree. Player 2 gets to feel the tree. After Player 1 leads player 2 back to the starting point and spins them around again, Player 2 has to try to guess which tree they hugged. If they can't figure it out after 2 minutes, Player 1 wins. Then switch roles.
8. Age of Trees
    a. The player has to hug the tree and depending on how many hugs it takes to hug the tree and using the player's height, the age of the tree can be determined. There is a table in the app that does the conversion for the player.
9. Aboriginal Hand Talk Charades
    a. The visitor uses aboriginal hand talk that they learned throughout the park to play a game of charades that uses some of the hand signals they learned
10. Musical Objects
    a. The user uses hollow objects to create their own music.

4.2.4 Building

The building category was chosen because during the interview process the point that children enjoyed building was often brought up.

11. Giant Jenga
    a. Jenga made from large wooden blocks. Participants stack and remove blocks to try and create the highest tower possible without it toppling over.
12. Block Building Challenge
    a. The visitors are given a picture (in the app) of a block structure that they have to try and create on their own.

4.2.5 Scavenger Hunt

The scavenger hunt category was created for activities that were dedicated to exploring the park.

13. Garden Scavenger Hunt
    a. The user gets a clue that will direct them to a certain part of the park and once they are there you have to find different plants that are around that area. The scavenger hunt will change depending on the season and what is blooming during that time of year.
14. Art Scavenger Hunt
    a. The user will find the different pieces of art that are scattered around the park. They will be shown close up pictures of the art in the app. If you can find all of them, you win.
15. Aerial Photo Hunt
    a. The user will be shown different aerial photos of the park in the app and they will have to find out where that area of the park is.
16. Find the Kingfishers Scavenger Hunt
    a. The goal of the activity is to find as many different pictures of Kingfishers around the park as you can. Whoever finds the most gets their name on a board in the visitors center.
17. 7 Wonders of CERES
    a. The user will get clues and questions that direct them to different sections of the park. The goal is to answer all the questions and clues and make it all the way around the park.

4.2.6 Electronic

The electronic category was chosen because the use of sustainable technology and electronics is an important educational point of the park.

18. Turn off the lights
    a. There is a box with five lights inside and those lights are wired to switches. The switches are wired so that when you flip one switch, some lights will go on and some lights will go off. The goal of the game is to find the right combination to turn off all the lights.
19. Light Bulb Bicycle
    a. The visitor will use a bicycle to see how much energy it takes to power a light bulb.

4.3 Activity Evaluation Factors and Additional Considerations

As we explained in 4.2, the design criteria filtered a brainstormed list of activities to those that met those minimum requirements. Once we had that list, it was necessary to evaluate our activities. Through interviews with CERES educators and online surveys, we determined the activity evaluation factors. We used the evaluation factors to conduct the evaluation of our activities by

weighting the factors according to how necessary we and our interviewees thought they are for successful activities.

To begin with, **safety** must always be a first priority even though it was mentioned only by 3 CERES employees (Table 4.3-1). The site manager emphasized its significance to us and informed us that there is a safety manual at CERES. We consulted the standard safety procedures manual of CERES and held team discussions concerning the safety of each individual activity. Hence, we believe it clearly deserved the strongest weighting.

Fun was also on the top of our priorities, being the most discussed factor in our interviews (Table 4.3-1). As explained in 4.2, the primary purpose of the activities is to make the experience of visitors at CERES more fun. Thus, keeping the most fun activities was deemed important both by us and our interviewees. As shown in Table 3, fun is the only evaluation factor with a decimal place which stems from the fact that it was determined as an average of the scores given by 5 CERES educators and staff to ensure objective results.

Furthermore, our team learned by experience that as an outdoor, low-budget, and volunteer-driven institution, CERES relies on long-lasting and **robust** attractions which do not require maintenance. Specifically, the site manager suggested: "over-engineer everything to three times the strength you think it should have". CERES has had problems with vandalism and theft in the past. Hence, we paid particular attention to evaluating the robustness of each activity idea. Two factors were most significant in evaluating robustness. One was the longevity of the material which was required for the activity and the other was the site manager's assessment of robustness. Also, CERES staff have a demanding workload. Adding the maintenance of our activities to their workload would be a burden we had to avoid.

Table 4.3-1: The Number of Interviews in which each Evaluation Factor was mentioned

	CERES Educators (4 interviews)	CERES Management Staff (5 interviews)	Professionals Outside CERES (2 interviews)	**Total (11 interviews)**
Safety	2	1	0	**3**
Fun	4	3	2	**9**
Robustness	3	3	0	**6**
Values	3	2	0	**5**
Education	2	1	1	**4**

Our team also agreed that the **values and message** of CERES should be communicated through the activities. The relatively weak weighting of values and message for several of reasons. First, conveying the park's values is less important for frequent CERES visitors because they are already familiar with them. Secondly, allowing a visitor to draw their own conclusion or message out of an activity is preferable to trying to convey a pre-specified message. However, it does deserve to be an evaluation factor because some underlying theme was recommended both by a Scienceworks curator and by 5 CERES staff (Table 4.3-1). Measuring whether an activity is effective in conveying CERES' values is subjective, so instead of relying on our own judgement we asked 5 CERES

employees for their opinions. Then, we overlaid that with team discussion to come up with the grades in the matrix.

Finally, we considered **education** as an evaluation factor, as well as a design criterion, despite its weak weighting due to several reasons. First, background research suggested that people will not learn anything from an activity if it is not fun enough to play in the first place; they will get bored and abandon the game, thus losing any potential educational value (Agarwal, 2008). Secondly, several of our application-based activities incorporate education and engagement by teaching visitors on issues, such as the natural environment (i.e. Age of Trees activity) and culture (i.e. Aboriginal Hand Signals activity), while being fun. There is a section in CERES' Chook mobile application called "Curious" which includes facts related to the activity improving its educational value. In spite of the above, education could not have a stronger weighting, since during our interviews CERES educators unanimously agreed that other factors such as fun, robustness and values are more important.

Table 4.3-2: Activity Evaluation Matrix (AEM)

		Safety	Fun	Robustness	Values	Education	Totals
	Weights	10	9	8	7	6	400
Classic	Sliding Riddle Puzzle	8	7.2	7	7	6	285.8
	Kingfisher Puzzle	10	6.4	7	7	7	304.6
Observational	Picture Frame Tripod	10	7	8	8	7	325
	Weather Rock	9	5.6	9	8	7	310.4
	Sounds of CERES	10	6.8	10	7	8	338.2
Hands On	Bin Games	8	7.6	7	9	7	309.4
	Tree-Hugging	9	7.6	10	8	7	336.4
	Age of Trees	9	7.4	10	8	8	340.6
	Aboriginal Hand Talk Charades	10	7	10	8	7	341
	Musical Objects	9	7.8	8	8	5	310.2
Building	Giant Jenga	6	6.6	9	5	3	244.4
	Block-Building Challenge	6	6	9	5	4	245
Scavenger Hunt	Garden Scavenger Hunt	9	7.2	10	6	8	324.8
	Find the Kingfisher Scavenger Hunt	10	6.6	10	6	5	311.4
	Art Scavenger Hunt	10	6.4	10	5	6	308.6
	Aerial Picture Hunt	10	6.8	10	5	9	330.2
	Seven Wonders of CERES	10	6.2	10	8	10	360.8
Electronic	Turn off the Lights	9	6	4	6	8	266
	Lightbulb Bicycle	6	6.4	4	7	8	246.6

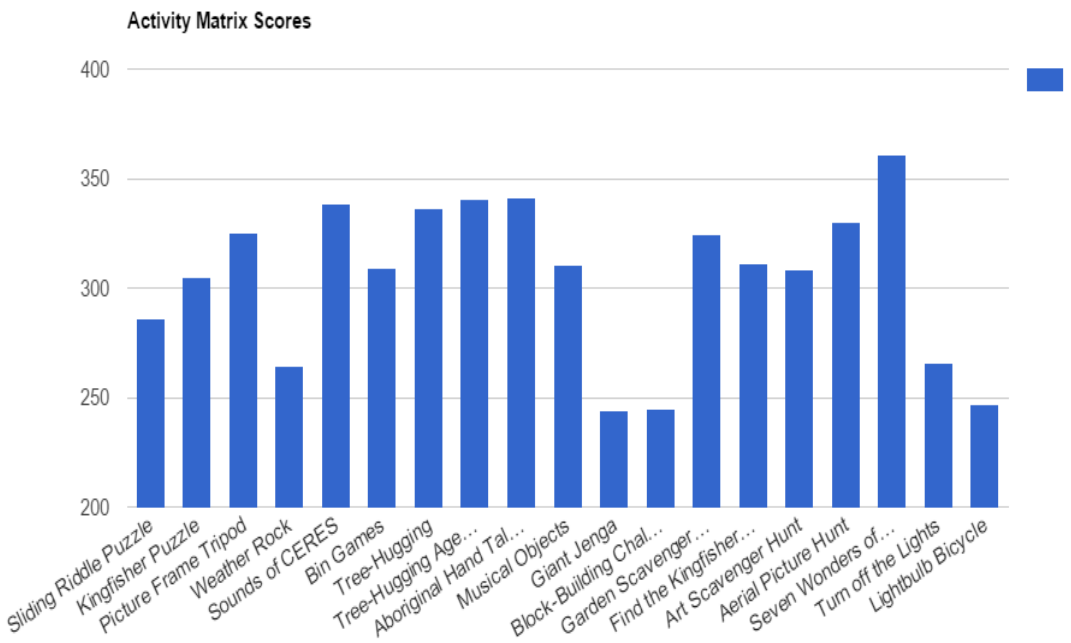

Figure 4.3-1: Histogram of Activity Scores based on Activity Evaluation Matrix

Based on the Activity Evaluation Matrix, the reduced list includes the following activities:

1. 7 wonders of CERES
2. Tree Hugging
3. Age of Trees
4. Sounds of CERES
5. Picture Frame Tripod
6. Aboriginal Hand Talk Charades
7. Weather Rock
8. Kingfisher puzzle
9. Sliding Riddle Puzzle
10. Bin games
11. Aerial Picture Hunt
12. Art Scavenger Hunt (the one scavenger hunt chosen).

During our work on the above activities, we were confronted with additional considerations and obstacles. First, CERES management insisted on avoiding signage. Extensive signage would ruin that natural character and environment of the park. Secondly, the tool shed of the park had recently been robbed. Therefore, most tools which were necessary to build some of our activities were stolen and had not been replaced yet. These obstacles rendered the kingfisher puzzle, bin games and sliding riddle puzzle, which were all physical activities, infeasible. Therefore, we made use of the Chook application, to which we could upload text and media-based activities.

Additionally the aerial picture hunt was delayed due to drone failure along with the backup drone being uncompleted. Finally the Seven Wonders of CERES, which scored the highest, was not deemed a particularly appealing idea by the communications manager and the partnership manager, namely our sponsors, and thus we did not proceed with developing it.

Therefore, from the activities we considered, we chose to implement those that performed well according to our evaluation matrix and were not rejected by other practical considerations.

The final list of activities that we developed:

1. Tree Hugging
2. Age of Trees
3. Sounds of CERES
4. Picture Frame Tripod (Past and Present of CERES)
5. Aboriginal Hand Talk Charades
6. Weather Rock
7. Art Scavenger Hunt (Art Discovery)

The above activities were all uploaded to CERES' Chook application with appropriate instructions for each. All the activities can be seen as they appear in the app in the following pictures (Figure 4.3-2 to 4.3-5).

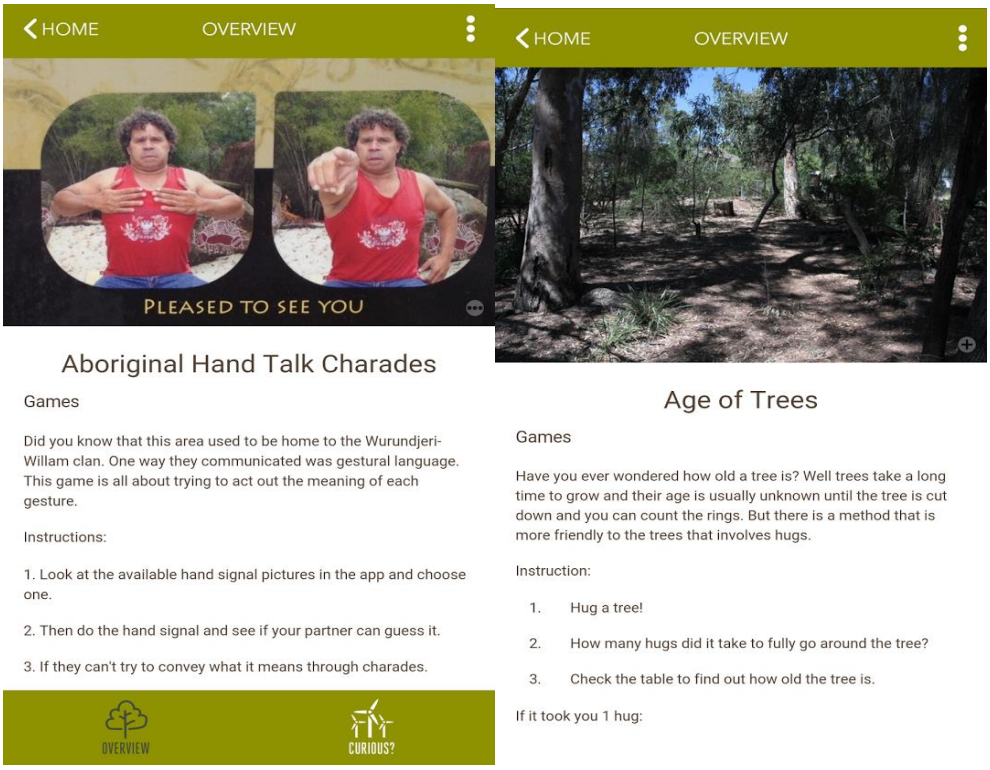

Figure 4.3-2: Aboriginal Hand Talk Charades and Age of Trees Activities as they appear in CERES' Chook application

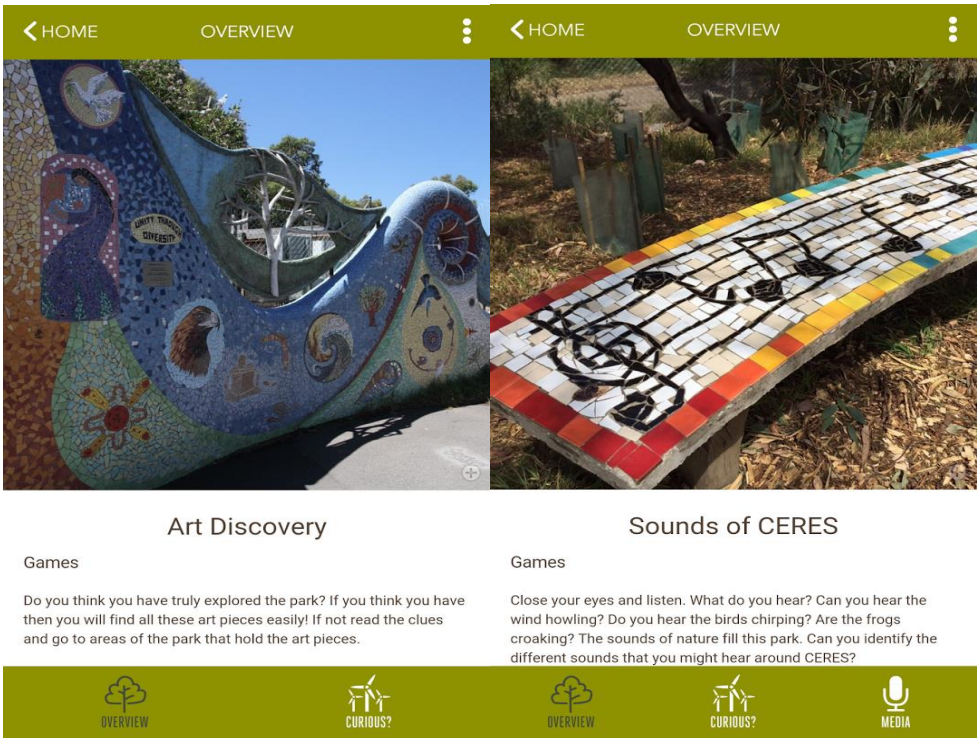

Figure 4.3-3: Art Discovery and Sound of CERES Activities in the Chook application

Figure 4.3-4: The Past and Present of CERES and Tree Hugging Activities in the Chook app

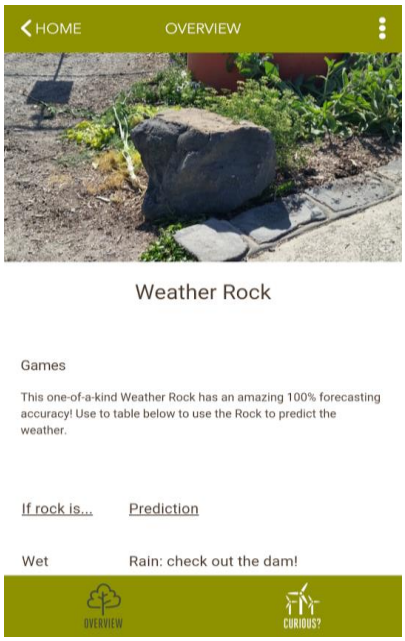

Figure 4.3-5: The Weather Rock Activity as it appear in CERES' Chook application

4.4 Activity Location Findings

After having a final list of activities, we needed to know where to place each activity. Incorporating survey data, interview suggestions, hotspot observation, and the popularity of each entrance gives a complete picture of where activities would be best utilized at CERES. Our activities should be placed at the following locations:

Table 4.4-1: Locations of activities we developed

Activity	**Location**
Tree Hugging	Dam Tree Glade, Village Green
Age of Trees	Dam Tree Glade, Village Green
Sounds of CERES	Throughout the Park
Picture Frame Tripod	Northern Mound
Aboriginal Hand Talk Charades	Eco House, By the Creek, Village Green, Namalata Willam
Weather Rock	Energy Park, Village Green
Art Scavenger Hunt	Throughout the Park

To determine the activity locations, we visited all different locations around the park. We found that the playspace and commercial areas are highly trafficked by visitors and so activities

placed there would have a large audience. The majority of survey respondents said they visited CERES for the playspace and commercial areas. Also, interviews mentioned the need to draw more people back down into the park because they often stay near the top for the cafe.

4.4.1 Entrance Usage

Another significant piece of data we collected and helped us form an opinion on activity location was the entry and exit data which we collected by monitoring the entrances of the park during 2 Saturday mornings and afternoons. This data is a standalone deliverable that is useful to CERES for understanding visitor entry and exit flow. The comprehensive data collected is shown below (Table 4.4.1-1 and 4.4.1-2):

Table 4.4.1-1: The number of visitors who entered/exited from each entrance/to each exit of the park (during the two days we collected data)

Overall	ENTRY		EXIT			
	Adult	Child	Adult	Child	TOTAL	ENTRY
Creek	71	14	73	11	169	85
Main Park	313	86	240	51	690	399
Main Energy Park	27	6	39	6	78	33
Energy Park	45	9	47	4	105	54
Lee Street	74	8	67	10	159	82
Bike Shed	52	9	4	0	65	61
Flood Path	87	13	58	14	172	100
SUM	669	145	528	96	1438	814

Table 4.4.1-2: Percentage use of each entrance to the park

Entrance Usage	entry %	children %
Creek	10.44%	9.66%
Main Park	49.02%	59.31%
Main Energy Park	4.05%	4.14%
Energy Park	6.63%	6.21%
Lee Street	10.07%	5.52%
Bike Shed	7.49%	6.21%
Flood Path	12.29%	8.97%
SUM	100.00%	100.00%

From Tables 5 and 6 we conclude that nearly half the adult visitors enter through the main entrance.The rest of the entrances account for the other half of the adult visitors of CERES. Figure 9 also depicts the popularity of each entrance, which is shown as the width of each arrow. Nearly 60% of children visitors enter the park through the main entrance and explore the oval-shaped orange area of Figure 9. Figure 10 depicts the relative use of each entrance for adult visitors. It

confirms that the playspace, which is located close to the path along which most visitors who enter through the main entrance walk, is a good location for placing an activity. Additionally, Table 4.4.1-2 shows that the Energy Park entrance is rather unpopular. The weather rock can be an opportunity to change that, as it will be a new added feature to the energy park which visitors can enjoy.

Figure 4.4.1-1: Map of CERES with its entrances

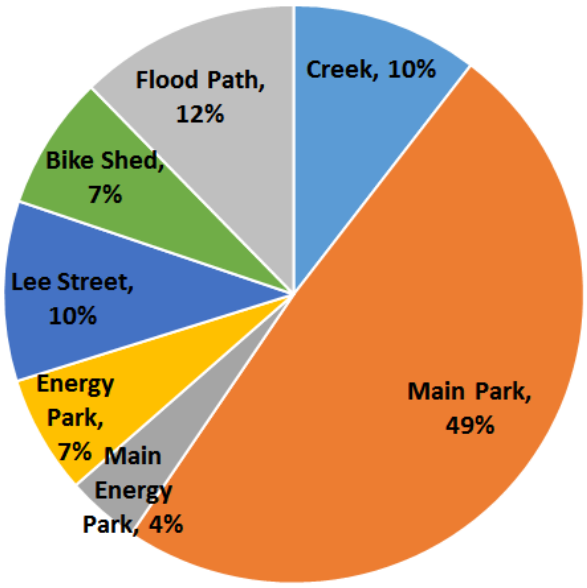

Figure 4.4.1-2: Pie chart depicting the relative use of each entrance of the park

Furthermore, the creek entrance is not an obvious entrance to CERES and should be modified with a sign to point visitors in the correct direction. Although signage is not the most preferable option, the majority of visitors entering from that entrance were confused as to whether that path is indeed an entrance to CERES. An added benefit of selecting the Namalata Willam (Aboriginal hand talk charades) and Playspace (Sounds of CERES) as activity locations is that they can help increase the popularity of the creek entrance. We also noticed that visitors were mainly couples, groups of adults or adults with children aged 3-9. The activities can potentially create the opportunity for CERES to attract more families with young children.

4.4.2 Location Hotspots

Another significant part of our work related to location of activities was hotspot observation (Figures 4.4.2-1 and 4.4.2-2). It is a standalone deliverable that is useful to CERES for understanding where visitors tend to spend most of their time.

Our observation method (described in Section 3.3) produced a point cloud of visitor locations throughout the park, as seen in Figure 4.4.2-1.

Figure 4.4.2-1: Map of CERES with clusters of visitors depicted

Then, to mine information from this data, the k-means clustering algorithm was applied, treating the 2D position of each marked pixel position as a data point, and the number of clusters set to the number of activities we were attempting to place. The algorithm produced an average position for each of the point clusters, which implied a central location where an activity would be most viewed. For visual effectiveness, we also used a density estimate based on a Gaussian distribution to generate a smoothed heat map for our observations, as seen in Figure 4.4.2-2. The complete Python code used to automate this process may be found in Appendix F.

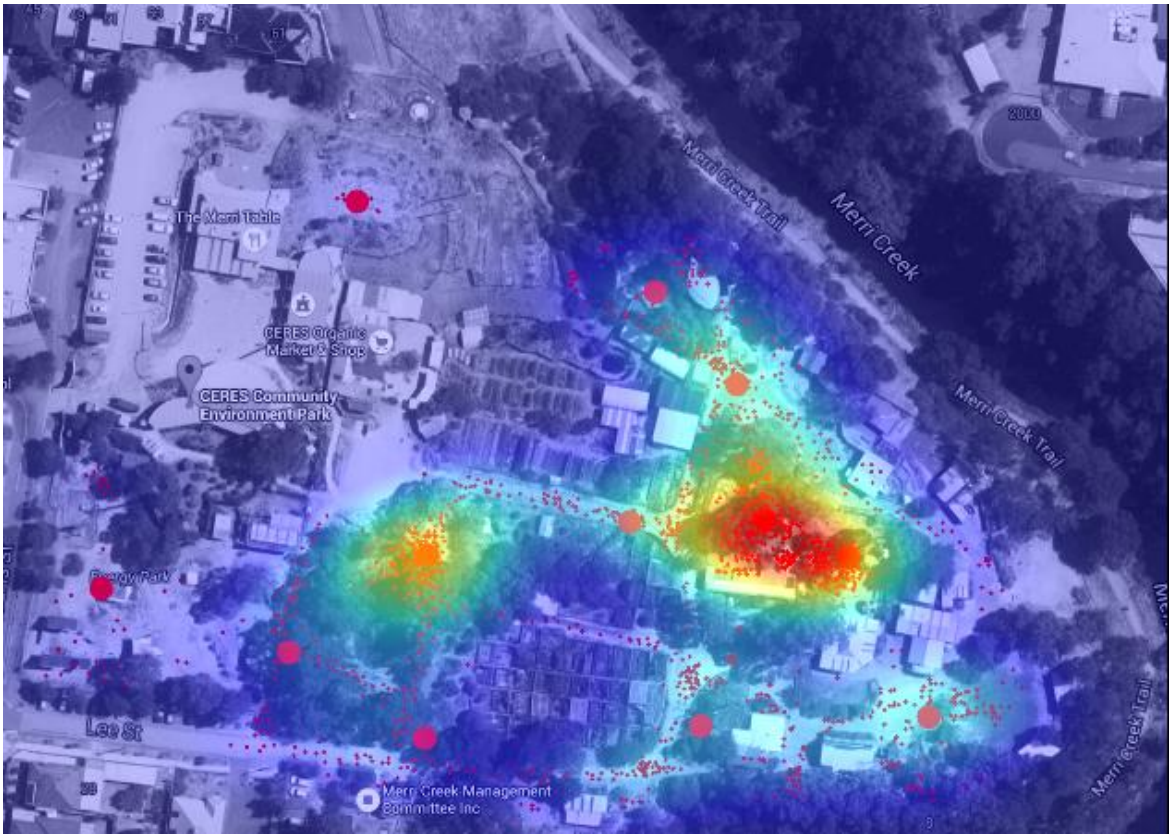

Figure 4.4.2-2: Heat map with identified hotspots (red circles)

Several locations which were produced as clusters of visitors coincide with the suggested locations we got through the interviews and the entry/exit data. According to our hotspot observations, the playground, main entrance path, flood path, and dam tree glade are good locations for placing activities.The Energy Park was rendered as a suboptimal location confirming its lack of popularity. However, the fact that the Energy Park is unpopular may also be interpreted as an opportunity to highlight a less popular section of the park.

Overlaying these hotspots with our interviews with CERES educators, we obtained the locations shown in Figure 4.4.2-3 as stars. Specifically, locations which are shown in Figure 4.4.2-3 are the Northern Mound, the Namalata Willam, the Playspace, the Village Green, the Dam and the area by the main entrance. Those are not only hotspots but were also suggested by CERES educators as locations which can add value to the park if we placed our activities there.

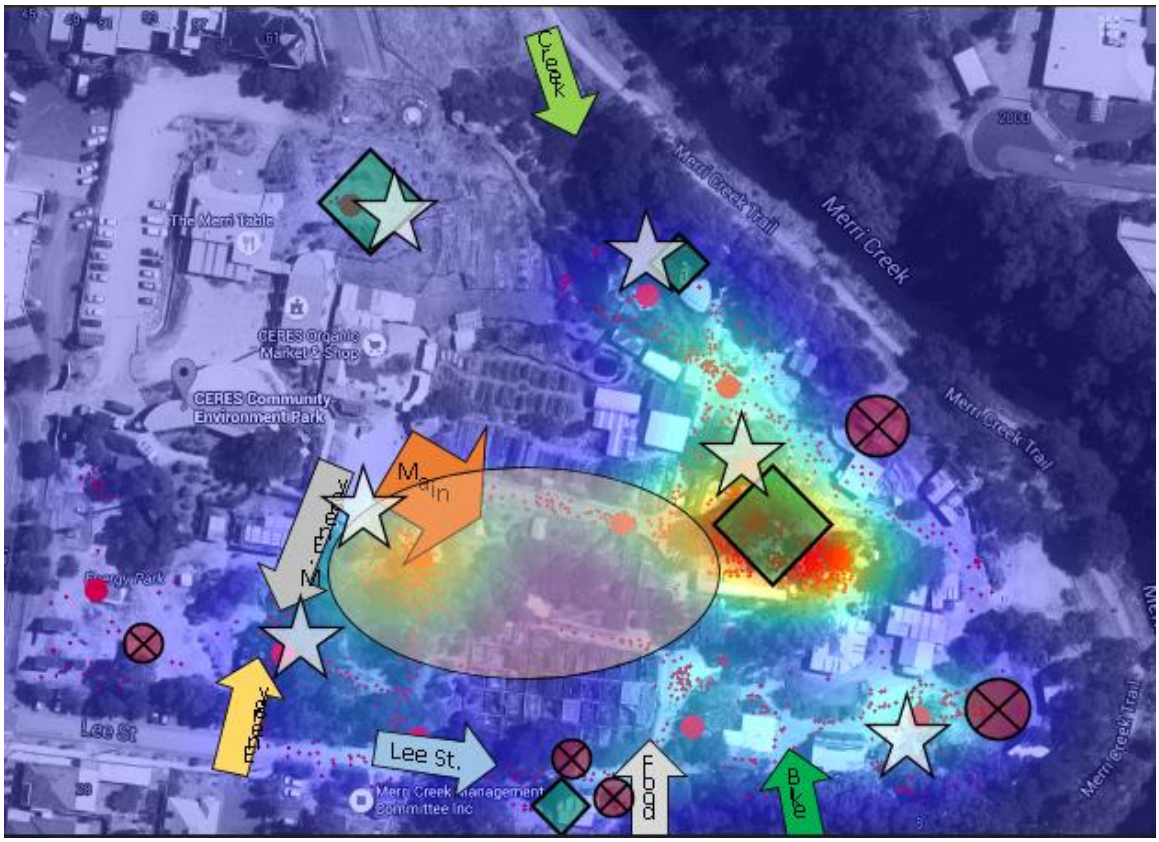

Figure 4.4.2-3: Combination of identified hotspots and interviews with CERES educators for determining activity locations

4.5 Playtesting Findings

Through playtesting, we found that overall our games were fun and engaging. No participant had many major negative comments or scores in our post-playtest survey. In fact, all the activities' fun scores were higher than originally estimated (in Figure 4.3-2) by the excursion educators at CERES. Additionally, none of our playtesters stopped playing halfway through any activity. Most of the activities were brought to over 90% completion. However, some people did not try the activities mostly due to unclear instructions or young age.

We found tactile games to be the most entertaining for children. When we asked each participant to rate the activities fun on a scale of 1-10, we found that tactile games such as Tree Hugging had the highest fun scores as seen in Figure 4.5-1.

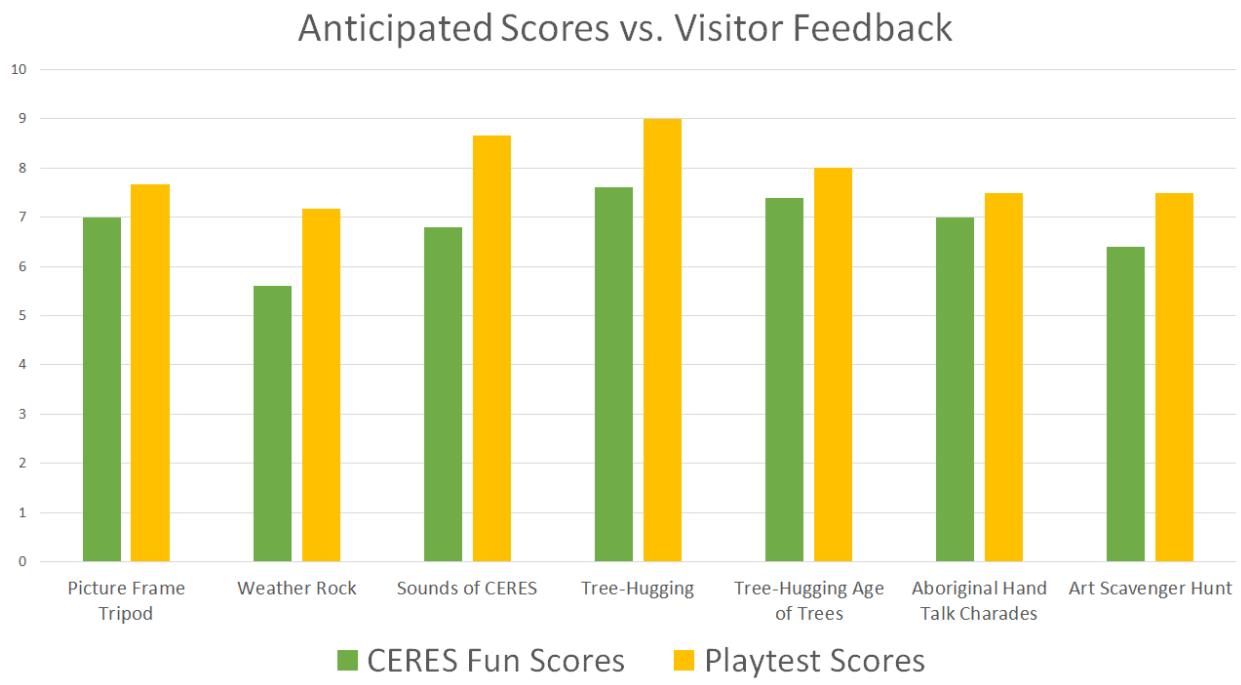

Figure 4.5-1: Average Playtesting Fun Scores for Activities

Tree hugging not only received the highest fun score, but was also the favorite game of two out of three playtesters, with children ranging from 4-10. This validated our interviews with CERES excursion educators who stressed the importance of tactile elements in activities. Also according to our background research competition is a major factor in keeping people engaged. Since the tree hugging introduced competition every group completed it once or multiple times showing high levels of engagement.

Playtesting confirmed the significance of education and values as design factors. These were proven relevant during our post-playtesting survey where we asked about which activities provided educational values or CERES values. One difficulty that participants had with the survey was deciding which activities were most educational. We believe that the educational factor of each game will rely heavily on how a parent explains the activities to their children. The activities in the app include facts which need to be read so that an activity retains its educational value. Similar issues arose with the values. When participants were asked which activities were good at demonstrating the values of CERES, consensus was that each activity alluded to CERES values but they were not being "shouted in your face" as one participant described.

Much of the collected data during the surveys that followed playtesting included feedback on how to clarify the instructions, and enhance fun and education of all the activities. Participants would often state the fun value of a game and follow it up with a comment on how the game could have been improved. One example is a playtester who, after giving Aboriginal Hand Talk Charades a low fun score, went on to describe that the reason for this low score was that the directions were difficult to understand. This data would be used to improve the games for the future.

Participants and WPI playtesters were able to give us feedback on both the activities and the Chook app. After surveying the WPI student "tourists" we found many of their biggest concerns to be with the interface of the app. Of the two group and ten students that toured the park, all reported at least some level of difficulty with using and understanding the app. One of the largest areas of confusion arose from the map function. The Chook map function works because of bluetooth

locators that are scattered throughout the park. When turning on the application the user is prompted to turn on the bluetooth on their phone. When bluetooth is activated on the user's phone, the app is able to tell where they are in the park and the attractions that are near them. There were varying responses on the map feature; some did not know that the map was able to locate their position in the park, some didn't know how to locate attractions from the map, and some did not know that there was a map feature at all. One student in particular mentioned how helpful it would be if there was a map that could help them see where they were in the park.

There were more features other than the map that went unnoticed by users. Neither group of testers used the "Collection" tab which separates the attractions into five categories: The Basics, Water, Energy, Food, and Activities. One group stated the reason for this was that they did not understand what collections meant in the context of the app. The other group did not know there was such a section as Collections. One group strictly used the "All Objects" feature to find interesting things they wanted to explore in the app and the other group mentioned how they only used the "What's around me" feature to find attractions. After finding the attractions in the app the students noted that they had difficulty finding the attraction in the park.

The final area of improvement that was noted by users was their inability to easily navigate the park. Both groups mentioned how it was difficult to try to find the attractions once they found it in the app. A few of the students talked of how they actually gave up looking for an attraction because it took too long to find it. One direct quote stated "We [tourists] want to find stuff quickly". In their responses they touched upon how helpful it would be for signs around the park to tell where different attractions were around the park. One of the visitors said that it would be helpful to have a list of sites to see while they were at CERES.

Chapter 5: Conclusions

Our project delivered seven complete app-based activities with playtest feedback from visiting families, along with two extra activities planned in detail for later development. The companion to these activities is the set of guidelines we compiled for activity design and evaluation, which can continue to be used by CERES in the future.

Additionally, our methods produced a variety of data useful to CERES, including characteristics of visiting families, usage of the various entrances, and location of high-traffic hotspots throughout the park. Finally, we provided several recommendations derived from our research and playtesting. These include suggestions to modify the interface and promotion of the Chook app as well as modifications to help increase CERES' appeal to tourists.

5.1 Activities and Guidelines

The original goal of our project was to develop a set of fun family activities that would attract families to CERES and allow them to interact and engage with the park. We achieved this goal in part by creating a reusable two-step screening process that begins with a brainstormed list of activity ideas, filters out those that fail to meet specified Design Criteria, then yields a list of final activities using weighted Evaluation Factors. This section describes our conclusions and recommendations associated with this process of screening and weighting.

Interactive activities appeal to families and will entice them to visit CERES more often. We recommend that CERES continues to add new activities to the park, beginning with the two additional activities we planned, the Garden Scavenger Hunt and Sliding Riddle Puzzle.

The survey of families distributed through the CERES monthly newsletter and Facebook page showed conclusively that families who already visit the park find the idea of adding family activities very appealing (Section 4.1).

Through playtesting of our activities with visiting families, we confirmed not only that the families enjoyed our seven "Chook Challenge"-themed activities (with instructions in the Chook app), but they reported each activity as being even more fun than the CERES education staff had predicted. The playtest participants overall showed immense enthusiasm for our activities, remarking that they would return to CERES again for the purpose of engaging in the activities and possibly even bring friends as well (Section 4.5).

This success leads us to recommend that CERES continues to develop and add new activities to the park. Because we have already produced detailed plans for two activities which we were unable to carry to completion during our project, we suggest that CERES completes these two activities.

Our Design Criteria are an effective initial screen for possible activities for CERES, and our Evaluation Factors are an effective way to rank activities before deciding which to fully implement. We recommend that CERES uses these guidelines for activity design and evaluation to continually assess and improve existing and new activities.

Because the theoretical range of all possible activities is so vast, the Design Criteria we developed through our interviews with CERES staff and experts from RMIT and Scienceworks were vital to the process of creating an initial long list of activities. This approach was validated when we conducted informal surveys with CERES excursion program teachers, and received

feedback that each of the activities that made it through the Design Criteria could potentially be a good fit for the park.

Since time limitations prevented us from implementing every activity idea (and to reflect the limited resources available to CERES), we created a weighted set of Evaluation Factors using responses from our interviews. Those factors in order of importance are Safety, Fun, Robustness, Values, and Education. These Evaluation Factors allowed us to calculate a ranking score for each activity on our long list (Section 4.2-4.3). This approach was validated through conversations with our sponsors, who agreed that our weighting of the design factors was appropriate. Indeed, they gave "scores" to the activities very similar to those of our Evaluation Factors (Section 4.5).

Due to our success with this two-step filter-and-rank approach to identifying activities to implement at the park, we recommend that CERES uses this same system to regularly assess and improve existing activities as well as to select new ones.

5.2 Future Work with Locations, the App, and the Park

In addition to providing the set of activities and associated guidelines, we found that our methods and data regarding activity location selection could be used by CERES for a variety of different purposes in the future. Furthermore, the playtesting we conducted for our activities produced useful feedback about the Chook app as well as the park in general. This section describes our recommendations resulting from these findings.

We recommend that CERES takes our location data into account when planning future installations or modifications to the park and continues to use our methods in the future to re-evaluate conditions as the park evolves.

By recording usage of the park's seven different entrances, we were able to conclude that the Main Entrance accounts for approximately half of all traffic into the park. Our high-traffic location identification method supported this result and showed that traffic near the Main Entrance can actually become congested during peak hours. It also demonstrated that while the PlaySpace is very busy, the Energy Park receives very little attention from visitors (see Figure 2.1.2-12.1.2-1 for a map of CERES). As a result, we recommend that CERES works to alleviate traffic flow at the Main Entrance, further develops the PlaySpace to support its many visitors, and makes the Energy Park more visible and attractive to visitors entering nearby.

The major limitations for both our entrance usage and hotspot observation methods was that due to time constraints, we were only able to apply them during peak hours on two Saturdays. To gain a more accurate picture of how the results we obtained would vary across specific days in the week, times of day, or even seasons of the year, it would be necessary to use our methods over significantly longer periods of time. It would also be prudent to redo the study on an annual or semi-annual basis to account for changing conditions at the park (or surrounding community).

We recommend that CERES works with the Chook app developers to make its interface easier to use.

During playtesting, we received consistent feedback that the Chook app interface requires improvement. Several features of the app such as the Interactive Map and Activity Collection proved very difficult to find. We additionally observed that even when participants managed to find an activity in the app, it was difficult for participants to use the app to find the corresponding activity location in the park itself. Because of these findings, as well as the note by several

participants that as tourists they truly "wanted to find stuff quickly", we strongly recommend that CERES works with the Chook app developer to streamline the interface.

We recommend that CERES promotes the Chook app through signage around the park in order to increase its usage among visitors.

Currently, the Chook app is severely underused, with an average of only one or two uses per week and less than 100 total downloads. When the WPI student playtesters arrived at the park, they noted that there was little to no signage at the main entrance advertising the app, such that they would have not known about it had they not been explicitly told. They additionally noted that there were no advertisements for the app clearly visible around the rest of the park. In order to increase visitor usage of the Chook app, we recommend that CERES places signs promoting the app around the Main Entrance, Visitor Center, Playground, and other highly trafficked areas around the park.

We recommend that CERES makes the park more attractive to new visitors by making the park easier to navigate through increased signage. We also recommend that CERES adds a trivia-based scavenger hunt activity, filling the role of a self-guided tour to be used by new visitors and tourists.

Although our WPI student playtesters gave many positive comments about the general atmosphere of CERES and its appeal as a tourist location, they universally found it difficult to navigate the park. Even though they recognized that "CERES has a lot to offer", they were unsure exactly what to look for, and so were unsure which areas of the park to prioritize exploring. The atmosphere of CERES encouraging visitors to slow down and appreciate nature could potentially be at odds with the mindset of a tourist attempting to view as many highlights as quickly as possible. To encourage increased tourist attendance, we recommend that as a first step CERES increases signage around the park pointing to the major attractions.

The more complete solution to this problem is the creation of a self-guided tour activity, possibly in the style of the trivia-based scavenger hunt we designed called the Seven Wonders of CERES. Because of this activity's ability to introduce visitors to the most important aspects of the park in a fun manner, it was highly commended in the interviews we conducted with CERES staff and educators, and scored significantly higher than any other activity using our Activity Evaluation Factors. Although we did not implement the Seven Wonders activity (at the suggestion of our sponsors) and it would take some significant work to more fully flesh develop, it provides an elegant solution by increasing the tourist appeal of the park in a fun and interactive manner.

5.3 Significance

Our project resulted in both functional activities and research-supported recommendations which will have tangible benefits for CERES. After we conducted research establishing that visiting families find the idea of additional activities at the park very appealing, we were able to use the combined knowledge of many of the on-site staff and educators to create a comprehensive set of guidelines for activity creation and evaluation. Using these guidelines, we created seven complete activities that each received extremely positive feedback from visiting family playtesters. We also produced data useful to park management on the characteristics of visiting families, usage of the various entrances, and the park's high-traffic areas. Finally, we were able to use our research and playtesting to make several recommendations to CERES to further improve both the Chook app and the park itself. These combined deliverables will aid CERES in the future by ultimately allowing it to expand its audience.

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Appendices

Appendix A: Survey Questions

Preamble: CERES is looking to create some fun, free, family friendly activities for park visitors. If you are a parent or caretaker of a child in primary school, we would very much appreciate hearing your responses to this brief survey. All responses will be anonymous.

1. Approximately how often do you visit CERES? (Once/rarely, monthly, weekly, daily)
2. Why do you come to CERES? (Bike Shed, Community Gardens, Exploring the Park, Merri Table, Nursery, Organic Market, Playground, Visitor Center, Other)
3. Approximately how long is your typical visit to CERES? (30min, 1hr, 2hr, 3hr, 4hr+)
4. How many primary school children are typically in your group when you visit CERES? (1,2,3,4,5+)
5. How appealing would you find the addition of family activities around CERES? Why?
6. How appealing would you find linked activities that help guide you through the park? Why?
7. We would be very grateful if you would be willing to come to CERES to help test a fun family activity and if you are please write your name and email address below.

Appendix B: CERES Staff Surveys

Preamble: Hello! We're a group of university students here until December, doing a project on bringing fun family activities to CERES, and we have a few questions we'd like to ask you. It should take approximately half an hour.

1. So, what do you do around here? (Icebreaker)
2. Discover any potential issues/obstacles
3. From a park management perspective, are there any potential issues that we need to consider when creating/installing games? In any specific areas of the park?
4. What do you think are the overall values of CERES?
5. What does different areas of the park mean to you?
6. Do you have any personal ideas for good activities?

Appendix C: CERES Excursion Teacher Surveys

Preamble: Hello! We're a group of university students here until December, doing a project on bringing fun family activities to CERES, and we have a few questions we'd like to ask you. It should take approximately half an hour.

1. What activities do you teach?
2. What message do you try to get across in the different activities?
3. What activities do the children seem most engaged with? Why?
4. How do the activities/their execution vary across age groups?
5. Any activities that could be scaled down (to a single child, or small family)?
6. How appealing would you find the addition of family activities around CERES? Why?
7. How appealing would you find linked activities that help guide someone through the park?
8. What do we need to keep in mind when designing activities for 6-12 year olds?
9. What problems do you see arising?
10. Any suggestions on how we approach the process of creating the activities?
11. What areas of the park would most benefit from activities?
12. Any suggestions on how to attract visiting families to start using the activities?

Appendix D: Industry Expert Interviews

Preamble: Hello! We're a group of university students here until December, doing a project on bringing fun family activities to CERES, and we have a few questions we'd like to ask you. It should take approximately half an hour.

Lauren Ferro:

1. So, what do you do at RMIT? What is your research in, specifically? (Icebreaker)
2. How familiar are you with CERES? Have you been here before? (Offer tour)
3. Have you worked with games that are tailored towards children before?
4. Is there anything to avoid while making activities for children?
5. What is the interaction between technology and children?
6. How do our current activity ideas sound?
7. What's the appeal of some sort of structured guide for CERES?
8. Any specific activity ideas that come to mind?
9. What advice or sources can you give us? Anything specifically on playtesting?

K**ate** Phillips:

1. So, what's your role at Scienceworks?
2. What activities do the children seem most engaged with? Why?
3. How do the activities/their execution vary across age groups?
4. What specific considerations are necessary for children's activities?
5. What do we need to keep in mind when designing activities for 6-12 year olds?
6. What problems do you see arising? Is there anything to avoid while making activities for children?
7. Any suggestions on how we approach the process of creating the activities?
8. What's the best way to approach using an app like ours, which is pretty much limited to text/video/audio directions?
9. Any considerations on a structured guide?
10. Any suggestions on how to attract visiting families to start using the activities?
11. Any other people/sources you could point us towards?

Appendix E: Entrance Usage Observations Worksheet

Entrance Usage Observations
Melbourne B15: Team CERES
Nicholas Bradford, Connor McGrath, Ioannis Skourtis, Jonathan Stump
11/21/2015, 11/28/2015

Instructions: For each half-hour interval, observe any visitors (Adult or Child) entering or exiting through your assigned location under the appropriate column, using tick marks.

	ENTRY		EXIT	
Time	**Adult**	**Child**	**Adult**	**Child**
10-10:30				
10:30-11				
11-11:30				
11:30-12				
12-12:30				
12:30-1				

Appendix F: Python Code for Location Analysis (Clustering and Heat Map)

Files are publicly available at: https://github.com/nsbradford/iqp

README.md

#IQP

A method for the Worcester Polytechnic Institute (WPI) Interactive Qualifying Project (IQP), Melbourne-B15: Team CERES.
Used to analyze the locations of CERES park visitors to find hotspots.

Author: Nicholas S. Bradford

##Description

Takes a satellite image from /images to use as a reference base. Then, generate a point cloud by recording all changed pixels between the base and the /observations observation images (park visitor locations marked on the map). Using this point cloud, apply the KMeans clustering algorithm to find centroids, and a gaussian distribution to create Heatmap. Finally, blend with base image and save to /output. Original satellite image size and file names are hard-coded in as globals.

Dependencies: opencv, scikit-learn, matplotlib, PIL

##Usage

```
 iqp.py [-h] [-o N_OBSERVATIONS] [-c N_CLUSTERS] [-b N_BINS]
optional arguments:
  -h, --help            show this help message and exit
  -o N_OBSERVATIONS, --n_observations N_OBSERVATIONS
                        number of observation files
  -c N_CLUSTERS, --n_clusters N_CLUSTERS
                        number of clusters to generate with KMeans
  -b N_BINS, --n_bins N_BINS
                        number of bins to use for the Heatmap
```

##Data Collection Method for CERES

You will need at least 4-5 participants for data collection to cover the entire CERES park. Begin by making copies of "/images/satellite.png" and distributing them to each participant, who will then open the image using Microsoft Paint and select the Pencil tool (edits single pixels) with Red color (any non-greyscale color should work). Distribute the participants so that they combined have a view of the entire park, and assign them a specific area such that there is no overlap between participants. Then, every 2 minutes over the course of an hour (or longer), the participants use the pencil tool to mark the positions of all visitors in their area.

After the set amount of time has elapsed, every participant returns their modified image file, which are moved to the /observations folder and renamed "observation_XX" (where XX is the 2-digit increasing number of the observation, starting with 01). Finally, run the program to produce the hotspot clusters and heatmap.

iqp.py

```
#!/usr/bin/python

"""IQP location analysis tool.

A method for the Worcester Polytechnic Institute (WPI)
Interactive Qualifying Project (IQP), Melbourne-B15: Team CERES.
Used to analyze the locations of CERES park visitors to find hotspots.
Authored by Nicholas S. Bradford.

Takes a satellite image from /images to use as a reference base. Then,
generate a point cloud by recording all changed pixels between the base and
the observation images (park visitor locations marked on the map). Using
this point cloud, apply the KMeans clustering algorithm to find centroids,
and a gaussian distribution to create Heatmap. Finally, blend with base image.

Usage:
    usage: iqp.py [-h] [-o N_OBSERVATIONS] [-c N_CLUSTERS] [-b N_BINS]

    optional arguments:
      -h, --help            show this help message and exit
      -o N_OBSERVATIONS, --n_observations N_OBSERVATIONS
                            number of observation files
      -c N_CLUSTERS, --n_clusters N_CLUSTERS
                            number of clusters to generate with KMeans
      -b N_BINS, --n_bins N_BINS
                            number of bins to use for the Heatmap
"""

import argparse
import numpy as np
import cv2
from sklearn.cluster import KMeans
from scipy.stats import kde
import matplotlib.pyplot as plt
from PIL import Image, ImageChops

#images are 1163 x 828
X_MIN = 0
X_MAX = 1163
Y_MIN = 0
Y_MAX = 828
SATELLITE_FILE = "images/satellite.png"
OBSERVATION_FILE = "observations/observation_0"
OBSERVATION_FILE_EXT = ".png"
MAP_VISUAL_FILE = "output/1_data_map.png"
RAW_VISUAL_FILE = "output/2_data_raw.png"
RAW_CLUSTERS_FILE = "output/3_data_clusters_raw.png"
MAP_CLUSTERS_FILE = "output/4_data_clusters_map.png"
RAW_HEATMAP_FILE = "output/heatmap_raw.png"
TRANSFORMED_HEATMAP_FILE = "output/heatmap_transformed.png"
HEATMAP_FILE = "output/5_heatmap.png"
```

```
def cluster_map(data, n_clusters, output_img, base_img):
    """Apply KMeans clustering to
    Args:
        data: list of [x, y] coordinates.
        n_clusters: number of clusters to generate with KMeans.
        output_img: image to overlay clusters onto.
        base_img: original map image without any data or observations
    Returns:
        None
    """
    kmeans = KMeans(n_clusters)
    kmeans_data = data
    kmeans.fit(kmeans_data)
    for x, y in data:
        cv2.circle(output_img, (int(y), int(x)), 4, (0, 0, 255), -1)
    cv2.imwrite(RAW_VISUAL_FILE, output_img - base_img)
    cv2.imwrite(MAP_VISUAL_FILE, output_img)
    for x, y in kmeans.cluster_centers_:
        cv2.circle(output_img, (int(y), int(x)), 10, (255, 150, 0), -1)
    cv2.imwrite(RAW_CLUSTERS_FILE, output_img - base_img)
    cv2.imwrite(MAP_CLUSTERS_FILE, output_img)



def heat_map(data, n_bins, output_img):
    """Overlay a Heat Map onto the output image.
    Args:
        data: list of [x, y] coordinates.
        n_bins: number of bins to use for the Heatmap.
        output_img: image to overlay Heatmap onto.
    """
    data = np.array(data)

    # Pyplot: Evaluate a gaussian kde on a regular grid of n_bins x n_bins
    x, y = [i[0] for i in data], [j[1] for j in data]
    fig, axes = plt.subplots(ncols=1, nrows=1, sharex=True, sharey=True)
    k = kde.gaussian_kde(data.T)
    xi, yi = np.mgrid[Y_MIN:Y_MAX:n_bins*1j, X_MIN:X_MAX:n_bins*1j]
    zi = k(np.vstack([xi.flatten(), yi.flatten()]))
    plt.ylim((X_MIN, X_MAX))
    plt.xlim((Y_MIN, Y_MAX))
    plt.axis('off')
    axes.pcolormesh(xi, yi, zi.reshape(xi.shape))
    plt.savefig(RAW_HEATMAP_FILE, bbox_inches='tight', pad_inches=0)

    # PIL: remove bordering whitespace (crop), rotate, and resize
    im = Image.open(RAW_HEATMAP_FILE)
    bg = Image.new(im.mode, im.size, im.getpixel((0, 0)))
    diff = ImageChops.difference(im, bg)
    diff = ImageChops.add(diff, diff, 2.0, -100)
    bbox = diff.getbbox()
    im = im.crop(bbox)
    angle = 270
    w, h = im.size
    im = im.rotate(angle, expand=1)
    im = im.resize((X_MAX, Y_MAX))
    im.save(TRANSFORMED_HEATMAP_FILE)

    # OpenCV: blend images
    heat_img = cv2.imread(TRANSFORMED_HEATMAP_FILE, cv2.IMREAD_COLOR)
    dst = cv2.addWeighted(output_img, 0.8, heat_img, 0.5, 0)
    cv2.imwrite(HEATMAP_FILE, dst)
    cv2.imshow('Heatmap with Clusters', dst)
    cv2.waitKey(0)
    cv2.destroyAllWindows()



def main(n_observations, n_clusters, n_bins):
    """Use a set of observations to create Clusters and a Heatmap.
```

```
    Args:
        n_observations: number of observation files.
        n_clusters: number of clusters to generate with KMeans.
        n_bins: number of bins to use for the Heatmap.
    Returns:
        None
    """
    base_img = cv2.imread(SATELLITE_FILE, cv2.IMREAD_COLOR)
    assert base_img is not None, "SATELLITE_FILE did not load."
    data = []
    for i in xrange(1, n_observations + 1):
        data_file = OBSERVATION_FILE + str(i) + OBSERVATION_FILE_EXT
        data_img = cv2.imread(data_file, cv2.IMREAD_COLOR)
        assert data_img is not None, "OBSERVATION_FILE did not load: " + data_file
        img = base_img - data_img
        output_img = base_img.copy()
        rows, columns, channels = img.shape
        for i in xrange(rows):
            for j in xrange(columns):
                if img.item(i, j, 2) > 0:
                    data.append([i, j])
    cluster_map(data, n_clusters, output_img, base_img)
    heat_map(data, n_bins, output_img)



if __name__ == "__main__":
    np.random.seed(13)
    parser = argparse.ArgumentParser()
    parser.add_argument("-o", "--n_observations", default=4, type=int,
        help="number of observation files")
    parser.add_argument("-c", "--n_clusters", default=12, type=int,
        help="number of clusters to generate with KMeans")
    parser.add_argument("-b", "--n_bins", default=1000, type=int,
        help="number of bins to use for the Heatmap")
    args = parser.parse_args()
    main(args.n_observations, args.n_clusters, args.n_bins)
```

Appendix G: Playtest Observation Sheet and Survey

Playtesting Observation Sheet
Melbourne B15: Team CERES
Nicholas Bradford, Connor McGrath, Ioannis Skourtis, Jonathan Stump

Activity Name:

General Observations

Do the participants appear to be having fun? Child and Adult? (Laughing, smiling, etc.)

Are the parents explaining the game to the child?

Does the child seem to understand the game?

Did they complete the activity?

Did they play the activity more than once?

If there is a physical structure are the participants not using it as intended?

Did the participants ask any questions about the activity? If so what were they?

Chook App Observations

Were they able to navigate to the activities in the app?

Were they able to find the activity locations in the park

Are the participants following the instructions? Do they appear to be confused by the instructions?

Are they playing the activity as intended?

Playtesting Survey
Melbourne B15: Team CERES
Nicholas Bradford, Connor McGrath, Ioannis Skourtis, Jonathan Stump

Preamble: [Introduce ourselves, make sure to wear nametag]

Thanks so much for coming to help us out!

A little bit of background: we are a group of university students from the United States, here on a research project. Our goal is to bring fun family activities to CERES using the new Chook app that was just recently launched.

The idea for testing is for us to lead you around

Questions:

1. **Did you feel any certain activities were trying to communicate a specific message, or relate to some of the values of CERES? If so, please list the activity and the message you felt it was trying to convey.**

2. **Did you feel any certain activities were trying to communicate a specific educational message? If so, please list the activity and the message you felt it was trying to convey.**

3. **Would play any of the activities again?**

4. **Would you recommend these activities to a friend?**

5. **Would you download the Chook app on your own? Why or why not?**

6. **Do you have any advice or feedback on using the Chook app?**

7. **Do you have any overall suggestions or feedback on the activities?**

8. **How do you think the experience would go if you were doing it on your own, without our guidance?**

9. **Overall, how much did you like each activity? (Strongly Dislike, Dislike, Neutral, Like, Strongly Like)**

Activity	Likeability
Picture Frame Tripod	
Weather Rock	
Sounds of CERES	
Tree Hugging	
Tree Hugging Age of Trees	
Aboriginal Hand Talk Charades	
Art Scavenger Hunt	

10. How fun did you find each activity? (Please rate each activity on a scale of 0-10)

0 = Not Fun 10 = Very Fun

Activity	Fun Score (0-10)
Picture Frame Tripod	
Weather Rock	
Sounds of CERES	
Tree Hugging	
Tree Hugging Age of Trees	
Aboriginal Hand Talk Charades	
Art Scavenger Hunt	

Appendix H: Guidelines for Activity Design and Evaluation at CERES

Activity Design Instruction Manual

Design Criteria

During the initial brainstorming of activity ideas make sure that they satisfy these minimum requirements listed below. Pitfalls are a must to abide by or the activity will be prone to failure, while incorporating several elements from values and How to engage children will lead to a successful activity. Also make sure that the activities you are creating are safe, robust and not easily stolen. After you are done brainstorming activities you can run them through the evaluation matrix.

Values

- Stimulate thought and discussions through practical activities instead of trying to indoctrinate.
- Promote imaginative and natural play by engaging with the park, particularly areas not as well explored.
- Particularly with energy, use the economic viewpoint of efficiency. Appeals to parents as well
- Fit in with the "style" of CERES: recycled and quirky.
- Themes, stories, and characters (or even unified symbols) make it much easier to mentally link the activities together to become engaging and memorable.

Pitfalls

- Don't create an exact copy of an existing CERES program.
- Don't portray negative messages.
- Don't "overcompensate" by having rewards be the focus of the game.
- Don't make the activity too complex for a child (or their parents) to understand.
- Don't make the activity overly informative (break info into small chunks).

How to Engage Children

- Activities should be tactile and allow children to build, jump on, play with, feel, role-play, etc.
- Make the games interesting and it will be easy to keep the attention of children.
- Make activities mysterious and investigative to stimulate natural curiosity.
- Popular attractions around the park:
    - Water
    - Gadgets
    - Chooks
    - Playground

- Make the activities to be thought provoking to older children (over 10) because they tend to be more conscious of their place in the world.

Evaluation Matrix

This matrix shown below allows you to make a final decision on what activities will be taken to completion. There are five factors in the matrix safety, fun, robustness, values and education. To get safety and robustness scores run each idea past the site manager or look at the CERES safety manual. To get fun scores run each idea past the educator staff. To get value scores use your best judgement. To get the education score look at raw information provided to people and open ended information. The scale is from 0-10 on all the factors with 0 being low and 10 being high (Example: for the robustness factor if an activity scores a 0 it isn't robust and if an activity scores a 10 it is very robust).

	5 Factors	**Safety**	**Fun**	**Robustness**	**Values**	**Education**		**Totals**
	Weights	**10**	**9**	**8**	**7**	**6**		**400**
Activity								
#1								

How the matrix works: First you score each factor on a 0-10 scale. Then you take that score and multiply it by the appropriate weight (Example: if something scored a 5 in robustness you would multiply 5 by 8 and get a **value** of 40). After you score each factor for an activity you add up all the **values** and get a total activity score (Example: Activity 1 scores a 9 for safety, 6 for fun, 10 for robustness, 7 for values and 9 for education. The activity score would be 327, which comes from the addition of these **values** 90+54+80+49+54 these values come from the scores times the weights (9x10)+(9x6)+(8x10)+(7x7)+(6x9)). You then compare the activity score of all the activities and the activity or activities that scored the highest should be fully implemented.

Location Observation

Entrance and Exit Observation

To do entry and exit observation you need a minimum of 4 people (1 by the main entrance, 1 by the north creek entrance, 1 by the lee st and energy park entrance and 1 by the bike shed and flood path entrance). You create a table like the one shown below and mark how many children and adults enter and exit the park. Make note of any other general observations (Weather, Why they are entering the park, general age of children, ect).

	Entrance		Exit	
	Children	Adult	Children	Adult
10:00-10:30				
10:30-11:00				
11:00-11:30				

Hotspot Observation

To download the necessary software, navigate to: https://github.com/nsbradford/IQP
After setting up the project (with dependencies), follow the instructions in the README (partially copied here):

Data Collection Method for CERES

You will need at least 4-5 participants for data collection to cover the entire CERES park. Begin by making copies of "/images/satellite.png" and distributing them to each participant, who will then open the image using Microsoft Paint and select the Pencil tool (edits single pixels) with Red color (any non-greyscale color should work). Distribute the participants so that they combined have a view of the entire park, and assign them a specific area such that there is no overlap between participants. Then, every 2 minutes over the course of an hour (or longer), the participants use the pencil tool to mark the positions of all visitors in their area.

After the set amount of time has elapsed, every participant returns their modified image file, which are moved to the /observations folder and renamed "observation_XX" (where XX is the 2-digit increasing number of the observation, starting with 01). Finally, run the program to produce the hotspot clusters and heatmap.

Description

Takes a satellite image from /images to use as a reference base. Then, generate a point cloud by recording all changed pixels between the base and the /observations observation images (park visitor locations marked on the map). Using this point cloud, apply the KMeans clustering algorithm to find centroids, and a gaussian distribution to create Heatmap. Finally, blend with base image and save to /output. Original satellite image size and file names are hard-coded in as globals.

Dependencies: opencv, scikit-learn, matplotlib, PIL

Usage

```
iqp.py [-h] [-o N_OBSERVATIONS] [-c N_CLUSTERS] [-b N_BINS]
optional arguments:
  -h, --help            show this help message and exit
  -o N_OBSERVATIONS, --n_observations N_OBSERVATIONS
                        number of observation files
  -c N_CLUSTERS, --n_clusters N_CLUSTERS
                        number of clusters to generate with KMeans
  -b N_BINS, --n_bins N_BINS
                        number of bins to use for the Heatmap
```

Playtesting

When having people playtest it is important that you read them the preamble first. Then you bring them around the park to each activity and hang around to answer any questions. Wait until they have completed the activity and then lead them to the next one and continue this process until all the activities are done. After the playtesters have finished all the activities sit down somewhere and ask them the survey questions below. After they are finished with the questions don't forget to be polite and thank them for their time. With all the information gathered you will be able to rescore all the activities and be able to improve them and then you playtest them again and repeat this process until you are satisfied.

Preamble: [Introduce yourselves, make sure to wear nametag]

Thanks so much for coming to help us out!

A little bit of background: we are a group of *Blank* from *Blank*, doing research on activities. Our goal is to bring fun family activities to CERES using the new Chook app that was just recently launched. We will lead you around the park and have you play a few activities and at the end there will be a short survey.

If you have any questions feel free to ask and let's begin with our first activity.

Questions:

1. Overall, how much fun did you find each activity? (0-10, 0 being not fun and 10 being a lot of fun)

Activity	Fun
Activity 1	
Activity 2	
Activity 3	

2. Did you feel any certain activities were trying to communicate a specific message, or relate to some of the values of CERES? If so, please list the activity and the message you felt it was trying to convey.

3. Did you feel any certain activities were trying to communicate a specific educational message? If so, please list the activity and the message you felt it was trying to convey.

4. Would you play any of the activities again?

5. Would you recommend these activities to a friend?

6. Would you download the Chook app on your own? Why or why not?

7. Do you have any advice or feedback on using the Chook app?

8. Do you have any overall suggestions or feedback on the activities?

9. How do you think the experience would go if you were doing it on your own, without our guidance?

Appendix I: Summative Team Assessment

Since the beginning of IQP our team has worked cooperatively with each other, and throughout this term we got to know each other better as both partners and friends. However, during the beginning of the ID2050 our meetings did not have the greatest group environment. We would usually meet for an hour or two, do our work and then leave, without much group discussion. Since then we have developed better team skills and have learned to better communicate and express our ideas in our meetings. Not only have our meetings themselves increased in quality, but the way we assigned work to our team has improved.

We originally assigned everyone different parts of a single chapter. As we progressed through the IQP process, we shifted to assigning whole chapters to individual team members and then editing them as a team, which turned out to be much more efficient and produced more cohesive writing.

One of our proudest areas of improvement during the ID2050/IQP process has been our presentations and associated skills. We began in A-term with visually bland off-the-shelf templates, and filled the slides with primarily text and cumbersomely placed images. This approach bled into our effectiveness at presenting, as we were prone to simply reading off our slides in a dry manner. However, we have gradually made progress throughout the term to shift more creative ways to animate and display content, while simultaneously giving ourselves much more practice time to become confident and comfortable with our material. This process has taken our team from having presentations as one of our weakest components, to being effective enough that nearly every other team has referenced our "Dynamize" tagline in their own work.

Our first day of IQP we encountered one of the biggest challenges of our project, since our project changed completely. We went from being convinced we were designing a videogame to creating physical activities. One major problem was that all of the research we did in ID2050 was rendered useless. But we did not let this discourage us and we worked hard to do all of our relevant background research, rewrite our methods and then complete the project. Not only did we complete the tasks our sponsors wanted, but we were able to produce extra deliverables.