

Mystery Room: Engaging Marginalized Youth through an Immersive Experience



Abstract

We worked with Banksia Gardens Community Services to develop a mystery room program for their after-school homework club. A mystery room is an immersive, hands-on experience where participants complete a series of activities to complete a target objective, and our team created one with the goal of heightening student engagement in Science, Technology, Engineering, and Math (STEM) concepts. To do this, we researched student engagement and expert processes for designing mystery rooms, and conducted observations of the participants' interests and soft skills. Based on this, we developed an iterative design process to create a fantasy mystery room experience. We then piloted our room with eleven participants, which we assessed through observation and post-experience focus groups. During the experience, most of the participants were actively listening and responding to the actors. A majority of them were working together to solve puzzles and for the most part believed that they were in a new world. From this, we determined that mystery rooms provide an engaging experience for students, spark their interest in learning, and that incorporating a brief post-experience lesson would further solidify academic concepts.

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Student Engagement: A Stepping Stone for the Future

Engagement, or what Lombard and Ditton call “engrossment in mediated experiences”¹, is a crucial element in educational environments. Traditional, or passive, learning — a method where a professor gives instruction to their students in the form of a lecture and students take notes on the materials² — sometimes makes it difficult for students to feel engaged and to reach the levels of motivation necessary for a path to graduation and further success. This need to engage learners is especially prevalent in Broadmeadows, a disadvantaged community within Victoria, Australia, where 74% of students do not graduate from high school. This is extreme, especially when compared to the national statistics where only 24% of students throughout Australia as a whole do not graduate high school.³

Fortunately, many educators have begun to integrate active methods of education into their curricula.² Active learning, defined by Felder and Brent, is anything course-related that all students in a class session are called upon to do other than simply watching a lecture and taking notes.⁴ Research has found that active learning successfully improves student engagement⁵, which motivates students to persevere in their learning. Perseverance will make it much more likely that they reach the ultimate goal of graduating high school and finding employment.

Banksia Gardens’ Initiatives to Increase Interest

The Banksia Gardens Community Services, a neighborhood house located in Broadmeadows, is attempting to use methods of active learning to engage disadvantaged students through a variety of interactive programs. Two of its most popular

programs are the after-school homework club and computer club, both of which focus on children with a need for academic support while simultaneously providing access to growth through active social, emotional, and recreational activities (for more information, see Supplemental Materials E). Former WPI project teams have also worked with Banksia Gardens to create and enhance their educational programs.⁶⁻¹⁰ Our project followed up on these previous projects by designing and implementing an interactive mystery room learning experience.

Project Objectives

Our ultimate goal for this project was to assist Banksia Gardens in its efforts to increase student engagement in learning activities by creating an immersive mystery room experience for its after-school homework club. We established four underlying objectives to complete this overarching goal (Figure 1).

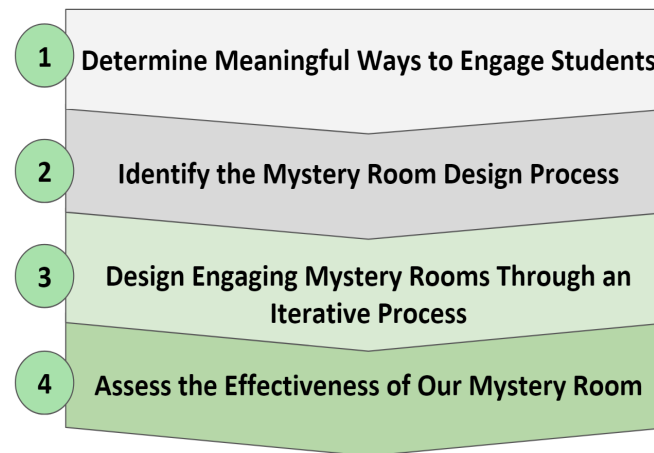


Figure 1. Objectives

Our primary deliverable was a full design — a narrative, a visual room plan, a set of puzzles, and a game progression flowchart — for four mystery room experiences which Banksia Gardens could adapt at any point in the future. This set of designs was accompanied by documentation on how to set up and run through each of the programs. Our second deliverable was to transfer one of the designs into a physical prototype to host a mystery room pilot event. We had to build, run through, and test all aspects of the room with youth from Banksia. Our third deliverable was a pamphlet and instruction manual explaining how to develop and set up mystery rooms for Banksia to use to continue this program. All of these objectives led back to our final goal of increasing student engagement at Banksia Gardens through our mystery room. In the following section, we will overview background information on student engagement and types of programs which foster it.

Creating an Engaging Experience for Students

In this section, we first review the concept of student engagement, and how active teaching styles promote this. Then, we examine the differences between motivation and involvement, which leads into how mystery rooms are effective in increasing these aspects by creating an immersive experience. We then discuss considerations and key components for creating mystery room designs.

Student Engagement: Traditional Versus Active Learning

Many school programs use a traditional style of learning. However, this is not the most viable form of education because as Jan van Driel, a professor at the University of Melbourne, noted, traditional methods

often fail to engage young people, making it hard for students to recognize the relevance of school topics in their daily lives and their futures.¹¹ Luckily, many schools are starting to use more active learning methods to engage students. As Benjamin Franklin once stated, “Tell me and I forget, teach me and I may remember, involve me and I learn”.¹² A greater presence in active learning will help to increase the learning capabilities of students.

Active learning, as defined in the introduction, has shown to be superior to traditional styles because it incorporates more hands-on activities, which help the students to better enjoy the subject matter and feel more involved with the material.¹³ Active learning can take many forms, such as in-class experiments, peer teaching, group projects, role-playing activities, and the increasingly popular game-based learning. Game-based learning utilizes games with a defined learning outcome, and involves balancing the need to cover the subject matter with the desire to prioritize game play.¹⁴

Defining Engagement, Involvement, & Motivation

The goal of active learning is to increase student engagement, motivation, and involvement in the subject matter. As aforementioned, engagement occurs when a person encounters and becomes absorbed in mediated experiences.¹ Key signs that a participant is engaged include self-involvement, participation, preoccupation, and active commitment¹⁵.

Involvement, which can occur in many different settings and can pertain to a variety of events, is a psychological state where one’s attention is focused on a set of related activities. A participant’s amount of involvement depends on their attraction and sustained attention to the activities.¹⁶ Full involvement is a clear sign of engagement.

Motivation is the drive or willingness to pursue

an outcome.¹⁷ In other words, motivation is the effect of engagement over time. Catherine Attard’s study conducted on Australian students’ engagement in mathematics in year six puts this idea into terms of education. When this group of students was asked which mathematics lessons were best, they chose those involving active learning situations using tangible materials or games.¹⁸ Attard concluded that incorporating exciting and innovative tactics increased their self-confidence, attitude, and motivation towards school.¹⁸ Motivation is directly correlated to interest, enjoyment, and achievement, and can further be indicated by one’s behavior, self-confidence, ability to overcome obstacles, and capability to rebound from disappointments.¹⁹

Mystery Rooms: A Rising Form of Education

One active learning strategy that can increase engagement is EscapED, a mystery room development framework. Mystery rooms (Figure 2), a relatively new method of active education, are also known as escape rooms, live action experiences, and immersive theater. As defined by Clare, Elumir, and Wiemker, a



Figure 2. An Immersive Experience

mystery room is an interactive, engaging room where participants must complete a series of tasks that all accumulate to one final task prior to time expiring.²⁰ Whether it be defusing a bomb or guiding a spaceship to its proper landing spot, the final task can relate to a broad range of themes and does not necessarily have to be escaping a room;²⁰ for instance, final tasks can be building a structure, fully unfolding a narrative, or restoring an object to a desired state. Common components across most mystery rooms are different types of puzzles, underlying narratives, hidden clues, and elements promoting teamwork.

According to Nicholson, “Escape rooms create a moment of passion around specific topics that can be used as the spark to then ignite interest in something for a player to learn about later”.²¹ Learning requires participation, and students are more likely to participate in an interactive setting. In addition, using mystery rooms as an educational tool for teaching mathematics and technology helps show practical applications.²¹ The objective of a mystery room can also be to improve the participants’ soft skills such as collaboration and communication.²²

Developing a Mystery Room

The EscapED framework is a structure that breaks down the design process for creating an educational mystery room experience.²³ We synthesized this structure with components discussed by other game theorists and program designers in Figure 3.

Physical Parameters

Game developer Alistair Aitcheson agreed with this EscapED framework in that the first step to developing a mystery room is establishing the allotted physical space and time.²² Knowing the available space and time allows the designer to determine the equipment, participants, and puzzles that can fit into the experience.

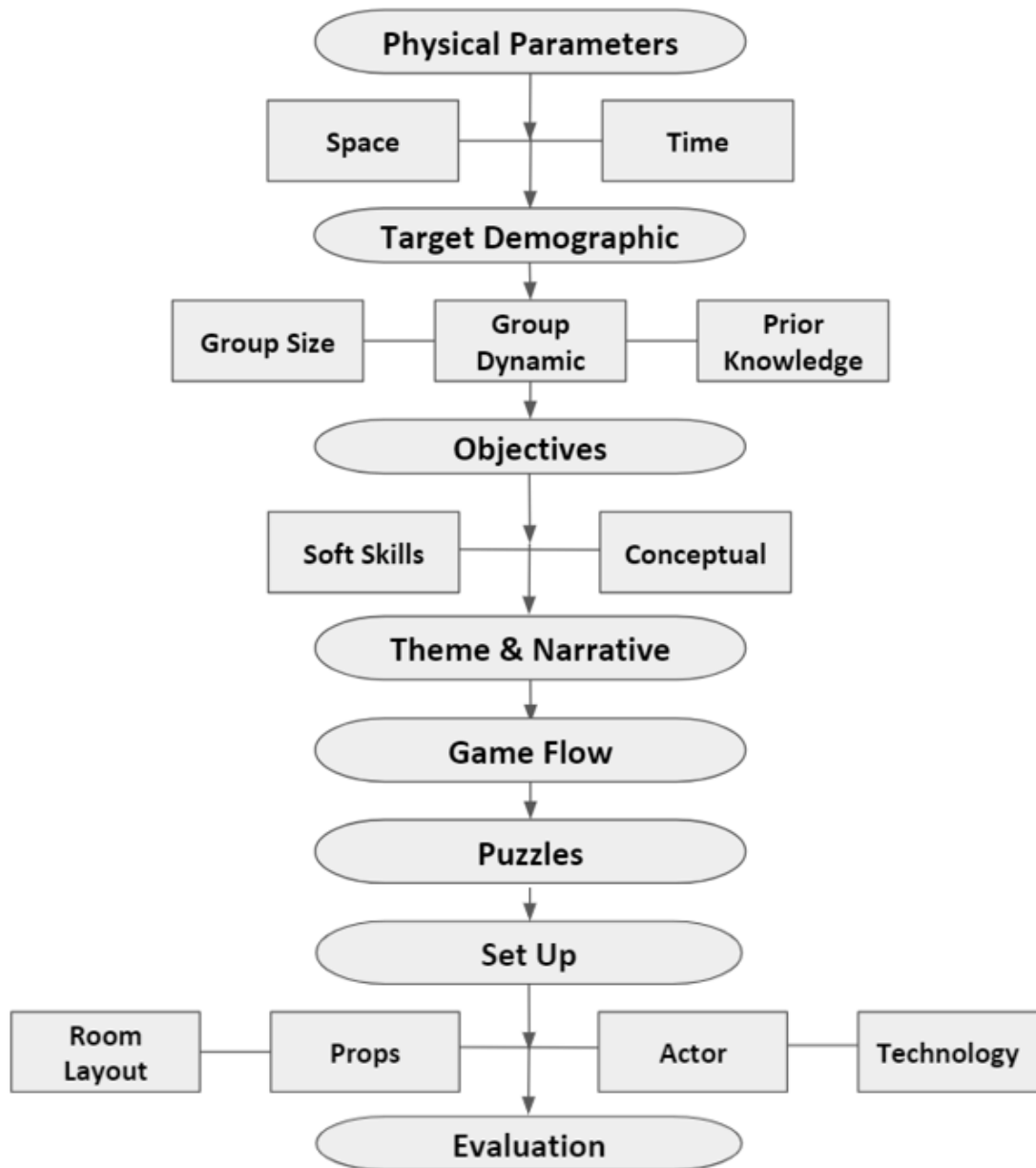


Figure 3. Mystery Room Framework Foundation

Target Demographic

Next, the designer must consider the target demographic, including prior knowledge and group size and dynamic.²² Properly anticipating prior knowledge is crucial to ensure the experience utilizes appropriate technology and provides appropriate instruction.²² Determining group size and dynamic establishes how many people can partake in the experience at one time while all remaining engaged.²²

Objectives

This ties into the next step, which is determining the desired player experience or outcomes. The primary goal of mystery rooms is often to provide an engaging, fun experience, but they can have other takeaways such as enhanced teamwork and communication skills, or educational value.²²

Theme & Narrative

The next step is creating the theme and narrative.²² Theme and narrative are related concepts that entail two different things. The theme is the overarching idea and the narrative, or the story behind the theme, ensures the participants come away with the desired objectives. An example of a theme would be “space rescue”, while an example of the narrative would be a stranded space crew needing to build a distress beacon to signal for rescue. The significance of the theme and narrative vary greatly depending on the designer. In some cases, information provided in the backstory, which is a set of events that happens before the main plot, is crucial to solving the puzzles, and in others, the theme loosely ties the puzzles together. Either way, theme and narrative give the experience consistency and context while providing a purpose and motivation. The theme sets the participants off on solving the puzzles, and the narrative fully immerses them in the experience.²²

A general narrative is structured around a character and how they progress through their life. A narrative can also take many other shapes and forms, with one example being the “Hero’s Journey”. The Hero’s Journey, shown in Figure 4, takes the structure of a normal narrative and adds more components that the main character goes through such as receiving a supernatural aid. This is how the popular

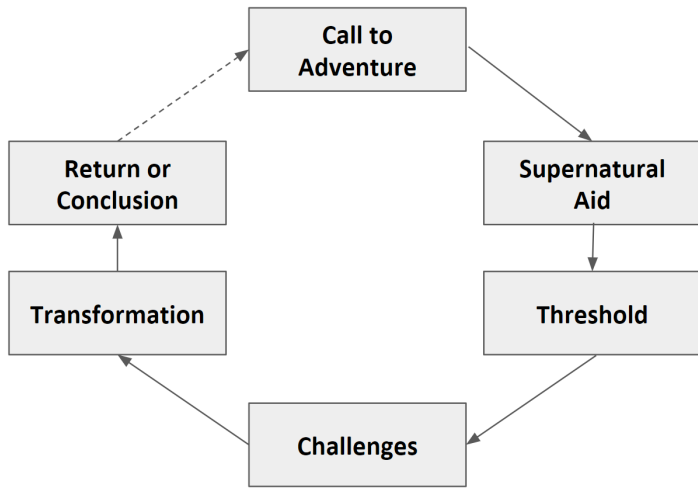


Figure 4. The Hero's Journey Flow Chart

series *Star Wars* structures their narrative. In *Star Wars*, the main character, Luke Skywalker, starts off as an outcast and low-life. Further progression leads to Luke receiving a call to adventure, which he turns away from. To move onto the next step of the journey, he needed a supernatural aid, which in the movie is his father's lightsaber being handed down to him. This is also typically when the threshold is crossed revealing the challenges and other steps needing to be solved to get to the main revelation. This is typically the climax of the narrative, which then leads to the return of the main character from his journey.²⁴

One particular type of narrative implementation which helps create a deep sense of interactivity is immersive theater. According to Julie Grossman, "immersive theater redefines stage conventions, relaxing the borders between audience and performer and drawing the non-artist into the production. It aims to establish a more fluid continuity in one's experience of life and art, imagining a malleable boundary between actors or artists and the audience".²⁵ Using an immersive theater approach

allows for the audience to become involved in the narrative.²⁵ In the case of mystery rooms, this is through the puzzles that help to keep the narrative flowing.

Game Flow

The next step to designing a mystery room is establishing how the game will flow and creating a flowchart. There are linear and nonlinear styles of flow, as shown in Figure 5. Linear flow (Left) requires participants to all work together to solve one puzzle before they can proceed to the next.²⁶ This style is typically less complicated and is better for a pure "race against the clock" game.

The other common style is a non-linear

flow (Right) which utilizes parallel puzzles, meaning tasks can be completed in any order or simultaneously. This style is typically better, as it allows more people to be involved and get a sense of accomplishment from completing a task.²⁶

Puzzles

After the flow is determined, the designer can develop the puzzles and incorporate them into the flow chart. The relationship between the puzzles is what creates the flow of the game.²⁷ The first step to creating puzzles is brainstorming the possible equipment that pertains to the theme and could be used as the basis for the puzzles. The best mystery room experiences also incorporate the narrative, and not just the theme, into the puzzles.²² The puzzles

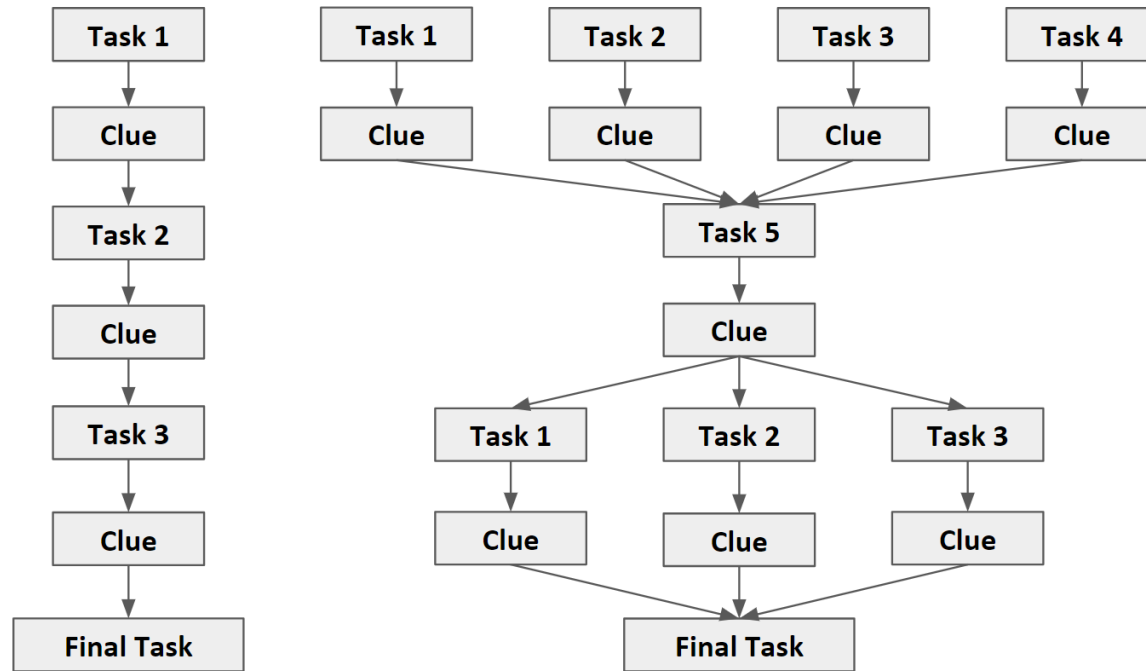


Figure 5. Linear Flow Versus Non-linear Flow

should guide the participants through the narrative. Having random puzzles is ineffective and comparable to giving students a worksheet. However, instead of a teacher grading the paper, the students are graded based on whether or not the task is completed.²⁸ Additionally, designers aim to implement a variety of puzzle mechanics and difficulties to appeal to all types of players and keep the experience interesting and engaging.²² Steps one and two also play a huge part in the design of puzzles. By keeping the target audience and objectives in mind when designing puzzles, the designer can be sure to provide proper instruction and to obtain full participant engagement. When necessary, clear instructions or hints should accompany puzzles keep the game flowing.²²

Erin Ottmar, a psychology professor at Worcester Polytechnic Institute, advised that puzzles should foster collaboration while avoiding heavy usage of technology, which would birth a competitive environment. Inherently rewarding puzzles, such as building a structure or unfolding a new part of a narrative, are important to spark natural motivation and curiosity. It is imperative to find the right balance of motivation and game to ensure success. Too many games and not enough motivation-heightening factors would not allow for an engaging environment.²⁹

Set Up

Once the theme, narrative, and puzzles are created, the physical space is set up to create a completely immersive experience. This includes the creation and incorporation of room layout, physical props, technology, and an actor. Although an actor is not always used, it can help deepen the immersion. Props are objects meant to create an immersive experience. Ideal props are common, inexpensive objects with the potential to convey information and that fit the theme, such as using playing cards to reveal a lock combination in a game themed room.²² All of these elements together in the physical space make the experience believable and engaging.²³

Evaluation

The last step in designing a mystery room is to determine an evaluation method to assess the effectiveness of the mystery room in providing intended objectives and outcomes. One method is through an iterative design process, where feedback from the participants for one version of the room flows into a newer version, ultimately bettering the overall mystery room. This step also involves creating a reset list covering everything that needs to be done in the room before another group can enter.²³

Key Components to Engaging Participants in Immersive Experiences

Whitmer and Singer have noted that there are several factors to consider when creating engaging, presence-enhancing programs. Degree and immediacy of control must be looked at because greater levels of control, and greater weight of consequence and anticipation, will enhance the experience. Elements such as world interactivity and world isolation will also increase the immersion since greater interaction enhances the realism of the experience.¹⁹ This means participants should never feel as though they are on the outside looking in. For example, if they kick a ball, the ball should behave as it would in the real world and move away.

Mel Slater, a research professor at the Catalan Institution for Research and Advanced Studies, believed that the two key components of engagement in immersive experiences are place illusion and plausibility illusion. He defined place illusion as the type of presence that refers to “the strong illusion of being in a place in spite of the sure knowledge that you are not there”.³⁰ Slater acknowledged that, while a participant’s experience with place illusion cannot be directly measured or quantified, it can be indirectly assessed using questionnaires and physiological and

behavioral responses. The results of each of these can be compared to responses that would be expected had the experience happened in reality to get a sense of how strong the illusion was.³⁰ For example, if a participant's heart starts beating faster during a stressful situation, then the illusion is strong. Researcher Richard Skarbez agreed that in order to gauge a participant’s quality of presence it is best to have them compare and contrast the experience to other times they felt similarly engaged.³¹

Plausibility illusion, on the other hand, is about what a participant is perceiving. Slater defined this as “the illusion that what is apparently happening is really happening”.³⁰ In order to create plausibility, the environment must respond to the participant’s actions, events in the environment must address the participant directly, and objects or events must follow the basic expectations and rules of the real world.²⁶ *Voice of VR* podcast host, Kent Bye, claimed that the more a participant can interact with the environment, the more believable the environment becomes and the more of an emotional experience the participant has. In the same podcast, Skarbez connected emotional presence to plausibility illusion. He found that engaging emotions is what takes the participants out of reality and into another realm inside the immersive experience.³¹

Incorporating active learning methods that build upon the common curriculum in a fun, immersive way is an effective method for increasing student engagement (for more information on the Australian Curriculum, see Supplemental Materials F). Studies show that high levels of engagement lead to increased interest and motivation, which leads to better academic results, and more promising futures. One increasingly popular method of active learning is game-based learning, particularly mystery rooms, which are engrossing, collaborative experiences in which various academically stimulating puzzles and tasks can be placed. In order to increase the engagement levels of youth who often feel alienated from school, our IQP team incorporated mystery room experiences in Banksia’s after-school programs.

Creating a Mystery Room: Our Process

We carried out our methods in the manner shown in Figure 6. The background research we conducted on engagement and mystery room design for Objectives 1 and 2 informed our work on Objective 3. This third objective covered the iterative design process for creating our mystery room, which entailed observing the youth at Banksia, determining our desired objectives, creating a theme and game flow with puzzles and room layouts, and pretesting and refining our ideas along the way. Objective 4 focused on evaluating our finished mystery room design. This took place through user testing and focus groups. Once this objective was complete, we were finished with that particular mystery room iteration; we used what we learned, however, to recommend future changes to our design and to conceptualize additional mystery room designs.

Objective 1 - Determining Effective Engagement Strategies: Methods & Results

The first objective for our project was to determine meaningful ways to engage, involve, and motivate youth. We first conducted a literature review which looked into the uses of active learning and game theory, and how these concepts could relate to Science, Technology, Engineering, and Math (STEM) objectives in the current Australian curriculum. This revealed the benefits of using active education as opposed to traditional methods of education, and an understanding of mystery rooms and their place in education. Additionally, the literature review gave insight into the STEM topics and procedures that students are expected to learn at each level, and gave us a basic idea of how to include conceptual concepts

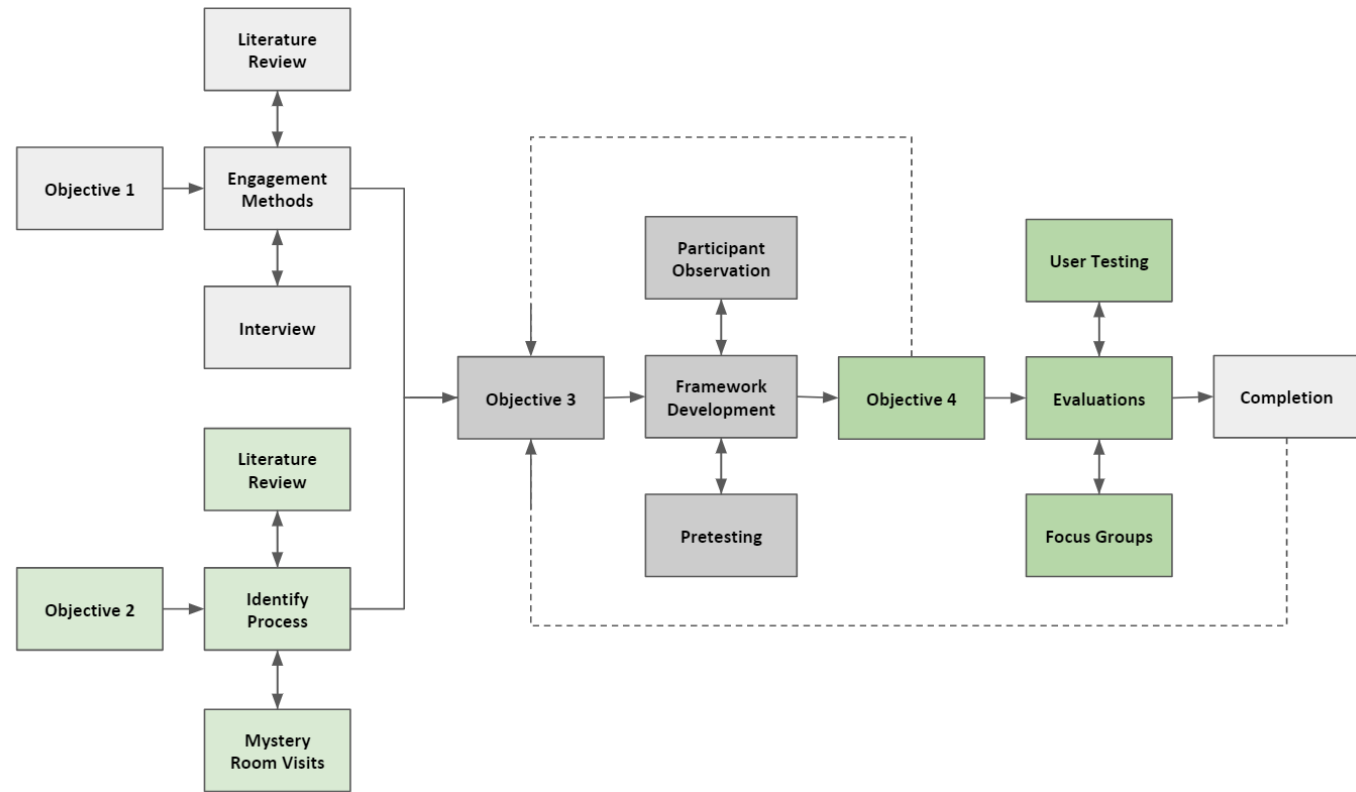


Figure 6. Methodology

in an engaging experience. The results of the literature review can be found in the previous section. We gathered additional information on these topics an interview with Erin Ottmar, an expert on active learning methods (Supplemental Materials G).

In the end, we identified numerous benefits caused by active learning, such as greater enjoyment of material, a more concrete grasp of concepts, and higher levels of attention. We also gained insight on ways to utilize active learning within our mystery room experience, such as through collaborative activities that do not rely heavily on technology. This information helped us in determining our research direction on engaging and immersive game development.

Objective 2 - Identifying the Design Process for a Mystery Room: Methods & Results

In order to complete the second objective of developing a mystery room design process, we conducted a literature review on EscapED and other various expert mystery room frameworks and design methods. The results of this review were discussed in the previous section. We also visited several mystery rooms in order to better grasp how the spaces worked and how narrative was woven throughout the experience. We recorded these visits on the observation sheet found in Supplemental Materials H;

this sheet included information on themes, types of rooms, numbers of hints provided, and the overarching narrative.

Our evaluation of EscapED and other expert methodologies gave us a walkthrough on the creation process and greatly helped us in developing our own approach. Our visits to preexisting mystery rooms provided us with a firsthand look at proper balancing of narrative, motivational aspects, and gameplay, as well as a deeper understanding of how to get players engaged immediately, and theme and hint integration within a physical world. As an example of this, one aspect from a space-themed room which we visited

that was particularly well-implemented was the communicative spaceship that gave us hints whenever we were stuck. This system didn't break our immersion, and even added to the futuristic atmosphere of the experience. From this, we began brainstorming how we could implement a system like this, and started looking more into the topic of immersive theater; this strategy could combine elements like actors and interactive narration, and would allow for a more natural, thematic introduction and guidance through our narrative than visual cues would.

Objective 3 - Creating an Engaging Mystery Room through an Iterative Design Process: Methods & Results

Our third objective was to create an engaging experience by utilizing an iterative design process. We fulfilled this goal through informal interviews and participant observation, as well as by using prior knowledge gained from our literature reviews. The steps taken to develop our mystery room can be seen in Figure 7.

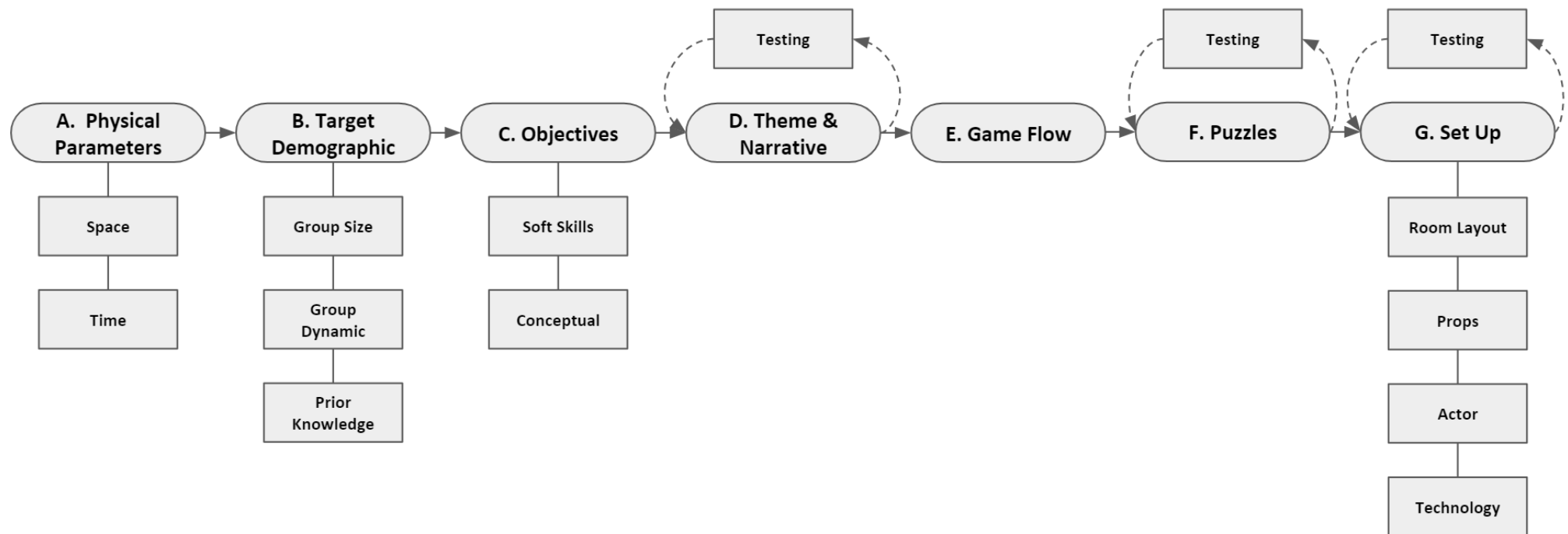


Figure 7. Our Iterative Mystery Room Design Process

In order to determine physical parameters for our project (Step A), our team drew on informal interviews with representatives of Banksia Gardens. We established that the allotted physical space was their childcare room and computer room. We also determined time constraints; each mystery experience would need to last no more than 25 minutes.

The next step of discerning the target demographic for our mystery room experience (Step B) was done through employing information gained from our interviews with Banksia, and through participant observation sessions with the children participating in Banksia's homework club. From our interviews, we decided that each mystery room experience should have a maximum of four participants at a time. Through our participant observation sessions, we were able to determine group dynamics by seeing how well the children could focus on tasks, how effective they were at problem-solving, and how they worked with others, among other things. In addition, we were able to start observing what sorts of topics the children would be intrigued by within our mystery room experience.

For our observations on basic interests, we kept logs on what motivated the children, as well as which activities they were drawn to (Supplemental Materials D). While volunteering, we spoke with the children about their homework, which school subjects they liked the most, and what activities they liked to do. Some activities that they found the most appealing were ones with fantasy themes; for instance, one of the children brought in a dragon book and all of the other children were very interested in it. We also found several activities with underlying educational concepts such as electric circuit games or engineering a car, and set these out for the children. We then observed which activities the children used and fought over. This method of observing basic interests helped us see which subjects the children naturally gravitated towards, and provided different information from when we directly asked which subjects they preferred. For our direct observations on soft skills, we watched

for key elements, such as collaboration and communication skills, how competitive the children were, and abilities to work as individuals; this helped us to determine the group dynamic. Knowing this helped later in the development of learning objectives based around soft skills.

In Step C, we used our participant observations from Step B to establish the soft skills and conceptual objectives we wanted participants to take away from our experience. For instance, during our observation sessions, we often witnessed quarrels and likewise competitive traits which led us to make collaboration one of our goal soft skills. Other soft skill objectives that we felt were needed were helping others, following instructions, and communication. We hoped the children would be able to gain exposure to, and improve in, these soft skills. We had also noted that the children favored activities that included building structures and putting pieces together. Because of this, we decided to implement this type of physical activity as one of our learning objectives so that we could help cultivate this natural interest.

The objectives for the first iteration of our design are summarized in Table 1.

Table 1. Learning Objectives

Overall Objective: Student Engagement
Soft Skills Objectives: Collaboration, Teamwork, Helping Others, Following Instructions, Communication
Educational Objectives: Components of Fire (Chemistry), Mixing/ Measuring Substances (Chemistry), Manipulating Fluid Flow (Physics), Causing Flootation (Physics)

We then communicated with our sponsor to decide on an engaging theme and narrative to use in our first iteration (Step D); we used a fantasy theme and a narrative based around helping a wizard restore the element of fire to the world after a spell had gone wrong. The process behind the decision was to incorporate some of our sponsor's ideas of fire and dragons into an engaging theme and narrative that would also involve the participants. From some of the trends that we observed during our volunteering sessions, we believed that a fantasy theme would fully immerse the participants in the experience. In order to ensure deeper levels of immersion with this story, we worked with an actor that Banksia hired to really bring our experience to life. From this collaboration, we were able to flesh out full character designs, draft dialogue, and better weave our puzzles into the story progression.

Our narrative starts off with the children in the modern day meeting an archaeologist named Dr. Bones. Dr. Bones informs the children about how dragons went extinct. It turns out that a wizard (Figure 8) had taken the dragons' fire because they kept burning down the wizard's house. Because of this, dragons lost their ability to defend themselves. The

wizard tried to reverse the spell, however, it was so powerful that it had taken the fire away from the whole world. The remorseful wizard created a portal to the modern world in hopes to receive help in restoring the dragons' fire. Dr. Bones is far too busy to help, so the children must go instead. Once they enter the portal they are brought to the land of the dragons and come face to face with the wizard. The wizard is upset that he took the dragons' fire and wishes to help them. The wizard explains that in order to help the dragons, the children must complete a fire beacon by combining the three components of fire, which are wood, oxygen, and a spark. Each of these components are hidden throughout the room. In order to get them, the students solve three puzzles (Figure 9). Once collected, the children place the three components into the fire beacon to create fire. From here the wizard summons a dragon and gives their fire back. A full script of our narrative with stage directions can be found in Supplemental Materials J.



Figure 8. Concept Drawing Next to Actual Wizard

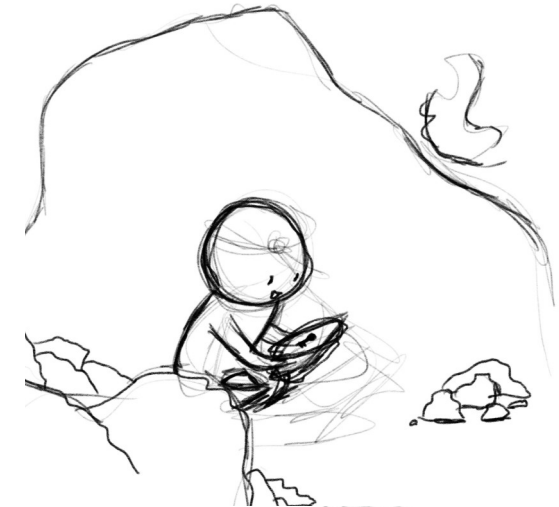
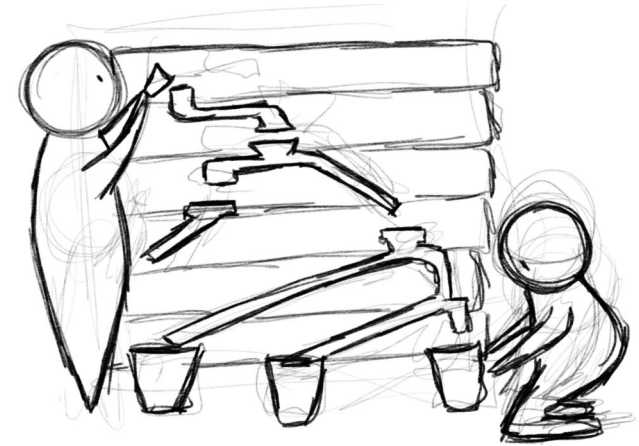


Figure 9. Concept Drawings of Puzzles

Step E required us to determine an appropriate flow for the mystery room, which we accomplished by using linear and nonlinear methods, as described in the background, to create an experience that would meet the learning objectives determined in the previous steps. For example, one of our objectives was collaboration, so the flow needed crossover points where the students had to work together to solve the puzzle. These crossover points occurred when the children had to solve the riddle to open the door and when they had to use the three components of fire to complete the circuit. Another learning objective was helping others, so we created parallel puzzles where students could work by themselves and receive aid, or give aid, as needed. We made a separate chart for each mystery room design to provide a visual representation of how the puzzles flow together (Figure 10).

We created puzzles (Step F) for our designs based on our previously developed learning objectives, theme, and narrative (Supplemental Materials K), as well as on our own experiences with mystery rooms, ideas given by our sponsor, and online examples of puzzles. These puzzles were created in such a way to inspire the children in the conceptual learning objectives, foster the development of soft skills, and help move the children through the narrative. Our puzzles for our first pilot room included solving a riddle to unlock a door, directing water flow to make a key float, mixing elements to create a chemical reaction, using black lights to find a secret map in a cave, and combining elements to create fire. The water puzzle was used to demonstrate that safety is important when dealing with fire, so before they could get the spark they needed to get water. The chemistry puzzle was used to get oxygen as a common

byproduct of many chemical reactions is oxygen, and oxygen feeds fires. The map puzzle was then used to guide the children to the tree where they could find wood, the fuel for the fire.

Puzzles were then tested with members of the Banksia staff and youth to determine timing of puzzles, amount of instruction needed, and any faults in the designs. Examples of the feedback that we received from testing were making sure the explorers in the room knew they were looking for a symbol in the cave that would correlate to the symbols in the wood pile. Another example was the amount of vinegar we needed for the chemistry puzzle because, when testing it, the original recipe caused the potion to bubble over the top of the beaker. The other major feedback we received was to make sure the key location on the water puzzle was highlighted. All of this feedback seemed to have a commonality between

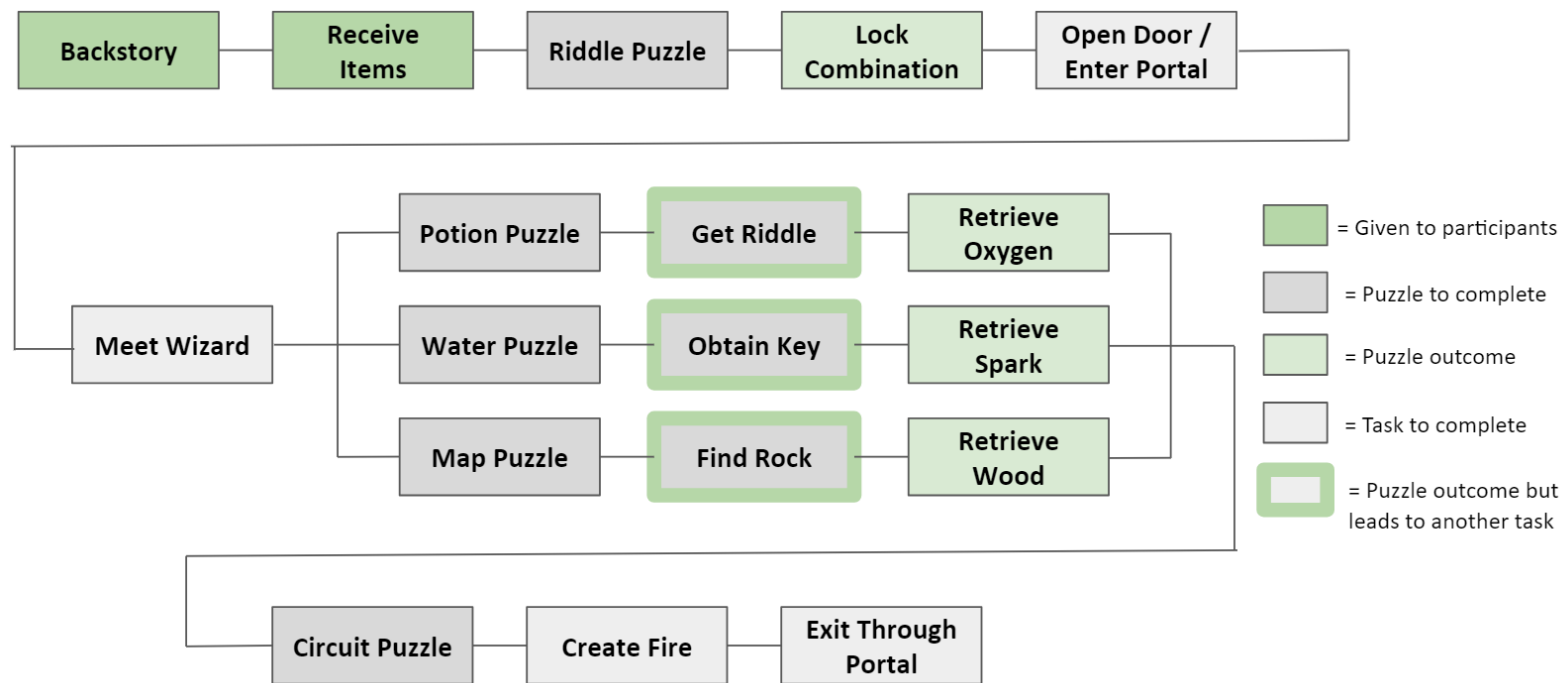


Figure 10. Dragon Room Progression (or Game Flow)

them in that there is a difference between playing the game and designing the game. When designing, you may overlook some aspects of the puzzles that may seem to be very intuitive, but they actually do need small hints or tips to solve. We then altered our designs according to this constructive feedback.

The last step before we moved on to user testing of the completed mystery room was to design the layout of the room (Figure 11). We figured out where each puzzle and prop was to be placed within the room to create the desired immersive, theme-based environment. Through working closely with our sponsor, we created a design plan and bought the

necessary materials. We worked with the actor to develop the characters that the participants would interact with during the experience. In addition, we set up the lights, sounds, and other electrical components to help create an immersive environment. From this step, we tested individual electrical components of the room and ran through the narrative with the actors. We also set up the room, and got feedback from staff at Banksia on its aesthetic appeal and ability to convey a different environment. Our room layout, props, narrative, and electronics were adjusted according to this feedback. For instance, during this time we realized that the font size and color of our

chemistry instructions made it hard to read in the darker environment. Due to this, we chose a different font color and increased the text size. In addition, we used the feedback to choose sound volume and light color.

We used this iterative design process to create and test a finalized mystery room experience, which we discuss in the next section. This design process also informed three additional mystery room design concepts we later created, which we discuss in the future room designs section.

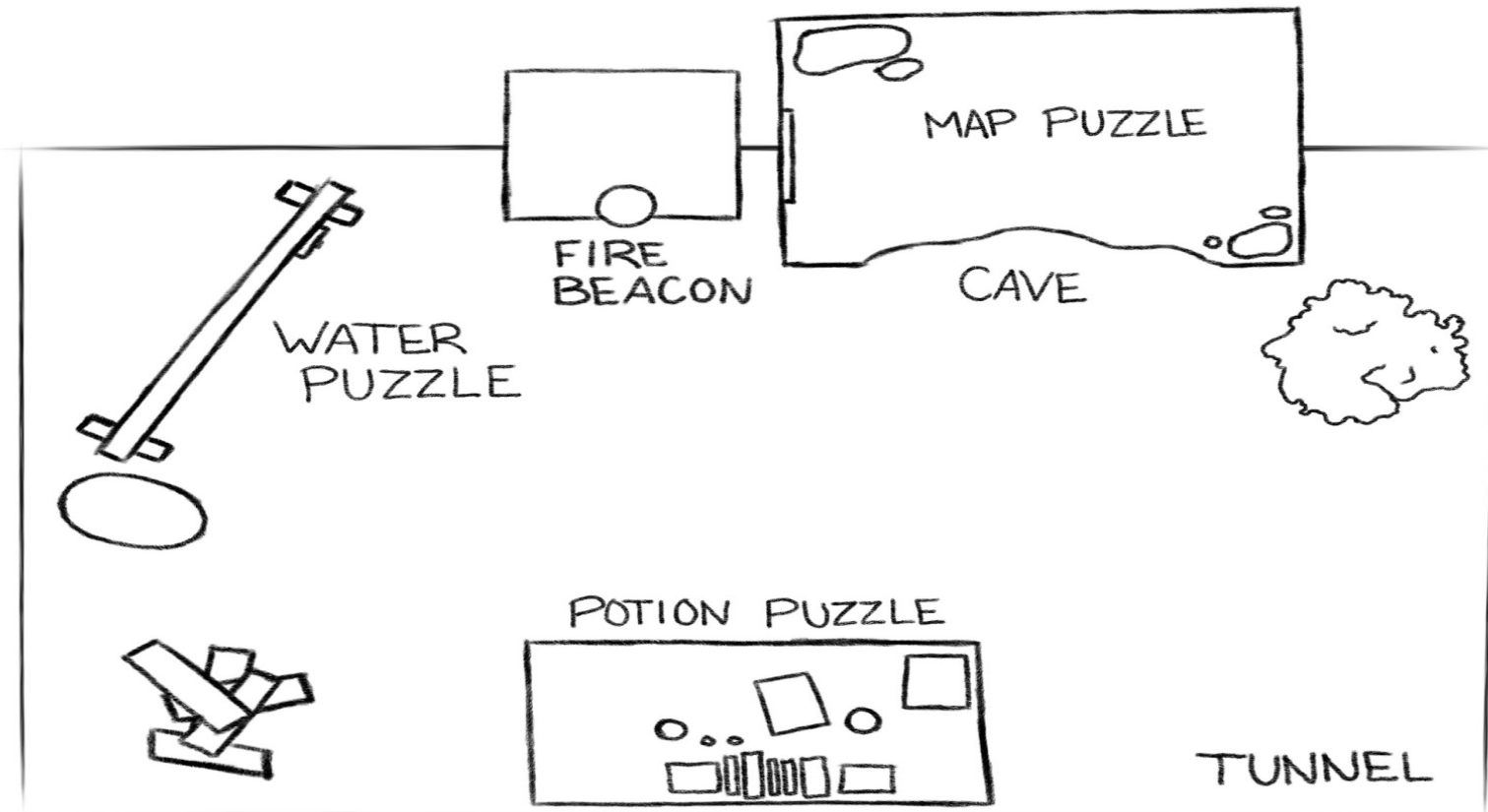


Figure 11. Dragon Room Layout Diagram

Objective 4 - Assessing the Completed Mystery Room: Methods & Results

The final objective for our project was to assess the effectiveness of our completed mystery room on our targeted demographic, which we did through direct observation of the children using the room, and post-experience focus groups on our pilot testing day. The pilot testing of our mystery room was on April 13, 2018, with a two hour time slot. Three sessions were run, with the first two having four children and the final session having three children. Each trial session lasted for a maximum of 25 minutes. During each session, we had three observers stationed around the outside of the enclosure. Each observer was responsible for writing down observations for one puzzle. These observations were done in accordance with our observation form (Supplemental Materials L), which was formatted as shown in Table 2.

In addition, general observations were noted by both the actors, who had direct contact with the children, and the technical support individual, in charge of running all the technology in the room. Observations by the actors are especially advantageous as they provide more direct, personal results. The comments from the actors can be found in Supplemental Materials M and all other observations can be found in Supplemental Materials N.

By reviewing the observations on these subjects, we were able to determine the degree to which we met Banksia's requirements and fully engaged the students; we did this by compartmentalizing our data into three main sections: functionality, engagement, and soft skills. Our observations on engagement were split into three categories: body language, emotional cues, and verbal cues. In this case, body language refers to physical signs such as jumping up and down, slouching, or staring out into space. Emotional cues are responses from the children such as sadness, fear, joy, or fascination. Lastly, verbal cues are things the

children said throughout the experience. We specifically looked at these as evidence of self-involvement, participation, focused attention, and active commitment, which our background research revealed to be signs of engagement. For example, if a student is yawning, looks bored, or starts talking to their friends about things other than the room, then they are not engaged in the experience. Conversely, a student who is actively answering the wizard's questions, emotionally responding to the actors, or jumping with excitement and amazement is engaged in the experience. By focusing on these three categories of observations, our team was able to better judge the level of engagement than would be possible from simple questions and answers alone.

Table 2. User Testing Observation Sheet

Basic Logistics	
	<ul style="list-style-type: none"> Room theme Time allotted Time needed for completion Number of participants Age range of participants
Per Puzzle & General Observations	
<u>Functionality:</u>	<ul style="list-style-type: none"> Assistance needed Problems encountered
<u>Engagement:</u>	<ul style="list-style-type: none"> Times sidetracked Difficulties encountered Body language Emotional cues Verbal cues
<u>Soft Skills:</u>	<ul style="list-style-type: none"> Any arguments Collaboration & teamwork Following instructions Communication

User testing helped us see which concepts worked best, what aspects needed to be tweaked, and how engaging the entire experience proved to be. This method also allowed for seeing how well varying numbers of participants worked out, and how differing personalities reacted to the environment we had setup.

The focus groups were carried out when the participants were done with the experience (Supplemental Materials O). The questions asked in these sessions helped our team determine certain aspects of logistics, as well as specific views on elements of the experience that we otherwise might not have picked up on during our observations. Questions asked in the focus groups were as follows:

- Did you feel like you were in the story's world?
 - If not, why didn't you feel like you were?
 - If yes, how did you feel like you were in the world?
- What was your favorite part?
- What was your least favorite part?
- Were the puzzles too hard?
 - If so, which ones were the hardest?
- Were the puzzles too easy?
 - If so, which ones were the easiest?
- Did you like the story?
- What stories would you like to see in the future?
- Did this experience remind you of any other experience you had in the past?
 - If so, which ones?

General Observations

General observations of the room helped determine logistical functionality. In order to determine how long the participants spent in each section of the mystery room, we had observers keeping track using timers. For each run through of our experience, the introduction section in the computer room took between five and seven minutes, and the main experience took around twelve to fifteen minutes.

Functionality

Functionality of the overall room included determining how robust the puzzles were in terms of durability and clarity to the participants. This was done for each individual puzzle by observations done during the experience.

For the potion puzzle (Figure 12), only one of the three runs of the room resulted in the correct reaction, meaning that there were issues with the puzzle's implementation. Reasons for this varied from incorrect amounts of mixture, to the room being too dark to see the instructions, and the colors of food coloring provided being difficult to determine. These issues could easily be fixed by ensuring that all items provided are properly labeled and easy to see. The actor playing the wizard also suggested making it clearer that the potion key was leading to the books, as participants needed guidance to realize this.

The functionality of the map puzzle (Figure 13) contained some issues with the participants not knowing that they were looking for a specific symbol in the pile of wood. A couple of the children needed to be brought back to the cave by the wizard to fully understand what they were looking for. The actor also observed that participants got distracted by the riddles on the other pieces of wood and did not realize they only needed to pay attention to the one with the correct symbol. Once the wizard told them they needed the specific symbol and that the other riddles were irrelevant, the children quickly solved the rest of the puzzle by themselves.

For the water puzzle (Figure 14), no pieces broke, although there were occasional issues with minor leaks from the children pulling a bit too hard on the various pieces. This was easily fixed in between runs of the room, and can be avoided in future rooms by adding extra reinforcement to the various pipes. Effectiveness of instructions for this puzzle was determined through whether or not the children needed help from the actor in the room. In each case, the children were able to read the instructions and

deduce what exactly they had to do; the only part which left some room for improvement was the children needing to use the hook provided to them earlier on in the experience in order to obtain the key from this puzzle. The actor in the room also stated that the children had a hard time reaching the top of the water puzzle and a suggested fix could be to provide a step stool. This could also possibly help with the consolidation of water and keep it from spilling everywhere.

The fire beacon (Figure 15) was functionally the most inconsistent puzzle. During the first group, the lights did not turn on despite the children putting in the three rods that represented the spark, wood, and oxygen. One participant in the group mentioned that we were experiencing "technical difficulties" when nothing happened, breaking immersion from the experience. One of the children suggested rearranging the pieces and that time it did work, however it should have worked the first time. During the last group, the smoke machine was not working, but the actor quickly realized and turned the attention away from it. Additionally, the participants did need some help with the placement of the rods, as they didn't realize the rods had to push in the metal lever. However, this was fixed with some minor prompting from the wizard.

Overall, the puzzles proved to function properly with only minor errors or faults in instructions. The errors and faults seemed to stem from the fact that we overlooked minor details in the flow of the puzzles, which were easily fixed. This information will help for future experiences.



Figure 12. Potion Puzzle



Figure 13. Water Puzzle



Figure 14. Map Puzzle



Figure 15. Fire Beacon

Engagement

Levels of engagement were determined through analyzing the children's body language, emotional cues, and verbal cues in order to identify the key signs of engagement identified in the background.

Body language was the first thing our group looked at to determine engagement. From our observations on the room as a whole, the children that were participating in each experience were quickly darting around to solve each puzzle, and they were jumping up and down once they figured out a solution. A majority of the children were also extremely energetic outside of the room once the experience was finished. However, one of the biggest tells of engagement was the focused attention of the children while they were in the computer room with Dr. Bones. Most of the students sat still with attentive body language and actively listened to the archaeologist's "lecture" for the first five to seven minutes of the experience (Figure 16). During the part of the

experience where the children had to find the components of fire, almost all of the children were observed to be diligently working to solve the tasks at hand showing active commitment and participation in solving the problem at hand.

The second thing we looked for was emotional cues. One key emotional sign was that most of the children would not stop talking about how thrilled they were to be able to help the dragons. This showed a high level of engagement because they felt they were inserted into another world and were actively involved in the narrative. We also observed expressions of excitement (Figure 17), and genuine concern for the crying wizard, which were both major signs of emotional engagement. In addition, the children were fascinated by the contact juggling that the wizard was doing while they were in the room. The wizard felt as though it was distracting at some points, so they had to stop several times throughout the pilot day as it proved to hinder the children's attention toward the activity.



Figure 16. Children Attentively Listening and Participating



Figure 17. Children's Faces Showing Excitement

The last thing we looked at was verbal cues. This ended up being the most telling on the children's engagement levels. Throughout the pilot day, the actors noted that many children asked questions about the wizard and archaeologist, both during and after the experience, such as: "Are you a real wizard?"; "What made you so interested in dragons?"; "How did you do that with the crystal ball?"; and "Wait, are you the wizard? You sound a lot like the wizard". Additionally, most of the children answered the questions asked of them during the experience, such as what the components of fire were, how they could help the dragons, and how fire was taken away in the first place. One of the biggest signs of engagement was that some of the children asked if they could participate in another, or even the same, mystery room again while we were asking them questions in the focus groups. After one of the more difficult puzzles, the chemistry puzzle, one of the students mentioned that they felt like a wizard in training. These verbal cues were evidence of self-involvement and participation, two major aspects of engagement. There was, however, one instance of disengagement during

the third run with a participant who had seen the puzzles before. She opened the curtains and tried to talk with the backstage crew, and she answered the wizard with “we need three rods to make fire”. This behavior broke the immersion for her and the rest of her group, and is a sign that it is important to wait before reusing themes and puzzles to achieve full engagement.

In addition to collecting data on pure engagement, our team also wanted to determine if our puzzles were engaging the children in the underlying STEM concepts incorporated into the narrative. The goal with these objectives was not to teach the concepts, but to introduce them in an engaging way in hopes that the children might pursue them further on their own. With the potion puzzle, we watched to see if the children were actively committed to following a basic chemical procedure and were excited when they completed the reaction. The puzzle proved to engage the children as they really wanted to complete the puzzle correctly. However, they had a hard time doing so and needed a significant amount of assistance from the wizard. This may have been due to darkened room, making it difficult to see the instructions, ingredients, and reaction. Because of these encountered obstacles, this puzzle is unlikely to inspire the children to delve deeper into the topic. While solving the water puzzle, we heard the children in the first experience say, “Oh, we need to get the water to flow down into the crate!” and “If we turn this faucet, it should close off this pipe so that the water flows this direction”. These sorts of comments showed that the participants understood the subject of water flow, and demonstrated that we were effective in engagingly introducing this concept. For the fire beacon puzzle, we wanted to introduce the elements needed to make fire, rather than the detail of thermal reactions. We effectively did so by asking the children what elements are needed to make fire at the start of the experience, which they eagerly answered with guidance from the actor. These elements were further instilled in their minds as the children solved puzzles to find each element in the room.

Soft Skills

Our observations on soft skills gathered data on our set objectives: collaboration, helping others, following instructions, and communication. We witnessed constant collaboration and teamwork from all groups throughout the experience (Figure 18), with the children splitting tasks, helping others whenever needed, and sharing puzzle materials between each other. This was evident through the participants using the phrase “we completed this puzzle” rather than “I completed this puzzle.” One of the actors overheard the children telling each other to “each take a rod” to put in the fire beacon, a clear sign of collaboration.

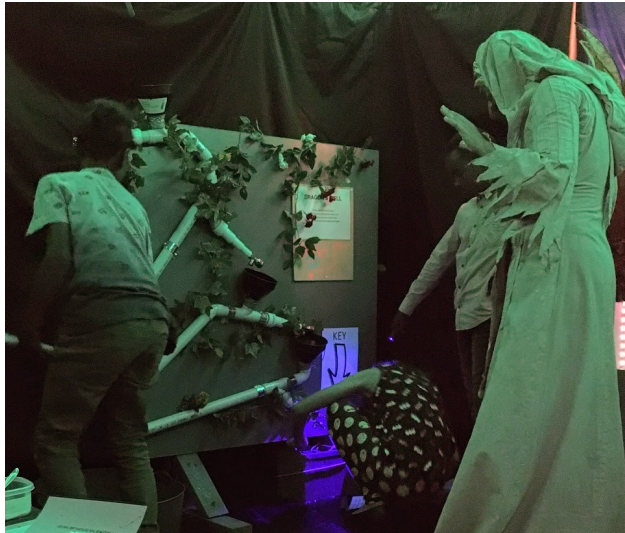


Figure 18. Children Collaborating

The objective of following instructions was observed by noting how well the participants followed the written instructions, as well as by how effectively they utilized verbal cues from the actor in the room. In all three experiences, the children were not turned off by the presence of written instructions but were adamant about following them closely, although many struggled to do so. However, after seeking and receiving help from the wizard in the form of verbal

step by step instructions, the children were able to succeed (Figure 19). There was only one instance where one participant in the third group, while working on the chemistry puzzle, noticed the instructions but proceeded to randomly put ingredients in the beakers. However, he did later follow the written instructions given to him by the archaeologist. As for verbal instructions given by the wizard, the children in the third group did not wait for the wizard to finish their instructions and instead went right into the puzzles. This was in contrast to the second group where the children were actively listening to the wizard’s instructions prior to starting any tasks.

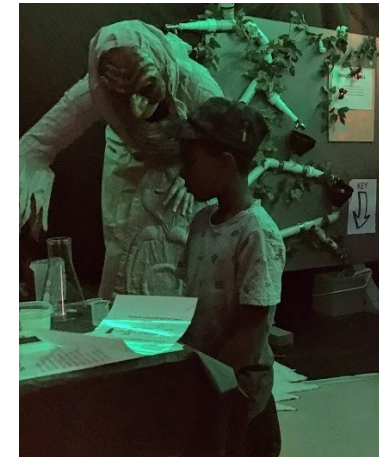


Figure 19. Wizard Assisting with Instructions

For communication, we noted whether or not the children fought, and how well they interacted with each other through their language. One example of communication was, when working on the water puzzle, two participants would walk up to solve it, view it for a moment, then divide up how they should go about figuring out the puzzles. The result in the case of all three room experiences was that one child would pour water into the funnel and turn the faucets while the other gave verbal directions and informed how close they were to being able to reach the key. Another instance of communication around the room was whenever one puzzle was finished, the participants would ask around and see if anyone needed help. There were a few times the children bickered, however there were no notable instances where the children fought over objects, tasks, or the correct way of doing something.

Future Room Designs & Documentation

In this section, we discuss our project deliverables. In addition to the previously discussed dragon room (Supplemental Materials P), we proposed three additional designs for future mystery rooms, with instructional materials on how to design and set up mystery rooms.

Proposed Design 2: Pirate Room

The idea for our second design is based on a pirate theme. It begins with a member of the Banksia staff acting as though they found an old message in a bottle while cleaning out a closet. This staff member presents it to the children, who open it to find three coded messages and a map of Banksia that leads to right outside the computer room. Using cartography skills, the children must find their way to the correct location and speak the words “We’ve come to parlay”, as directed on the map, causing two boats to appear. The children get in the boats and are pulled into the childcare room to find it has been transformed into a pirate cove (Figure 20). Someone acting as a pirate explains the backstory and asks for the children’s help in escaping the cove where the pirate was marooned.

The children will then decode the riddles from the bottle using a key the pirate has, which leads them to three separate puzzles (Table 3). The reward from each successfully completed puzzle is a key to a treasure chest with three locks. The chest contains a map that will lead the pirate home.

Once the children collect the keys from these tasks they will gather around the pirate.

The pirate will direct them to walk the plank over to the treasure chest, which they will unlock and obtain the map for the pirate. The pirate will exclaim their gratitude and explain that home is in the other direction (opposite corner of the boats), but that the children should go out on the boats. Figure 21 shows how the participants will progress through the puzzles and narrative.

In addition to the conceptual objects listed under each puzzle, this room design aims to enhance the participants soft skills in the areas of collaboration and teamwork, communication, following instructions, and problem solving. The full detailed design of the pirate room, including the narrative, room setup, and puzzle instructions, setup, and procedures, can be found in Supplemental Materials Q.

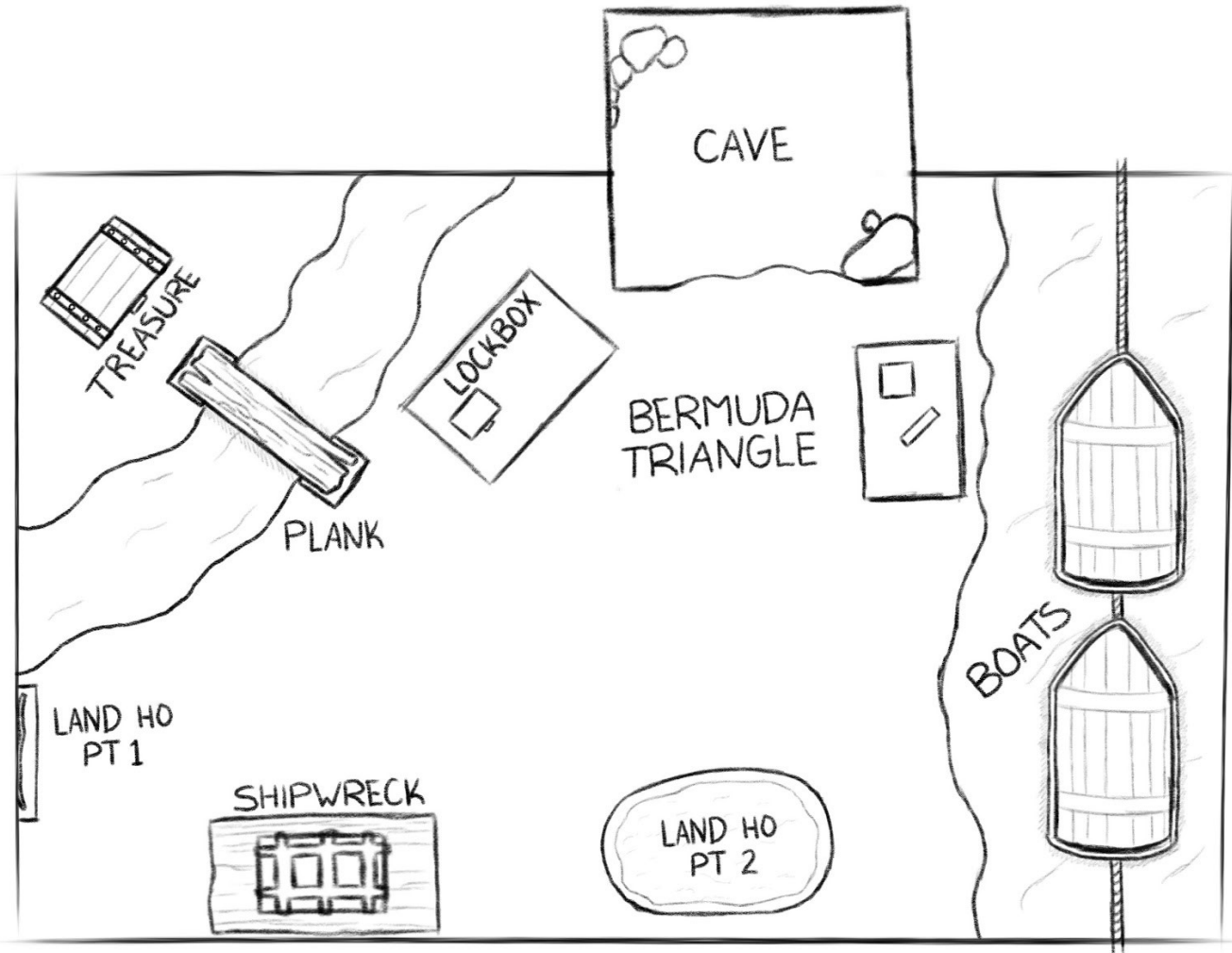

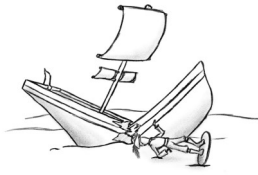
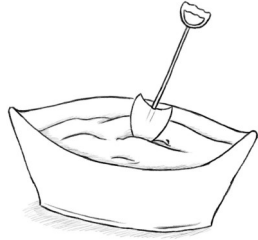


Figure 20. Pirate Room Layout

Table 3. Pirate Puzzles

	<p style="text-align: center;"><u>Bermuda Triangle</u></p> <p>The children must use the compass to find an object to the East which disrupts the compass' natural sense of direction; they must then use this object to unlock a special box in order to get the key.</p> <p>STEM/Educational Concepts: Magnetism, Navigation</p>
	<p style="text-align: center;"><u>Shipwrecked</u></p> <p>The children must to add enough salt to a container of water to increase the density, causing a small pirate figure on the bottom, which has a key attached, to float to the top where they can grab it.</p> <p>STEM/Educational Concepts: Water Properties</p>
	<p style="text-align: center;"><u>Land Ho!</u></p> <p>The children must use the international codes of communication for nautical exploration to determine that flags spell out SAND. They will then go over to the bin of sand that is in the room and search through it to find a small treasure chest containing a key.</p> <p>STEM/Educational Concepts: International Codes</p>

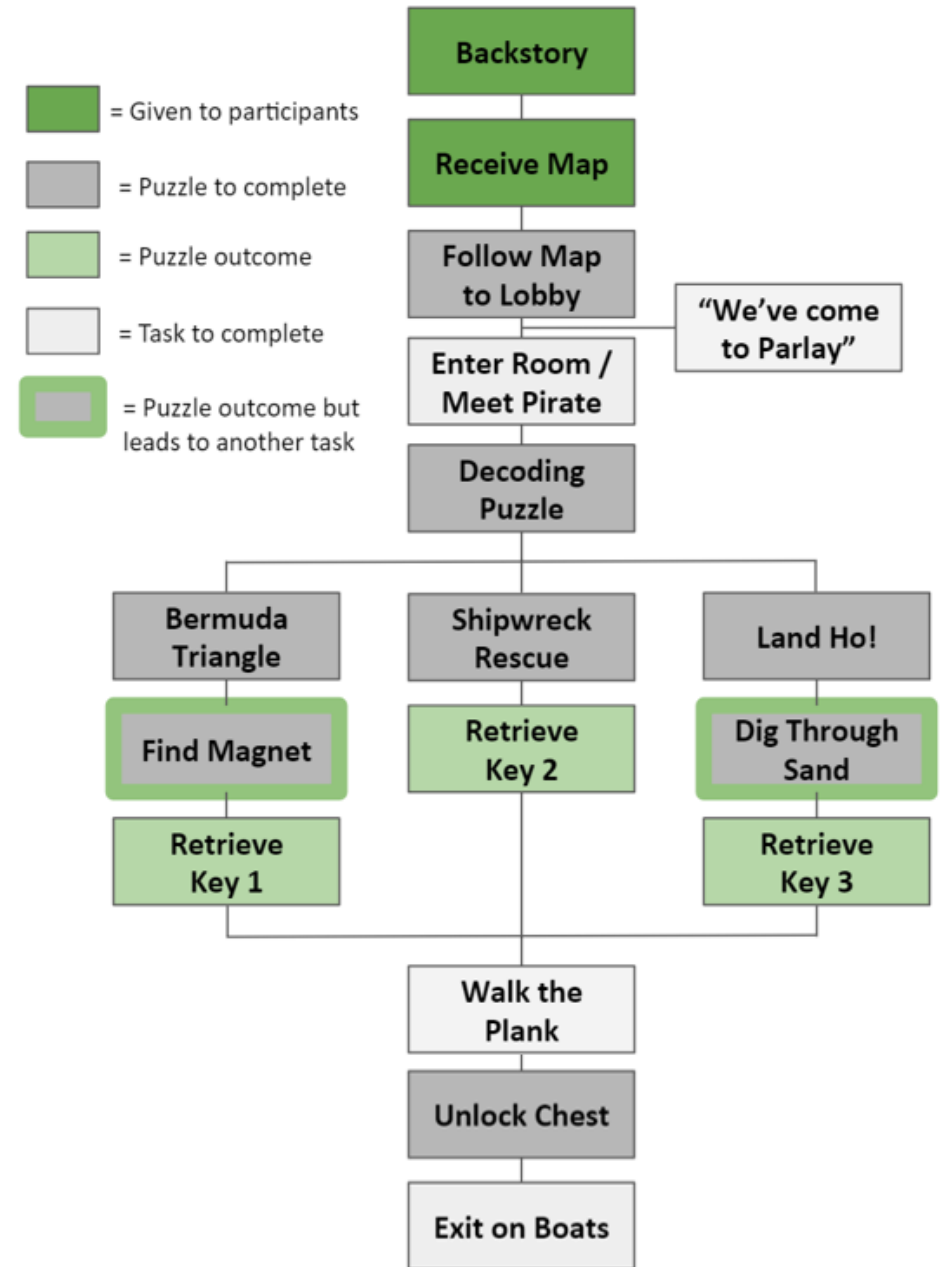


Figure 21. Pirate Room Game Progression

Proposed Design 3: Dinosaur Room

The idea for our third design is based on a dinosaur theme. The experience begins with the children gathering in the computer room for a debriefing with a ranger from Jurassic Island who is looking for new ranger recruits. After hearing the basics of the job and dressing for the part, the children are led into the childcare room, which has been set up to be a jungle control room (Figure 22). Almost immediately, the white lights in the room go out, plunging the participants into darkness. Moments later, red lights come on. The ranger guesses that the

power has gone out, and implores the children to help build an audio distress beacon to contact the mainland and get someone to come fix the power. Without the power, the temperature regulators in the dinosaurs' enclosures will turn off, and the dinosaurs could get very sick. The children must then complete a set of tasks as explained by the ranger to collect pieces of the beacon (Table 4).

Once the children collect all three pieces of the beacon, they must follow the ranger's blueprint to construct the audio beacon. The ranger will then use the beacon to call for help, at which point the lights will turn back to white and Jurassic Island's mechanic will come to restore the power. This culminating

puzzle introduces the participants the STEM concepts of basic engineering, object assembly, and radio transmissions. Figure 23 shows how the participants will progress through the puzzles and narrative.

In addition to the conceptual objects listed under each puzzle, this room design aims to enhance the participants soft skills in the areas of collaboration and teamwork, communication, task management, helping others, following instructions, problem solving. The full detailed design of the dinosaur room, including the narrative, room setup, and puzzle instructions, setup, and procedures, can be found in Supplemental Materials R.

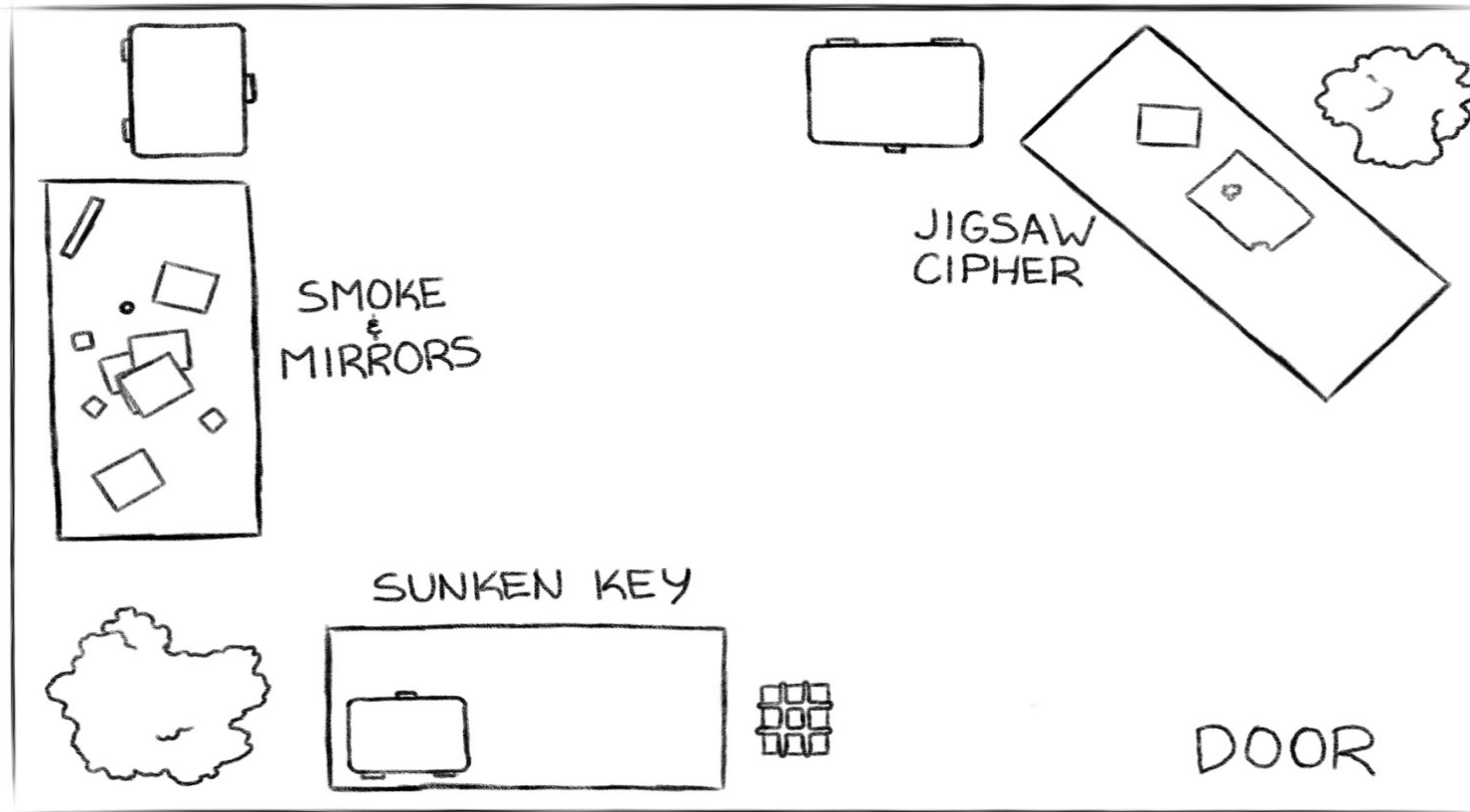





Figure 22. Dinosaur Room Layout

Table 4. Dinosaur Puzzles

	<p style="text-align: center;"><u>Sunken Key</u></p> <p>The children must use a magnet to guide a key from the bottom of a container of yellow liquid to the top. The container is attached to the floor and has a grate so the key may not be reached any other way. The key opens a box containing an audio beacon piece.</p> <p>STEM/Educational Concepts: Magnetism</p>
	<p style="text-align: center;"><u>Jigsaw Cipher</u></p> <p>The children must assemble pieces of a puzzle to reveal an encrypted combination with a cipher guide. They must decode the combination and use it to unlock a box in the room which contains a piece of the audio beacon.</p> <p>STEM/Educational Concepts: Cryptography</p>
	<p style="text-align: center;"><u>Smoke & Mirrors</u></p> <p>The children must find a piece of paper with combination written on it in reverse with a highlighter. Then they must use a mirror and a blacklight flashlight to correctly see the combination, use it to unlock a box, and collect a piece of the audio beacon.</p> <p>STEM/Educational Concepts: Reflections, UV Radiation</p>

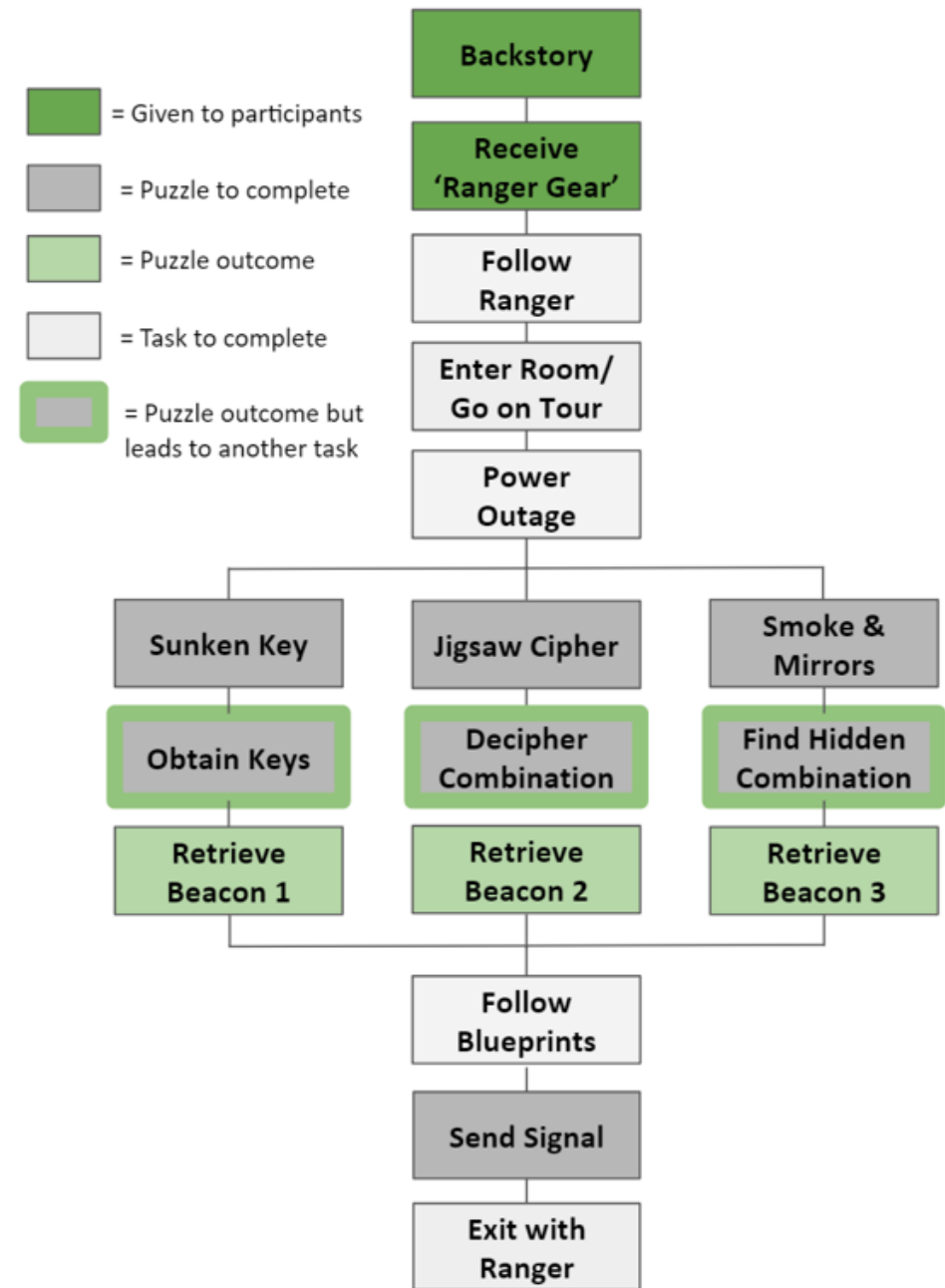


Figure 23. Dinosaur Room Game Progression

Proposal Design 4: Circus Room

The idea for our fourth design is based on a circus theme. This experience starts with the children gathering around a ticket booth, located outside of the childcare room, where a ticket seller greets them. The children are tasked with using magnets to help the ticket seller open the lockbox to obtain their tickets and enter the childcare room. They enter the room to find it dark and quiet, but suddenly circus music and bright lights will turn on to reveal the room has been transformed into a circus tent with a ringmaster (Figure 24). The ringmaster tells the children about

the performers and staff being sick, and implores them to help get the show up and running by completing a set of tasks.

The children will then be assigned tasks that needs to be done in preparation for the show (Table 5). As each puzzle is completed, the ringmaster will turn on light boxes with the names of the activities. Once all of the light boxes have been turned on, the show can commence.

After all of the tasks are completed, and all of the lights are on, the ringmaster will gather the children together and congratulate them. Then a circus showing will be projected on one of the walls with circus-

related activities and popcorn will be given out. Figure 25 shows how the participants will progress through the puzzles and narrative.

In addition to the conceptual objects listed under each puzzle, this room design aims to enhance the participants soft skills in the areas of collaboration and teamwork, communication, helping others, and following instructions. The full detailed design of the circus room, including the narrative, room setup, and puzzle instructions, setup, and procedures, can be found in Supplemental Materials S.

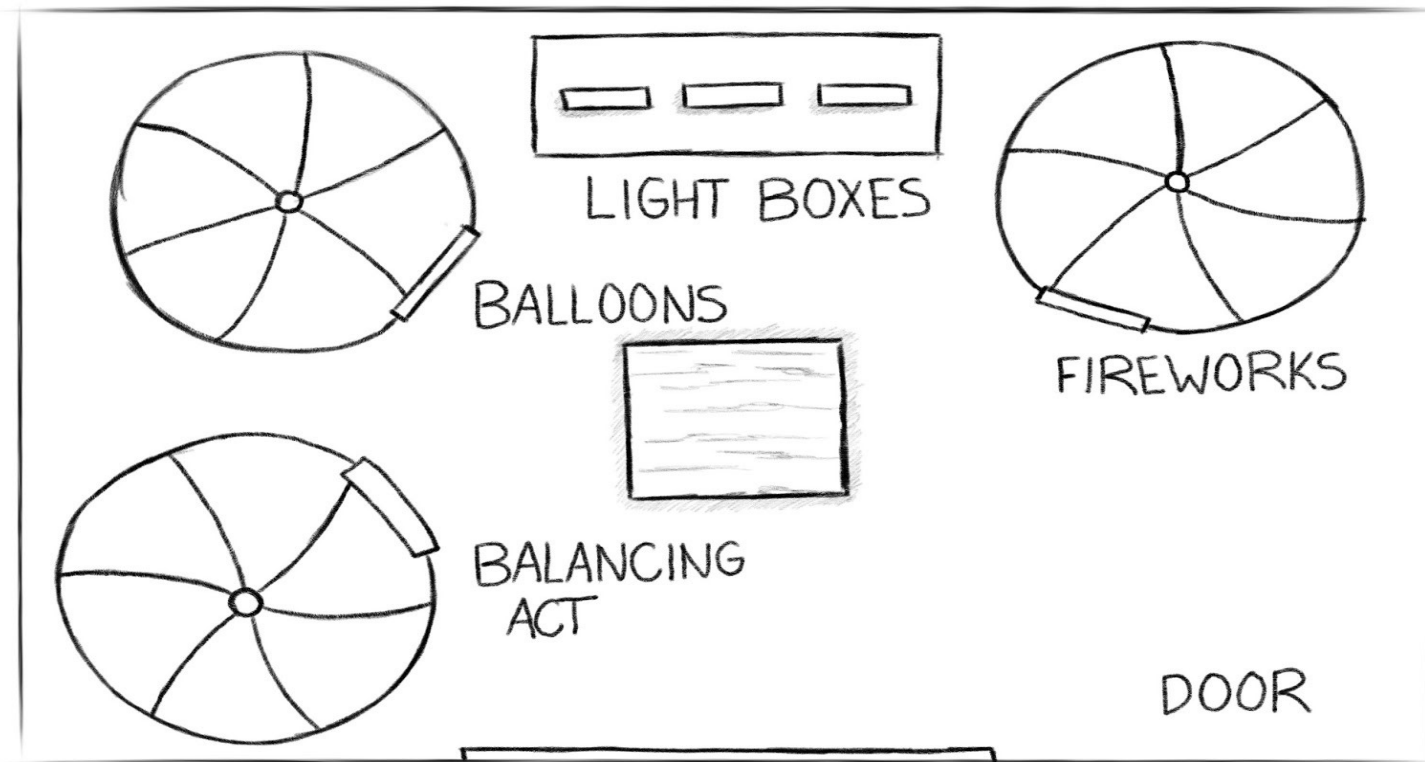

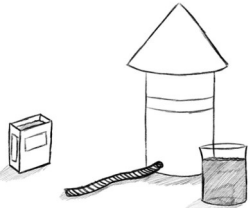
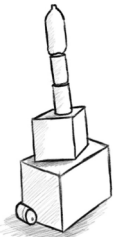







Figure 24. Circus Room Layout

Table 5. Circus Puzzles

	<p style="text-align: center;"><u>Bottled Balloons</u></p> <p>The children must follow instructions to mix citric acid and baking soda to create a carbon dioxide reaction using citric acid and baking soda in a 250ml soda bottle. They must repeat the reaction a few times to inflate a few balloons.</p> <p>STEM/Educational Concepts: Air Properties, Chemistry</p>
	<p style="text-align: center;"><u>Faux Fireworks</u></p> <p>The children must follow instructions in order to mix together the correct powders (cocoa powder, sugar, baking soda, salt, etc.) and piece together the correct blocks and canisters, creating a faux firework.</p> <p>STEM/Educational Concepts: Chemistry (Measuring)</p> <p><i>Note: This puzzle is entirely fabricated, and will not teach the participants anything about creating legitimate fireworks. It is purely for teaching how to follow instructions, take measurements, create basic mixtures,</i></p>
	<p style="text-align: center;"><u>Balancing Act</u></p> <p>The children must use the stackable objects provided (blocks, bottles, cans, wooden boards, etc.) to construct a tower of a predetermined height. If the tower falls they must reconstruct it until it stays up on its own.</p> <p>STEM/Educational Concepts: Physics (Forces, Balance)</p>

-  = Given to participants
-  = Puzzle to complete
-  = Puzzle outcome
-  = Task to complete
-  = Puzzle outcome but leads to another task

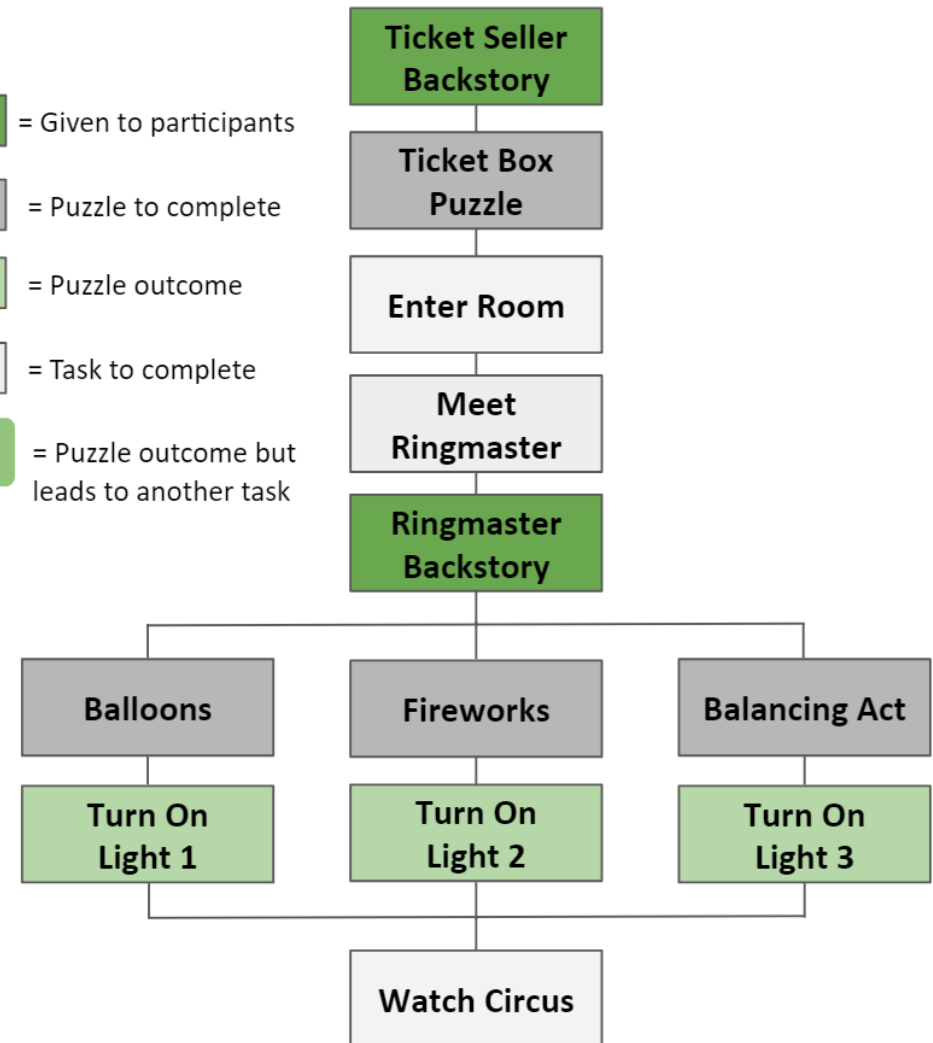


Figure 25. Circus Room Game Progression

Documentation for Future Rooms

We created two documents that will greatly assist Banksia in creating and implementing future mystery rooms. The first is an instruction manual (Figure 26, Supplemental Materials T) which explains how to set up the childcare room for a mystery room experience. This includes instructions, warnings, and troubleshooting for setting up and running each of the major, universal components of any mystery room: the curtains, the lights, the projector, the smoke machine, and the sound system. This document will be crucial to Banksia to run mystery rooms effectively and efficiently in the future.

The second document is a design process pamphlet (Figure 27, Supplemental Materials U) which guides the reader through a simplified version of the previously discussed process of creating a mystery room. It also includes some recommendations based on our own experiences. This pamphlet will serve as a quick reference guide to those designing future rooms.

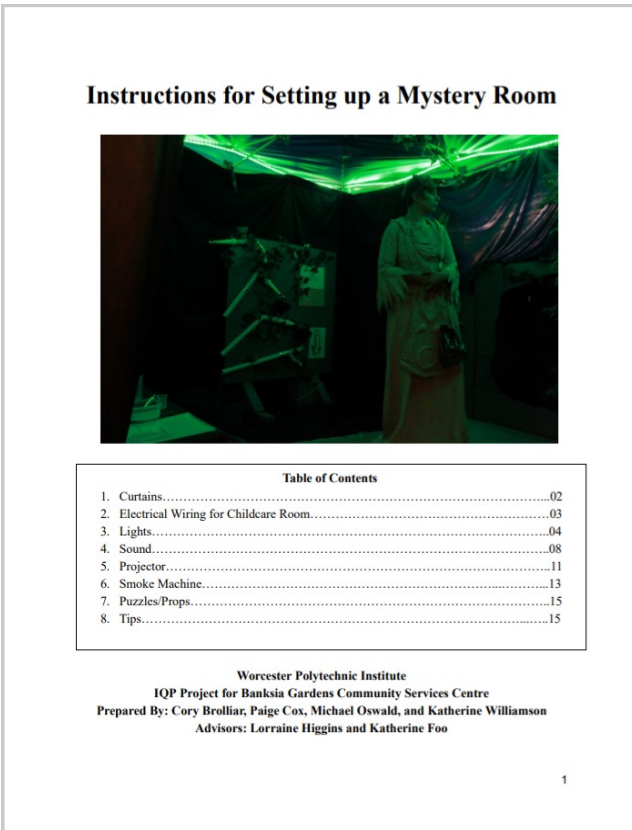
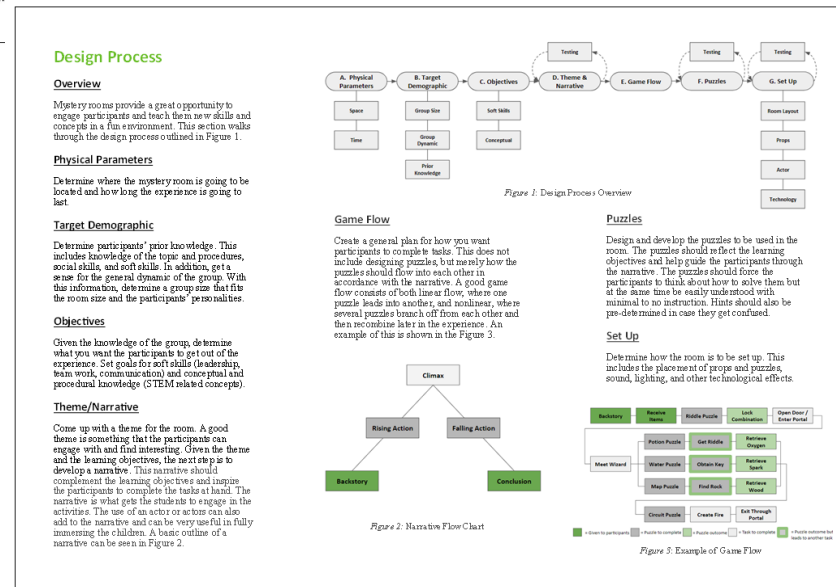


Figure 26. Instruction Manual



Figure 27. Design Process Pamphlet (Front and Back)



Recommendations & Conclusions

Upon completing this project, our team has some final recommendations for Banksia Gardens Community Services to help them continue to grow the mystery room program.

1. Given the time and effort required to develop and execute new mystery rooms, and Banksia's limited staff, our team would recommend doing the mystery room activity once a month at most. To implement brand new mystery room experiences, the actors need time to prepare, the script and puzzles have to be made, and test runs need to be done to ensure success.
2. Reusing puzzles week after week saves money, however part of the immersion is the wonder behind the room. Reusing puzzles could break immersion from the experience. We recommend waiting several iterations before bringing back old puzzles and to change the puzzle in some way.
3. We also recommend finding a way to better keep the design of the mystery room a secret.
4. It would be beneficial to have a period after the room where the children are given a brief lesson on the concepts and procedures behind the activities once they finish the mystery room.

The purpose of this study was to develop a mystery room program for Banksia Gardens Community Services that would provide an engaging experience for the children attending their after-school homework club. We hope that this program will eventually increase the children's interest in STEM and other academic subjects.

In order to carry out this study, our team researched the best practices to engage students. We applied these findings, along with our own observations and work with Banksia, to develop a

mystery room design framework which could be used to create several mystery room experiences. Our design process relies heavily on creating an immersive environment through the use of a theme and narrative to grab the interest of the children and get them engaged in the experience. In order to meet our overarching objective of student engagement, our team used themes and narratives that were not solely academic, but still incorporated STEM and soft skills into the actual puzzles that the children had to complete. For example, we incorporated the concept of fire and its components into a narrative and puzzles structured around saving dragons. In this narrative, the children learned the three components needed to make fire: oxygen, fuel, and a spark. In order to get each component, the students had to complete activities related to STEM concepts such as water flow and measuring and mixing liquids for a chemical reaction.

When designing our mystery room, our framework worked well in ensuring that all the components of a mystery room were present and functioned well together. One thing that we noticed was despite the objectives, narrative, game flow, and puzzles in the design process being distinct steps, they tended to be done simultaneously. This allowed for a more cohesive design where the individual components complimented each other rather than being distinct features of the mystery room.

Upon completing the pilot of our mystery room, our team came to the conclusion that the use of mystery rooms is a viable method to engage students. These students showed verbal and behavioral evidence of being engaged and focused during the 20 minute experience, signs that differed dramatically from their behaviors and attitudes in other after school activities. Perhaps because they were more engaged, children who tend to fight with each other demonstrated soft skills such as helping each other complete tasks. Additionally, we determined that observing body language, emotional cues, and verbal cues is an effective way to analyze student engagement. This

method allowed our team to recognize self-involvement, participation, active commitment, and other key signs of engagement through the student's natural responses.

Despite the high levels of engagement that a mystery room can provide, the mystery room cannot be used as the sole means to teach detailed STEM concepts and procedures. They do, however, provide an engaging way to introduce a topic and give practical applications.

In addition to developing the pilot mystery room, our team provided three other mystery room designs and documentation which can be used to further the work we did at Banksia. These will ensure that the staff has all the important information they need in order to continue putting on mystery room programs for the children attending the homework club.

Acknowledgements

Our team would like to give our sincere gratitude to our sponsor organization, Banksia Gardens Community Services, for allowing us to do this study. Our team would also like give a special thanks to several people who have greatly contributed to the success of our Interactive Qualifying Project (IQP):

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- Our Sponsors, Edgar Caballero and Jonathan Chee
- Anna Thomson
- Erin Ottmar, Psychology Professor at Worcester Polytechnic Institute
- All of the Banksia Staff and Students

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Supplemental Materials for this project (raw data, research instruments, additional project references, and outcomes) can be found at wp.wpi.edu/Melbourne, using key words from the project title.
