

Sensory Morning e-games

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ABSTRACT

Sensory Morning is a program designed to make the Walters Art Museum more accessible to children with Sensory Processing Disorders and Autism Spectrum Disorders. During the two-hour event, the museum provide a number of resources to the participants including hands-on activity stations, educational lessons, and physical 'fun packs'. While both children and families tend to be satisfied by the event, there are a number of issues that currently exist with these in-person events. This study will address these problems, and then will create a mobile application that is similar to the 'fun packs' in order to help solve some of these problems.

Categories and Subject Descriptors

I.2.2 [Assistive Technology] - *Autism Spectrum Disorder, Sensory processing disorder, Mini-games, Mental Health.*

General Terms

[Human Factors, Design]

Keywords

Mini-games, ASD, SPD, Mental Health, Sensory Morning, Autism, Sensory Processing Disorder.

1. INTRODUCTION

Sensory morning is a program designed to make the Walters Art Museum more accessible to children with Sensory Processing Disorders. The museum welcomes participants to explore the museum an hour before it opens to the public. During the event, the children are not only encouraged to explore exhibits through activity stations. These stations offer tactile activities that may be related to the surrounding exhibits. These include things such as playing with beads, painting murals, and doing activities such as song and dance. In addition, the children can access 'fun packs', which are bags that contain a number of toys, activities, and calming mechanisms.

While both children and families are very positive about the event, there are number of problems that

may prevent further engagement or interaction with the museum.

The primary problem is low retention rates due to limited resources. In the two Sensory Mornings I was able to attend, only half of the 120 registered participants actually attended. While retention rates of this target audience have not been fully studied, the majority of families interviewed also said that they tend not to visit outside of this event.

One of the reasons why is due to the resources that are only deployed during Sensory Morning. As mentioned, participants are given the option of renting a 'fun pack', which allows children to have structured play as well as calming tools. This can be especially helpful in having a set way of exploring the museum. However, there is a limit to the number of physical resources available: there were only 4 'fun packs' available for the 60 people that showed up at the event. Retaining interest outside these events may require additional resources that the museum may find hard to implement.

There is also another concern when it comes to retention: how much educational is presented and retained. Although both the fun packs and activity stations try to educate children through play, the activities available are often not structured in a manner that is conducive to learning.

The last problem I hope to address is how the actual exhibits can be incorporated into the fun packs. Although the activity stations are often in close proximity with exhibits and drawings, the children may be interacting with objects that are somewhat tangentially related to the surrounding gallery. One example that occurred within the event was playing with beads and coins in an exhibit that was largely about Greek and Roman sculptures. While there might be some relation to the actual exhibit in a historical sense, it is problematic when trying to get the children to interact with the surrounding museums.

My research goal is to create a mobile app version of the 'fun pack' which teaches an overall educational

theme through mini-games. This 'fun pack' will be available even outside of the Sensory Morning events, and will be structured in a manner which teaches children through repetition. Lastly, the app will allow the child to haptically interact with the exhibits without resulting in physical damage.

2. Related Work

In order to design a mini-game for Sensory Morning, it is first important to understand what a mini-game is.

Serious games, which are video games designed for educational purposes, have been successfully used in multiple fields[16-18]. A number of key aspects of them, such as puzzle/problem solving, are also used in formal educational instruction[19].

In addition, a study done by the Behavioral Sciences Institute of Learning shows that utilizing serious games may help improve retention rates of learning significantly.[15] This is possibly due to allowing the user to learn by performing in simulated real-life scenarios.

Mini-games, however, face a different set of constraints when compared with serious games.

Zaman [19] defines mini-games as:

“...small, self-contained games that usually take a short amount of time to complete and focus on a specific topic.”

There are a number of advantages to creating mini-games. According to Prensky [12], mini-games are often cheaper, simpler, and require less time to create compared to complex games. In addition, mini-games can involve the target audience in the design process, sometimes even allowing them to create the mini-game.

However, mini-games must be limited in their scope, usually able to teach a single concept. In addition, there may be problems in maintaining engagement within larger narratives or themes. As we begin to look at the target audience of these games, however, it becomes clear that these disadvantages are not very problematic.

2.1 Sensory Processing Disorders

According to the Sensory Processing Disorder Foundation,

“Sensory Processing Disorder, formerly known as sensory integration dysfunction”, is a condition that exists when sensory signals don't get organized into appropriate responses...A person with SPD finds it difficult to process and act upon information received through the senses, which creates challenges in performing countless everyday tasks. Motor clumsiness, behavioral problems, anxiety, depression, school failure, and other impacts may result if the disorder is not treated effectively.” [1]

There are three different categories of SPD: Sensory Modulation Disorder, Sensory Discrimination Disorder, and Sensory-based Motor Disorder. [2] Each of these disorders has a much different set of requirements.

Children with Sensory Modulation Disorders can be classified into three categories: Sensory over-responsivity, sensory under-responsivity, and sensory seeking. Sensory over-responsive children usually avoid particular senses and can be upset by certain types of stimuli. Sensory under-responsive children are unable to understand sensory inputs. This may result in things such as clumsiness. Sensory seeking children tend to seek particular stimuli, interested in odd material or being messy. [3]

Sensory Discrimination is a characteristic humans use to distinguish between sensory inputs, similarities with different senses, and the quantity and quality of said sense. Children that have Sensory Discrimination Disorder may not be able to understand how hard they are pulling something, or may not even understand that something hurts.

Lastly, Sensory Motor Disorder comes in two forms: Dyspraxia and Postural Disorder. Postural Disorder prevents children from maintaining stable positions, often leading to them appearing clumsy. Children with dyspraxia cannot organize several steps in advance.

Given that children with these disorders may have varying levels of abilities, it is important to clearly define what the target audience of this project is. The project will mainly be concentrated on the

children with Sensory Modulation Disorders. The main reason for this is due to the nature and medium of the game.

The main goal of this project is to allow children to interact with the exhibits that are located around them. The game design will incorporate multiple forms of sensory stimuli that can be toggled on and off in order to accommodate for all types of children with Sensory Modulation Disorders. The medium used, an iPad, does not seem to be the right method for treating children with Motor or Discrimination Disorders.

In addition, Sensory Morning as an event may be better suited for the other activities. Many of the activities at the event are designed to accommodate a children with different disorders. The events were set up in a number of different environments, ranging from bright open areas which allowed the child to gain stimulation through multiple senses to a darkened auditorium. As this game is meant to be a supplement to the event, we will just concentrate on this group.

2.2 Requirements for Game-based Learning

After examining the user needs of the target audience, the next thing to address is the wide range of requirements for game-based learning. In order to incorporate mini-games into this event, an extensive list of requirements was examined.

One of the first requirements, as addressed by Laurillard[5], is that any theoretical or conceptual model must be able to be illustrated in a practical environment. He also stresses the idea that the specific lesson should not only be able to be applied in a practical setting, but that the specific lesson be able to fit in a larger generalized body of knowledge. [6]

Koper and Olivier introduced the idea that mini-games should be “learner-centred, non-linear and self-directed.” Some of the requirements that they stressed include being compatible with different standards and being customizable to different user's needs. [7]

Other authors include Merrill [8], with the “first principles of instruction”, which talks on how new knowledge is used and applied to existing foundations, and Paras and Bizzochi [9], who

examined other criteria such as Norman's “seven basic requirements of a learning environment.”

Greitzer[10] put forth the idea of cognitive principles that guide the creation of learning-based instruction. These principles are:

- Stimulate semantic knowledge.
- Manage the learner's cognitive load.
- Immerse the learner in problem-centered activities.
- Emphasize interactive experiences.
- Engage the learner.

While this is a somewhat lengthy list of possible requirements for game-based instruction, none of these lists have specifically been targeted towards the disabled population. Therefore, one last set of requirements must be examined: those used to teach children who have these disabilities.

Kwon [11] offers a number of useful tips on how to approach designing games for children with special needs. One thing she addresses is to create a concept paper, which explains the essential idea of the game. There are several things to be included in this paper, including instructional objective, game genre, and mini-games. She also addresses special strategies to utilize when dealing with this audience. These strategies include:

- Repetitive practice
- Immediate feedback
- Visual cues
- Task analysis
- Experience of success
- Individualized play

In addition, she also mentions how designers must pay special attention to graphics, as they may distract the user from the gameplay. She specifically mentions that the Background, Cut Scenes, Characters, Objects, Items and GUIs should be taken into special consideration.

Attending Sensory Morning also allowed me to gain additional insight from Kennedy Krieger High School (KKHS) therapists. They offered a number of guidelines used by those who teach children with sensory processing disorders. These include things

such as providing sensory breaks for movement, having a clear visual schedule, allowing for tactile fidgets such as pens, and allowing the child to skip things that may overload the senses.

After reviewing the literature, I have come up with my own list of requirements that will be incorporated into the mini-game. They are:

1. The mini-game should utilize repetition of the educational theme, but through multiple methods.
2. The mini-game should seek to create specific examples and then incorporate them into more generalized knowledge.
3. Sensory stimuli should be able to be toggled on/off based on the user's desires.
4. The mini-game should provide tactile feedback based on user input.
5. The mini-game should seek to individualize the user's play experience.

After establishing this set of requirements, I used a pre-existing theme from the fun pack, Faces and Emotions, and incorporated that into a mini-game.

3. Methods/Prototype design

Concept	How it is addressed in mini-game
Target Audience	Children with SPD/ASD who either attend or wish to attend Sensory Morning
Game Genre	Puzzle (word matching)
Target Platform	Tablet (iPad)
Instructional Objective	1. Present educational lesson in text 2. Test user's knowledge through multiple means
Storyline	Let's talk with the paintings and find out how they are feeling!
Mini-games	Word matching mini-game Matching emotions to faces mini-game Scavenger Hunt Mini-game

Table 1: Kwon's Concept Paper for the mini-game



Figure 1. The first mini-game. Participants are asked to find the painting within the museum and identify it.

I first created a prototype based on an existing theme within the 'fun packs' called Faces and Emotion. The purpose of this theme is to teach the user what type of face or body language a person may use to express a certain emotion.

The prototype was divided up into three mini-games. The first mini-game was designed to allow the child to explore the museum. The app first gives a little bit of introductory explanation about emotions, and how both body language and speech can help express emotion. There is a toggle to turn on sound if the user would rather hear the text instead of read it, but this will not be implemented in the scope of this paper.

The painting will then ask the user to find them within the museum. These paintings will be long-term pieces that will be on display to avoid any confusion. Included with the picture will be identifying text, such as the Title, the Period that the piece is from, and the location in the museum.

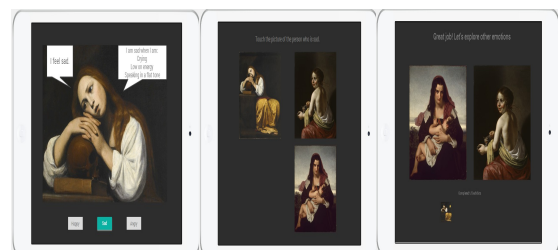


Figure 2. The second mini-game. The user is taught how body language can express emotion, and then is asked to match emotions with pictures

Once the user has chosen their answer, the next mini-game is set up. The emotion that the painting is displaying is explained, along with common body language that may indicate what this emotion is. When they are familiar enough with these signs to proceed, then the app prompts the user to touch the painting which expresses a certain emotion.

Once they select the correct painting, they can repeat this mini-game with other paintings.

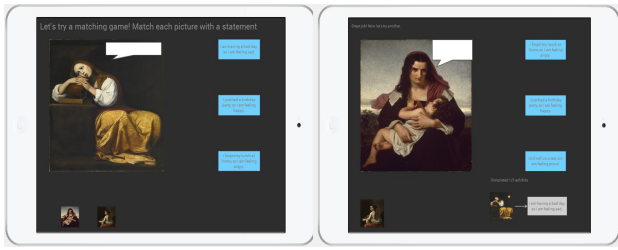


Figure 3. Word matching game. The user is asked to match emotional statements with paintings.

When the user has completed all of the exhibits with touch-based game, then they move on to the third and final mini-game. This is where the user is asked to match statements which show emotion to a specific painting. Each time the user answers correctly, the corresponding dialogue box will be greyed out, and a line between the painting and dialogue box will be formed. After finishing this mini-game, the user will reach a completion screen signifying the end of the application.

4. Results

There were a number of problems that prevented the successful implementation of the prototype.

One of the early issues that I ran into when designing the prototype was that the overall problem was not conducive towards actual gameplay. The first was having to restrict the user's input to prevent error. I could only provide the illusion of choice, because having too many options might distract the children from being able to complete the task. My mentor thought it would be better to provide the right answer immediately in order to provide clarity, so it was often necessary to simply disable everything but a single button.

In addition, multi-modal stimuli was unable to be implemented. While mini-games often rely on things such as colorful graphics and music to help bring about immersion, there were problems with the prototyping software.

However, these were not the only problems that I faced. Midway through the semester, it was decided that they wanted to utilize their own resources rather than getting parents to download an app. As a result, they wanted it to be accessible through their own iPads rather than as a mobile Android app.

Given that it was very late in the semester to start learning about how to program in iOS, we agreed that a prototype would be sufficient rather than a fully-formed app.

As a result, I began to develop a wireframe prototype using Justinmind, which supported testing on both mobile devices and tablets. However, the software was problematic for this theme. High quality images from the Walters Online Art Collection were used to allow the child access to how emotions were expressed. However, due to the structure of the fun pack, these images had to be implemented several times throughout the screen.

As a result, the size of the prototype grew immensely, something that Justinmind had trouble supporting. This meant the editing and creation of the prototype took much longer than necessary, but also caused a massive problem when trying to test during the next Sensory Morning on December 14th.

I had not fully examined the museum's resources available, and as a result there were a number of technology-related issues that prevented effective user testing.

The museum's iPads were running an operating system too old to support the Justinmind prototype. We attempted to update the operating system but the wireless was not quick enough to finish in time.

My mentor's iPad, which was also supposed to be accessible, was unable to be used due to a password issue. I tried to load the prototype on my phone, but the large size and spotty connection caused that to fail as well.

I ended up having to use my laptop as a prototype base in order to try and have my target audience interact with my exhibit. However, this was a complete failure: my target audience did not like staring at a laptop screen, and were quick to abandon it.

As a result, I tried to gather as much feedback as I could from people well-versed in interacting with the target population. This included therapists and teachers from Kennedy Krieger, experts from the Sensory Morning Resource Fair, and the parents of children with SPD. I ran them through the process of the fun pack, and then questioned them in specific about what the target audience might like and dislike.

4.1 User feedback

There were 5 categories of feedback that I received:

- Trying to do too much
- Good variety but too long
- Lack of motivational context
- Slow loading
- Visually Unappealing

The first, and most common, theme was that I was trying to do too much. A therapist working at the Resource Fair told me:

“It doesn't matter if they can match emotional statements to paintings. It's enough that they are able to recognize a certain emotion.”

In particular, some experts felt as though the word matching game was unnecessary and that children would quickly grow bored if forced to do it.

“I like the idea of a scavenger hunt, but it takes too long.”

Another problem that I encountered was that it was hard to maintain interest throughout the entire app. A therapist from Kennedy Krieger told me that forcing children to search entire floors of the museum several times would be exhausting and few children would be motivated to complete it.

This was also seen in other mini-games as well. One of my most successful cases, A parent-child pair who was able to complete 75% of a module, expressed dismay that there was no easy method for changing activities. The parent later said:

“It's hard to motivate them when only some screens are interesting.”

While most interactable objects were immediately visible through color contrast, at the same time I did not want to give too much stimuli to the child. As a result, the simple design of certain pages often did not catch the child's attention.

“It's too slow/it loads too slowly”

Due to the large size of the prototype, the program was not as responsive as people might have liked. One child, in particular, simply left when the

screen was loading due to not having any response time.

“It's looks simple and not that visually appealing”

I intentionally created a simple interface in order to get users to concentrate specifically on the painting. As a result, I did not include things such as fidgets or other visual stimuli that might distract from the experience. However, having a child not able to fully engage due to using a laptop instead of an iPad definitely hurt the overall appeal.

5. Discussion/Limitations

While I do believe that having to use a non-ideal device (a laptop vs the iPad) definitely hurt the prototype testing, I am unsure my prototype would have fared well even in ideal circumstances.

One of the reasons why is due to children's motivation. While most of my design was based on literature and consulting experts, I did not properly account each individual child's source of motivation. The app was largely designed around the idea of interacting with the painting, but children were not drawn to interact with the app as much as I had hoped.

The other reason, which also ties into motivation, is that I did not properly balance between educational and entertainment. Due to both size constraints and restrictions on choice, the app does not incorporate many chances to explore or otherwise play. The few chances that the child did have, however, did not work well unless there were specific prompts. Without direct parent-child interaction, these prompts tended to be ignored.

6. Conclusions/Future work

One of the main things that I understood from this was that it is more important to have something simple which can be modified to fit an individual user's preferences and needs. While many people liked the individual games that were able to be accessed through the app, they had problems with how it was implemented.

In terms of future work, I would like to examine if the implementation of toggle-able sound

(which was one of the features which I originally had planned) would help in establishing a more engaging experience for the user. In addition, I would like to see how games are used on mobile devices in other museums, and what accommodations that they made for people with disabilities.

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