

Final Project

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Introduction

PandaGo is designed as an app that based on Augmented Reality (AR) and it intends to teach kids about nature and science about the giant panda, including interesting facts about their behaviors, diets, and habitat in the wild. The target age group of the app is kids from 6 to 8 years old. Kids between this age range are more capable of getting focused and reading the instructions and they are willing to make sure that they are understanding the rules right (Gelman, 2014). According to the study by Kamarainen et al. (2013), it indicated that combining AR interfaces with the environment can enable contextualized, just-in-time instruction, and a self-directed collection of real-world data and images. As a manipulative app that offers digital manipulatives for guided discovery, it falls within some pre-determined and scripted parameters (Goodwin & Highfield, 2012), but the game also offers some level of freedom to explore since it supports active manipulation through AR exploration.

When presented with the natural environment and interactive animals, kids will be able to explore pandas' living through a self-directed collection of information and getting to know what is unique about giant panda's diet, which is dominated by bamboo. In the meantime, kids will be able to obtain further information about the evolution of pandas, including the reason that they have rounder face and larger molars than other bears, as well as their behaviors, such as how long they sleep and eat. By interacting with these pandas, they will be able to take photos of different panda friends and save them in the photo book. In addition, kids would not only learn about the main character – panda, but also get to some other animals that share the same habitat such as parrotbills and snub-nosed monkeys. In this way, kids will be able to form a deeper understanding of the whole ecological system. By getting the card from different

species, kids can collect the information to their photo book and retrieve it when they want to. To prevent kids from spending too much time on the app, kids will see all pandas going to sleep after they have played for a certain time. They are encouraged to check back on them after taking a break.

Objective and significance

The objective of PandaGo is to provide kids in the target group an interactive, immersive, and engaging experience about the environment and science about pandas through Augmented Reality. Through an early searching on relevant apps, I found that currently only a few apps introduce animals and their environments in a self-exploratory manner. Considering the vulnerable conditions of pandas that live in the wild, PandaGo centers on the subject domains that kids have less access to in their daily lives. Different from putting information together through texts, it presents concepts and knowledges in a real-time manner through interactions with Augmented Reality.

As an emerging field, AR integrated 3D virtual objects into a real environment in real time (Azuma, 1997). AR is defined as a system in which offers three basic features: a combination of the real world and virtual objects, real-time interaction, and accurate registration of objects in three dimensions (Azuma, 1997). To be more specific, instead of emerging players in a completely virtual world, AR allows users to see the real environment with virtual objects superimposed within the real world and it enhances their interactions with the real world.

The benefits of AR have been investigated by researchers in different perspectives.

Several studies found that AR leads to better learning performances of kids on different subject domains. For example, Dunleavy and Dede (2014) suggested that AR supports students learning and scaffolds their participation through situated learning, as it aligns with constructivist learning theory and provides students with an authentic physical environment to interact with. The study by Kamarainen et al. (2013) found that students' content understanding has increased when they used an AR app to learn environmental science during a field trip to a local pond environment. Teachers also reported that students were able to better comprehend water quality measurement than before. Similarly, in Sin and Zaman's (2010) research, students were divided into two groups and asked to use either AR or textbook to learn about the solar system. It turned out students using the AR system demonstrated greater learning and their performance increased by 46 percent compared with the pre-test, while students using the textbook improved by 17 percent. These studies have presented the effectiveness of applying AR into kids' scientific inquiries, including the solar system and environmental science. Similarly, PandaGo mainly focuses on the environment and science about a certain animal in the wild and reveals some interesting facts that kids do not have access to in their ordinary lives. By applying AR into the game, kids' understanding of the ideas behind the scene can be enhanced through the self-directed exploration.

Researchers have also identified that players are more engaged with AR experiences with higher satisfaction and more willingness to try the experience again. Di Serio, Ibáñez, & Kloos (2012) has used the Instructional Materials Motivation Survey (IMMS) to measure middle-school students' motivational factors in a visual arts course. They found that their attention and

satisfaction has increased in an augmented-reality-based learning environment compared with the traditional slides-based learning method. A similar study by Gopalan, Zulkifli, and Bakar (2016) examined whether the use of the enhanced science textbook using augmented reality could lead to more efficient learning in secondary school students. The result showed that the immersive character of AR was able to provide engagement and fun, thus enhancing students' motivation. In the game, kids are encouraged to interact with adorable pandas and their creativity and motivation will be enhanced through the active learning experience on the smartphone. Other studies investigated the contribution of AR from the cognitive perspective and suggested that the immersive interaction provided by AR can increase conceptual gains and has a significant effect on recalling in a highly memorable framework. Vincenzi et al. (2013) found that learners were better at immediate recall when using AR than learning through printed materials or videos. Their long-term recall test also provided to be significantly higher than the video group. When learning about the environment and science through PandaGo, their memories on the subject domains will be enhanced through the process.

User Scenario

Kim is a 6-year-old boy who lives in East Lansing, Michigan. He likes spending time on outdoor sports, such as soccer and tennis. He also likes to visit zoos and museums around the town during weekends with his family. His parents have taken Kim and his sister to some famous local places, such as Potter Park Zoo and Binder Park Zoo. Parents found Kim and his 4-year-old sister both love animals and they have seen and interacted with animals like giraffes, ostrich, and elands for many times. Both kids fell in love with pandas after they watched *Kung Fu Panda* series on TV. Kim said he loves pandas because of their distinctive colors and

extremely round face. He also wondered if real pandas are as lazy and clumsy as Po, however, but none of the family get the chance to see pandas in real life other than on cartoons and TV shows. Kim's parents really would like the kids to have some experience with cute friends. The closest zoo that has real pandas, however, is Smithsonian's National Zoo in Washington D.C., thus the cost is a little high for the whole family if they are going to travel there. They also concern what time they should take kids to the capital, as both parents are pretty busy with their work. They are looking for some immersive and cost-efficient technology on smartphones or tablets that kids can play with and get more information about real pandas. Both parents feel this kind of technology would entertain them a lot and prepare them if they finally get a chance to visit pandas in the future.

With PandaGo, parents will first download the app for their kids on tablets or smartphones. Kids will interact with pandas in their own physical spaces, especially in their rooms. As kids are pretty familiar with their own spaces and they don't need to walk outside, parents will feel safe and secured about their kids. Besides individual's place, the app can also be used as supplementary materials in informal settings like zoos. If kids get the chance to learn interesting facts about the panda during the class, they can use digital devices and the virtual component on their own tables. When kids are on a field trip to zoos that introduce panda, the app would also provide them additional descriptions.

In order to interact with the app through AR, kids will be notified to hold the phone and orient it towards a bright surface to place the Panda Land (Figure 1). There will be some signifiers that help kids to set up their virtual objects (Figure 2). After putting the 3D Panda Land (virtual objects) on their own surface (real objects), there will be a short instruction at the

beginning, so kids will be able to learn the basic rules in the game. Baobao, as the main character in PandaGo, will firstly introduce herself and ask for the name of the kids. The input from kids allows for personalized information in the following part of the game. At the same time, parents can participate as they assist their kids to figure out how to apply AR in their own space and read through the instructions. By moving forward, kids will be able to get closer towards objects on Panda Land, including pandas, bamboo, and other animals. Kids can also move their phones left and right in order to see more scenarios. When they tap on different objects, information will be triggered as a conversation box which provides images or short descriptions. For example, when kids tap on the panda that is eating, they will need to select their favorite food and then get more details with regards to their diets. Similarly, other kinds of interactions can reveal more facts about them. For example, kids will be able to know that pandas develop large jaw muscles and strong molar because of their diets. This leads to the results that they have rounder faces than other bears. As kids move on with their exploration, they will not only meet pandas, but some animals that share the same habitat with pandas in southwestern China. This gives kids an opportunity to investigate the whole ecological system instead of a single species. Considering the concern that parents hold for their kids, the game would incorporate time control so that kids cannot spend so much time playing. This being the case, kids are able to take a break and come back to the game later.

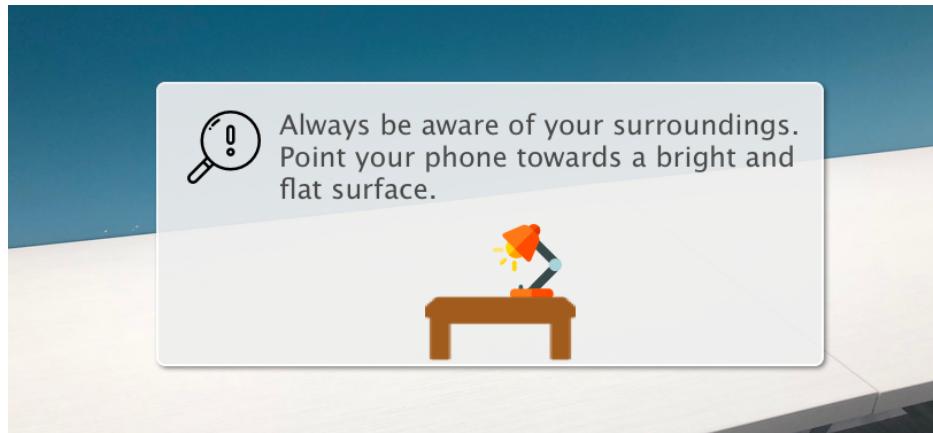


Figure 1. Screenshot of the notification page

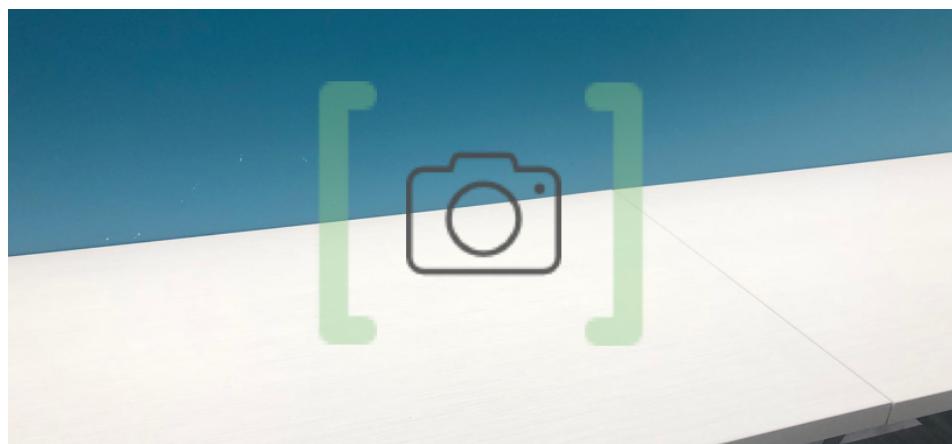


Figure 2. Setting up virtual objects

Features

Engagement and Active Learning

Kids should be engaged in different types of activities and behaviors that promote optimal development. An affordance refers to the relationship between the properties of the physical object and the capabilities of the interacting agent that determine how the object could possibly be used (Norman, 2013). When it comes to interactive media, tablets can offer quite intuitive interactions, such as tapping and swiping, making the content accessible to kids of different ages. Tablets also enhanced learning experiences that demands children's attention

and active participation (NAEYC, 2012). As pointed out by Hirsh-Pasket et al. (2015), kids learn the best if they are cognitively and physically engaged. Fredricks, Blumenfeld, and Paris (2004) reviewed the definition of behavioral, emotional, and cognitive engagement and suggested it is critical to keep kids stay focused and prevent them from getting distracted. In PandaGo, kids are interacting with pandas and other animals imposed in the real environment and the experience is engaging in different perspectives as it provides students with an interactive and immersive environment (Dede, 2009).

In order to explore more details, they need to actively rotate and manipulate their smartphones in the space and move forward and background to zoom in and out.

An instruction will be provided by Baobao at the beginning of the game and they will comprehend basic rules such as controlling the smartphone in an appropriate way and tapping on the screen. Their interactions with pandas are not built upon the mere receiving of information, as they need to make cognitive efforts by observing the environment, finding possible hints, and making correct choices. Selecting the panda's favorite food, for example, requires kids to make connections with surroundings and make decisions. As for emotional engagement, kids will develop a stronger affection when interacting with adorable characters in the game. In order to communicate to the audience what actions are possible and how they should be done, designers use signifier to communicate their design to the recipient and inform them where they can touch on the screen.

Moreover, they are able to feel a sense of agency when they utilize the relevant information provided in the game and explore the environment by themselves. The whole

process requires them to manipulate their own agency through instruction provided in the game and gives them an opportunity for active learning. As a touch-screen app, the environment is controllable and accessible by children of almost any age. For example, kids need to identify pandas' favorite food by finding hints and answering the questions. They would learn to apply what they found in the environment and get the answers (Figure 3).



Figure 3. An interactive activity on pandas' diet

Also, as kids should be engaged in the game, feedbacks will be provided throughout the game (Hirsh-Pasket et al., 2015). In the game, we are not providing excessive feedback such as fancy animations until kids achieve the objectives of the game. This being the case, kids would be able to have sustained engagement and their cognitive process would be a coherent experience. When they interact with pandas on the screen, their behaviors will be reinforced through an immediate response, thus making them focused in the game. Motivational messages, including "good job" and "try again" are provided in response to their actions (Figure 4). Other feedback such as happy sounds of pandas will be immediate as kids perform correct actions. I would avoid providing negative feedbacks such as an unhappy face or "you lose" as

the feedback for wrong answers. By giving kids another opportunity to try, they will be able to gain a sense of control over their brain capacities and retain confidence in the game. This would also be helpful to cultivate their growth mindset by encouraging them to make a little progress each time (Hirsh-Pasek et al., 2012).



Figure 4. Positive and personalized feedback

Parasocial Relationship

Parasocial relationship talks about the emotional relationship that children develop with media characters (Brunick et al, 2016). The majority part of the game is interacting with the main characters on the screen – pandas. When it comes to learning from the media, social interaction is one significant part of their experience. As identified by Richert, Robb, and Smith (2011), children will be better at forming a relationship with the on-screen characters in a way that increases their belief that those characters are reliable sources of information. Similar to the way that kids establish a real relationship with people, parasocial relationship can provide them with a network of symbolic experience that can be beneficial for their development

(Calvert, 2015). It would be beneficial to use pandas as characters to facilitate the development of a parasocial relationship. In the game, I am primarily trying to help them form a parasocial relationship with the cartoon version of Baobao, a female panda who was born at the National Zoo in Washington D.C. In the game, she would act as the main character that assists kids by providing instructions and kids can interact with throughout the game. As in the article by Brunick et al. (2016), three major factors would help to develop parasocial relationship in kids: attachment, character personification, and social realism. First, researchers found that kids are more likely learn from teachers as the most trustworthy to them, similarly they would learn better from their favorite onscreen media characters when they are accurate and credible (Harris & Corriveau, 2011). Therefore, it would facilitate the formation of better parasocial relationship by creating a character that acts like humans and shares similar thoughts and emotions. As a cute and fluffy friend, Baobao would introduce her own life like as human beings as she also needs to eat food, drink milk, sleep, and play toys, as many kids do. She also expressed her feelings such as appreciation and happiness as people do. Moreover, Baobao will ask for the kids name first so that she can give personalized information (Figure 5). The instruction with personalized information enables kids to feel that the character is talking to them directly. As Calvert et al. (2014) found in the study, kids who had personalized characters who know their name and gender have better performance than the nonpersonalized characters.

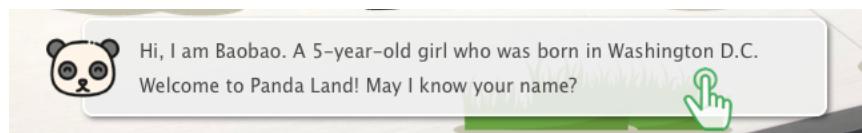


Figure 5. Personalized characters

Instruction and Rules

As identified in the article by Dirin and Laine (2018), apps and games adopting AR require more than mere touching on the screen. Users may need to walk around the room to trigger a location-based experience or need to orient the device through an appropriate spatial relationship. They may also need further interactions such as gestures to control objects. Good mobile apps should be usable and compatible with what children can comprehend and do. Unfriendly designs of the app could possibly discourage and disengage users from playing.

In order to communicate to the audience what actions are possible and how they should be done, I would use several signifiers to communicate their design to the recipient and inform them where they can touch on the screen. This is especially important for kids from 6 to 8 years old, because they become extremely careful about the opinions from others and getting things right (Gelman, 2014). They won't be happy and motivated to feel that they are dumb or unsophisticated when they are playing the game. Therefore, an instruction at the beginning with rules listed clear would relieve their sense of anxiety. On the other hand, the instruction should not be too complicated or frustrating for kids to read. Therefore, the whole experience and design should be easy for kids to figure out. The instruction of PandaGo is based on the narrative from the main character, Baobao and the instruction becomes part of the storyline, so kids would feel it is natural to follow the narrative and they are one part of the story. There are several signifiers used in the instruction, including the exclamation mark next to Baobao and the hand icon on the conversation box (Figure 6). These signifiers are provided at the beginning of the game, so kids will grasp them and apply the rule into the later part of the story.



Figure 6. Signifiers in the instruction

Embodied agents

Besides Baobao, there will be many other pandas that kids can interact with, which are all digital representation whose behaviors reflect the computational algorithm designed to accomplish some specific tasks (Bailenson & Blascovich, 2004). They will live in Panda Land and be programmed to do actions such as climbing trees and eating bamboos. Kids can interact with them and get information about them. For example, when interacting with a panda eating food, kids can select food for them and receive a feedback such as “Thank you, I love bamboo” when they get the right answer. By interacting with different pandas in Panda Land, kids are able to establish a more interactive relationship with them. Some studies on augmented reality found that these triggered actions were important in encouraging exploration in the game and these agents were strategically placed in the game to introduce reflection in players (Squire & Jan, 2007). When kids receive information by interacting with these non-player characters in the game, it helps to contextualize the story by increasing engagement and facilitate meaningful learning (Squire & Klopfer, 2007). For example, after getting to know the diet of pandas, kids

need to identify the differences between them and their bear relatives by observing their heads carefully. The fact that they have rounder faces than other bears resulted from their diets, therefore, the detailed explanation will be triggered after they finished the step (Figure 7).

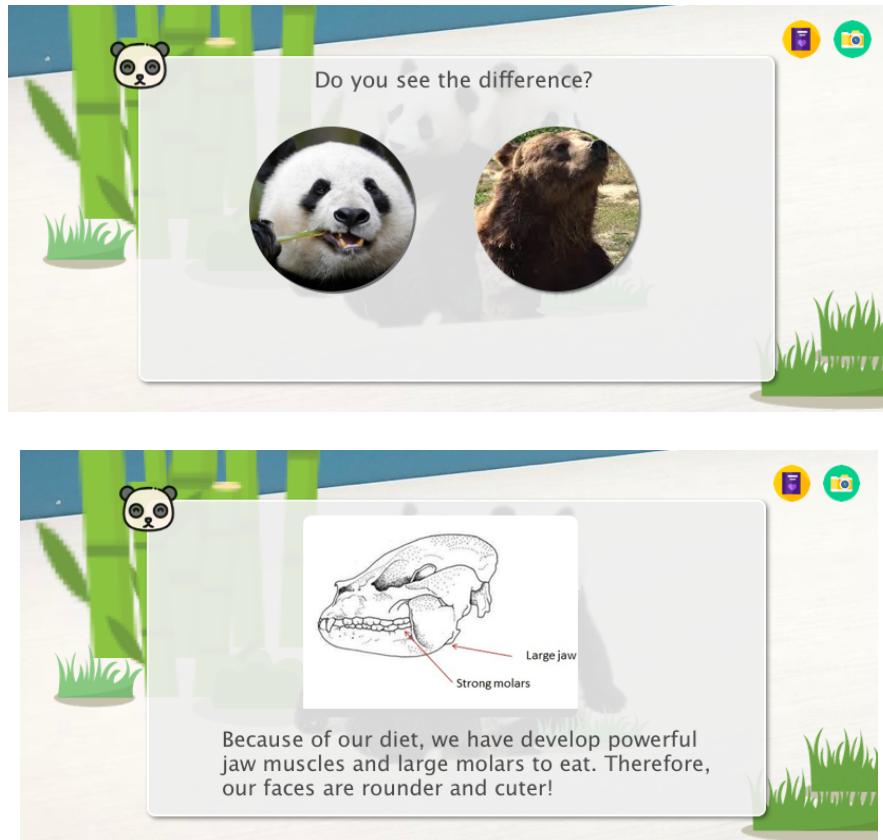


Figure 7. Triggered events through embodied agents

Saving and Collecting

According to Gelman (2014), it is difficult for kids to comprehend the idea of continuity when they are toddlers. Kids would feel uncomfortable or bored when they are asked to explore the same scenario every time they turn on the game. In order to reinforce the concept of continuity in a digital environment, kids are able to save and store the accomplishment in the game from where they stopped last time. In other words, they will retrieve the scenario where

they quit, the experience would be rewarding and comforting to kids around this age. Moreover, According to Baker and Gentry (1996), they found that children enjoy talking about their collections. The study reveals that kids enjoy the process of collecting for multiple motives, including it allows them to get away from boredom and it fulfills their curiosity about their collecting domain. In PandaGo, the collection stores their unique experience and trajectory in the game and the process of collecting photos from different animal species in the ecological system makes them learn more (Figure 8). They may also feel encouraged when they are able to show others their collections to others or associate with others, especially friends and family (Baker & Gentry, 1996).

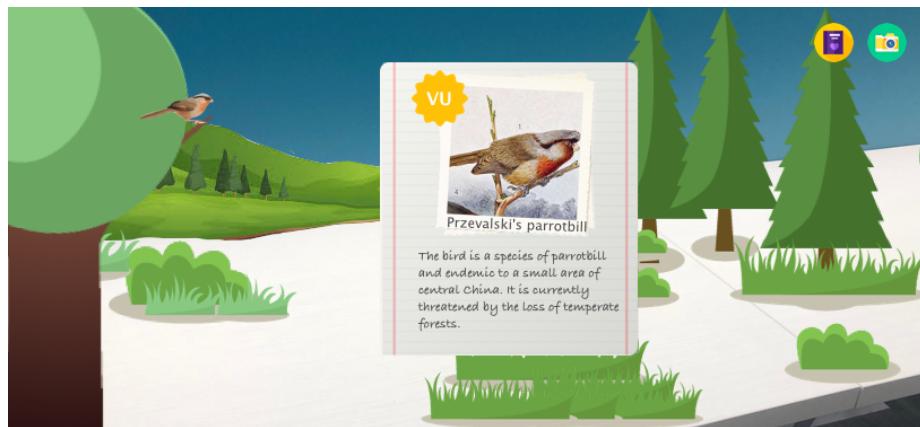


Figure 8. Collection of parrotbills

Safety and Trust

Needfinding provides a dynamic, well-organized, and systematic way to understand the target audience and adopt an iterative process to refine their design (Patnaik & Becker, 1999). Like how social science researchers immerse themselves in the community that they are trying to investigate, designers would bring research questions and observe how users are interacting

with the object and make records accordingly. Adopting the Needfinding approach helps researchers to kids' and parents' needs in real-life settings. Most importantly, by getting to understand the need from the parent and her kid, it enables me to better figure out possible solutions in the long-term.

Safety and trust are critical when designing for kids, therefore the app is primarily designed to operate in the kids' own space. Some previous studies have revealed safety concerns for many GPS-based AR games, as players can be so concentrated on the game and ignore their real environment (Dunleavy, Dede, & Mitchell, 2009). In order to capture the attention of kids' parents, safety information will be provided at the beginning of the game. Instead of situating the game as a GPS-based game, kids are more encouraged to play inside their own spaces so that parents will not be too worried about the safety of kids when they are playing outside. With regard to content safety, the app would be free from advertisement and provide age-appropriate content.

Today's parents are pretty open to educational apps, but they are still looking for ways that can make their kids more self-disciplined and kids can truly learn something from the app. Considering that many kids are addicted to playing the game for a long period of time, many parents have expressed their concerns over time control. My own experience during the observation also reveals that kids are actually able to break the password if parents have set up any. As identified by researchers, the majority of features nowadays supported parental control over self-regulation among teenagers, while better solutions need to be developed that promote more positive processes and outcomes (Wisniewski, 2017). In other words, if the feature on time control is able to center on the kids' perspective, the solution would be more

positive and effective. In order to solve the issue, PandaGo provides a scenario where pandas all go to sleep in the wild, as pandas usually take more than half a day sleeping in order to keep their calories (Figure 9). This idea is similar to virtual pets that kids raise, and they have to wait for a certain hours after they feed their pets. Kids have to take a break after playing for a certain period of time but won't feel they are forced by their parents, so it is more an integrated part of their growth. In the game, Baobao will explain the reason why pandas need to sleep for a long time so that the story is contextualized with the whole game.

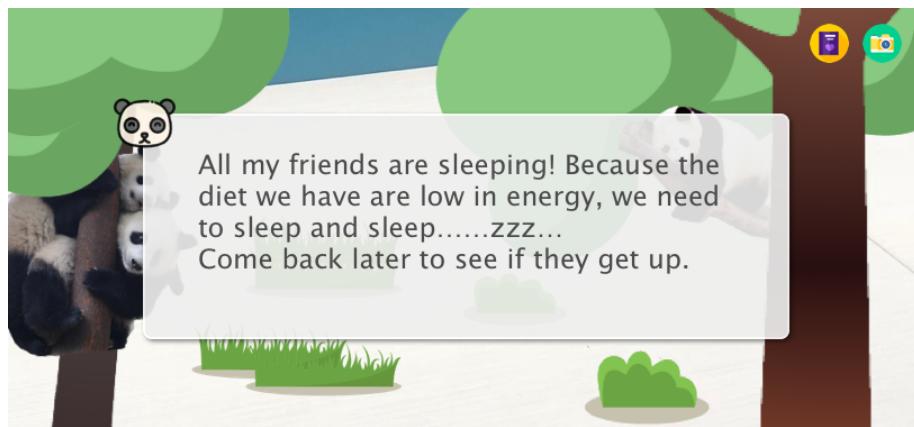


Figure 9. Time for break in the game

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Appendix A: Design Artifacts

