Using Motivation, Emotion, and Best Practices to Design a Mobile Application for Children

by

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Abstract

The following paper presents the evaluation of a mobile application, *MotoRobos,* that was designed utilizing motivation research, emotion research, and best design practices. *MotoRobos* will be used by parents and potentially teachers to help motivate their children and students to complete tasks and/or behave. Currently, most applications focus primarily on extrinsic motivators (rewards). Research has shown that when extrinsic motivators are the sole reason that individuals are completing tasks, it is highly likely that motivation will diminish over time. Using intrinsic motivators in conjunction with extrinsic motivators, however, provides individuals with long-lasting motivation, particularly when those motivators allow individuals to express creativity. The proposed mobile application will not only allow children to unlock rewards for completing tasks, but will encourage them to use those rewards creatively. The opportunity to be creative will instill intrinsic motivation, which will increase the likelihood of continued use.

Keywords: Intrinsic Motivation, Extrinsic Motivation, Emotion, Heuristics

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Chapter 1: Introduction

Users often turn to products and applications to solve their everyday problems. User Experience (UX) designers should work to ensure that these products are usable, help solve the user's problems, and are enjoyable for users. In order to design such products, UX designers often use best practices, user research, and other tools. It is fairly easy for UX designers to focus solely on usability, allowing them to design products based on best practices alone. However, in these situations, designers fail to take into account the emotions the products can elicit from users and do not consider the motivations the users have for using the products. If UX designers want to create exceptional products, not ones that are merely usable, they must understand the users' motivations for using the products as well as the emotions that the products elicit.

MotoRobos, short for "Motivation Robots," is a mobile application that uses motivation, emotion, and an understanding of their effects on users in order to help parents/teachers solve a common problem: motivating children to behave and/or do chores. A key component to solving this problem is the gamification of tasks, which has been shown to motivate children (Eyal, 2014). Currently, most applications focus primarily on extrinsic motivators such as rewards (Pink, 2011). Research has shown that when extrinsic motivators are the sole reason that individuals are completing tasks, it is highly likely that motivation will diminish over time (Pink, 2011; Deci & Ryan, 1985). Using intrinsic motivators in conjunction with extrinsic motivators, however, provides individuals with long-lasting motivation, particularly when those motivators allow individuals to express creativity (Deci & Ryan, 1985).

MotoRobos will not only allow children to unlock rewards for completing tasks, but will encourage them to use those rewards creatively. The opportunity to be creative will intrinsically motivate the children, which will increase the likelihood of continued use (Pink, 2011). This type of application is important because it teaches children the inherent benefits in completing tasks. *MotoRobos* will enhance children's motivation, which will in turn help them to be successful later in life. *MotoRobos also* encourages a strong work ethic and creativity, both of which are essential in any job or any endeavor.

Chapter 2: Literature Review

An Introduction to Motivation

In its simplest form, motivation means to be moved to do something (Ryan & Deci, 2000). By this definition, one can assume that whenever a user chooses to use a product, it is due to a certain level of motivation. Research has shown that people can vary in levels and orientations of motivation (Ryan & Deci, 2000). The orientation of motivation is concerned with the underlying attitudes and goals that give rise to action. The two most common orientations of motivation are intrinsic motivation and extrinsic motivation. Intrinsic motivation is defined as doing something because it is inherently interesting or enjoyable. Extrinsic motivation is defined as doing something because it leads to a separate desirable outcome. Both intrinsic and extrinsic motivation can move users to do something; however, the quality of the experience and the performance due to said motivation can be extremely different. It is therefore important to understand both intrinsic and extrinsic motivation and how they can be utilized in UX design.

Intrinsic Motivation

Three constructs are typically examined when a researcher is trying to understand a user's intrinsic motivation: autonomy, mastery, and purpose (Pink, 2011; Ryan & Deci, 2000; Deci & Ryan, 1985). Autonomy is concerned with the user's actions being self-directed. People need autonomy over what they do, when they do it, and how they do it (Pink, 2011). Mastery is concerned with the user's ability to meet the challenges he/she is facing. Mastery typically begins with flow, a state where a user's abilities almost completely match the challenges he/she is facing (Csikszentmihalyi & Rathunde, 1993). Flow is also known as the "optimal experience." Mastery is one of the most motivating aspects for a user in that it requires the user to recognize that his/her abilities can always be improved (Hauser-Cram, 1998). This notion, always being able to improve one's own abilities, can both captivate and frustrate users. The last construct, purpose, is when a user aspires to make a contribution to a cause greater than himself/herself (Haradkiewicz & Elliot, 1998).

Intrinsic motivation is defined as the doing of an activity for its inherent satisfactions rather than for some separable consequence (Ryan & Deci, 2000). So when a user is intrinsically motivated, he/she is acting because the activity in it of itself is rewarding. The user is not acting because of external pressures or rewards. Early psychology research demonstrates that humans in healthy states are exploratory, playful, and curious even in the absence of reinforcement or reward (White, 1959). This inquisitive nature is critical for development. When a person acts through his own self-interests he/she is able to grow cognitively, socially, and physically (White, 1959).

Behaviorism theory maintains that behaviors are motivated by rewards, so intrinsically motivated behaviors are those in which the reward can be found in the activity itself (Skinner, 1953). Learning theory maintains that all behaviors or actions are motivated by physiological drives, and intrinsically motivated activities are those that provide and meet psychological needs (Hull, 1943).

Self-determination Theory (SDT) is one of the leading motivation theories, and maintains that autonomy, mastery, and purpose are the factors that contribute most to intrinsic motivation (Ryan & Deci, 2000). SDT is framed in terms of social and environmental factors that facilitate or are detrimental to intrinsic motivation. Designers can identify, use, or avoid these factors to design a product that peaks a user's intrinsic interests. Researchers believe that if a user has intrinsic motivation to use a product he/she is more likely to continue using the product (Pink, 2011; Rouquette,2007). Research has shown that extrinsic motivation has the opposite effect, causing users to lose interest in and cease using the product (Pink, 2011).

Extrinsic Motivation

In certain instances, extrinsic motivation can extinguish intrinsic motivation because the user is only motivated and focused on the reward (Pink, 2011). So if the reward is no longer appealing to the user he/she will no longer be motivated to use the product. Extrinsic motivation can diminish performance because the user is less focused on the problem than he/she is on simply completing the task in order to obtain the reward. Extrinsic motivation can also crush creativity and lead to bad or unethical behavior because

of the user's desire for the reward. Research has also shown that extrinsic motivators create addictions and foster short-term thinking (Pink, 2011).

SDT proposes that there are multiple types of extrinsic motivation (Ryan & Deci, 2000). For example, students can have different motivators for completing homework assignments. Some students are motivated by a fear of punishment for not doing their homework, while other students are extrinsically motivated to do their homework because they value progress and learning. You might think the second student is intrinsically motivated because he/she is performing the behavior due to his values but intrinsic motivation occurs when the user is satisfied by the mere action of the activity, not the values he/she gets from it (sense of progress or value of learning). While both instances are examples of extrinsic motivation, they can lead to very different outcomes. The first student is being externally pressured, which can produce mediocre work. The second student is finding value in the activity, which leads to a better result and an increase in motivation. Ryan and Deci (1985) would conclude that the second student is partaking in a process called internalization and integration of values.

Internalization is the process of accepting a value or regulation (Ryan & Deci, 2000). Ryan and Deci (2000) believe that by increasing internalization, a user will have greater persistence, more positive self-perceptions, and a better quality of engagement. Integration is when individuals act on their own due to the value they are internalizing. It is believed that these constructs provide a continuum in which varying forms of external motivation lie (Deci & Ryan, 1985; Ryan & Deci, 2000). The continuum consists of: amotivation, external regulation, introjected regulation, regulation through identification, and integrated regulation.

Amotivation is the state of lacking an intention to act (Ryan & Deci, 2000). It results from not valuing an activity (Ryan, 1995), not feeling competent to do it (Deci & Porac, 1978), and/or not believing it will yield a desired outcome (Seligman, 1975). External regulation results in behaviors being performed to satisfy an external demand or an external reward (Ryan & Deci, 2000). This type of external motivation is supported by behaviorists (Skinner, 1953).

Introjected regulation is an internal regulation in which people are motivated to act in order to avoid guilt or anxiety and/or to enhance their egos or pride (Ryan & Deci, 2000). Regulation through identification is an external motivation where the person identified the personal importance of an action and has accepted its regulation as his/her own. Finally, integrated regulation is a form of extrinsic motivation where integration occurs when the identified regulations have assimilated with the self. In order for this motivation to exist, the individual must examine the actions he or she is being asked to perform and consider whether they are congruent with his/her values and needs. While this form of motivation shares many qualities with intrinsic motivation, it is indeed a form of external motivation, as the behavior is not what is motivating the person.

Forms of extrinsic motivation such as integrated regulation and regulation through identification are associated with greater engagement from users (Skinner, Wellborn, & Connell, 1990), better performance (Miserandino, 1996), and greater psychological well-being (Kasser & Ryan, 1996). The literature reviewed has shown that intrinsic motivation has the greatest positive impact on a user acting. Certain types of extrinsic motivation, such as amotivation, have a negative effect on a user acting. However, certain forms of extrinsic motivation, such as integrated regulation, can have a positive effect on a user acting.

Motivation and Children

Carlton and Winsler (1998) examined the development of motivation in early childhood. Children are intrinsically motivated to interact with the environment, and these interactions help them learn. As children get older, this motivation starts to diminish.

Motivation comes from goal-directed behavior and can be intrinsic or extrinsic (Pintrich & Schunk, 1996). Children who are intrinsically motivated experience more enjoyment from learning, have more insights, have higher self-esteem, have more confidence, and are more persistent (Pintrich & Schunk, 1996; Carlton & Winsler, 1998).

Consistent with adult motivations, intrinsic motivation in children comes from the needs for purpose, autonomy, and mastery (Carlton & Winsler, 1998). As children develop, they start to connect their actions to changes in the environment. This gives them a sense of control and helps to define their purpose. This concept is emphasized in *MotoRobos*.

Children have the autonomy to decide whether or not to complete their tasks, and are then given the control to mark their tasks as "complete."

When children are younger, parents help them regulate their behavior. Parents use both rewards and punishments to help children regulate their behavior. When parents are asked what they use to motivate their children, common answers include: money, toys, taking things they like away, and point charts. As children get older and learn more about the world around them, they start to realize the importance of autonomy. They begin to regulate their own behaviors and understand that everyone's actions come from within (Carlton & Winsler, 1998). Young children have a strong intrinsic motivation to master their environment. If children are given the autonomy to impact their environment, it can impact both their current sense of self-worth and their motivation later in life.

Children who are motivated to do tasks solely for an extrinsic reward are more likely to be unsuccessful (Carlton & Winsler, 1998). If the reward will enhance something that the child is intrinsically motivated by, he/she is more likely to complete the task simply to get the reward. *MotoRobos* creates a feature within an application that a child is intrinsically motivated to use, and then provides rewards that enhance that feature. The child completes tasks set forth by his/her parent, and is rewarded with something that enhances the activity he/she is intrinsically motivated to do.

An Introduction to Emotion

Emotion is a reaction to events deemed relevant to the needs, goals, or concerns of an individual (Brave & Nass, 2003). It encompasses physiological, affective, and behavioral components. It is impossible for an individual to have a thought or perform an action without at least unconsciously engaging his/her emotional systems (Picard, 1999). It is important that emotions are considered whenever designing an interface. UX designers typically design for usability, creating an interface that is intuitive and reduces cognitive load. However, designers do not typically take into consideration the emotional effects that products can have on users. The following research will give more insight into emotion theory and how it can be used to design a better user experience.

Neuro Model of Emotions

To better understand emotions, one must understand the neuroscience behind them. LeDoux's (2000) neuro model of emotions posits that there are three main regions of the brain involved with emotions. These regions are the thalamus, limbic system, and cortex. The thalamus is responsible for taking the input of the event and sending that input to the cortex and limbic system simultaneously (LeDoux, 2000). The limbic system evaluates the needs and goal relevance of the inputs. This system is helping the user to determine whether the stimulus is worth his/her attention. If the limbic system determines that the stimulus is worthy, it sends the signal to the body and the cortex. The signal elicits physiological responses causing the user to become cognitively aware of the stimulus. The thalamus and limbic system are primarily responsible for primitive emotions such as the startle system. This system will be active when something on the interface surprises the user. The interaction between the limbic system and cortex is responsible for secondary emotions (LeDoux, 1996). Emotions like frustration and satisfaction are the result of these systems. These emotions are the ones the user is most cognitively aware of when interacting with the system. They can have a strong impact, both positive and negative, on the user experience.

The Main Schools of Thought

There are three main schools of thought for emotion theory, two of which lie on each end of the spectrum (Brave & Nass, 2003). On one end of the spectrum are evolutionary theorists, on the other end are social-learning theorists, and in the middle are basic emotion theorists. Evolutionary theorists believe that all emotions are innate and address a specific environmental problem. Each emotion is associated with a unique set of physiological and cognitive-biasing responses. Social-learning theorists believe that, with the exception of startle emotions (they consider these pre-emotions), all emotions are learned social constructs. These theorists emphasize the role of higher cortical processes to differentiate emotions. Basic emotion theorists believe that there are a small set of innate basic emotions shared by all humans. The list of basic emotions typically include: fear,

anger, sadness, joy, disgust, and surprise. Other more complex emotions such as frustration and satisfaction are seen as combinations of these basic emotions.

Emotions, Moods, and Sentiments

Emotions, moods, and sentiments are three constructs that are closely related (Brave & Nass, 2003). Emotions are intentional and short-lived. Moods are not intentional, and are more global and general. Usually users cannot identify what puts them in a certain mood; it can be something that users are not consciously aware of. Moods can influence emotions and can last hours or days. A user can be in a depressed state (mood) or he can be angry (emotion) because he cannot find the menu button on an interface.

Sentiments aren't related to specific events but can be the result of multiple interactions (Brave & Nass, 2003). They are associations users attribute to certain things. A user has a positive sentiment towards a product and he associates it with a positive emotional state. The reason for this association is that he/she consistently has a good user experience with the product. Sentiments can bias a user and can last forever. If a user has a strong positive sentiment towards a company, that company can get away with making mistakes. The company can do something that a user does not like and he/she doesn't experience as strong of a negative emotion as he/she would if he/she had a negative sentiment towards the company.

Defining Emotions Dimensionally

In certain models that define emotion, each emotion lies within a particular dimension (Barrett, 1998). The two most common dimensions are valence and arousal. Valence corresponds with the pleasure/displeasure scale; happiness would be a positive valence and sadness would be a negative valence. Positive valence is associated with improved attention, creativity, and positive judgements.

Arousal corresponds with the excitation/passivity scale (Barrett, 1998). A user who is enraged would be experiencing a high-level of arousal and a user who is at peace would be experiencing a low-level of arousal. In certain cases, a user who is experiencing an emotion that is of a higher arousal can have increased cognitive performance and attention selectivity.

Appraisal Theory

Appraisal theory states that emotions are present when a user gives meaning to and appraises an event (Frijda & Mesquita, 1998; Scherer, 2009). The event holds more weight based on the personal significance of the event in relation to the user's life. The subjective interpretation of the event is used to explain the emotion. The primary appraisal is related to the user's personal goals and values. The secondary appraisal is the user's ability to cope with the positive or negative consequences of the event. The user's control over the event and how he or she adjusts is related to secondary appraisal.

These two forms of appraisal are responsible for physiological changes, actions taken, motor expression, and subjective feeling (Scherer, 2009). These changes result in an emotion that the subject identifies with. The flow for this process consists of the following:

1. Event
2. Appraisal (Primary or Secondary)
3. Physiological Changes/Action/Motor Expression/Subjective Feeling
4. Identified Emotion

Appraisal theory is used to identify the goal-congruency of interaction events, how the users copes with interactions that are goal-incongruent, and the resulting emotion due to the interaction (Jokinen, 2015). This appraisal of interactions occurs throughout the experience and is largely unconscious. The user can mentally represent emotional states which leaves him/her with a conscious emotional experience.

The UX designer can use appraisal theory to assess, via user testing, the congruency of the user's goal and his/her interaction with the product. If the user expresses frustration or any emotion of a negative valence, the designer can conclude a negative appraisal of the interaction. This negative appraisal signals to the designer that the design is not meeting the user's goals and needs to be changed.

Affective Design

Aarron Walter (2011) argues that emotional design uses psychology and craftsmanship to create an experience for users that makes them "feel." Traditionally, designers focus on making the interface functional, reliable, usable, and easy to learn;

however, they often neglect the emotional experience and deny the user a potential pleasurable experience. Walter (2011) argues that in order for a product to emotionally engage the user and leave a lasting impression in his or her memory it must be designed to have a personality. This claim is supported by neuroscience in that the same area of the brain that is used for long term memory also activates when an emotion is experienced by a user (LeDoux, 2000).

In order to provide a user with a positive emotional experience, the designer needs to start by creating a personality for the product, making it seem human (Walter, 2011). This can be accomplished by using design principles that elicit emotions from users:

- The baby face bias: creating a product that shares characteristics with a baby's face.
- The golden ratio: creating a product that has human characteristics because humans appreciate the beauty of their own image, especially when it is reflected in a design.
- Visual contrast: looking for patterns, and any type of a break in a pattern draws the user's attention, eliciting emotions such as surprise and pleasure from experiencing something novel.
- The aesthetic-usability effect: recognizing that attractive things work better because things that are beautiful elicit positive emotions and put users in better moods (Walter, 2011).

Using these principles as well as other insights from emotion research, *MotoRobos* will create an experience that consistently elicits positive emotions from its users.

Design Principles

Designing to motivate and elicit positive emotions from users is great, but this product will not be successful if it does not follow industry-accepted design principles. If a designer does not adhere to accepted principles, the likelihood of motivating users is low. Walter (2011) argues that when a designer adheres to traditional design principles, he or she is making the product usable. When the designer focuses on emotion, he is making the product pleasurable (Walter, 2011). However, there is no pleasure without the product being usable. The following principles lay the groundwork for a good user experience.

Norman

Norman (2013), provides designers with a wide array of accepted design principles. For instance, objects on an interface must have natural signals that make the interactions clear and intuitive. For example, a designer creates a menu for settings, and these settings have binary options. A designer can create a switch object to signal to the user that the setting can be option A or B, but not both. The product must have clear affordances, and what the user perceives to be the function of the product should be as close as possible to the actual function. An example of an unclear affordance would be a hamburger menu that, when clicked, causes the user to go back a screen instead of opening a menu.

Norman (2013) argues that to design a good user experience, the user's mental model must match the product's conceptual model. A mental model is what the user thinks the product should do before he/she actually uses it. A conceptual model is the actual model of the product (Norman, 2013). If these two models do not match it can cause the user to misunderstand the function and feel frustrated which may lead to a poor interaction with the product.

Norman (2013) identifies two constructs that a designer must consider when creating a product. The first is the *gulf of execution*, which poses the question: does the product provide actions that align with the intentions of the user? If a user purchases a mobile banking app in order to deposit a check, but the app does not allow the user to deposit checks, the app does not adhere to the *gulf of execution.*

The second construct is the *gulf of evaluation*, which poses the question: does the product provide the user with a physical object that can be used to act on the intentions and expectations of the user? In order for the mobile banking app mentioned above to adhere to this principle, it would allow the user to deposit checks and might signal this to the user by having an icon with a camera on top of a check.

Nielsen

Neilsen's (1995) usability heuristics are widely used by UX designers. To determine the usability of a product, researchers typically evaluate the product against these heuristics:

1. Visibility of system status: the product needs to let the user know what is happening. For example, if the user is completing a multi-page form, the product should include a progress bar to inform the user how much of the form he or she has completed.
2. Match between system and the real world: the product needs to be familiar. It should be similar to products that the users utilize every day. This will ensure that it is intuitive.
3. User control and freedom: do not limit the user. Allow him/her to customize the product in such a way that it meets his/her goals and standards. For example, in most video games users have the ability to change the controls.
4. Consistency and standards: use objects, icons, and language that is frequently used in popular products. For example, the hamburger menu icon is used for almost all mobile applications. It would be unwise to use a wheel icon to represent a menu on a mobile application instead of the hamburger menu.
5. Error prevention: make sure the product has checks in place for important interactions. For example, when someone exits a word document without saving, a message pops up asking the user if he or she wants to save. Give the users a chance to fix errors.
6. Recognition rather than recall: provide users with options to choose from instead of them having to come up with ideas themselves. For example, when a user finishes watching a YouTube video, he/she is presented with a recommended video. Having good labels and headers allows a user to recognize information instead of having to remember it.
7. Flexibility and efficiency of use: ensure that the product is flexible. Advanced users, novices, and beginners should be able to get something out of the product. There should be options that allow the user to customize the product for his or her own purposes.

8. Aesthetic and minimalist design: only include things in the design that are essential for the product. Do not overcrowd the interface with useless objects. Simple is better.
9. Help users recognize, diagnose, and recover from errors: errors are bound to happen, but the product should be designed in such a way that allows the user to identify and correct his/her errors. For example, if the user forgets to fill out a field on a form, that field should be highlighted, indicating to the user that he/she needs to fill it out.
10. Help and documentation: make documentation for the product and the ability to obtain help easily accessible (Nielsen,1995).

Designing for Children

Research conducted by White 2016) outlines processes and heuristics for designing for children. Designers should:

1. **Determine the age range for the application before starting to design so that features can be tailored appropriately.** Not being cognitive of that range will lead to a poor experience for the children using the application. For example, if your audience is children ages 4-8, it would be inappropriate to create a text-heavy application. Children within that range are still learning to read. If there is text, it should be simple and coupled with graphic representations, such as icons.
2. **Understand a child's feelings towards the subject matter.** Getting this type of feedback will allow the designer to explore options to elicit positive emotions from the child. For example, if the goal of the application is to motivate children to do chores, the designer needs to figure out a way to make the chores exciting or rewarding. Children and adults do not feel the same way about certain topics. If the designer designs an application solely based on how he/she feels about the topic, and his/her feelings differ from those of children, the children will not use the application or enjoy using it.

3. **Design elements within the application in such a way that children can easily use the application.** Affordances should be used to illustrate to the children which elements are interactive. For example, buttons should have drop shadows so that children know the button can be pressed. Because most children appreciate color, the application should be designed in such a way that it is colorful while still making clear which elements are interactive. Call to action buttons should be large so they draw the child's attention. Any time something happens within the application, there should be feedback. Children should never have to wonder whether a button press actually did something. Whenever possible, images should be used instead of words. A designer should not rely on sound as the main form of interaction, since the child might not be able to use the application with sound, depending on where it is being used.
4. **Consider the context in which the application is being used.** An application that is used exclusively at home would be different than an application used exclusively at school. At school one teacher is guiding an entire classroom. Designers need to account for this and adjust accordingly.

One of the best approaches to learning how a child will respond to a certain stimulus, whether it be a mobile application or a toy, is to observe him/her in a natural environment. White (2016) emphasizes that children are inherently creative and that observing this creativity can provide designers with insight. White also points to co-design as another effective method for learning how a child will react to stimuli. Co-design relies on the designer and child working together to create a product. Another approach is having the child teach the designer how to use the application. If the child can easily teach the designer how to use the application, one can be confident that the application is intuitive and usable for the child.

Gamification

Gamification is when a process, application, or task uses elements of game design in non-game contexts, products, and services in order to motivate desired behaviors (Deterding, 2012). Websites, applications, and education platforms utilize gamification to

motivate users. For example, Code Academy rewards users with trophies and badges when they finish lessons.

If a designer uses gamification with his/her product, it must be done in a way that engages users. Points, trophies, and leaderboards are the least essential elements of a game but are relied upon heavily when a company decides to use gamification (Deterding, 2012). Designers need to ensure that the form of gamification it introduces is meaningful to users and is coupled with a user's pursuit of goals. When this is done, gamification is a valuable strategy for motivating users.

Gamification drives the long-term participation we see on the social web (Antin, 2012). The concept can be traced back to the Boy Scouts of America and merit badges (Antin, 2012). Motivation is found through pursuing goals, mastery of an activity, and identifying the valuable accomplishments of an individual. Lawley (2012) believes that, in order for gamification to work, it must include game design as well as game components. The components would be points or trophies. The design is a thoughtful process that considers the behaviors that should be rewarded. The rewards should encourage users and accurately reflect their accomplishments, contributing to their sense of competence and progress.

Rajat Paharia (2012) argues that the product being gamified needs to have intrinsic value already. The product should have something within it that the user is intrinsically motivated to use. Coupling this feature with gamification will intensify the user's desire to use the product. One feature within *MotoRobos* that provides intrinsic value is *Robot Runner,* a side-scrolling platform game where the child uses rewards that he/she has unlocked as power-ups to facilitate his/her journey through the game. Another feature that provides intrinsic value is the *Creation Canvas.* This feature allows the child to create paintings and drawings. The child can animate these creations with the robots and the rewards that he/she earns. This allows the child to be creative and establishes *MotoRobos* as an interactive technology that enhances creativity.

Interaction Design and Creativity

Interaction design and creativity is a topic that has been examined by Human Computer Interaction researchers (Decortis, Rubegni, Tillon, & Ackermann, 2013). Interaction design examines how interactive technology can be used to enhance children's creativity and imagination. Several components influence creativity. These components include: motivation, knowledge, skills, intelligence, personality, emotional factors, environmental factors, and cognitive style (Lubart, 2005). Creativity is considered the result of the complex interactions of these components. For example, painting a mural can encompass all of these components.

Vygotsky (2004) argues that creativity is a learned process of playful and mindful engagement that results in the person expressing him/herself. His research supports the notion that creativity helps children to develop. When a child utilizes his/her imagination, he/she is sharpening his/her skills for problem-solving and knowledge acquisition. There are four types of relationships that combine imagination and reality resulting in creativity: experiences with the environment, social relationships, emotions, and physical objects (Vygotsky, 2004).

Digital technologies can be used to enhance creativity, in turn helping the child to develop (Bonnardel, 2009; Roquette, 2007). Products need to have features and interactions that allow the child to engage his/her imagination. Whether it is a space to draw, build, or solve puzzles, the interaction needs to stimulate a child's imagination. If the product effectively motivates the child, he/she will be more likely to use it and continue his/her creative growth (Bonnardel, 2009). This is what *MotoRobos* aims to do.

Competitor Applications

The researcher evaluated and reviewed three potential competitor applications. The data from these evaluations and reviews were used to predict the potential success of *MotoRobos* with premier applications of the same genre.

Class Dojo

Class Dojo is a classroom communication platform for teachers, parents, and students. It tracks a student's behavior and communicates the results to parents (ClassDojo,

2017). Class Dojo accounts are free and have a web platform as well as mobile/tablet applications. The main page presents users with a demo class feature that introduces them to the application. From this page, the teacher can add new classes, see associated schools, and view tips from the community

The demo class shows the user a sample classroom. Each child chooses an avatar and is awarded points based off his/her behavior. The landing page for the classroom displays the student avatars. The student avatars shows the amount of points the child has earned or lost. The teacher typically displays this page on a projector so the students can see their points. There are sounds that play every time a child earns a point or loses a point. The purpose of this feature is to help the child self-regulate. The points are the motivation tool for the children to behave.

The teacher has the ability to reward all students at once, reset points for the children, set timers, and record behavior. After awarding children points, the teacher can generate reports. The report displays a donut chart that gives an overview of the child's behavior. Parents have the ability to see the reports. There is a running list that shows each point that was awarded or taken away. This list shows the behavior that resulted in the point change. The teacher also has the ability to send parents messages.

The teacher has the ability to create behaviors. The behaviors have point values and an icon. The icon comes from a library provided by Class Dojo. The amount of points for each behavior is customizable. The teacher can also choose avatars to represent each child. The avatars are monsters, critters, or a picture. The child does not have the ability to interact with the application. There are no features or games for the child. The teacher decides whether or not they are behaving and the child gets points. What happens with the points is completely up to the teacher, and the points do not unlock anything within the application

The interface is clean and easy to use. The design is minimalistic with clear affordances. The navigation within a classroom page consists of: classroom tab, reports, messages, back to home screen, and edit class. The main interaction involves clicking on a student and choosing a behavior that either gives a point or takes it away. The application is intuitive and easy to use, but there is not much substance, especially for students.

ChoreMonster

ChoreMonster is a web and mobile application that rewards children with interactive monsters as well as external rewards for completing tasks (FamilyTech, 2017). There is a parent and child side of the application. The parents have the ability to set chores for their children, review settings, look at overdue chores, approve completion of chores, and confirm rewards. When creating a chore the parent can specify the date and time it is due as well as how many points it is worth. A picture of the chore can also be included.

The sections for the child includes: chores, points, rewards, and monsters. In the chore section is a chore list that is purely text. It gives the child the chore name, date and time it is due, and the amount of points that it is worth. If the parent sets a picture for the chore the child can expand the task in the list and see that picture. The child earns points after completing each chore. These points are tracked in the points section. The child can spend the points to earn real world rewards after completing tasks. After reaching milestones, such as 50 points earned, the child earns interactive monsters. The child cannot do anything with the monsters, besides collect them.

Overall, the design of the application is adequate. The color choices for text and background do not provide enough contrast. This makes it hard to read which might cause accessibility issues. There isn't much to the internal rewards so it causes the parents to rely heavily on coming up with external rewards. The application is colorful but some components that are clickable do not have a clear affordances. Overall, the concept is like *MotoRobos* but the execution of the idea is mediocre.

Chortopia Chore App

Chortopia Chore App, available for iPhone and iPad, gives parents a creative way to assign their children chores (Chortopia Chore App, 2017). The application turns chores into stories. Children are awarded with stories, collectible character cards, and games to play with said cards. The recommended age range is ages 5-8.

Users start by entering a child's name. They are able to have multiple profiles, one for each child. The child enters the application by pressing his/her name, and it opens like

a story book. The child is introduced to the land of *Chortopia* and is told he/she is the new hero that has to save the land. After this brief introduction, the child is presented with a map that has a path the child has to work its way through. Each block on the map is locked and the child needs to complete chores in order to progress through the map.

The child has a guide who explains how to progress through the story. The character says the dialogue out loud and has a speech bubble. Each spot on the path contains chores set by the parents as well as a part of the story. When a child completes a task, he/she receives chore power. In order to move beyond a task, a parent must approve its completion. Once the parent approves the task, the child can use his/her chore power to complete that part of the adventure. The child is presented with another part of the story and a mystical box which contains a character card. There is a collection section where the child can see all of the cards that he/she has unlocked. Those cards are used in the games contained in the games section.

The Parent side of the application includes a list of chores that fall into three categories: behavior, outside, and inside. The parent chooses chores and they are then added to the child's adventure. The parent also has the ability to create chores that are not on the predetermined list. The parent has a list which shows the chores the child marked as "complete." The parent can then approve or deny completion.

This application is designed with children in mind. It uses a lot of colors, but it is clear what the child can interact with. Navigating within the application is fairly easy. The navigation items are brief. The information is chunked in such a way that the user can easily identify what he/she can and cannot do from each screen. There is a guide within the game called Mr. Rybit that gives the game personality and helps the child navigate the application.

The concept of unlocking cards that can be used within a game is very similar to the reward system of *MotoRobos* (note: this application was reviewed after the final design of *MotoRobos* was finished). Children can use the application to play the card game or to read more of the story, intrinsic motivation. Completing chores enhances that experience, extrinsic motivation. It makes the connection between intrinsic and extrinsic motivation.

The application seems like it is being well-received by consumers. It received 5 star reviews from “The iPhone Mom” and “The iMums.” It received a 4.7 star review from “Best Apps for Kids” and a 4.5 star review from “Smart Apps for Kids.” The concept behind this application aligns with the concept behind *MotoRobos*.

Chapter 3: *MotoRobos'* Initial Design and Features

MotoRobos is an application that can help parents and possibly teachers motivate their children to behave and/or complete tasks. The proposed age range for this application is four to eight years. In order to reduce application dropout, it will have features that allow the children to be creative, thereby instilling intrinsic motivation. The application will have two main characters: Ronny and Rita the Robots. They will be designed using principals such as the baby-face bias and the golden ratio. The motivation for using characters in the application is to give it a personality. As the literature on affective design shows, applications that feel personable are more likely to elicit positive emotions.

The application will have two main functions, the first of which will involve a list of tasks that a child is to complete. Each time a child completes a task, he or she will be given the option to unlock an outfit or object that Ronny and Rita can wear or use. This is where extrinsic motivation comes into play. The child is completing the task in order to unlock the reward. Ronny and Rita will have voice lines that stress the importance of completing tasks. This will likely result in the child completing the tasks not because of an external demand, but because of the value that he or she has internalized.

The second function of the application will provide the child with a canvas where he/she can draw whatever he/she wants and place the robots in the picture with their new outfits and objects. This function will intrinsically motivate the child to continue using the application because it will allow him or her to be creative. The child can use this feature as soon as the application is downloaded. The child does not have to do tasks to access or use this feature. Over time, new types of creative features will be introduced, such as an option to allow children to build environments and have Ronny and Rita interact with the created environment.

The application will be designed using the principles/heuristics reviewed. It will be usable, motivate children, and elicit positive emotions from them. The *MotoRobos* design will elicit emotions that are of a positive valence and are therefore associated with higher arousal. Therefore, the user will be engaged and excited when he or she is using the

application. The experience will be pleasurable and it will ensure that children continue to use the application.

Design and Features

The following section will go through the initial *MotoRobos'* design and explain each screen. For the purposes of this project, only the mobile version of the application was built out. The initial designs were sketches (see Appendix A) that were transformed into an *Axure* prototype. The sketches were instrumental when it came to the overall design. They helped flesh out the designs of the robots, layout of the application, and features that were ultimately included. The application is divided into 2 sections: a Parent section and a Child section. All users land on the following screen where they can choose to login (see Figure 1).

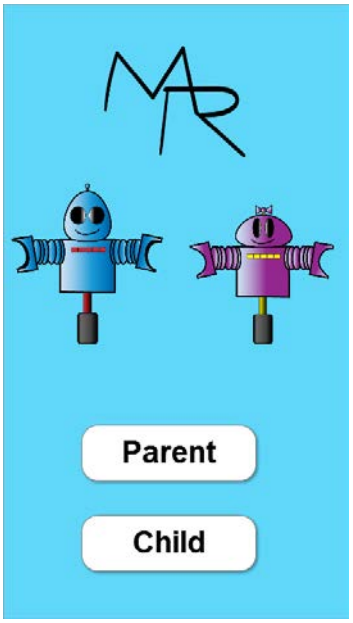

Figure 1. Landing Screen for the Application.

Parent Side of the Application

After choosing the Parent option, the user is presented with a login flow. The user must enter a username and password. The parent is then presented with a screen to choose which child he/she wants to assign tasks to, or which child's profile he/she wants to view

(see Figure 2). The user can have profiles for as many children as he/she wants. Each profile thumbnail will have a picture or icon for the child and the child's name. By having separate profiles for each child it should be easier for the parent to track information pertaining to that child.

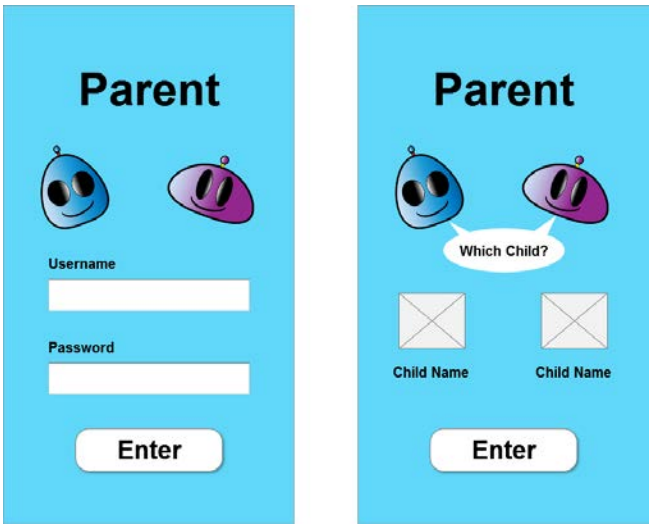

Figure 2. Parent Login Flow.

After logging in, the user arrives on the Parent Main Screen (see Figure 3). From here the user has access to all of the application's Parent features. These features include: *New Tasks, Pending Approval, Completed Tasks, Incomplete Tasks, Painting Gallery, and Reward Gallery.* The user also has access to the navigation bar, which is present on every screen once the user logs in. The navigation bar has the menu and the lock icon to logout. The call-to-action buttons are large and it is evident that they can be clicked. Each button component has an icon and label. A minimalistic approach was taken when designing the application. The menu gives the user multiple paths to access each feature.

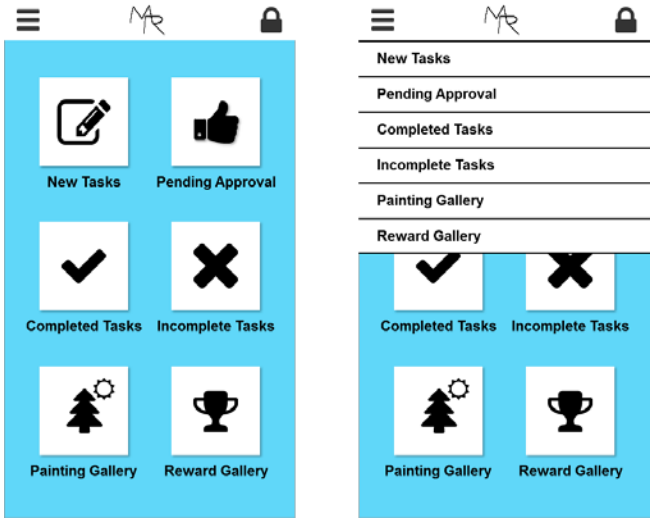

Figure 3. Parent Main Screen.

New Tasks is the feature that allows users to assign children new tasks or saved tasks (see Figure 4). When users open this feature the "New Task" component is expanded. Users can name the task, designate a reward, describe the task, set a due date, and save it for future use. After pressing "enter," the task is delivered to the child's *Task List.* "Saved Tasks" allow users to quickly choose a task that they have assigned to the child before. When expanded, the screen looks similar to "New Task," except the user chooses a new reward and sets a new due date.

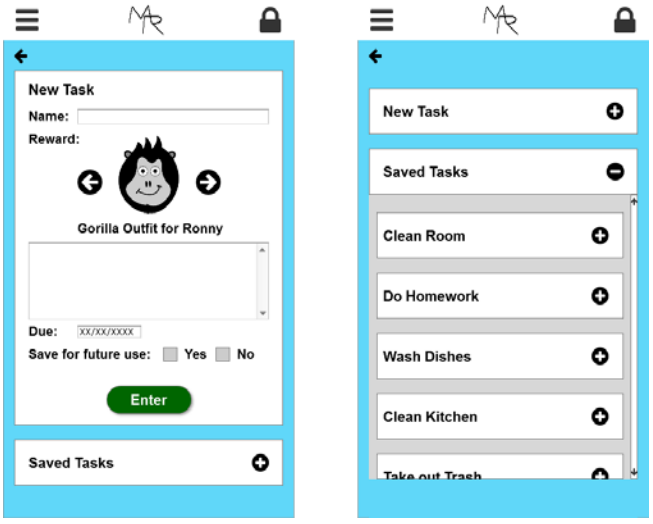

Figure 4. New Tasks.

Pending Approval is the feature that allows users to approve or deny the completion of the task (see Figure 5). The user is presented with a list view where he/she can sort alphabetically and by day. Each time a child marks a task as "complete," it is pushed to this list. When the user expands each task component, he/she is presented with the reward that will be earned and the ability to approve or deny task completion. If the user approves completion, the child receives the reward. If the user denies completion, the task is sent back to the *Task List. New Tasks* and *Pending Approval* have a limited number of interactions. These two features are the backbone of the Parent side of the application. Because the design is simple, both features are intuitive and easy to use.

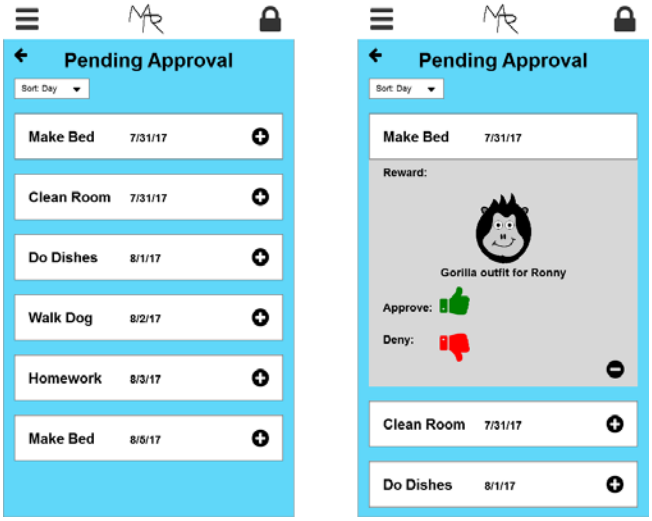

Figure 5. Pending Approval.

*Completed Tasks (*see Figure 6) and *Incomplete Tasks* (see figure 7) provides users with statistics pertaining to task completion. When a user clicks *Completed Tasks* he/she is presented with a list of tasks and the day they were completed. Each task can be expanded to show what reward was unlocked, as well the number of times the task has been assigned and successfully completed. *Incomplete Tasks* is fairly similar to *Completed Tasks* except there is no reward displayed. The user can expand the task component and see the number of times the task has been incomplete and the number of times it has been assigned. The purpose of these two sections is to give the users a brief overview of what their children are doing well and where they need improvement.

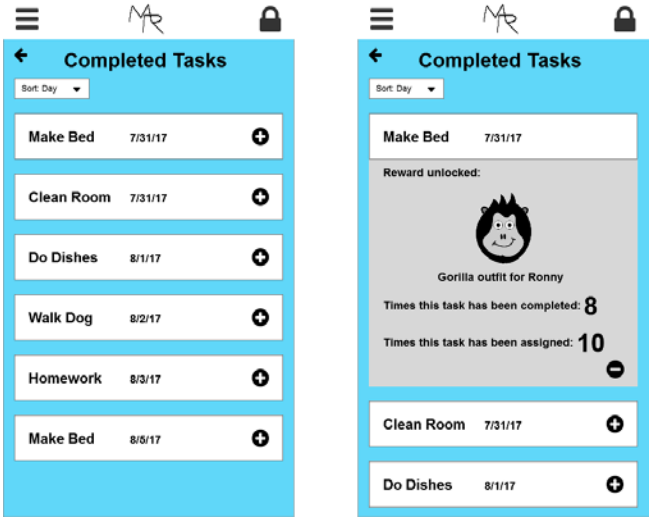

Figure 6. Completed Tasks.

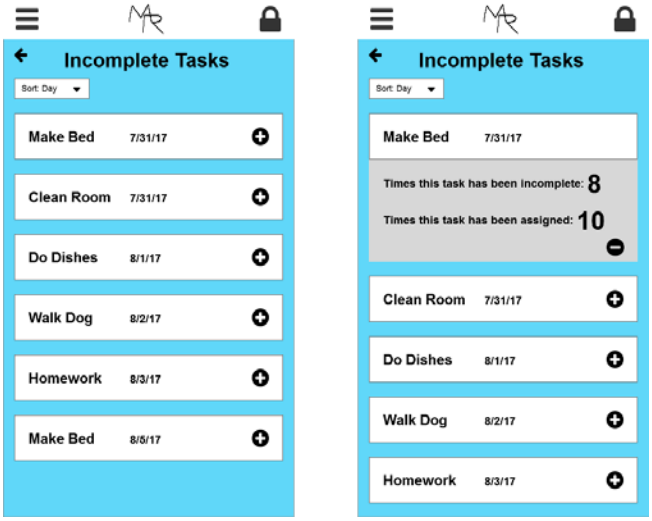

Figure 7. Incomplete Tasks.

Painting Gallery (see Figure 8) shows users everything their child makes in the *Creation Canvas.* The parent can blow the image up. He/she can also print out the creation or share it via social media, text, or email. The user can delete the creation without deleting it from the child's gallery. The *Creation Canvas* allows the child to create paintings and drop the robots into the paintings wearing outfits or using objects that they unlocked from completing tasks.

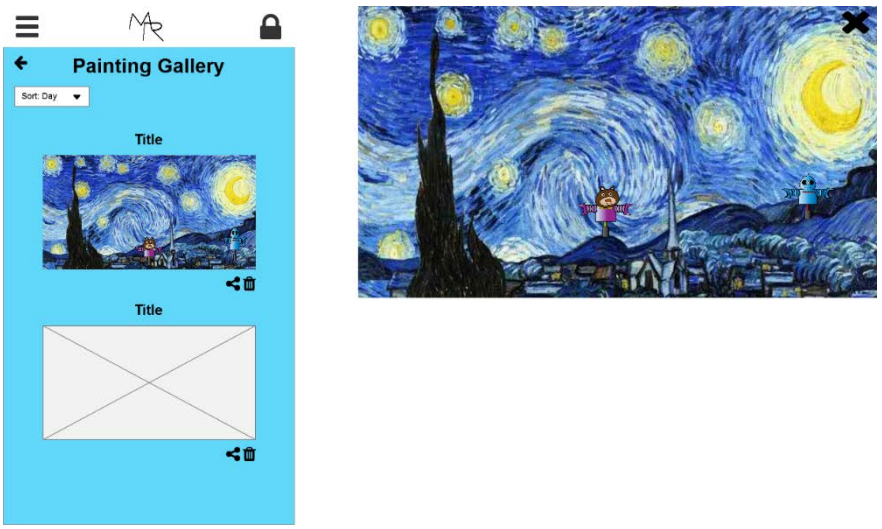

Figure 8. Painting Gallery (parent).

*Reward Gallery (*see Figure 9) is where the parent and child can go to see the rewards that can be unlocked. The parent and child can click into the reward to view a description of it. These rewards are costumes, outfits, and objects that the child can use on the robots that he/she puts in his/her creation. This feature is exactly the same for parents and children. A large number of rewards are available so that the child does not get bored with the options available to him/her. The rewards include animal costumes, outfits, and cars among other things. All of them can be used in each creation.

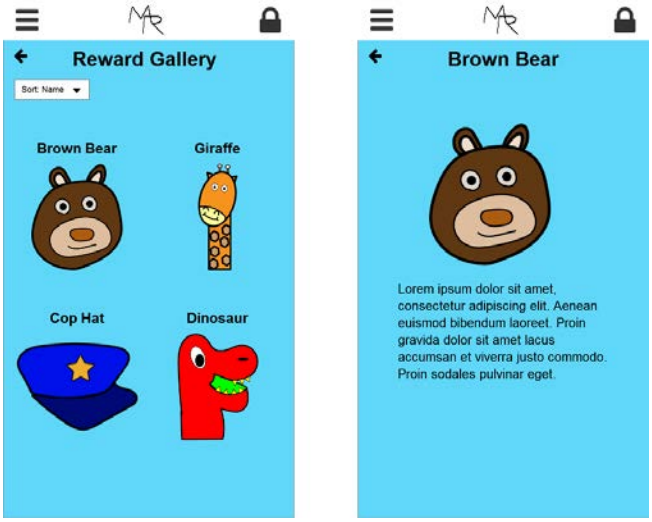

Figure 9. Reward Gallery (parent and child).

Child Side of the Application

After choosing the Child option, the child is presented with a single login screen (see Figure 10). The child chooses his/her profile and presses "enter." Every time the child lands on this screen, the robots will tell him/her a joke. This gives the user a first look at the robots' personalities. They are fun and quirky. This will elicit positive emotions from users. Everything that a user sees within text bubbles will also be said out loud by the robots. This feature should increase accessibility for children who have difficulty reading. This option can be turned off, which will help users account for the environment they are in. The profile component will have a picture of the child or an icon to represent him/her.

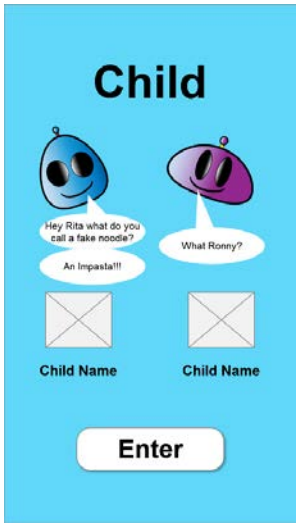

Figure 10. Child Login.

After logging in, the child arrives on the Child Main Screen (see Figure 11). From here, the child has access to the application's Child features. These features include: *Task List, Creation Canvas, Painting Gallery, and Reward Gallery.* One additional feature on the Child main page is a message from the robots related to completing tasks. This will help children internalize the values in completing tasks. The child also has access to the navigation bar, which is present on every screen once the user logs in. The navigation bar has the menu and the lock icon to logout. The call-to-action buttons are large and it is evident that they can be clicked. This is especially important for children. A child should not look at a component and have to guess whether or not it is interactive. Each button component has an icon and a label. The icons will help children who have problems reading

identify the features. Just like with the Parent side of the application, a minimalistic approach was taken. The child is not overloaded with information. The menu gives the user multiple paths to access each feature.

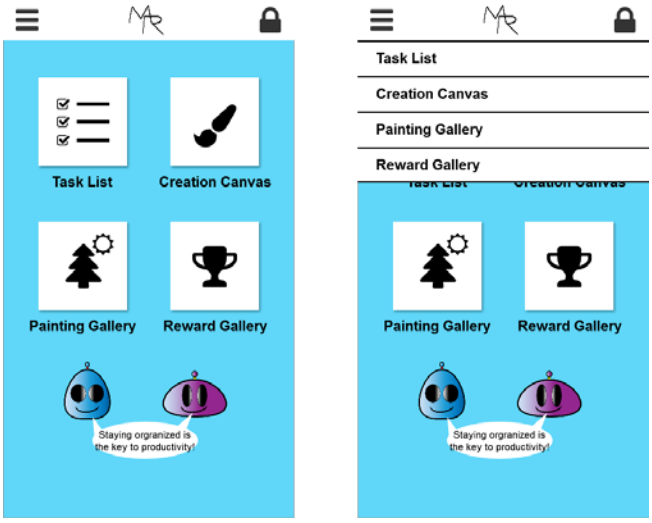

Figure 11. Child Main Screen.

Task List (see Figure 12) is where the child will see his/her assigned tasks. The tasks, by default, are sorted by day, with the next-due task at the top. The child can also sort alphabetically. Each task component has the title of the task and the due date. When the child expands the task component, he/she will see the reward that he/she will unlock. The child also has the ability to mark the task as "complete." Once the child marks it as "complete," it will be sent to the parent's *Pending Approval* list. Once the parent marks it as "complete," the child unlocks the reward and the task component is removed from the *Task List*.

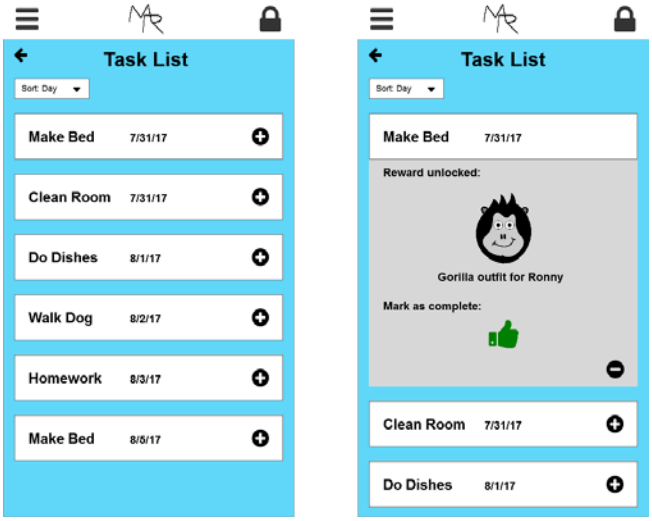

Figure 12. Task List.

Creation Canvas (see Figure 13) is the main feature of the application for children. The child can draw, paint, and create various types of artwork within it. The child can enhance the artwork by dropping the animated robots into the creation and equipping them with the rewards that have been unlocked. This part of the application is where intrinsic motivation comes into play. The activity of creating is what is motivating the child, and this motivation would be intrinsic. The child would then complete the tasks that his/her parents assign to him/her to further enhance the creations. This would be the extrinsic motivation part of the application. The child can create landscape or portrait creations. The canvas starts out blank. The child has multiple tools at his/her disposal: pencil, paint brush, crayons, fill, shape creator, eraser, insert robot tool, insert reward tool, and save. The child can specify the color for each drawing tool. The child can also hide the tools to get a full view of the canvas. Once the child saves the creation, he/she is brought to the *Painting Gallery*, where he/she can give the creation a title.

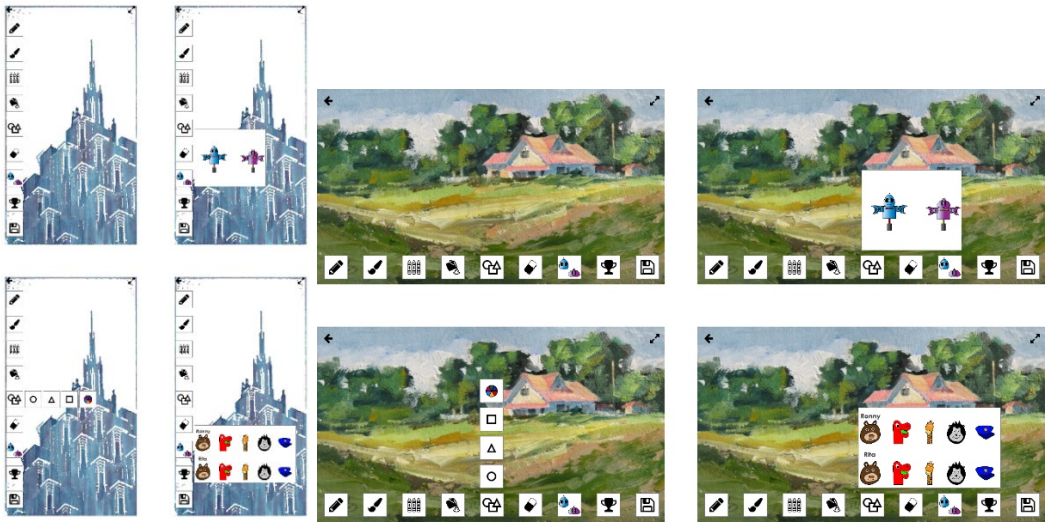

Figure 13. Creation Canvas.

Painting Gallery (see Figure 14) shows the child everything that he/she makes in the *Creation Canvas.* The child can blow the image up. He/she can also print out the creation or share it via social media, text, or email. The child can delete the creation without deleting it from the parent's gallery. The child can also edit the creation at any time.

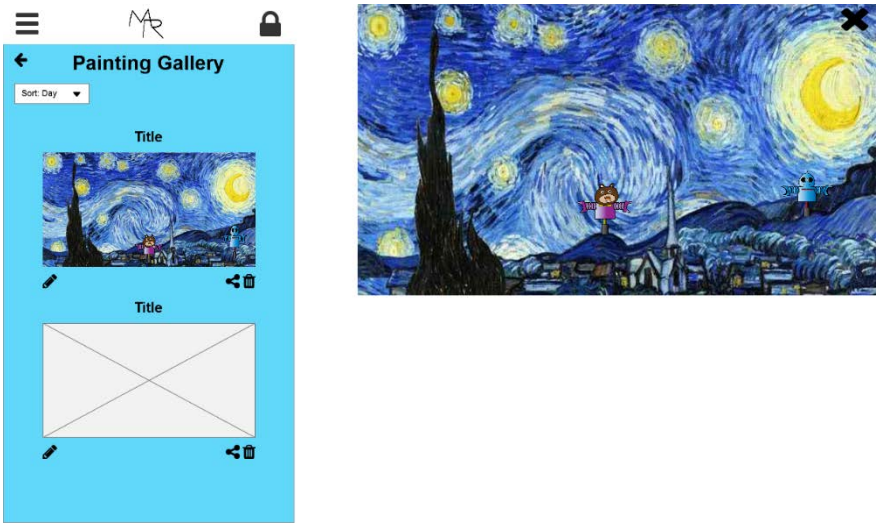

Figure 14. Painting Gallery (child).

Chapter 4: Methods

This section is an overview of the methods taken to setup and complete the study. The purpose of the study is to validate the proposed designs and to improve the user experience based on participant feedback.

Participants

This study used 14 participants (who served as parents and proxies for children) to conduct usability tests of the proposed application *MotoRobos.* The participants were parents and teachers; most of the participants were both a parent and a teacher. Unfortunately, due to time restraints and internal policies, testing with children was not viable. Recruitment for this application was done via social media, specifically Facebook. All participants were briefed on what the study would consist of and the researcher obtained their consent to participate and be recorded.

Procedures

The usability tests were in-person, one-on-one moderated sessions. A moderator's guide (Appendix B) was used to make sure the best possible feedback was obtained from each session. Before the session, the researcher asked the participant to read and sign a consent form (Appendix E). This form asked the participant whether he/she consented to the researcher using his/her data in his report. The form also asked whether the participant consented to having the session recorded.

A prototype was developed using *Axure,* and it was made interactive with *Adobe XD.* There were four sessions in total. The first session had two participants, the second session had six participants, the third session had three participants, and the final session had three participants. After the first session, the prototype was updated to include an account creation flow. Participants in sessions 2 and 3 saw this flow as well as all the screens from session 1. At the conclusion of these sessions, the prototype was updated to the final design. The final session consisted of three participants who saw the final design. The screens for the final design are in the following sections.

A *Google Pixel* was used to test the prototype in all sessions. The phone was connected to a computer in order to share and record the screen using *Vysor*. *Vysor*

projected the phone's screen onto the desktop monitor. *Camtasia* was used to record the desktop screen and the audio from the session. A large diaphragm condenser microphone was used to capture the audio for the session. Each session was approximately 60 minutes long. The first five minutes were dedicated to background questions, the next 45 minutes were dedicated to the tasks, and the last 10 minutes were used to capture the participant's final thoughts and suggestions.

Sessions 1 through 3 were conducted as task-based moderated sessions. Session 4 was an exploratory session where the final participants were given free rein to go through the application and give feedback. The researcher gave participants scenarios and asked them to complete tasks within the application. There were 15 tasks in total (Appendix C). 10 tasks were for the Parent side of the application and five tasks were for the Child side of the application. It should be noted that participants in session 1 (2 participants) did not receive the "account creation" task. The participants in session 4 were given no specific tasks.

Each task was given a performance task score on a scale from 1 to 3 (Nielsen, 2001). A score of 1 indicates that a participant failed the task. The participant did not complete the task or find the requested information. Or, in other words, he/she *thought* he/she had completed the task or found the correct information, but did not. A score of 2 indicates that the participant passed the task with difficulty. The participant succeeded in completing the task or finding requested information, but information retrieval was inefficient or he/she was confused in the process, or the moderator had to redirect him/her in some way so that he/she could complete the task. A score of 3 indicates that the participant passed the task. The participant immediately understood where he/she needed to go to find the requested information or to complete the task. He/she succeeded easily without assistance from the moderator.

At the conclusion of the session, all participants were asked to complete a survey with two questions (Appendix D). The first question asked them to rate the understandability of the content the participants saw. The second question asked them to measure the "Net Promoter Score (NPS)." The NPS is an index ranging from -100 to 100

that measures the willingness of customers to recommend a company's products or services to others ("Net Promoter Score," 2017). It is used as a proxy for gauging the customer's overall satisfaction with a company's product or service and the customer's loyalty to the brand. If a company has more detractors than promoters, the score will be negative and vice versa. A higher NPS tends to indicate a healthier business, while a lower NPS can serve as an early warning sign that potential customer satisfaction and loyalty issues need to be researched. An NPS over 50 is considered excellent.

Data Analysis

The researcher watched all of the recorded sessions in order to finalize his notes and to validate the task scores he gave participants during the session. The researcher observed participants closely in order to determine changes that needed to be made for the final design. The researcher also extracted memorable quotes from each session. Answers to questions from the background and debrief portions of the study were examined. The designs were finalized and shown to the last participants in session 4 in order to validate the design.

Chapter 5: Results

This section is an overview of the results from the usability tests. Answers from background questions, task scores, and answers from debriefing questions will be reviewed. Certain screens for *MotoRobos* were redesigned, new screens were introduced, and certain screens were replaced. These changes were made based on observations and suggestions from participants.

Background Questions

Background questions (Appendix B) were asked in order to get a sense for a participant's need for an application such as this. When participants were asked whether they assigned their children chores all responded yes (n=14). Most participants said their children completed chores 100% of the time. Participant bias, or the desire to be perceived in a positive light, might have influenced the answer to this question. Seven participants motivated their children with a point system. Two of the seven participants were also teachers, and mentioned the application *Class Dojo* as their application of choice. Two participants mentioned taking something away from the child, while five participants mentioned giving the child an external reward such as money or Legos.

Participants were asked their thoughts on using a chore/task application to motivate their children. All of the participants would use an application pending the design and premise of the application. One participant said, "With the world we are living in, I want to introduce them to applications early. It is important for them to understand how to use this stuff." Participants were asked what age a child would have to be in order to be successful with an application. The following table (see Table 1) shows the participants' answers.

Table 1.

Participants' Suggested Age Ranges for Application (Pre-Study)

Participants	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Reponses	5-12	5-12	7+	7+	8-12	4-10	4+	6+	7+	1-3	Up to 8	4-10	5-8	4-9

Participants were asked about the benefits of children completing tasks, and whether tasks can teach the children anything. The common theme among answers were children gaining a sense of responsibility and productivity. 3 participants said that tasks are a part of life, and there are consequences when they are not completed. 2 participants said completing tasks gives children a sense of self-worth and accomplishment.

Task Results and Survey Results

Tasks were split into two categories: Parent and Child. It should be noted that Participants 12-14 did not complete any tasks because their sessions were exploratory in nature. Participants 1 and 2 did not have the "Account Creation" task. The results were overwhelmingly positive. Out of ten parent tasks (see Figure 15), participants were 91% successful (ten failures out of a possible 108). Out of five child tasks (see Figure 16), participants were 100% successful. Participants who failed the "Pending Approval" task went to the *Completed Tasks* section. Participants who failed the "Saved Tasks" task missed the "Saved Tasks" label. Participants who failed the "Incomplete Tasks" task did not go to the *Incomplete Tasks* section. All three participants who failed stayed in the *Completed Tasks* section and figured out the number of incomplete tasks by looking at the score under "Times this task has been completed" label and subtracting it from the score under the "Times this task has been assigned" label.

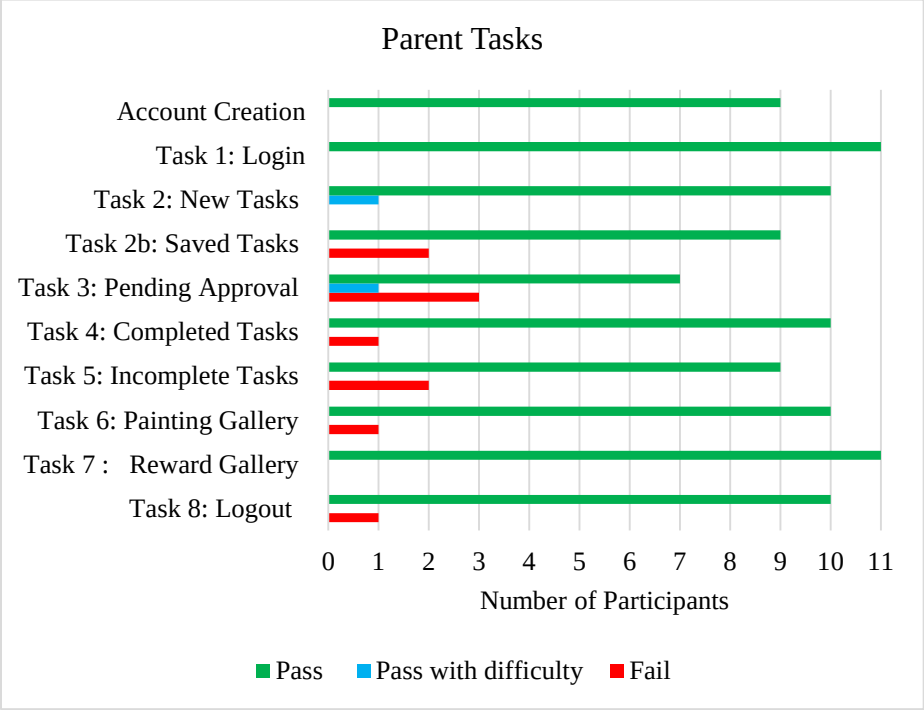

Figure 15. Parent Tasks.

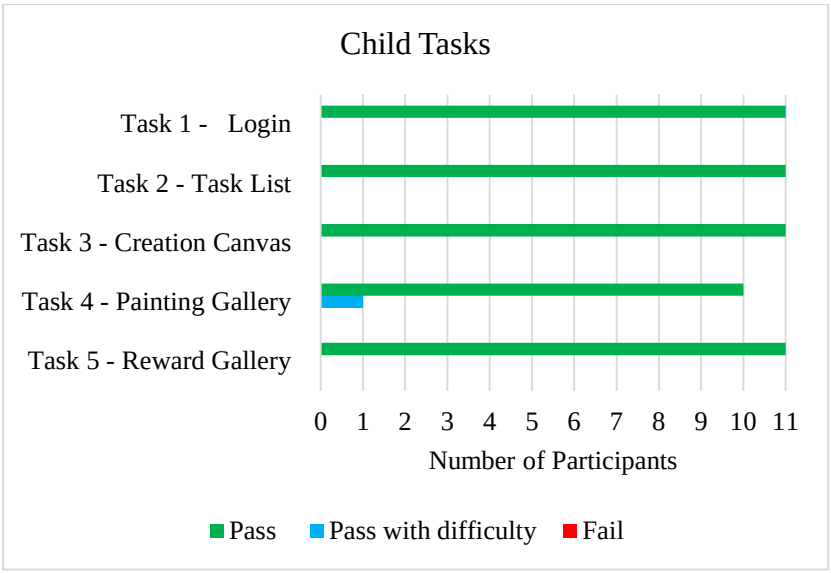

Figure 16. Child Tasks.

At the conclusion of their sessions, all participants were asked to complete a survey with two questions (Appendix D). The first question was to rate the understandability of the content the participants saw (see Figure 17). The average score for this question was

8.92 and the median was 9. The second question was to measure the "Net Promoter Score (NPS)" (see Figure 18). The average score for this question was 9.35, the median was 10, and the NPS was 79. An NPS over 50 is considered excellent ("Net Promoter Score," 2017).

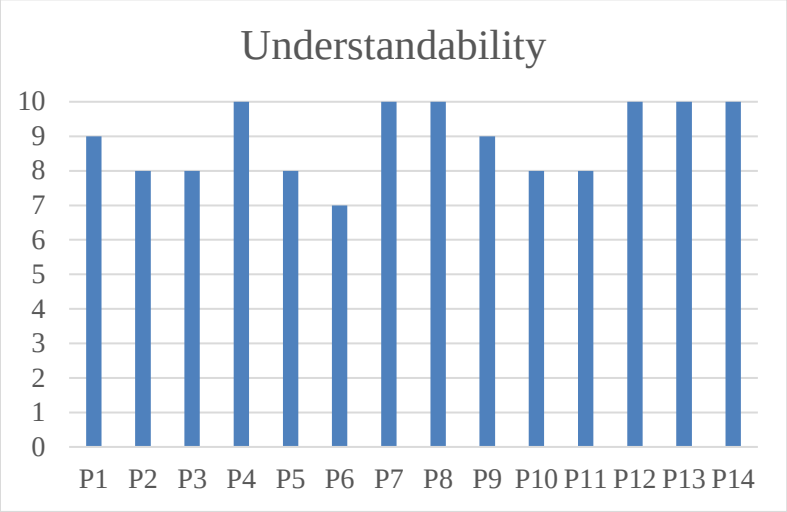

Figure 17. Understandability Survey.

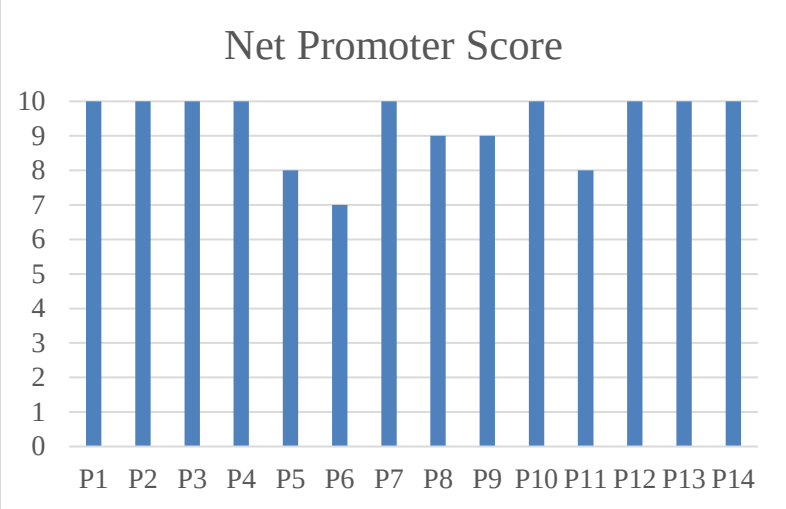

Figure 18. Net Promoter Score.

Debrief Questions

After fully exploring the application, participants were asked debriefing questions. These questions were asked in order to determine the participant's overall impression and to touch upon topics that were not discussed during the tasks. Participants were asked

whether any additional features for the children were necessary. Four participants mentioned adding a game feature. Those participants believed utilizing both the *Creation Canvas* and a game would engage most children. When participants were asked whether they thought *MotoRobos* would motivate children to do tasks, all 14 said yes. After reviewing the application, the participants were asked what age range they think *MotoRobos* is best suited towards; their answers can be found in Table 2.

Participants were asked for their overall impression of the application and all of the responses were positive. One participant, who echoed most of the other participants' responses to this question, said, "I really like how easy it is to use. I think I am pretty intuitive with using technology, but I think I could give this to someone who isn't really intuitive with technology and they could use it pretty easily. I had barely any instructions and I was able to do it. I like how the rewards are fun, especially for younger kids. I like how parents have a different menu than the kids."

Table 2.

Participants' Suggest Age Ranges for MotoRobos (Post-Study)

Participants	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Reponses	4-8	3-7	3-10	7-12	5-11	4-7	4+	4+	3-6	1-4	4-8	4-10	5-7	4-7

Chapter 6: Redesign

After conducting the usability sessions, *MotoRobos* was redesigned in order to address the needs of users and to enhance the overall application experience. These new designs are based on observations and suggestions from the participants. After the first usability session, an account creation flow was designed and introduced for all other sessions (see Figure 19). The account creation form is limited to three fields. The third field is where the participant indicates the number of children that he/she has. Based off his/her entry, additional fields are displayed. In these new fields, the participant enters the child's name and designates a profile picture for the child. The first two participants suggested explaining the purpose of the application to users before they login for the first time (see Figure 20). They believed that this would make the concept of the application easier to understand. These screens were displayed immediately after the participant signed up for an account.

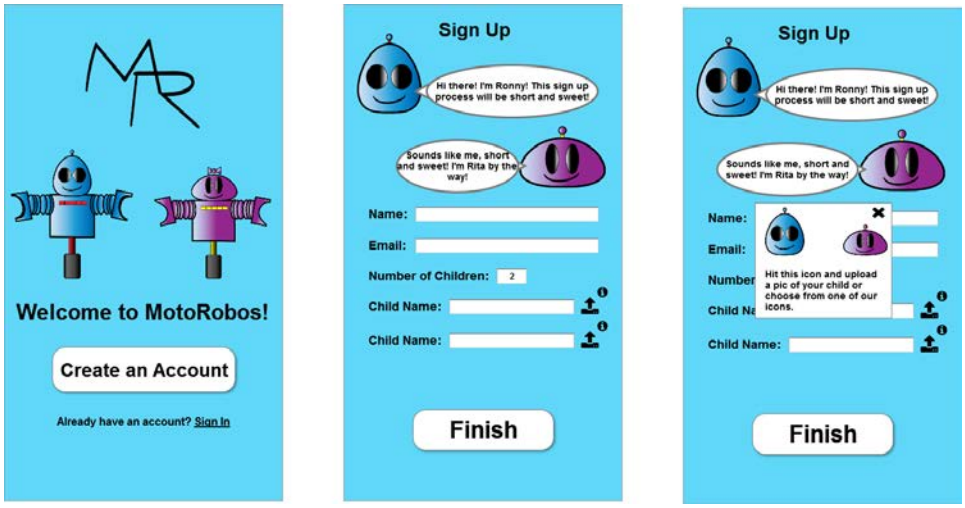

Figure 19. Account creation flow.

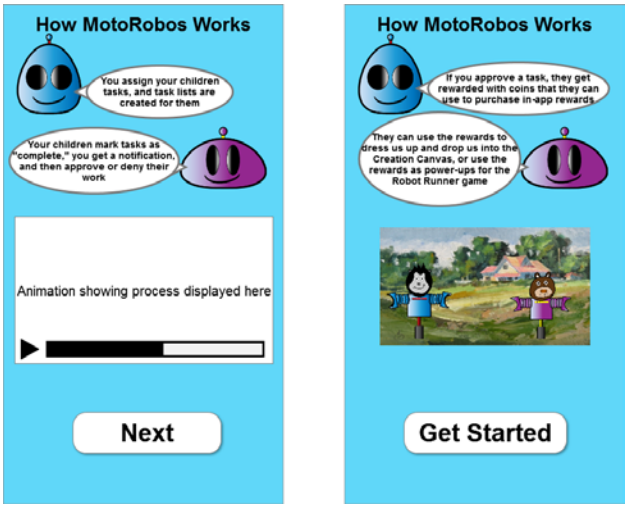

Figure 20. How *MotoRobos* Works.

Parent Side

Multiple changes were made to the Parent side of the application, which led to a new design of the Parent Main Screen (see Figure 21). Seven participants tried going to the menu to log out, so a logout feature was introduced to the menu (on both the Parent and Child side). The following features were redesigned: *New Tasks*, *Pending Approval*, *Painting Gallery*, and *Reward Gallery*. *Completed Tasks* and *Incomplete Tasks* were replaced by the following features: *Task Statistics* and *Calendar*.

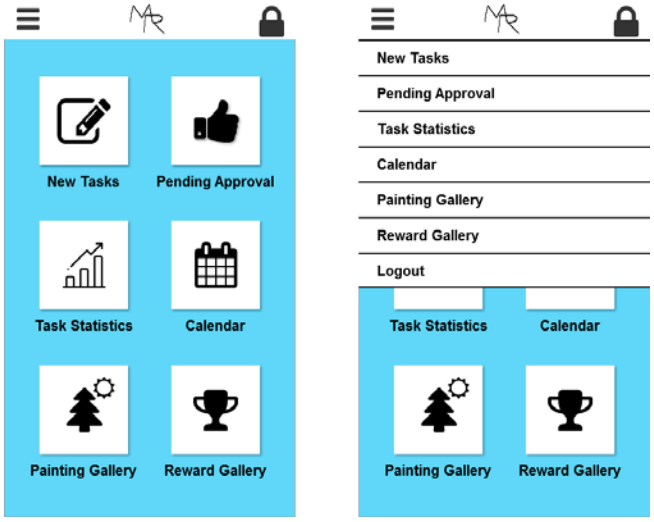

Figure 21. Parent Main Screen Final.

New Tasks was updated to make it easier for users to assign tasks (see Figure 22). Three participants confused the original label of "Name" for the child's name; it has now been changed to "Task." The reward system for *MotoRobos* was changed to a coin system where the children earn coins to pay for the application's internal rewards (the coin system is discussed more in the *Reward Gallery* section). A user can now specify the amount of coins his or her child will earn. The next section is for the description of the task. Originally, the user could only enter a text description. Now, the user can record a message so that the child can play it back, which should be helpful for children who are still learning how to read. Each task will now have an icon or a picture associated with it. Users can upload their own pictures or use one of the built-in icons. Three participants wanted the ability to indicate whether a task was daily, weekly, monthly, or occurs a single time. The user now has the ability to choose one of those options and specify the weekday or date it is due. Finally, a notification message was created to provide the user with a summary of the information that he/she entered.

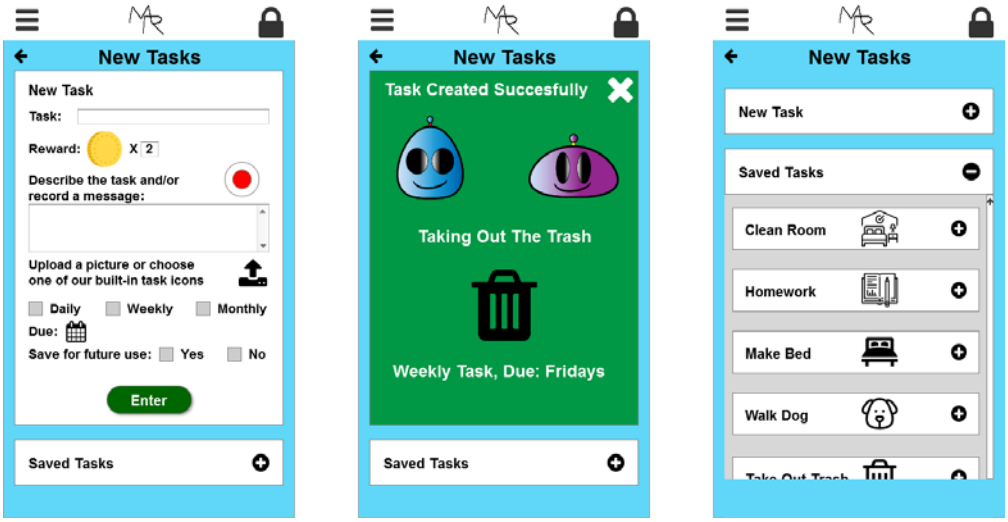

Figure 22. New Tasks Final.

Pending Approval was changed to make it more readable and to reflect the changes to the reward system and task creation. The user now sees icons for each task that he/she created. When the user expands the task, he/she sees the type of task it is (single, daily, weekly, monthly), the reward, and the ability to approve or deny the task.

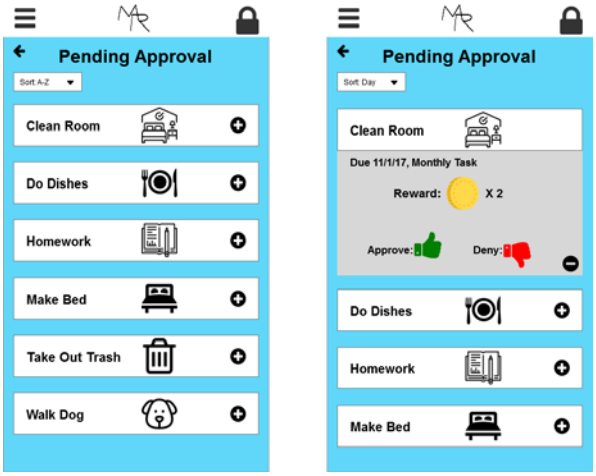

Figure 23. Pending Approval Final.

Task Statistics (see Figure 24) and *Calendar* (see Figure 25) replaced *Incomplete* and *Completed* tasks. The information provided to the user by both of those features could be rolled into one feature. *Task Statistics* provides the user with the ability to see a graph that shows him/her the success rate for a specific task and whether that task is currently in progress. Users can click "See All Details" to see the date the task was "complete" or "incomplete," as well as the reward for that task. 4 participants mentioned having a calendar to see a quick overview of tasks and the day they were due. The user can filter what appears on the calendar by tasks that are: in progress, complete, and/or incomplete. The user has 3 views for the calendar: month, 3 day, and 1 day. Each successive view provides the user with more details.

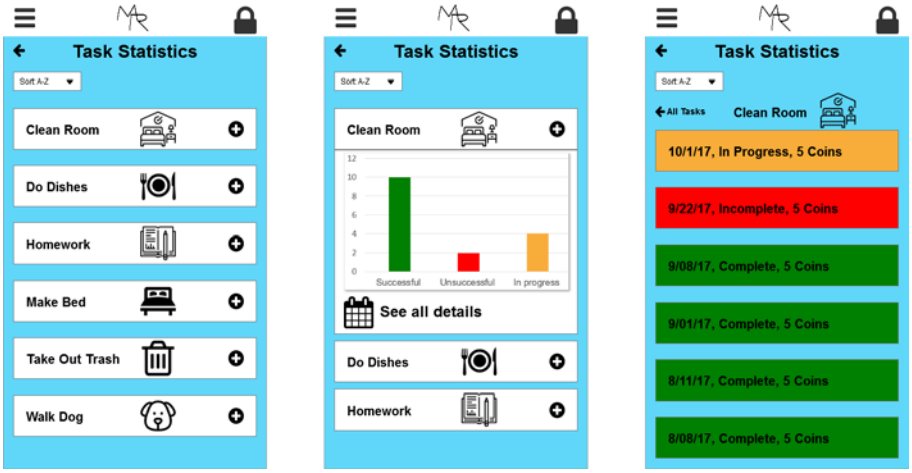

Figure 24. Task Statistics.

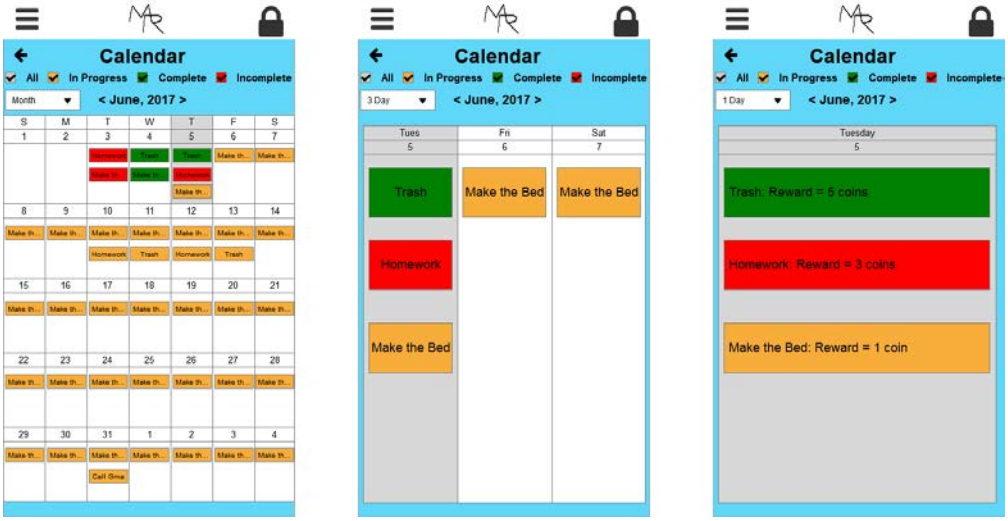

Figure 25. Calendar.

Painting Gallery has an additional feature where the user can add an emoji and message for the child for each painting (see Figure 26). *Reward Gallery* was changed to reflect the changes to the reward system (see Figure 27). Five participants mentioned using a point system so the child can choose his/her own reward. On the *Reward Gallery* landing screen, the user sees an image of each reward, the number of coins it costs, and whether or not it is locked. Once the user clicks on a reward, he/she will see what it looks like on the robots, if it is a costume or an outfit, as well as the power-up for the new game *Robot Runner* (explained in greater detail in the Child section).

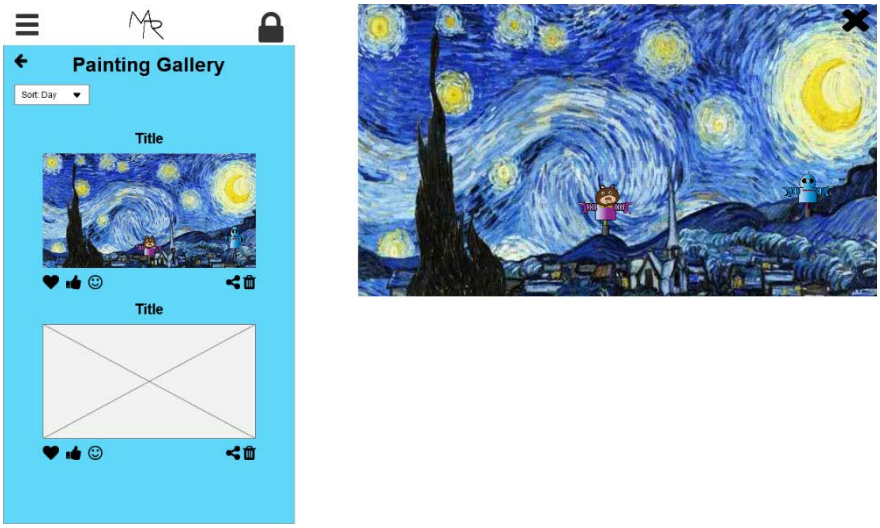

Figure 26. Painting Gallery (parent) Final.

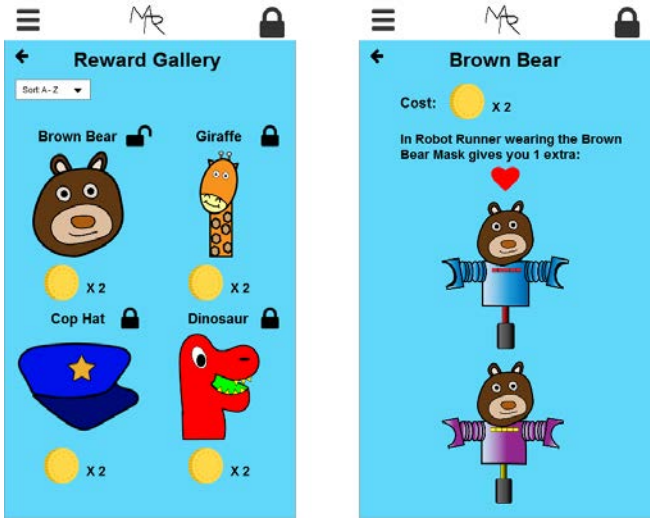

Figure 27. Reward Gallery (parent and child) Final.

Child Side

Multiple changes were made to the Child side of the application, which led to a new login flow (see Figure 28) and a new design of the Child Main Screen (see Figure 29). The child now has the ability to choose a picture password from a list while logging in. This should reassure a child that his/her siblings cannot get into his/her account. The Child Main Screen includes the robots as guides for the children. They talk the child through the application upon his/her first use. This should ease a child's acclamation to the application and assist younger children who have difficulty reading. The following features were redesigned: *Task List*, *Painting Gallery*, and *Reward Gallery*. Two new features were introduced: *Robot Runner* and *Lessons.*

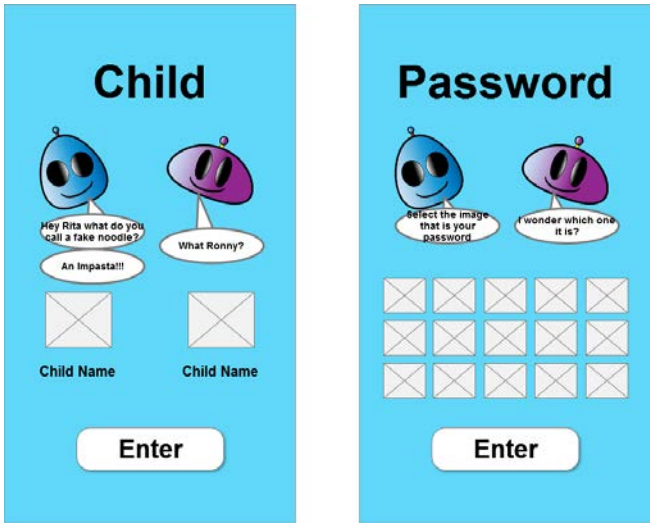

Figure 28. Child login flow final.

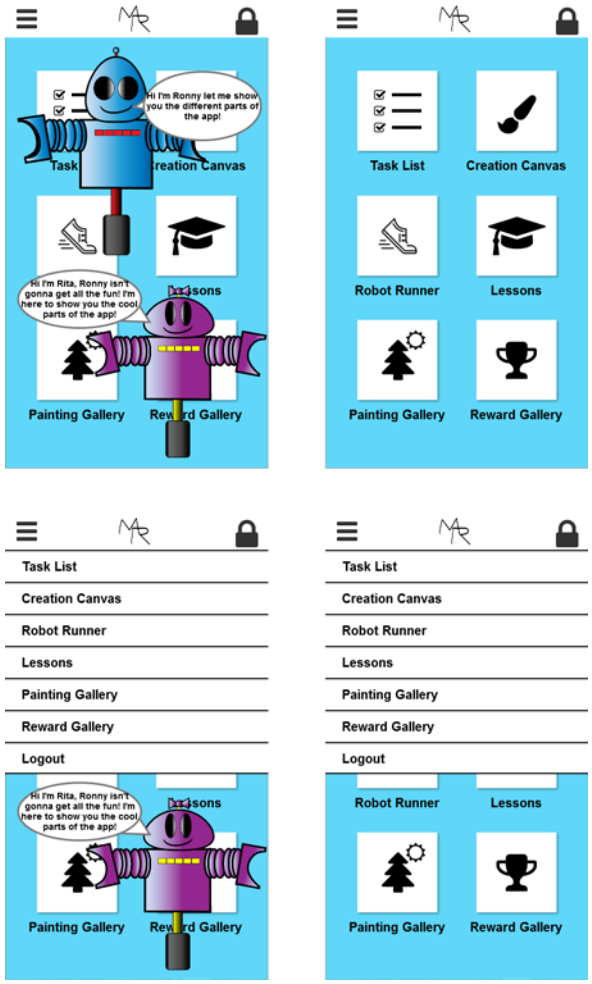

Figure 29. Child Main Screen Final.

Task List was changed in order to make it easier for the child to identify and understand the tasks (see Figure 30). Each task now has an icon or picture associated with it. The child can expand the task to see when it is due and how many coins it is worth. The child can also see the description and/or hear the voiceover description if his/her parent elected to add one. Five participants mentioned changing the feature so children can mark the task as "done" or "not done."

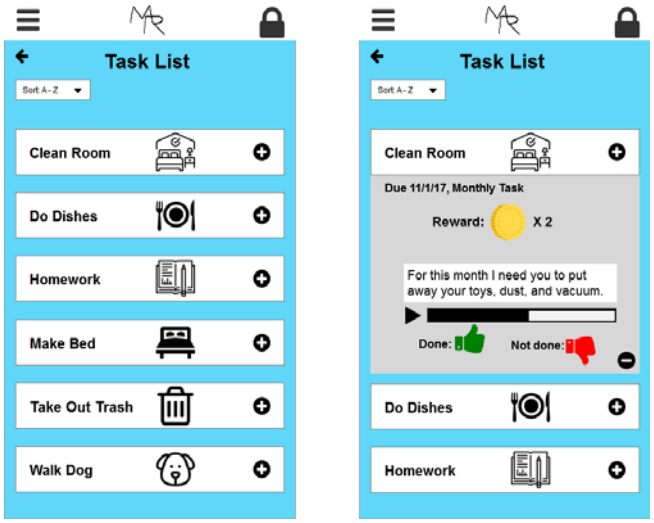

Figure 30. Task List Final.

Robot Runner is a new side-scrolling game where the child chooses a robot and progresses through levels while obtaining stars (see Figure 31). The child can use rewards as power-ups in the game. For example, the "Brown Bear" reward gives the robot an extra life. The child can pause his/her progress and come back later to play. Four participants mentioned including this feature for children who do not like drawing. This feature is designed to intrinsically motivate children to use the application. The rewards to make their character stronger will be the extrinsic motivators.

Figure 31. Robot Runner.

Lessons is a new feature where children will watch videos of the robots teaching them the values of doing tasks (see Figure 32). This feature is meant to transition the child from doing tasks for the sake of earning rewards to integrating the values of doing those tasks in his/her everyday life. Participants in the final session thought this feature would be valuable. It would help them teach their children the values of doing tasks in a fun and creative way. *Painting Gallery* was changed so that the child can see the messages his/her parent leaves him/her (see Figure 33).

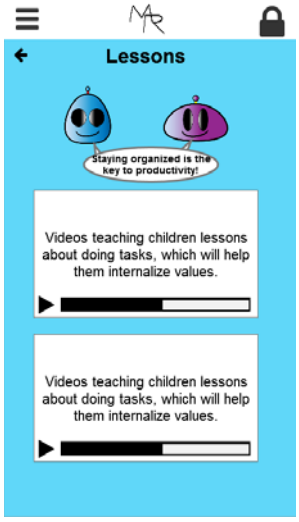

Figure 32. Lessons.

Figure 33. Painting Gallery (child) Final.

Chapter 7: Conclusion

MotoRobos is founded upon motivation theory. The name is short for motivation robots. The game concept was well-received by participants. Some quotes include:

- "I think this is awesome. I would love to use this with my kids."
- "I think it is really good for elementary school children. Very easy to use. It is a great starting point for children to start taking on responsibility."
- "I'm really impressed. I 100% would be on this. Kids these days don't have structure and this is structure. This allows them to be creative and allows them to use their minds."
- "I think this is great and from what I see today is a great start. Very simple and I would want to use it."
- "I like it, it's easy to use and everything was self-explanatory."

The *Robot Runner* game and *Creation Canvas* are the intrinsic motivators since children can use both features without completing a single task. The child can use the application for these two features exclusively if he/she pleases. The rewards from doing tasks serve as the extrinsic motivators. Children will continue to do tasks in order to enhance the experience of the activities that intrinsically motivate them (*Robot Runner* and *Creation Canvas*). The *Lessons* feature will teach the children the benefits of completing tasks. It will inspire values of productivity, organization, and perseverance. It will also increase children's senses of self-worth and promote a strong work ethic. Tasks become less of a "punishment" and more of an activity that a child knows he/she needs to do in order to be successful in life.

Ronny and Rita provide the application with a personality. They were designed with the baby face bias and golden ratio in mind. They interact with the child and will make him/her feel like he/she is interacting with a friend. They provide the application with visual contrast by popping up on-screen to give the children tips and to guide them. By engaging a user's emotions, the application will leave a lasting impression in his/her memory.

MotoRobos adheres to industry-accepted design principles. The application includes clear affordances. Users' perceptions of each function are close to the actual functions. The usability test supports the notion that the product's conceptual model matches the user's mental model. The final design provides the user with clear feedback. The application utilizes a minimalistic design and is intuitive. Users have the ability to create their own tasks and customize profiles. Icons, menus, and interaction are consistent throughout the application. The application is flexible, as indicated by the fact that users with little technical background had no problem interacting with the application. "I'm not technologically savvy, I hate technology, and this is easy to use," one participant stated. Upon first login, users are provided with a walk-through of the application, increasing the rate of success for users.

The final design minimizes the use of text for children and utilizes icons and pictures. The age range the application was designed for (4-8 years), mostly matched participants' expectations. To ensure a positive experience for children, buttons are large, the application is colorful, and sound is used appropriately. Future testing will utilize co-design and observation of children interacting with the application. This will optimize the experience for children. The application uses gamification in such a way that the coins enhance the intrinsic value of the application and are not the only form of rewards for children.

Some limitations of the study include: the application was only tested with parents, task scores could have been biased due to participants seeing other features in the application, and only a limited prototype was developed. Unfortunately, due to time restraints and internal policies, testing with children was not viable. For future tests, children will be included. Hopefully, co-design with children can be utilized as well. The sequence in which the participants went through the tasks could have taught them about features being tested in future tasks. This would have yielded more positive task scores. Finally, the participants only interacted with a limited prototype. Nothing was animated and the interactions were extremely basic. The application will be tested again when a full prototype is developed so participants can get the full experience.

If future designers are interested in creating an application like this, it is recommended that they test with their *whole* target audience as soon as possible. *MotoRobos* was intended for children and parents. Only getting to test with one of those populations puts the product at a disadvantage. If designers are creating something founded upon an abstract idea, such as motivation, including a short video for users upon first sign in, should clarify any questions the users might have. This will ensure a positive experience from the start.

Participants supported the claim that *MotoRobos* will motivate children to do tasks. It will allow children to be creative, in turn enhancing their imaginations and helping them to develop. Based off the findings from the usability tests, reviews of competitor applications, survey results from participants, and the application's adherence to design standards, *MotoRobos* should continue its path of development towards a final product.

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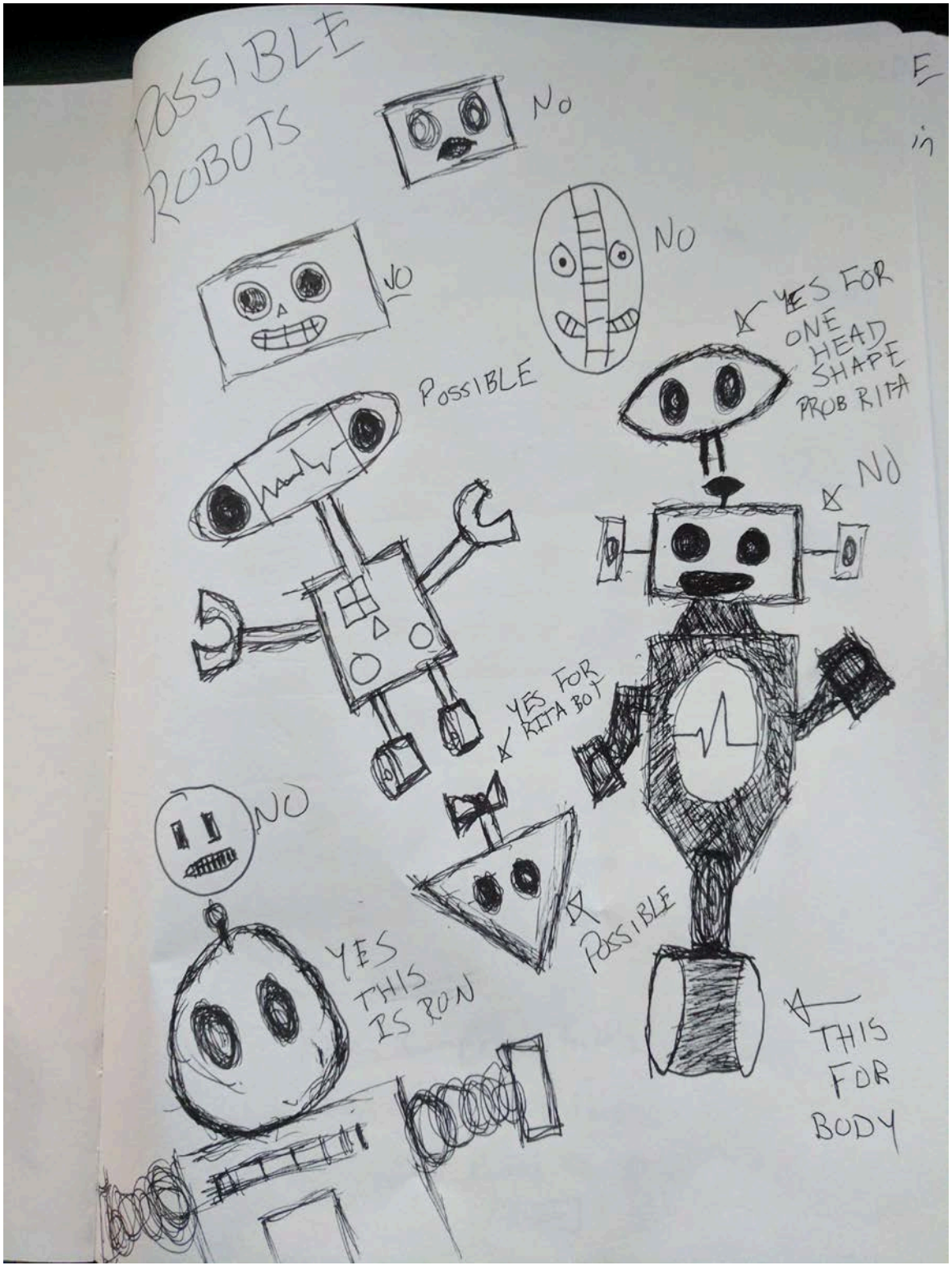
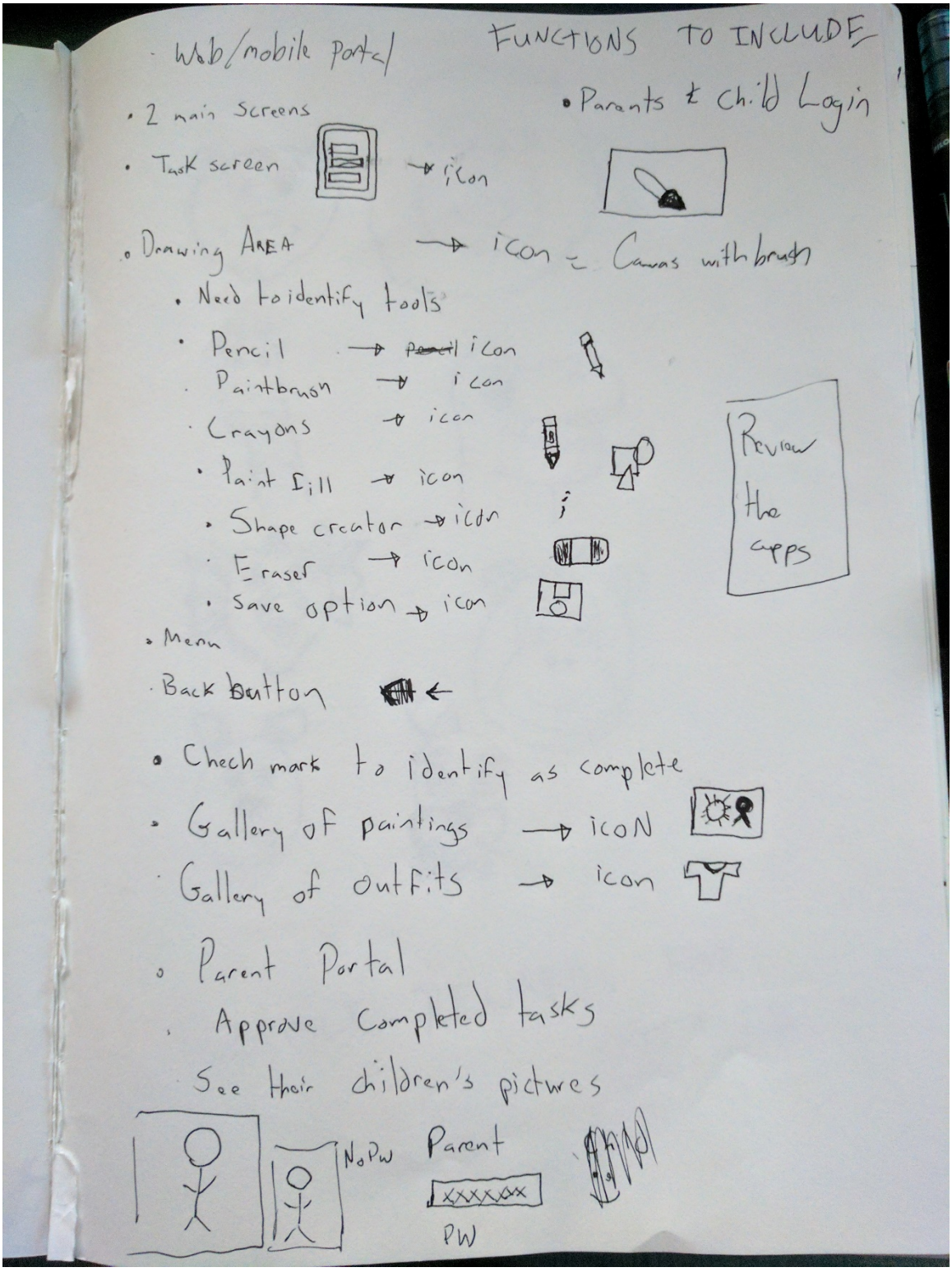
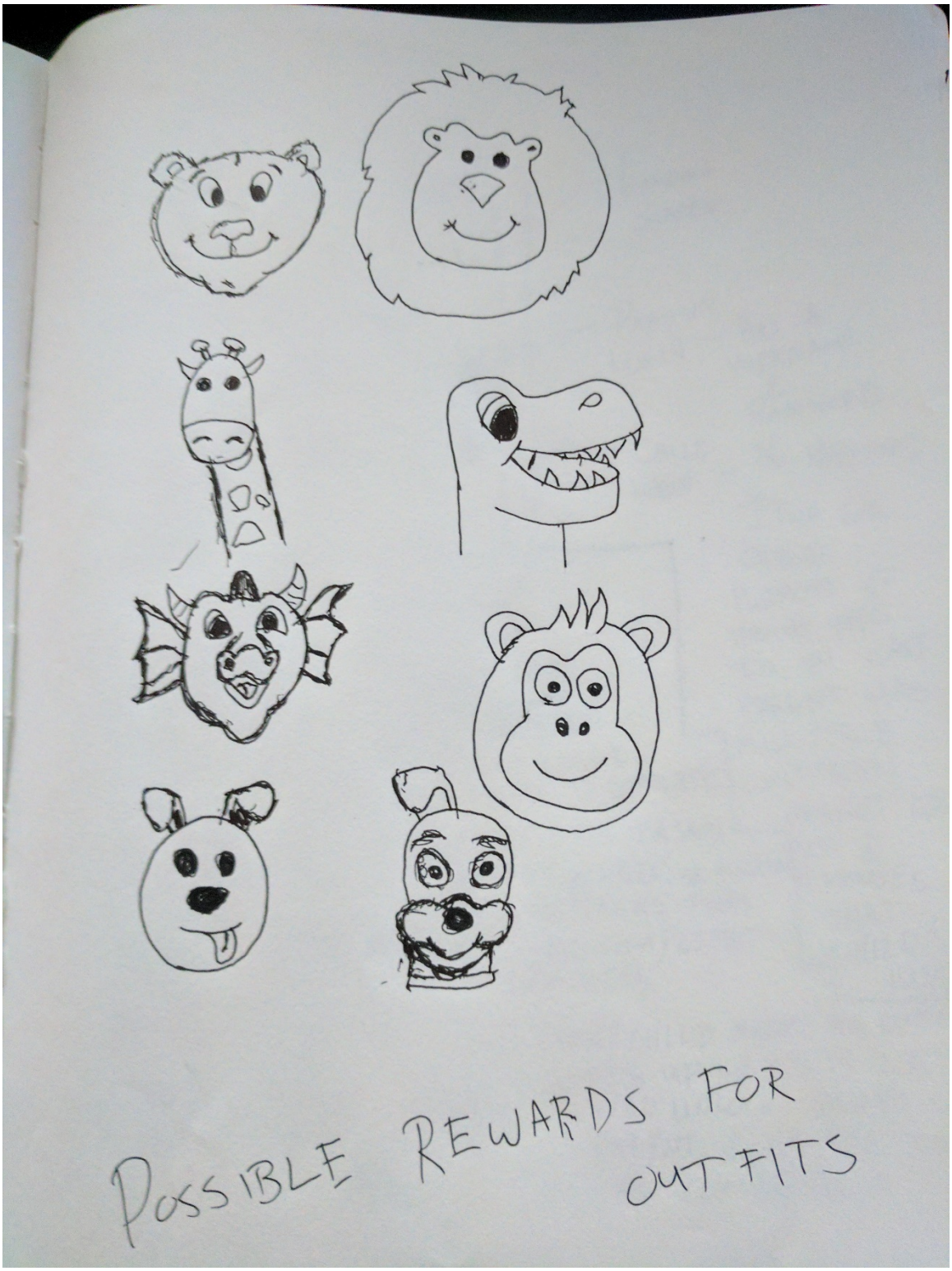
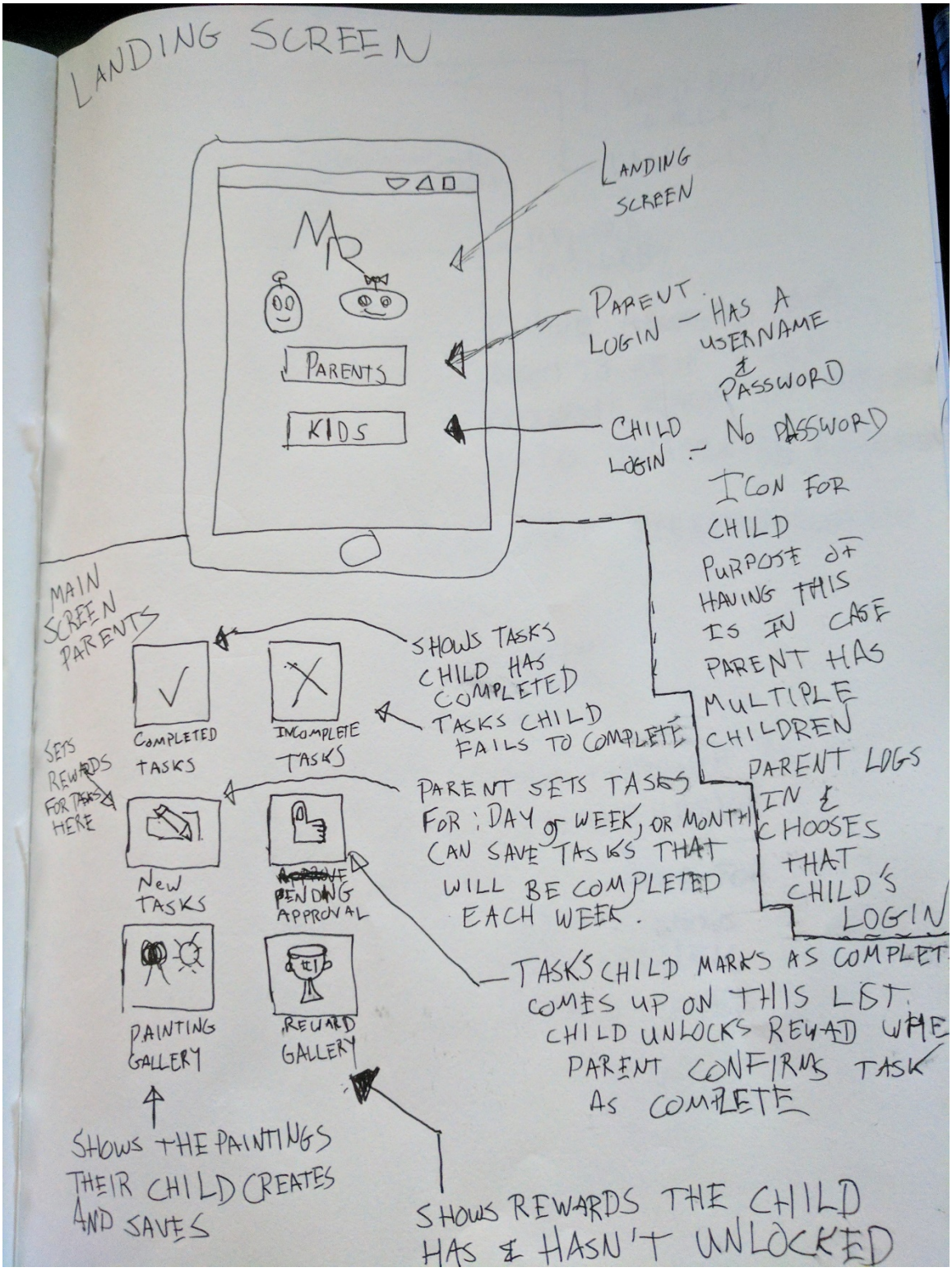
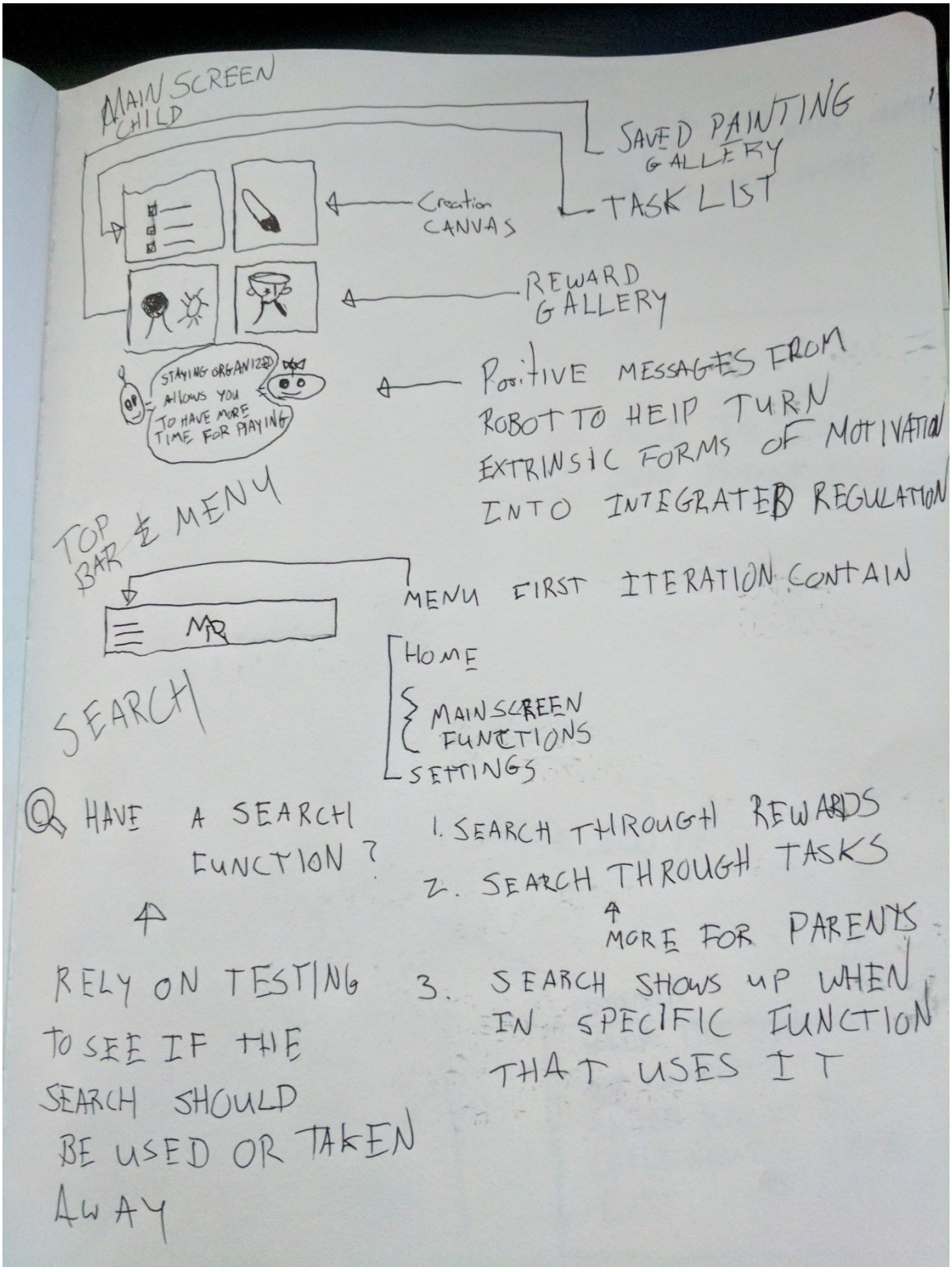
Appendix A: Sketches

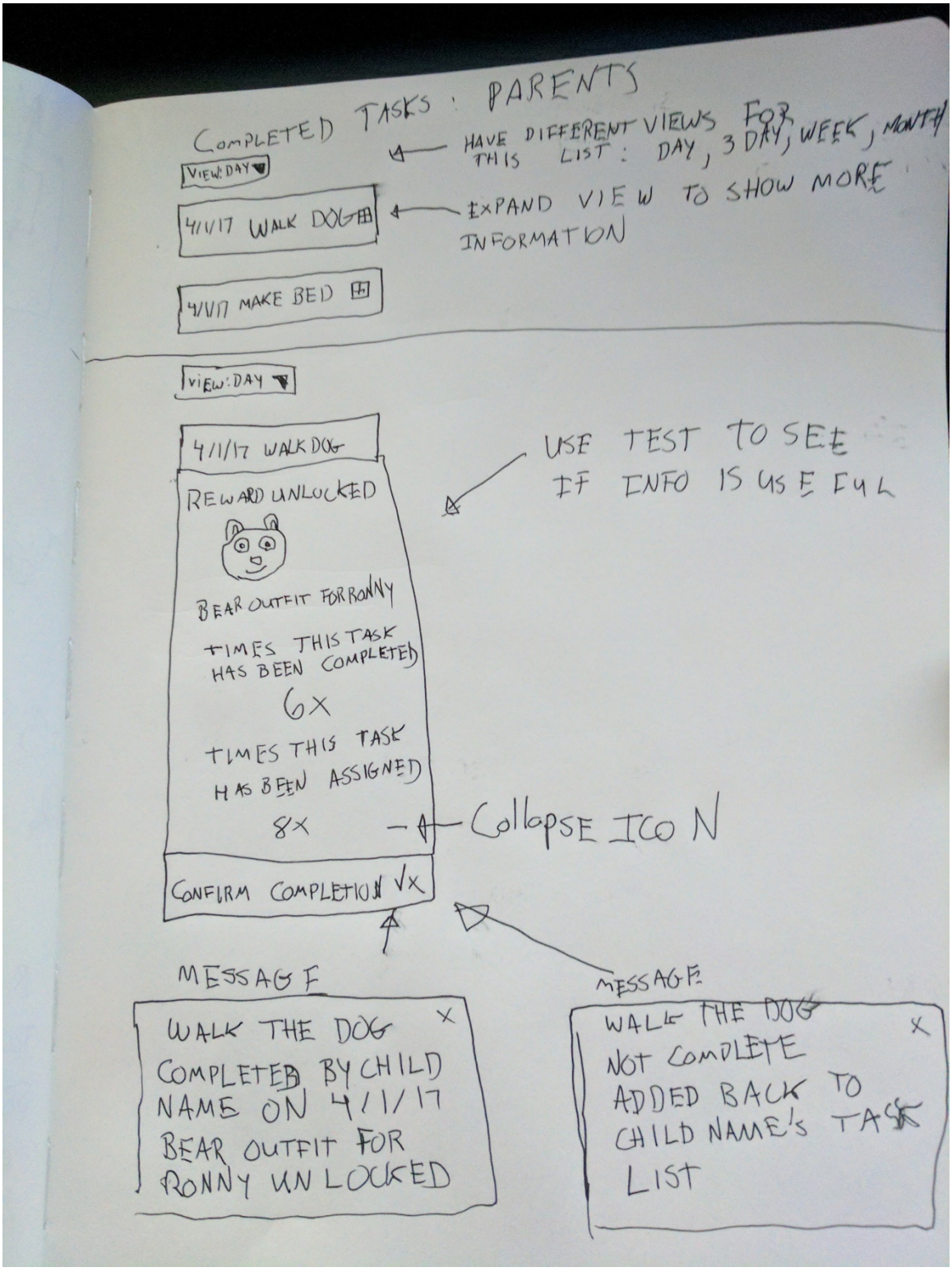


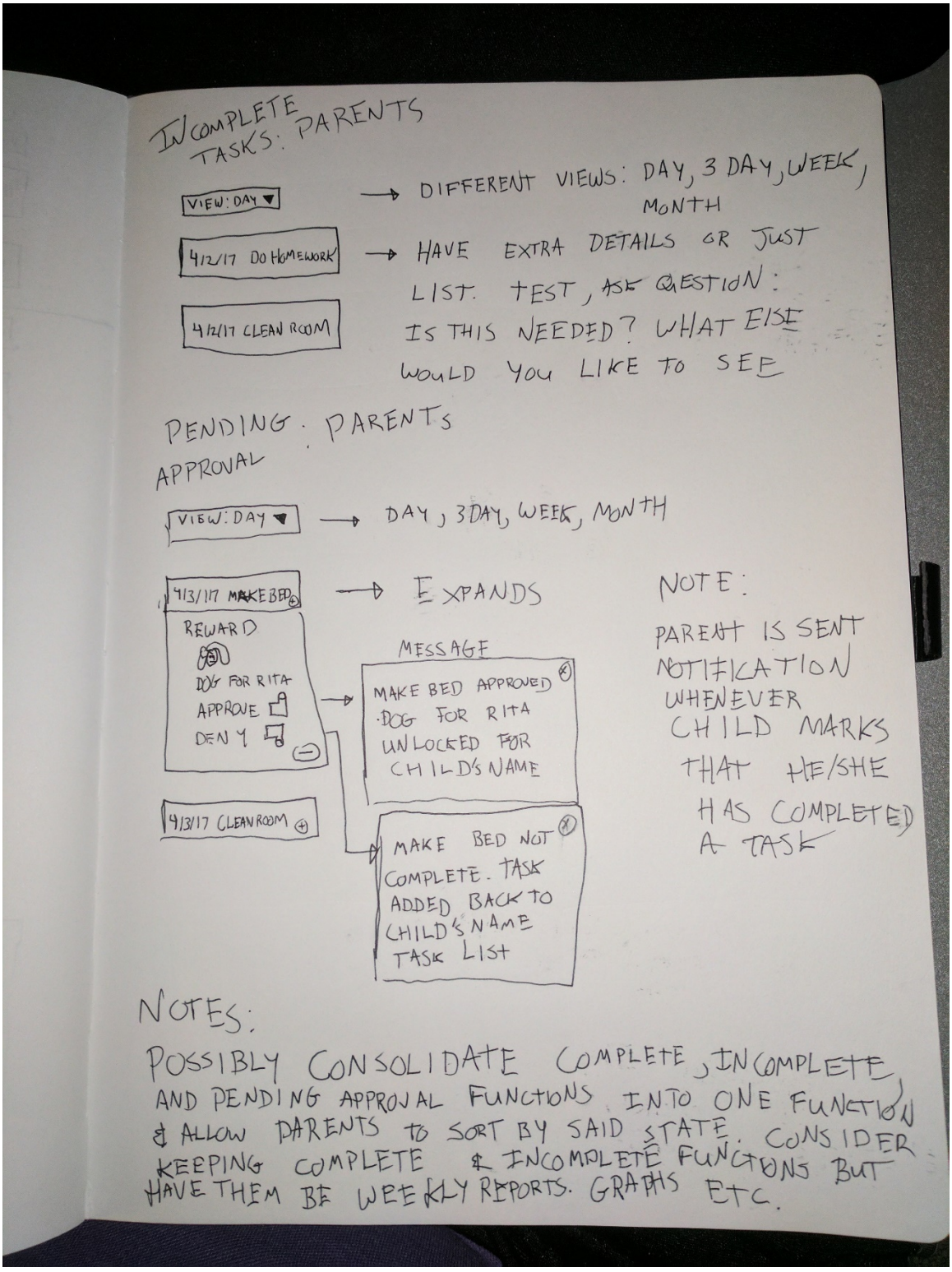


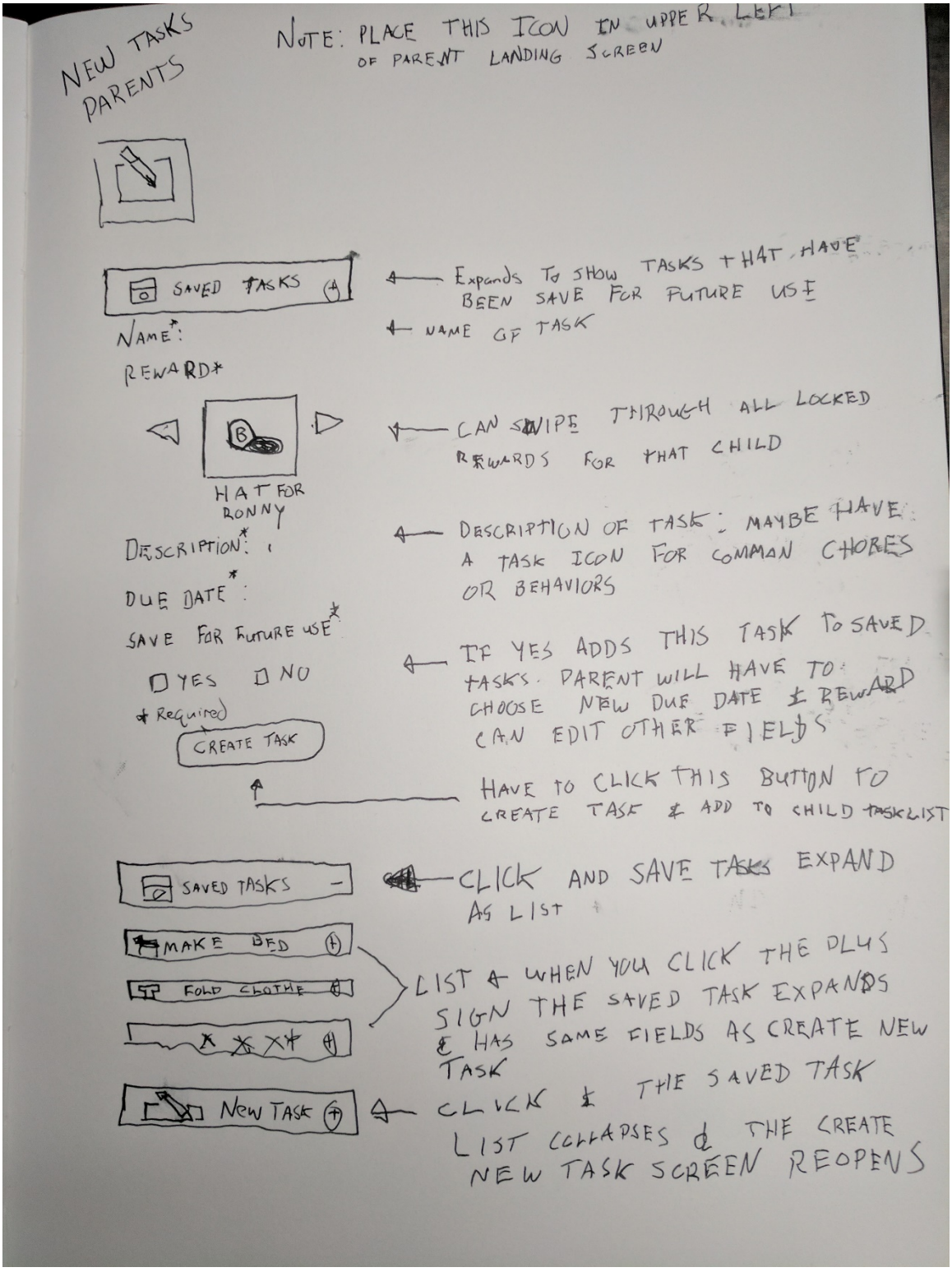


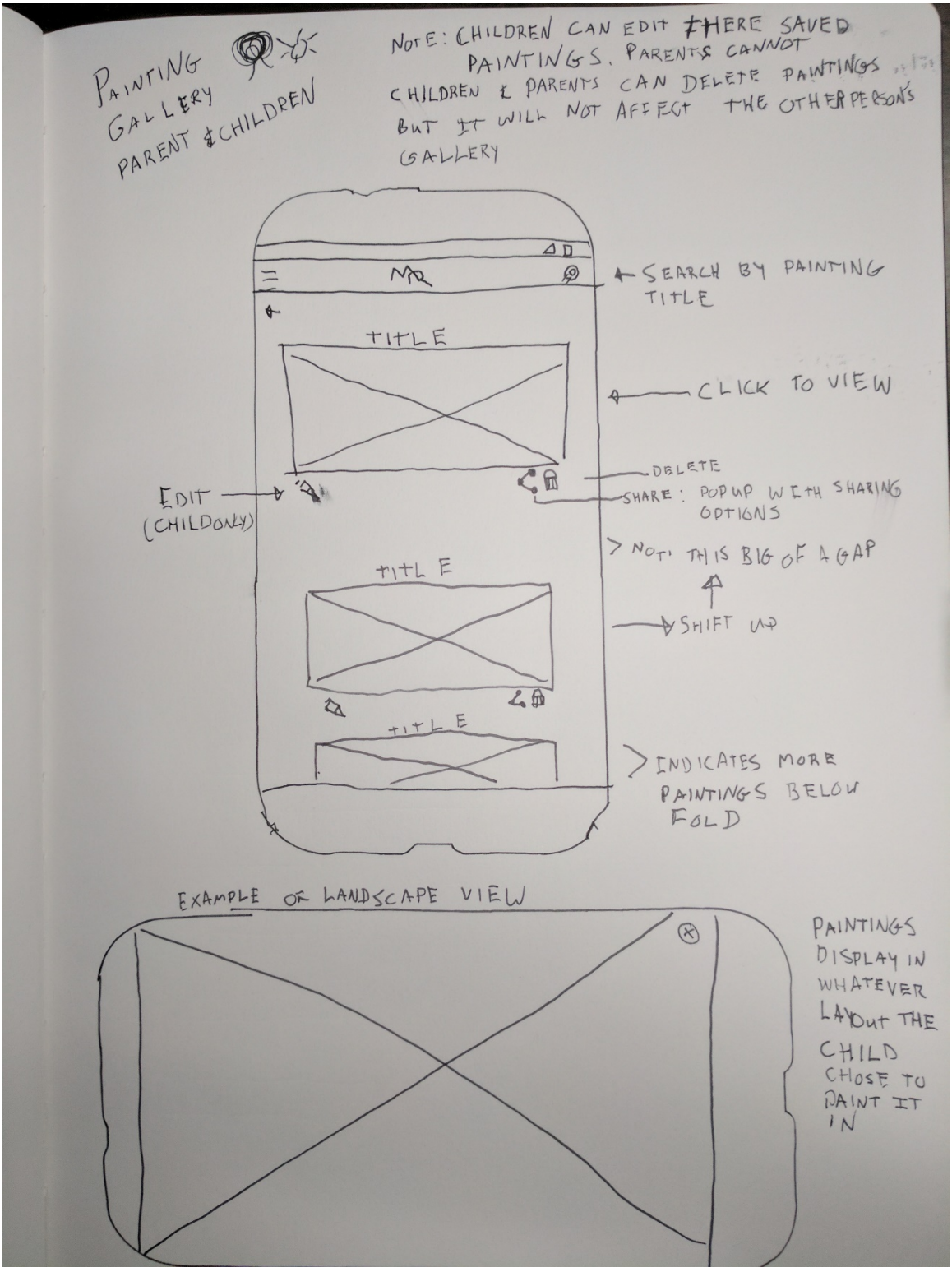


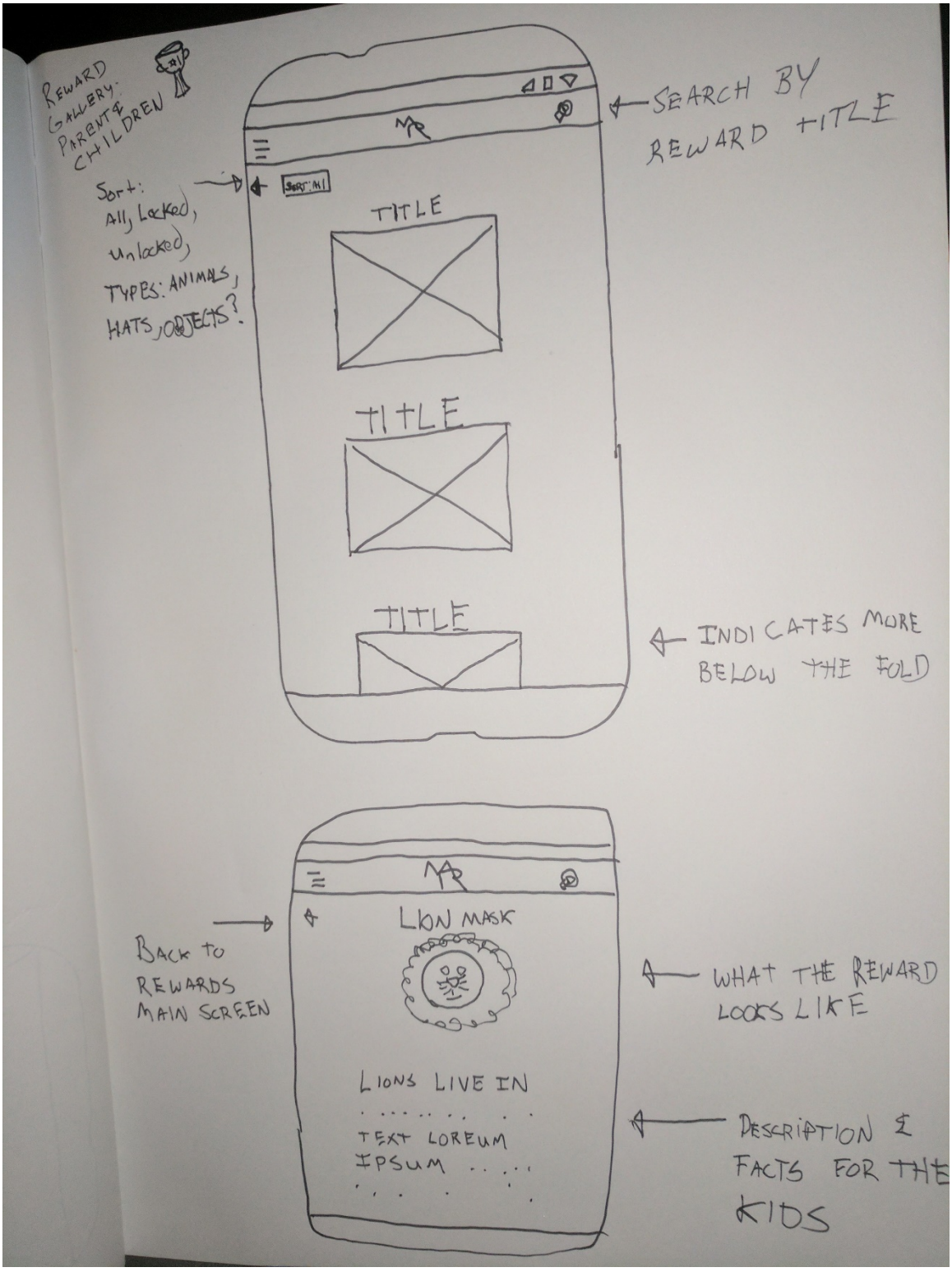


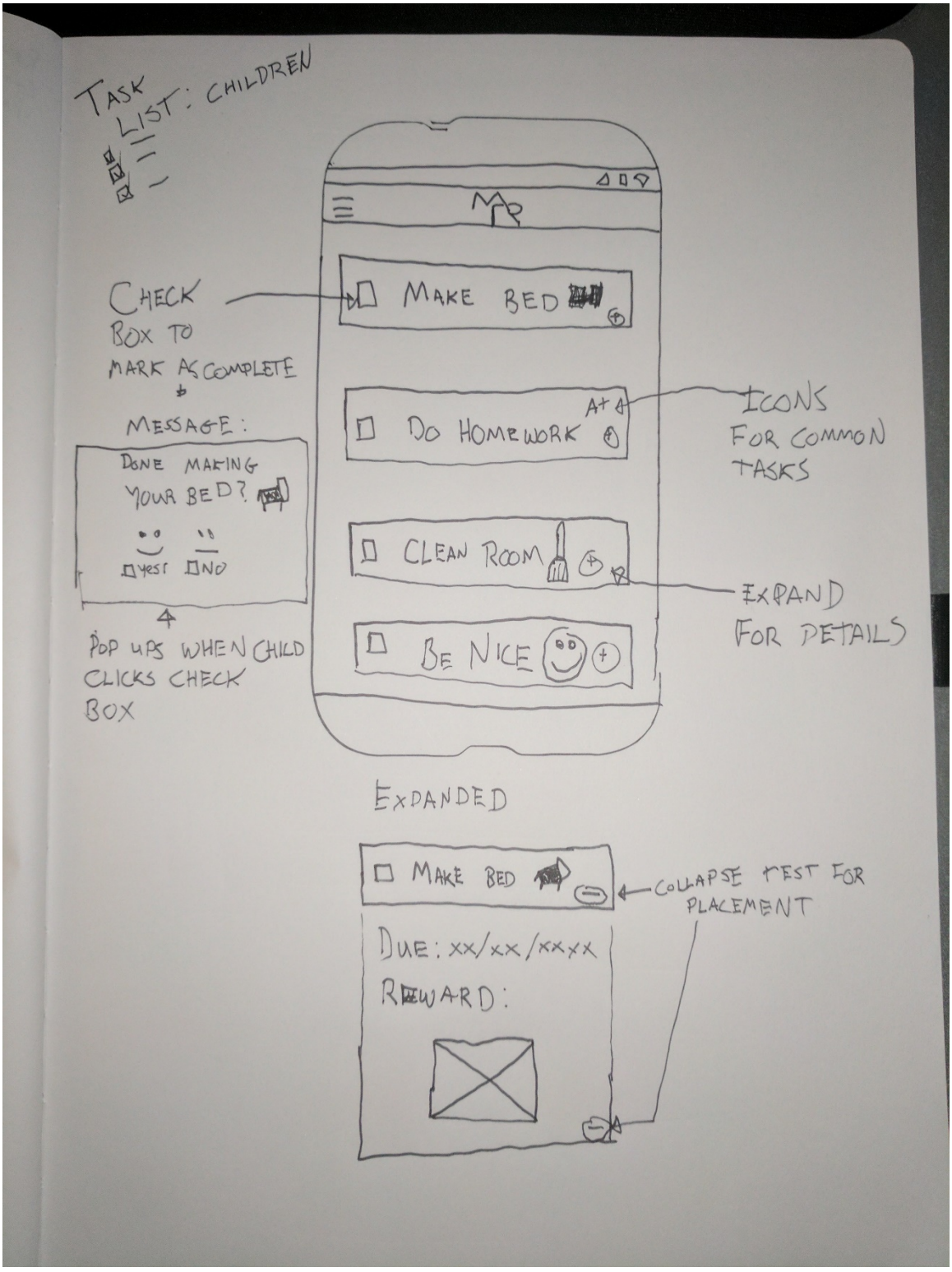


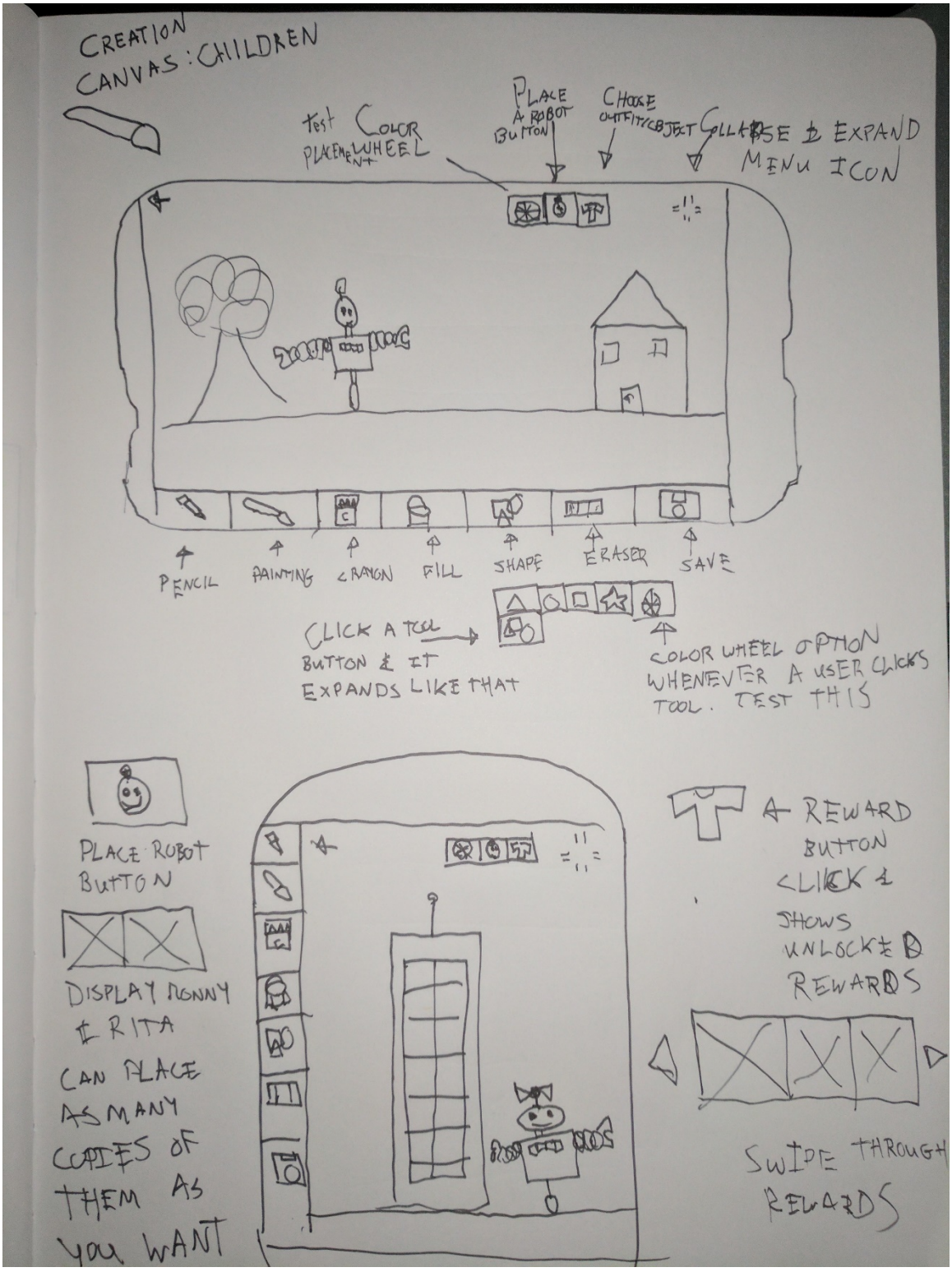












Appendix B: Moderator's Guide

Moderator's Guide for MotoRobos: Thesis Project

James Soldinger

Prototype and Tools

- Prototype is a clickable prototype developed with Adobe XD, screens were developed in Axure
- User will interact with the prototype on a Google Pixel first generation
- Phone will be connected to a computer and the phone screen will be streamed using *Vysor*
- Audio and video of the computer screen will be captured using *Camtasia*
- Audio will be recorded using a usb metal condenser recording microphone

Permission to Record

Thank you for participating in today's study to help me with my thesis project. As you read in the consent form, I'm going to record the session so that I can review it later for anything that I might have missed when I write my findings report. The recording includes the audio of our conversation and a video of the computer screen.

Please be assured that your name will not be associated with the recording or any data that I collect. To maintain your confidentiality, please avoid mentioning any specific names.

Do you have any questions about the consent form? Do I have your permission to start the recording? *(Moderator starts the recording after verbal permission.)*

Introduction

For this study, we're evaluating a prototype I have been developing for my thesis. I'd like you to look at these new designs and provide your feedback. The prototype is an application for parents/teachers and their children. The goal of the application is to help parents or teachers motivate their children to successfully complete tasks that are assigned them.

Today I will have you look at the prototype and complete some tasks. While doing these tasks I would like to get your feedback and any thoughts you have pertaining to the prototype.

During this session, I want you to be candid. You will not hurt my feelings. Please feel free to share anything that comes to mind, both negative and positive aspects of the new designs, such as something that works well and is clear or something that does not work or is confusing.

Today's session will take 60.

1. First, I will ask you some background information.
2. Then I'll ask you to interact with a prototype and get your feedback.
3. We'll finish with some wrap-up questions about your overall experience.

Do you have any questions before we continue?

Background Questions

1. Do or did you assign chores/tasks to your children?
2. How often would your children complete the tasks/chores assigned to them?
3. Did you do anything to motivate your children to complete said tasks?
4. What would you do if your children did not complete the task? Did they complete the task after you did this?
5. What are your thoughts on using an application to help motivate your children to complete tasks?
6. What would the application need to include for you to use it?
7. What do you think the age range of your children would need to be to utilize a mobile application and to be successful?
8. What are benefits of your child completing tasks you assign them? Is there anything they can learn from doing it? If yes can you give me some examples of tasks and what you think it teaches them?

Instructions

Before I show you the new designs, I have a few more things to go over with you:

Limited Prototype. Please note that what you're going to see is a prototype with limited interactivity or clickability, not a complete application. These images/screens are still work-in-progress, but they illustrate some design ideas.

Feedback. Please look at these screens and tell me your expectations, your thoughts of the language, content, and any suggestions you have to improve these new features. Also, I'd like to know what you would do from each screen, if the images were interactive.

Note: all tasks but the login task will be randomized

Parent Experience Tasks

Scenario

Your friend told you about an application she started using with her children to motivate them to do their chores and behave. She said it is called MotoRobos. She tells you the application uses two robots named Ronny and Rita to motivate the child.

Task: So you decide to download it and sign up for an account. You open the app and see this. What would you do?

Scenario part 2: After signing up for the account and creating profiles for each one of your children you go to login.

Task 1 - Login

For now you are concerned with the parent side of the application. How would you access the parent side of the application?

Path: Parent option > User name and password, enter > Choose child, enter > Parent main screen

Probe:

- What do you think of that login experience?
- Is there anything you would change? Add/take away?
- On parent main screen: Can you tell me where you are now and what you think you can do from here?

Task 2 - New Tasks

A. You want to assign a chore to your child, how would you do that?

Path: Parent main screen > New Tasks > Name the task > Choose a reward > Add a description > Assign due date > Decide if the task should be saved for future use > Press enter

Probe:

- What do you think of this experience?
- Is there other information you would want to enter pertaining to the task?
- Is there anything you would change? Add/take away?
- What would you expect to happen after pressing enter?
    - Notification that the task has been successfully added?

B. You have been using this application for a while and you want to assign a task to your child that they have done before, what would you do?

Path: New task screen > Saved tasks > Add a task with the plus sign

Probe:

- What would expect to see when you clicked the plus sign on one of the tasks?
    - Description saved and name?
    - Ability to add a different reward?
    - Ability to assign a due date?
- What do you think of presenting the saved tasks this way?

Task 3 - Pending Approval

Your child just came to you and said she finished making her bed and wants her reward so she can put it in her new painting. How would you give her the reward?

Path: Parent main screen > Pending Approval > Expand Make Bed > Thumbs Up

Probe:

- What do you think of this experience?
- Is there anything else you would want to do from this screen?
- Is there anything you would change? Add/take away?
- What would you expect to happen after pressing the thumbs up/down?

Task 4 - Completed Tasks

You want to see your child's progress on tasks that she has finished successfully? What would you do?

Path: Parent main screen > Completed Tasks

Probe:

- What information would you expect to be contained within Make Bed?

Task 5 - Incomplete Tasks

Your child hasn't made her bed again and you want to see how often this occurs, what would you do?

Path: Parent main screen > Incomplete Tasks > Expand Make Bed

Probe:

- Is this the information you would expect in this section?
- Would you prefer to see any other data?
- Is this section necessary?

Task 6 - Painting Gallery

Your child calls you on the phone and says she has finished a new piece of art and asks if you can look at it, what would you do?

Path: Parent main screen > Painting Gallery > click painting

Probe:

- Would expect to see anything else on this page?
- What can you do on this page?
- Do you think you should be able to do anything else on this page?

Task 7 - Reward Gallery

You want to see what prizes are available for your child? Where would you go to check?

Path: Parent main screen > Reward Gallery

Probe:

- What do you think you can do from this page?
- Would you add or take anything away?
- What do you think of this concept of rewards?

Task 8 - Logout

You are done with the app for the day. What would you do?

Path: Log out

Child Experience Tasks

Task 1 - Login

Let's say you are your child and you want to login to your account how would you do that?

Path: Child option > Choose child, enter > Child main screen

Probe:

- What do you think of that login experience?
- Is there anything you would change? Add/take away?
- On child main screen: Can you tell me where you are now and what you think you can do from here?

Task 2 - Task List

Your mom said she assigned you a new chore to make your bed. You are excited because you will be able to get a new reward so you go to look at the task to try and see what your new reward will be. How would you do that?

Path: Child main screen > Task list >Expand make bed

Probe:

- What can you do once you expand?
- Should there be more information here?
- What would you add?
- What would you take away?
- Describe the screen

Task 3 - Creation Canvas

Now you want to draw a picture with shapes and the robots wearing cop hats. How would you do this?

Path: Child main screen > Creation Canvas > Shapes icon > Robot icon > Reward icon

Probe:

- Can you tell me what you think each icon is?
    - Is there any way to remove the icons from this screen?
    - How would you get to the child main screen from here?
- Do you think a child would find this feature entertaining? Why?
- Would a child use this app just because of this feature? Why?
- Would you add or take anything away from this feature?

Task 4 - Painting Gallery

You want to look at one of your pieces of artwork, where would you do that?

Path: Child main screen > Painting Gallery > click painting

Probe:

- Would expect to see anything else on this page?
- What can you do on this page?
- Compared to the Parent Painting Gallery is there anything different?
- Do you think you should be able to do anything else on this page?

Task 5 - Reward Gallery

You want to see what prizes you can earn by doing the chores your parents set for you, where would you go

Path: Child main screen > Reward Gallery

Probe:

- Compared to the parent screen should this screen be changed in any way for children?

Debriefing Questions

Survey

1. How would you rate the understandability of the content of these screens ? Please use a scale of 1 to 10, with 1 being "not at all understandable" and 10 being "extremely understandable." (Answer: _____)

2. Pretend you have a choice between using this application and another one. Based on the screens that you saw today, how likely is it that you would recommend this application to a friend or colleague, using a scale of 1 to 10, with 1 being "not at all likely" and 10 being "extremely likely"? (Answer: _____)
Now, I have a few additional questions about your overall experience.

Additional Questions

1. What are some features similar to a creation canvas that you think would belong in this app?
2. Do you think this application would benefit from a web based platform?
3. Would this motivate children to do tasks? Why?
4. Could this application be used by teachers?
    a. For assignments?
    b. Behavior?
5. Age range?
6. Would you pay to use an application like this?
    a. Subscription
    b. One-time fee
    c. In-app purchases to unlock more rewards for your child
    d. Would you use this app if there were ads
7. How long do you think a child would use this before getting bored?
    a. Can anything be changed to ensure prolonged use?
8. What was your overall impression of this application?
9. Do you have any additional feedback?

Appendix C: Tasks

Parent Tasks:

1. Account Creation - So you decide to download it and sign up for an account. You open the app and see this. What would you do?
2. Task 1: Login - For now you are concerned with the parent side of the application. How would you access the parent side of the application?
3. Task 2: New Tasks - You want to assign a chore to your child, how would you do that?
4. Task 2b: Saved Tasks - You have been using this application for a while and you want to assign a task to your child that they have done before, what would you do?
5. Task 3: Pending Approval - Your child just came to you and said she finished making her bed and wants her reward so she can put it in her new painting. How would you give her the reward?
6. Task 4: Completed Tasks - You want to see your child's progress on tasks that she has finished successfully? What would you do?
7. Task 5: Incomplete Tasks - Your child hasn't made her bed again and you want to see how often this occurs, what would you do?
8. Task 6: Painting Gallery - Your child calls you on the phone and says she has finished a new piece of art and asks if you can look at it, what would you do?
9. Task 7: Reward Gallery - You want to see what prizes are available for your child? Where would you go to check?
10. Task 8: Logout - You are done with the app for the day. What would you do?

Child Tasks:

1. Task 1: Login - Let's say you are your child and you want to login to your account how would you do that?
2. Task 2: Task List - Your mom said she assigned you a new chore to make your bed. You are excited because you will be able to get a new reward so you go to look at the task to try and see what your new reward will be. How would you do that?

3. Task 3: Creation Canvas - Now you want to draw a picture with shapes and the robots wearing cop hats. How would you do this?
4. Task 4: Painting Gallery - You want to look at one of your pieces of artwork, where would you do that?
5. Task 5: Reward Gallery - You want to see what prizes you can earn by doing the chores your parents set for you, where would you go?

Appendix D: Survey

1. Understandability - How would you rate the understandability of the content of these screens? Please use a scale of 1 to 10, with 1 being “not at all understandable” and 10 being “extremely understandable.” (Answer: _____)

2. Net Promoter Score - Pretend you have a choice between using this application and another one. Based on the screens that you saw today, how likely is it that you would recommend this application to a friend or colleague, using a scale of 1 to 10, with 1 being “not at all likely” and 10 being “extremely likely”? (Answer: _____)

Appendix E: Consent Form

Whom to Contact about this study:

Principal Investigator: James Soldinger
Advisor: Greg Walsh
Department: Interaction Design and Information Architecture
Telephone number: (443)632-5373

CONSENT FORM FOR PARTICIPATION IN RESEARCH ACTIVITIES

MotoRobos: an application designed to motivate children utilizing motivation theory, emotion theory, and UX best practices.

I. INTRODUCTION/PURPOSE:

I am being asked to participate in a research study. The purpose of this study is to test mobile applications that focus on completing chores or tasks. I am being asked to volunteer because I am a parent and or teacher. My involvement in this study will begin when I agree to participate. About 20 people will be invited to participate.

II. PROCEDURES:

As a participant in this study, I will be asked to use a mobile application and give feedback on it. I will be asked to come to a location of my choosing where the principal investigator will meet me to interview. My participation in this study will last for 1 session and video will be taken of each session. None of my personal information will be on the video. I understand that my name will not be associated with the study in any way and the videos are to be reviewed by the investigator only.

III. RISKS AND BENEFITS:

My participation in this study does not involve any significant risks and I have been informed that my participation in this research will not benefit me personally, but give insight into the benefits of mobile applications that focus on completing chores or tasks.

IV. CONFIDENTIALITY:

Any information learned and collected from this study in which I might be identified will remain confidential and will be disclosed ONLY if I give permission. All information collected in this study will be stored in a locked file cabinet in a locked room. Only the investigator and members of the research team will have access to these records. If information learned from this study is published, I will not be identified by name. By signing this form, however, I allow the research study investigator to make my records available to the University of Baltimore Institutional Review Board (IRB) and regulatory agencies as required to do so by law.

Consenting to participate in this research also indicates my agreement that all information collected from me individually may be used by current and future researchers in such a fashion that my personal identity will be protected. Such use will include sharing anonymous information with other researchers for checking the accuracy of study findings and for future approved research that has the potential for improving human knowledge.

Include if necessary:

Check if images or video are recorded during the research study:

☐ Yes, I give permission to use my image in scientific publications or presentations.

☐ No, I do not give permission to use my image in scientific publications or presentations

Check if voice recordings are used during the research study:

☐ Yes, I give permission to use my voice in scientific publications or presentations.

☐ No, I do not give permission to use my voice in scientific publications or presentations

V. COMPENSATION/COSTS:

My participation in this study will involve no cost to me.

VI. CONTACTS AND QUESTIONS:

The principal investigator(s), James Soldinger has offered to and has answered any and all questions regarding my participation in this research study. If I have any further questions, I can contact James Soldinger at (443)632-5373 or jsoldinger31@gmail.com. You can also contact his advisor Greg Walsh at gwalsh@ubalt.edu.

For questions about rights as a participant in this research study, contact the UB IRB Coordinator: 410-837-6199, irb@ubalt.edu.

VII. VOLUNTARY PARTICIPATION

I have been informed that my participation in this research study is voluntary and that I am free to withdraw or discontinue participation at any time.

I will be given a copy of this consent form to keep.

VIII. SIGNATURE FOR CONSENT

The above-named investigator has answered my questions and I agree to be a research participant in this study. By signing this consent form, I am acknowledging that I am at least 18 years of age.

Participant's Name: _____ Date: _____

Participant's Signature: _____ Date: _____

Investigator's Signature: _____ Date:_____