

NOVEL GAME-BASED-LEARNING APPROACH IN TEACHING SELF-
REGULATION STRATEGIES TO CHILDREN

A Thesis

by

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ABSTRACT

Exploration of research linked to game-based-learning has suggested evidence that this approach may be suitable in encouraging children to learn about self-regulation or self-control. During early childhood, it is especially important for children to learn how to manage their self-regulatory processes and emotions for decision-making, problem-solving, and academic achievement. The ability to self-regulate emotions predicts positive outcomes of academic success, social competence amongst peers, and decrease in negative behaviors. This research aims to investigate the idea of digital game-based-learning as an effective approach to teach children ages 5-7 years how to learn about regulating their emotions.

DEDICATION

This is dedicated to my beautiful family, the love of my life - Eli Manley, and my Lord and Savior Jesus Christ for guiding me along my journey.

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1. INTRODUCTION & OBJECTIVE

1.1 Introduction:

As parents and educators, there is understandable concern to worry about how children may develop or function as they mature and transcend into grade school with emphasis on mental health and academic achievement. For instance, the transition into primary school is a pivotal point for young children that bring forthcoming challenges such as concentration skills, new teachings, and a greater degree of autonomy (Voisin et al., 2019).

Centers for Disease Control and Prevention define mental disorders as “serious changes in the ways children typically learn, behave, or handle their emotions” (“Key Findings: Child Mental Health Report,” 2019). In particular, mental disorders in childhood can negatively affect a child’s healthy development in ways that interfere with social, emotional, cognitive, and academic milestones (Ghandour et al., 2019).

Approximately, 1/2 of mental health disorders begin during childhood and adolescence (Kazdin, 2019), whereas many children experience mental disorders that make it difficult to achieve a healthy development, as well as social and emotional well-being (Andres, Schwartz, & Waddell, 2018).

Parents and educators want the best for their children, for them to ultimately be successful in not only academics but also in their social and personal lives (Payton et al., 2000). Such achievements may involve but are not limited to: taking the perspective of others, controlling impulsive behaviors, and learning how to react to certain situations in order to solve problems. To do this, it is important for children to learn how to apply

certain mental tools to help achieve these goals (e.g. self-regulation and executive functioning skills). This may also be characterized as social and emotional learning (SEL) skills which help preschool children manage their feelings, focus on attention, reduce problem behaviors, and learn how to effectively deal with personal and social challenges (Crowley, Greenberg, & Jones , 2015; Greenberg et al., 2017; Schonert-Reichl, 2017).

Emotional self-regulation is an important fundamental factor that influences a child's academic functioning and general development in which it allows one to control thoughts, behaviors, and emotions (Voisin et al., 2019). The ability to control or inhibit thought processes and actions develops rapidly during the preschool years (Carlson & Wang, 2007). Children that struggle with their self-regulatory processes may lack the ability to control their emotions and feelings which may result in aggressive behaviors (Dee Ray & Wilson, 2018). A child's ability to self-regulate or to have control of their emotions helps to decrease aggressive behavior during elementary school years (Cote, Gyurak & Levenson, 2010; Graziano et al., 2007; Keenan & Shaw, 1998).

1.2 Motivation and Objective:

Self-regulation is crucial to a child's academic success as well as school readiness during early childhood (Artelt, Edossa, Schroeders & Weinert, 2018; Blair & Diamond, 2008; McClelland, Messersmith, Ponitz & Tominey, 2010). It is important for young children to be able to regulate both their emotions and cognitions so that they may be prepared for formal instruction (Gagne & Nwadinobi, 2018). A child's ability to self-

regulate is also associated with positive outcomes and prosocial behaviors including high academic achievement.

Children who are able to regulate emotions are more likely to have greater social competence, as well as social skills, positive classroom behavior, and popularity amongst peers (Cameron & McClelland, 2011; Wallbaum et al., 2017). For example, Graziano et al. 2007 assessed in a kindergarten sample that emotion regulation had significant effects in encouraging children's academic success and positive school behaviors, as well as better relationships with teachers. In contrast, children that are unable to regulate their emotions effectively may be at risk for mental health and low academic achievement (Djambazova-Popordanoska, 2016). They may also be subjected to disruptive classroom behaviors within classrooms.

In hopes to assist children on how to manage their self-regulatory processes for social and emotional well-being, classroom behavior, as well as considering the lack of research behind both game-based-learning and self-regulation in young children, my research objective addresses the following question:

Can digital game-based-learning prove to be an effective and suitable approach to help children ages 5-7 years learn about regulating their emotions?

This research aims to explore how game-based-learning may be used as a tool to help children ages 5-7 learn about self-regulation strategies in hopes to better control their emotions for decision-making and behaviors. In my approach, I combine the power of play alongside game-based-learning with self-regulation strategies. To do this, I create a formal design and structure, illustrating how this concept as a tablet application will

work, look, feel, and function using video, animation, sound, color, as well as prototype representations. In addition, this work centers upon manipulations of multimedia learning, focusing on the design of psychology as well as child cognitive thinking.

This research paper acts as a proof of concept with further goals to implement user studies and user testing for future research. The investigation behind this idea begins with me first defining the background of emotions and self-regulation altogether, highlighting interventions that sought to teach self-regulation strategies to early childhood groups, and then outlining the methodology and implementation behind the current overall research design as a means for a tablet application.

2. LITERATURE REVIEW AND RELATED WORK

2.1 Construct of Emotions:

The concept behind emotion regulation is addressed in child development research mainly due to the theory that it allows integrating and understanding of regular and irregular development (Cole, Dennis, & Martin, 2004). Before diving into the context of emotional self-regulation, it is important to understand the full construct of emotions altogether.

Emotions are perceived to be a part of a child's immediate reactions to the environment in which their goals are met by ongoing events (Easterbrooks, Ginsburg, & Lerner, 2013). James Gross 1998 notes that the concept of emotions are "flexible response sequences that are called forth whenever an individual evaluates a situation as offering important challenges or opportunities," and that they "generally facilitate decision-making." As children develop, they start to become more perceptive on when to efficiently use emotions in a social setting or situation. This in part is related to a child's emotional self-efficacy, which centers upon the child's belief that he/she is in control of their emotions. In addition, emotional and self-regulatory processes allow an individual to accomplish a goal and respond to certain impulses or situations successfully.

2.2 Emotion-Regulation and Self-Regulation:

Although the term for emotion regulation has been broadly and conceptually defined throughout research, the definition adopted most states that emotion regulation

refers to the ability to effectively manage “or modify emotional reactions,” as part of the external and internal state to accomplish one’s goal (Thompson, 1994).

Emotion self-regulation may serve as the behavioral process that allows one to alter or monitor immediate reactions and responses to certain situations, thus allowing a facilitative way to cope with environmental changes. This in part is especially essential during early childhood in hopes to avoid educational and health issues for children that are in transition into formal schooling. Eisenberg and Spinrad 2004 define emotional self-regulation as the process of inhibition, modification, and maintenance of emotional states related to one’s social adaptation. It allows the modulation of emotions as well as the ability to meet social expectations. In this sense, emotion regulation may serve to encourage positive decision-making and inhibit or restrain negative responses.

Researchers on self-regulation define the term as the ability of individuals to balance or alter their cognitive thinking as well as emotional behaviors to accomplish a goal (McClelland, Messersmith, Ponitz, & Tominey, 2010). Similar to emotion regulation, it allows control and restraint for responses to certain stimulations and helps to play an important role in a child’s developmental process. For instance, a child’s ability to self-regulate produces positive outcomes such as social acceptance amongst peers, high academic success, engagement in school, as well as decreases in negative behaviors (Blair, 2002; Dee Ray & Wilson, 2018; Kim & Holloway, 2018; McClelland et al., 2010).

2.3 Facial Expressions and Emotions:

It is assumed that emotions are typically expressed through facial expressions and body movements and are related to neural responses. As Eckman and Friesen inferred, the six basic emotions (anger, happiness, fear, disgust, and sadness) are recognized universally across different cultures (Eckman & Friesen, 1971). These basic emotions proposedly come with distinct physical attributes or facial movement patterns that are characterized as recognizable across cultures as well (Jack et al., 2016).

However, it is important to note that there is a new science of emotion research that challenges the basic emotions theory (BET) to fully understand the meaning of emotional expressions as well as emotion categories and emotion cognition (Barret et al. 2019; Barret & Hoemann, 2019; Keltner et al. 2019). For instance, Barret et al 2019 suggest that facial expressions should not be generalized as reliably displaying emotional states, such that anger is expressed as more than just a scowl, and scowls express more than just anger. In short, facial configurations may be used to express an emotion but may not be *the* core expression of the emotion itself.

Nevertheless, facial expressions carry important information as social contexts in which people are reliably able to infer social meanings from these facial configurations and may be used as a means of communication (Barret et al. 2019; Batty & Taylor, 2003). In relation to BET, emotional expressions communicate current feeling, what is happening in the present moment, intentions or actions, desired reactions in others, and social characteristics (Barret et al. 2019).

2.4 Self-Regulation and Emotions During Early Childhood:

Assumedly, there are six basic emotions that are considered to be universal throughout human cultures: happiness, fear, anger, sadness, surprise and disgust (although current research proposes that there may be a subset of four basic emotions across cultures) (Jack et al., 2016). As children develop in their abilities to control their own bodies and to understand their environments, they are gradually able to take control of regulating their own emotions (Siegler et al., *How Children Develop*, p. 435, 2017). The self-conscious set of emotions being guilt, shame, pride, jealousy, empathy and embarrassment, are thought to emerge once children begin to have a sense of self, roughly around the age of 2 or 3-years-old (Siegler et al., *How Children Develop*, p. 426, 2017).

Throughout the development of early childhood, self-regulation moves from external to internal control as children begin to learn how to modulate or regulate behaviors emphasized by adaptive responses (e.g. thumb sucking as a self-soothing behavior to reduce stress) (Eisenberg, Eggum, & Spinrad, 2010; Kopp, 1982). The area of the brain most closely associated with self-regulation lies within the prefrontal cortex in which also has significant growth during the preschool years (Blair, 2002; McClelland et al., 2015). Evidence also suggests that self-regulation plays a major role in early child development for goals towards school success, paying attention, accomplishing tasks, and persisting through difficulty (Cameron, McClelland, Messersmith, & Tominey, 2010). Children from low-income backgrounds perform worse compared to their more

advantaged peers when it comes to academic achievement and school readiness (McClelland & Tominey, 2011).

The first step in developing an understanding of emotion is the recognition of different emotions in others. A child's ability to identify and label emotions helps them to respond appropriately to their own emotions and the emotions of others (Siegler et al., *How Children Develop*, p.428, 2017). At 3 months of age, infants are able to distinguish expressions of happiness, surprise, and anger; at 7 months, they are able to distinguish expressions such as fear and sadness (Siegler et al., *How Children Develop*, p.428, 2017). Children can understand and describe basic emotions roughly around the age of five; they can also describe complex emotions such as shame and guilt by age seven (Wallbaum et al., 2017). During the preschool years children are able to communicate about their emotions and also develop the ability to evaluate themselves and their emotions for awareness and understanding as either being "good" or "bad" (Buckley & Saarni, 2006).

2.5 Implemented Interventions Throughout Research:

Researchers have investigated studies that focus upon methods of implementing self-regulation strategies for children, particularly targeting those in preschool or prekindergarten. These studies typically focus on interventions to further improve inhibitory control. Some may be curriculum-based or may include mindfulness interventions alongside breathing techniques to improve self-control, while others may incorporate physical exercise programs and circle-time games (Gagne & Nwadinobi, 2018).

2.5.1 Curriculum-based interventions:

One curriculum-based intervention known as the “Tools of the Mind” or “Tools” incorporates EF (executive function) perspective methods, which refer to cognitive abilities related to maintaining focus, resisting temptations, or distractions. Tools of the mind is based on Vygotsky’s perspective of socio-cultural factors, as it encourages guidance from the teacher to assist with a child’s learning. This curricular intervention is play-based, child-centered, and includes 40 EF-promoting activities as well as training for attention, memory, and self-control (Gagne & Nwadinobi, 2018). One study using the Tools curriculum consisted of preschoolers from a low-income urban school district in which they were each randomly assigned. Results from the study indicated that the children performed significantly well compared to the other group in EF tasks, suggesting that executive function skills can be improved in 4-5-year-olds for regular public-school classes (Diamond et al., 2007).

Another curriculum intervention known as The Chicago School Readiness Project (CSRP) aims to support the development of self-regulation and early childhood problem behavior for low-income children. This intervention was implemented in a randomized control study that included two preschool classrooms from high-poverty neighborhoods that were participating in Head Start programs, which were also designed to foster school readiness in children from low-income areas (Raver et al., 2009). The results from this study showed that children enrolled in Head Start programs that had also been randomly assigned to the CSRP intervention scored significantly higher in attention skills, impulse control, as well as executive function skills. Results also showed

improvement in global self-regulatory skills versus the control group and indicated that children in lower income areas face a significant risk and economic disadvantage for school readiness (Raver et al., 2009).

The Promoting Alternative Thinking Strategies (PATHS) curriculum is an elementary school-based intervention with social-emotional elements as well as emphasis on behavior modification to support a child's own ability to self-regulate. Its design is meant to encourage the emotional development of school-aged children for school settings. Researchers developed a study using a preschool version of PATHS in which the curriculum components were modified to meet the appropriate needs for preschool children, and to be integrated effectively with early childhood programs (Greenberg et al., 2007). This study with an adaptation to PATHS, consisted of preschool-aged children from two regional Head Start programs. Data results that included reports from both teachers and parents showed significant effects for improvement in social-emotional competence, including self-regulation skills (Greenberg et al., 2007).

2.5.2 Mindfulness-Based Interventions and Deep Breathing:

Mindfulness intervention programs for children have been gaining a lot of attention where it has become increasingly popular in research and practice (Burke, 2010; Zenner et al., 2014; Zoogman et al., 2015). Jon Kabat-Zinn defines mindfulness as “the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding experiences moment by moment” (Kabat-Zinn, 2003).

The use of mindfulness-based-programs (MBPs) may promote self-control as well as help children manage awareness of their emotions or aggression. MBPs are not only remedial interventions used to address specific social and emotional problems in children but rather, they can also be implemented as preventive measures (Cejudo & Moreno-Gomez, 2018). Although the research behind mindfulness applications and its effects upon youth are still in preliminary development, these approaches towards the wellbeing for younger populations are still considered to be acceptable and potentially effective (Burke, 2014).

Mindfulness interventions have also been investigated in ways that suggest they may improve attentional functions in elementary school children (Tarrasch, 2018) and can be effective in improving a child's academic achievement (Cejudo & Moreno-Gomez, 2018). One study for example, consisted of a 12-week study using a mindfulness-based Kindness Curriculum (KC) that focused on executive function, self-regulation, and prosocial behavior skills in preschool-aged children in a public-school setting (Goldberg et al., 2015). The results indicated that children in the KC intervention group displayed significant levels in improvement for social competence and academics versus the control group who displayed more selfish behaviors; as such, this study also suggests that mindfulness-based interventions may enhance academic and prosocial skills in young children (Goldberg et al., 2015).

2.5.3 Executive Function and Effortful Control Interventions:

Some of the aforementioned studies for the curriculum-based interventions noted the utilization of teaching executive function (EF) skills to young children. Researchers

define the EF perspective as central skills centered upon cognitive abilities that allows for resisting of temptation or impulsive behaviors, appropriate shifting of attention, and the ability to stay focused towards a goal (Blair, Douglas, & Razza, 2005; Diamond, 2016; Mika et al., 2012). The development of these functions is crucial during early childhood (Graziano et al., 2007) and helps with concentrating on restraining impulsive behaviors or acting on automatic, ill-advised intentions. Two primary EF skills during early childhood are working memory and inhibitory control, with inhibitory control being a core EF skill that encourages one's ability to inhibit their attention in order to achieve a goal, emphasizing the reflection of self-control (Diamond, 2016).

In contrast, a distinguished difference between EF perspective methods and effortful control is that effortful control does not include working memory (Gagne & Nwadinobi, 2018). Similar to the EF perspective, effortful control (being a construct of self-regulation) pertains to the ability to inhibit, activate, or modulate attention or behavior, and centers upon the child temperament of self-regulatory capacities (Eisenberg et al., 2004; Niditch & Varela, 2018). It plays a central role in self-regulation for developmental and emotional processes (Eisenberg et al., 2004; Harlan, Murray, & Kochanska, 2000). Kochanska and colleagues 2000 also note that effortful control begins to develop throughout early childhood, emerging during the first year before rapidly developing into the preschool years.

One intervention utilizing EF skills (working memory and inhibitory control) conducted a study centered upon two groups of preschool children to determine if executive functions were related to mathematical efficiency (Espy et al., 2004). Results

showed that effects of inhibitory executive functions contributed to the emergence of mathematical proficiency with inhibitory control being a central aspect. Data correlations from this study also indicate that the numerical significance of inhibitory control had more effect compared to working memory (Espy et al., 2004).

2.5.4 Game-Based Intervention:

In one game-based-learning study, researchers tested circle games that were used to help children practice integrating inhibitory control and working memory (McClelland & Tominey, 2011). The goal was to investigate whether these games could help improve behavioral self-regulation, as well as gains in academic outcomes. Participants consisted of 65 preschool children from child development centers, half being from low-income families from enrollment by Head Start.

Using the HTKS (Head-Toes-Knees-Shoulders) measurement, children interacted playing a game where they are asked to touch their head or toes, or knees and shoulders in an alternate version (McClelland & Tominey, 2011). . The goal was for the children to remember four rules where they display attentive functioning and inhibitory control. Children also played Red Light, Purple Light, similar to the idea of “Red Light, Green Light,” where teachers acted as the stoplight, holding up different colored circles (orange being stop, purple being go) (McClelland & Tominey, 2011).. Other games included but are not limited to: “The Freeze Game” where children danced to music and froze once the teacher stopped it from playing; they were also asked to dance quickly to slow-paced songs and slowly to fast-paced songs (McClelland & Tominey, 2011). .

Overall, music and movement incorporated within the games proved to be highly effective to get the children engaged (McClelland & Tominey, 2011).. Results indicate that there were significant gains of emotion regulation for children that had initially entered the study with low behavioral self-regulation, although this did not affect the overall sample (McClelland & Tominey, 2011). This study also suggests that despite the preliminary research for game-based-learning, the effects of using it as a method for circle time games to target regulatory processes did show improvements in children with low initial behavioral self-regulation (e.g. working memory, academic outcomes, and inhibitory control) (McClelland & Tominey, 2011).

3. IMPORTANCE OF THIS RESEARCH

Although it is clear that behavioral self-regulation is necessary for academic success and may promote a child's social and emotional well-being, very little research has emerged on ways to improve self-regulation skills for young children as they transcend into grade school (McClelland & Tominey, 2011). There is a fairly extensive amount of self-control interventions throughout the literature, however, there is a limited number of existing self-control interventions that are centered upon school-age-children (Gagne & Nwadinobi, 2018).

Furthermore, despite various methods that investigate child behavioral self-regulation, there has also been very little research and exploration of digital interactive learning approaches that target self-regulatory interventions let alone mental health interventions for younger audiences during early childhood. It is important for children during early childhood to learn how to self-regulate their emotions as they transcend into grade school to attain positive outcomes for academic achievement, gain problem-solving skills, as well as social competence amongst peers. In hopes to help them achieve this, investigating ways to apply the power of play as a means for encouraging them to learn about self-regulation strategies may prove to be an effective approach.

The power of play and imagination can be a powerful tool. During the preschool years, a child's imagination is beginning to take off, whereas creativity and play may serve a pivotal role in helping them to learn. Researchers have noted the importance of Lev Vygotsky's theory of play, underlining it as a leading key factor during child

development, and how it serves as a model for cause-and-effect relationships (Bordova, Germeroth, & Leong, 2013; Bruner, Jolly, & Sylva, pg. 53, 2017; Moller, 2015).

There is an increase of technology being applied as a pragmatic approach in handling anxiety, stress, and negative emotions (Zhu et al., 2017). Considerably, mental health applications may potentially be used to overcome access barriers for an estimate of three million people predicted to own a smartphone in the year 2020 (Torous et al., 2019). With today's digital natives' interest in all things technology, it is no surprise in how technology is also steadily growing as a form of instruction within the realm of education (Kalogiannakis & Papadakis, 2017). In general, game-based-learning provides the ability to acquire knowledge, skills, and learning outcomes through the use of an actual game (Kapp, 2014; Killi, 2005). Marc Prensky 2003 states that children enjoy learning when the idea is not forced upon them, whereas computer and video games provide learning opportunities as a bridge between educational structures and a sense of enjoyment. Games make use of the principle of play for instructional strategy (Van Eck, 2006) and provide a meaningful framework that allows for the exploration of problem-solving (Killi, 2005).

Young children are able to explore and learn using mobile devices through actions that seem natural to them — touch, repeat, trial and error (Kalogiannakis & Papadakis, 2017). During the preschool age years, children are able to engage in rich play scenarios and are also able to learn from using digital interfaces (Hiniker et al., 2018). Tablets for example, are designed in an effective way where young users can use them easily (Kalogiannakis & Papadakis, 2017). Technologies can also “provide

unprecedented experiences through their great malleability, enabling children to modify their environments and experience them in ways that were not previously possible” (Diederich, Hourcade, & Pantoja, 2019). Additionally, research exploration of computer games as an educational framework are also becoming popular (Nietfeld & Shores, 2014) and may further encourage a child’s ability to learn.

4. METHODOLOGY

This research investigates the method of applying digital-game-based learning as a meaningful and interactive tool to help children ages 5-7 years learn about regulating their emotions. In this process, I demonstrate how this design works, looks, feels and fully functions as a child tablet application through the use of video, animation, sound, color, prototype representations, as well as other forms centered upon multimedia learning and child cognition.

This project will act as a mid-fidelity staged approach to be implemented for future research towards a high-fidelity design that will involve a large sample in a preschool classroom for user testing. There are two self-regulation strategies that I focus upon within my application design: executive function perspective methods and the modulation of mindful deep breathing. As part of a preliminary prototype, an emphasis on mindful deep breathing is demonstrated within my design as a fully functional working game.

Most, if not all of the interventions mentioned prior encourage teacher participation to assist with a child's improvement for self-regulation skills, whereas my method calls for self-learning interactivity that does not necessarily require help from an educator to physically guide the child. Although my research approach does not require an educator or caregiver to assist the child fully in person, my design provides interactive components as informal instruction (e.g. gestures from the chosen character that model how the technique works, animated user interface hints, prompts, and progress information) as visual scaffolds to help guide the child including voice

narration for cues or steps to take. The idea is that this application may be used as a tool both inside and outside of the classroom.

Before undergoing the design implementation for this process, it was important to fully understand the target audience in relation to development and cognitive load. In short, I needed to have a clear understanding of who this design was for in terms of usability. This also required me to understand what goals would be met for the target audience, as well as understanding the cognitive stage for this said audience when using my overall design. For methodology purposes, I break down the components identified within my design as procedures that mold and shape how effective this application is intended to be.

4.1 Emphasis on Jean Piaget's Preoperational Stage:

There are various theories that explore child social cognitive development from notable authors such as Piaget, Selman, Bandura, and others that thoroughly explored how a child goes about making sense of the world and their environment. Notably, Jean Piaget has devised a four-stage model of cognitive development in which details the transitional stages of children as they develop at certain ages.

For my research, I look to Piaget's second stage of the child cognitive development process known as the preoperational stage, centered upon children ages 2-7 years. During this stage, children's development of conservation, memory, imaginative thinking, logical thought, make-believe and play begins to take shape (Bashrin, 2015; Simatwa, 2010). Jean Piaget's child development theories for learning may also be associated in correlation to the benefits of games with the inclusion of assimilation and

accommodation by “fitting new information into existing slots or categories” (Van Eck, 2006). These thought processes centered upon the child cognitive load are used in my approach to help shape the internal structure for creative gameplay and overall application design.

4.2 Self-Regulation Strategies:

4.2.1 Mindfulness for Deep Breathing:

Breathing practice interventions have been a popular topic throughout research with studies suggesting it to be an effective approach for emotion enhancement, reduction in anxiety, and depression (Ma et al., 2017). Jerath et al. 2015 mention that the autonomic nervous system (ANS) “is closely associated with the experience of emotions.” The ANS is also linked to lung control in which it helps to regulate bodily functions and influences breathing (Widdicombe et al., 1970).

The ability to control breathing patterns may influence autonomic nervous system functions (Brown & Gerbarg, 2005) which may be productive for breathing techniques that target self-regulation processes. In addition, techniques that implement breath control properly may serve to help one achieve a desired state of wellness or calmness. Mindfulness breathing practices in particular helps to aid in the process of reducing anxiety (Cho et al., 2016). The construct of mindfulness encourages one to pay attention to their internal experiences that relates to breathing, emotion, and cognition (Cejudo & Moreno-Gomez, 2018; Cho et al., 2016). Focusing on this aspect, I incorporate mindful breathing as an instructive strategy to be applied as part of my

research design. This applied construct is evident throughout a built out mini game for gameplay in which I discuss further in the implementation.

4.2.2 Executive Functions Methods:

Gagne and Nwadinobi 2018 point out that due to the emphasis on self-control varying from age to age, children may not be able to fully engage in difficult EF-based skills as training programs; however, self-control interventions that incorporate the addition of toys or games would be more suitable. My approach considers utilizing EF skills as part of my research design centered upon gameplay. One of the core EF skills that I intend to incorporate within my design centers upon inhibitory control as well as the idea of cognitive flexibility (ability to adapt to changes or rules for decision-making) and working memory. These skills are to be applied as a component for gameplay that is similar to the idea of Simon Says as self-regulation strategies (e.g. paying attention, inhibiting impulses to recall order of events, and how to adapt to changes or rules that are being presented.)

4.2.3 Use of Color for Emotion:

Various research has investigated color associations and emotions. It is possible that color may be correlated with psychological functioning (Elliot, Maier, & Moller, 2009), whereas studies also indicate that color may be used to visually represent emotions or mood (Ikeda, 2019; Jonauskaite et al., 2019). A past study by Jacobs and Seuss 1975 investigated the effects of color associations with the four primary colors (red, blue, green, and yellow) correlated with emotion. Suggested evidence from the study noted that high anxiety levels were associated more with red and yellow than with

blue and green (Jacobs & Seuss, 1975). Another study investigated color, emotions, and music, in which red was linked to anger while sadness was linked to dark blue colors (Ikeda, 2019).

For my design, colors are used to visually correspond each emotion that will be represented throughout gameplay (green-happiness, yellow-fear, red-anger, and blue-sadness). Although these colors are not meant to fully justify the symbolization for these emotions, they are used to visually convey the expressive state for the emotions instead.

In terms of the interactive environment, a blue-green color scheme is applied as the setting theme or main palette of choice for my design, referencing to the idea that blue and green may be desirable and appropriate color palettes for children (Park, 2007). This idea is also implemented with the goal in mind of wanting the child to learn about emotion regulation which is all about calming or inhibiting the unwanted behavior. Green is considered to represent nature and happiness, while blue is considered to represent calmness (Park, 2007).

4.2.4 Facial Expressions & Meter for Emotion:

Although there is notably a new wave of emotion theory research that challenges the relationship between emotions and facial expressions, it is still thought that emotions may be expressed through body language and/or physical facial expressions as neural responses. Emotional configurations also carry meaningful and important information that allow people to reliably infer social meanings about an emotion and may be used as a means of communication. Behaviors related to emotion include changes in facial behavior, body language (posture), and active behaviors such as withdrawing or striking

(Gross, 2015). In relation to this groundwork, I apply the notion of facial configurations as a means to communicate an expression of four emotions presented throughout gameplay (happiness, anger, sadness, and fear). For example, if a character appears to be angry, then the physical feature applied to that character might be an expressive scowl or furrowed frown to communicate the emotion of anger to the child.

Aside from relying on the utilization of color and facial configurations to convey the expressive state of an emotion, I also incorporate the use of a meter to visually indicate the increasing and decreasing state of that particular emotion. This idea for incorporating the use of a meter is implemented to match the notion of emotion levels as being heightened and/or falling (e.g. if the state of an emotion seems to increase, the meter will rise, in contrast, as the emotion begins to decrease, the meter will fall).

4.2.5 Multimedia Learning and Multimodal Learning:

In my approach I utilize the elements of both multimedia and multimodal design to present learning environments for the user through the components of sound, audio, animation, and other elements. My approach also calls for user input as well as responsive feedback to assist with their learning.

Richard Mayer defines multimedia learning as the process through which an individual can make mental representations from words (i.e. printed text or spoken text) and pictures (i.e. animation, video, illustrations) (Mayer, 2005). This theory may also be applied towards multimedia instruction, which utilizes words and pictures to promote a multimedia learning environment (Mayer, 2005). An example of a multimedia learning

environment would be the display of a video animation that includes sound, narration, visual imagery or graphics, and text.

In addition, an *interactive multimodal* learning environment is one where the outcome of events occurs due to the actions of the user or learner — it is the responsiveness that initiates due to the user's actions while learning (Mayer & Moreno, 2007). An example of a multimodal learning environment might be a computer game that calls for user input, encompasses sound, text, narration, and feedback in response to the user's actions.

Much of the elements applied throughout my design refer to Richard Mayer's (2002, 2005, & 2014) principles for multimedia learning. In my approach, I encompass five of the multimedia principles to help structure my cognitive design process (Table 1). These principles are used to create a meaningful user experience for my intended audience and set them in the playful environment so to speak that allows them to be engaged through gameplay.

Table 1: Multimedia Learning Principles Applied Throughout This Design

Multimedia principle	Definition	Example
Voice principle	People learn better when the narration in multimedia lessons is spoken in a friendly human voice rather than formal style.	Friendly narration is spoken in a human voice versus a computer.
Personalization principle	People learn better from multimedia lessons when words are in conversational style rather than formal style.	Words are used in a one-on-one conversation or in first person and second person (e.g. “Choose your character,” or “We should help our friend calm down”).
Modality principle	People learn better from graphics and narration than from animation and on-screen text.	A short-animated clip presents graphics to describe how to ride a bike alongside friendly narration.
Signaling principle	People learn better when cues that highlight the organization of the essential material are added.	Visual cues (e.g. arrows) are used to highlight important information to get the user’s attention.
Temporal Contiguity principle	People learn more deeply from a multimedia message when corresponding animation and narration are presented simultaneously rather than successively.	Narration on how to ride a bike is timed correctly and used simultaneously alongside animation.

4.2.6 Gameplay and Storytelling:

As mentioned prior within the literature review, the six basic emotions that are considered to be universal throughout human cultures are happiness, fear, anger, sadness, surprise and disgust. These emotions serve as important functions for survival

as well as communication, appear very early in life, and are thought to be innate or natural (Siegler et al., *How Children Develop*, p. 421, 2017). With this in mind, I focus on three of the basic emotions for game and level design - anger, sadness, and fear, with a visual emphasis on anger as a built-out level for gameplay. These emotions are each paired with a short story and mini game for the child to choose from during gameplay.

Mayer 2005 mentions that words and pictures are effective when presented together as in a narrated animation, in which students are able to perform well. From the age of 4 to at least age 10, children are better at identifying emotions from stories that portray causes of an emotion versus pictures of facial expressions such as fear, disgust, embarrassment, and shame (Russel & Widen, 2010). Stories are also used to transfer and define information into an understandable landscape that is relatable (Reagan et al., 2016). For this reason, my design consists of three distinct levels or mini-games as correlating themes pertained to the three emotions that are represented (sadness, anger, fear) and are introduced as illustrated short-stories. Each short story for each level and emotion will demonstrate to the child the cause of that particular emotion.

The child is also presented with a goal to accomplish, which is to better help their chosen character attain a sense of calmness or happiness. In hopes to achieve this, the child will apply a self-regulation strategy in a given scenario by interacting with their chosen character throughout gameplay. For example, one scenario visually emphasizes the use of deep breathing as part of a built-out level. Other levels will also lead to the introduction of other self-regulation strategies (i.e. mindfulness deep breathing, executive functions and effortful control) for the child to learn about which are modeled

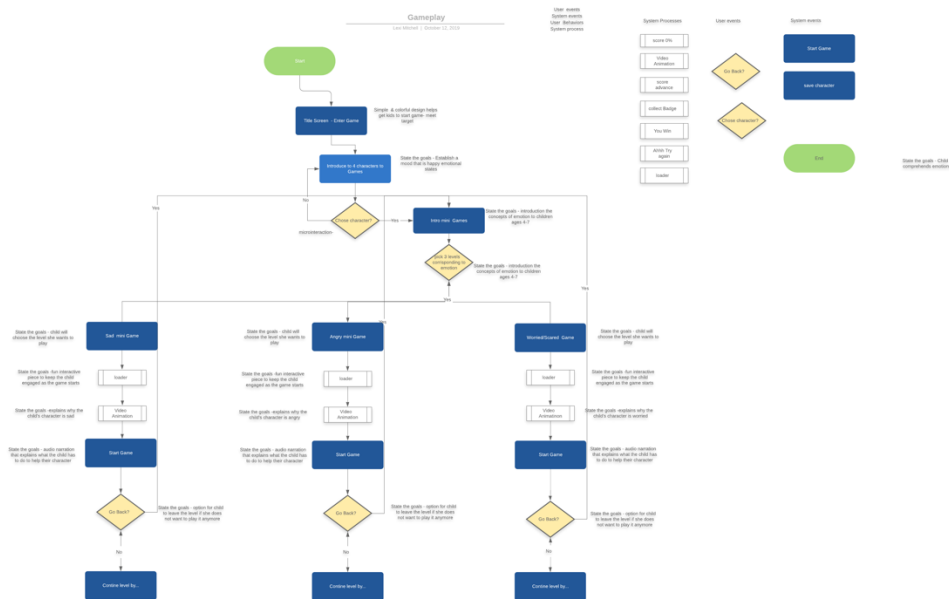
by their chosen character. For prototype purposes, I build out a sample version for gameplay centered upon the emotion of anger.

5. IMPLEMENTATION

This research design is created as a mid-fidelity level approach that is exemplified as a working tablet application for children ages 5-7 years. During the early childhood years (2-7) logical thought, imaginative thinking, and memory begins to take shape (Bashrin, 2015; Simatwa, 2010). My design is structured around these said elements to provide a meaningful user experience in the form of game-based learning for this audience using the methodology as outlined above. Interactivity for effective human-computer-interaction plays a central role within this design.

Here, I explain how the methodology is implemented in four stages for my game-based learning approach: (1) Initial Play & Introduction to Characters, (2) Selecting a Mini Game, (3) Storytelling and Narration, (4) Gameplay. Figure 1 below displays a flowchart (visual representation of sequences) that summarizes the format of my design. For a full-view of this chart, please see the respective link at <https://lexikobie01d6d0.myportfolio.com/work>.

Figure 1: Flowchart that Maps Out Sequences of Events for Application



5.1 (1) Initial Play & Introduction to Characters:

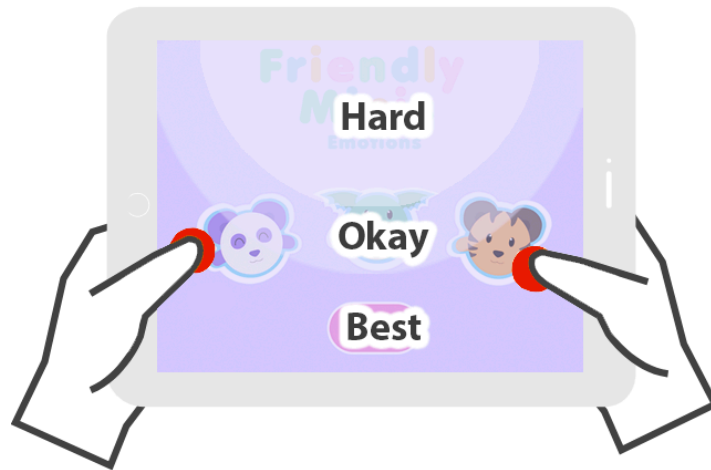
Children between the ages of 4-6 years are able to develop fine motor skills which enables them to perform more-complex multi-touch gestures (Roberts & Soliman, 2018). Piaget’s preoperational stage (with an emphasis on children 2-7 years) suggests that children’s motor skills develop rapidly during this phase with “an increased ability to coordinate their small muscles responsible for fine motor movement of their hands, eyes, and mouth” (Roberts & Soliman, 2018). Such groundwork is thoroughly taken into consideration throughout my design when calling for user-touch prompts meant for a tablet.

Once the child starts the app, they are taken to the landing screen or first screen that is the title page. The goal here is to have the child immediately get started at play. To do this, the button scales in and out repeatedly, signaling to the child that the object is tangible or touchable. These ideas for interactivity are centered upon the signaling principle, but also falls in line with the theory of Fitts's law in relation to human-computer-interaction: the time needed to move to a target is dependent upon the size of the target as well as the distance to the target (Karafillis, 2012).

Figure 2 displays a visual aid in how I apply Fitts's law towards my design centered upon child ergonomics. In short, this means that if the target or object is larger and closer in distance then it will be easier to move to it or reach it. This does not necessarily mean the bigger the better, but rather that usability plays a factor where the user is motivated or encouraged to press the button that you want them to press.

After the child taps "play" they are taken to the next page (the home page) to select a character. Figure 3 displays four distinct circular-shaped characters or pedagogical agents for the child to choose from on the home page. A pedagogical agent is an animated on-screen character that interacts with the learner (Mayer, chapter 13, 2005). Choices for each character design stems from the evidence-based suggestion that children can accurately identify circles during early childhood (Clements & Sarama, 2000); in addition, this also helps to establish a sense of comfortable familiarity in terms of objects for the child when first encountering these characters.

Figure 2: Interaction: Touch. (n.d.). Retrieved from <https://www.ibm.com/design/v1/language/experience/interaction/touch/>

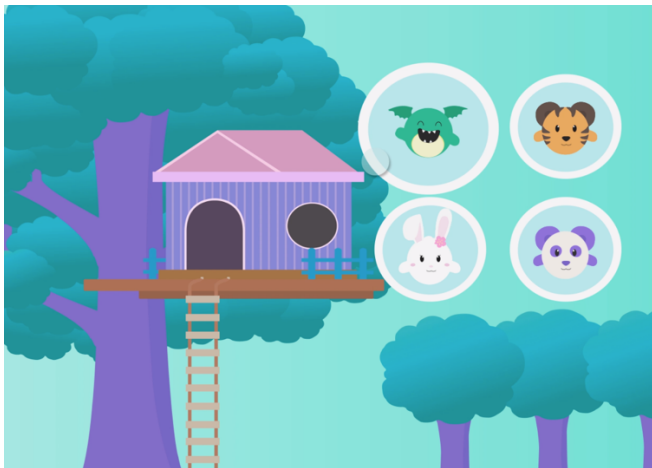


Using the signaling, modality, and voice principle, I set the tone of the environment to be fun, friendly, and inviting for the child. As the child is introduced to these cheerful-like characters for the first time, narration speaks the words, “Choose your character” in a friendly voice to help the child better understand the current goal of what they are needing to do. It is especially important that I use the word “your” when narrating to the child so that it feels more personal in terms of being in control of choices. The characters are also seen blinking, laughing, or moving as animated cues for the user to respond to. Additionally, size indicates interaction, whereas if the child hovers their finger over a target or object the object scales out (as indicated in Figure 4). For sample game-play purposes, we’ll have the child select the dragon as the main pedagogical agent to be used throughout this prototype.

Figure 3: Character Selection Screen



Figure 4: Hover Interaction



5.2 (2) Selecting a Mini-Game:

After choosing a character, the next stage takes the child to the environment map better known as the world map that involves options in selecting a mini-game or level. A cool green-blue color scheme is also evident throughout this environment to accentuate the idea of tranquility since the goal is to help the child learn about regulating their emotions. Here, the modality, voice, and signaling principles are each utilized once again to help shape the multimedia and multimodal environment: Audio narration instructs to the child in a friendly voice to “Choose the level that you would like to play” with animated target objects provided as subtle cues for selection.

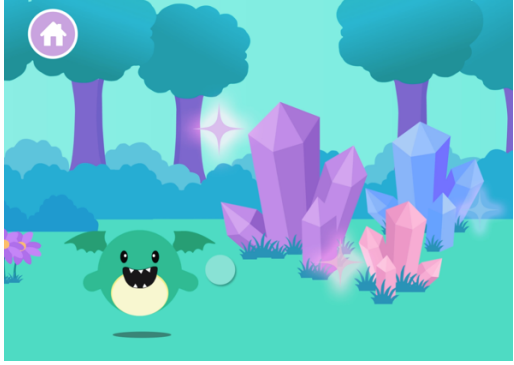
In this stage, I also apply the theory of Hick’s law in reference to human-computer-interaction, which states that if there are too many choices presented to users, it will increase the time required to reach a decision (Gross, 2012). In reference to this theory, my idea is to reduce the number of choices so that the child does not feel so overwhelmed by everything being presented at once but will instead focus their attention to the targets that are more noticeable or obvious. With this in mind, I intentionally scale certain objects to a bigger size that are easy to see, and touch as depicted in Figures 5-7. Additionally, I am careful so as not to overcrowd these objects with other distracting targets.

Figures 5-7 display all three pages of the world map for the child to explore and scroll through, including the three levels given as options to choose from. Each level involves gameplay that are each associated with a certain emotion (e.g. sadness, anger, and fear). These emotions each have their own scenario or short stories explaining to the

child the cause of that particular emotion that their chosen character will experience.

Table 2 gives a brief description of the three short stories that are correlated with each emotion and mini game. In this case, we will have the child select the second mini game where they are introduced to the emotion of anger.

Figures 5-7: World Map – Mini Games 1-3



5.3 (3) Storytelling and Narration:

Children are better at identifying emotions from stories that portray causes of an emotion (Russel & Widen, 2010). Storytelling can also serve as a powerful method to communicate emotions, values, and social skills (Wallbaum et al., 2017). These perspectives are applied in stage 3 of storytelling and narration for the second level, which introduces the cause and effect for the angry emotion.

Table 2: Descriptions of Each Short Story Correlated Alongside an Emotion

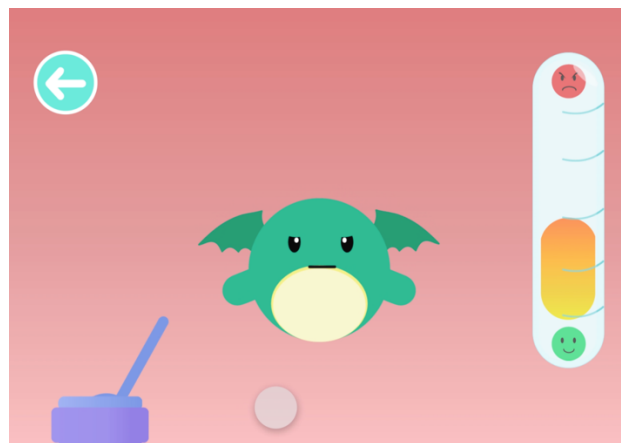
#	Short Story	Emotion
Level 1	The main character wants to plant a garden, but Fox hid away all the seed packages. If the seeds are not found and planted in time, then the garden won't be able to grow.	Sadness
Level 2	The main character is having fun playing outside blowing bubbles. Suddenly, a flock of birds pass by and decide to take away the main character's favorite object.	Anger
Level 3	The main character doesn't know how to make friends and decides to venture off alone. Without realizing it, the character becomes lost in a dark cave and needs to find a way out.	Fear

In this stage, I apply the voice, modality, personalization, and temporal contiguity principles to describe the story behind why the child's character becomes upset. Narration is used simultaneously in a conversational way alongside animation to illustrate a short story of how the angry emotion is evoked. Because the next stage is

centered upon gameplay in helping the angered character calm down, it is important to first explain to the child the cause of that particular emotion.

A friendly voice narrates to the child the story of why the character becomes angry or upset. In this particular example, the dragon becomes upset after having his gold stolen away by a flock of birds that disappear high into the mountains. The narrator in the story points out that it is important to stop and breathe deep when you are angry, and that if Dragon can calm down by blowing a giant bubble, he might be able to float up into the mountains to find his gold. This in turn sets the goal for the child in the following stage to help Dragon become happy or calm. Just before gameplay commences, the narrator says to the child “Let’s help Dragon calm down,” as an introduction to establish the next stage.

Figure 8: Dragon as Focal Point to Model Mindful Breathing



5.4 (4) Gameplay:

During gameplay, the child is introduced to a self-regulation strategy to help their character achieve a state of happiness or calmness. My demonstrated prototype for the angry emotion exemplifies the aspect of mindful breathing to be modeled or executed by the child's pedagogical agent. Mindful breathing is defined as a method for "calm and conscious deep breathing," and is an important quality of mindfulness-based stress reduction (Zhu et al., 2017).

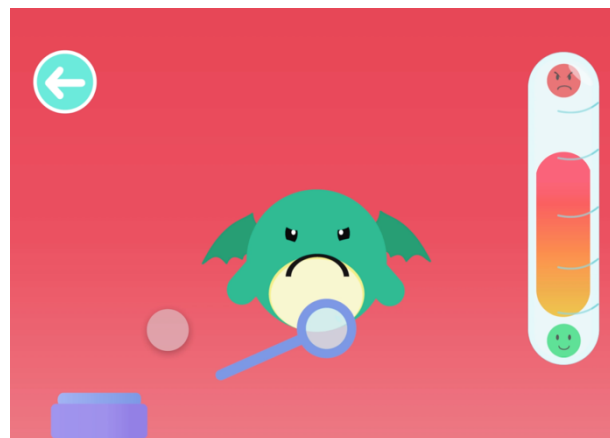
5.4.1 Child Interaction for Gameplay:

When designing for children, it is important to make sure that the user interface does not get in the way of the child learning and using skills to master challenges (Diederich, Hourcade, & Pantoja, 2019). Once again, I apply the theory of Hick's law where I am careful not to overwhelm the child with unnecessary information by providing less objects that are still noticeable. I emphasize the primary targets that I want the child to see. For example, Dragon is seen in the middle of the screen as the focal point so that the child can see how the modeling of deep breathing is to be executed (Figure 8). There is also the emphasis of the bubble bottle to the left of the screen with the angry meter to the right that play an important role in which I discuss further.

The main goal for the child in this mini game is to help Dragon calm down by blowing a bubble using mindful breathing. Bubble applications have been used as an effective mindfulness technique that enables children to calm down, observe their thoughts, and release them without judgement (Costello & Lawler, 2014). This is a strategy that I try to introduce to the child throughout gameplay for the angry emotion.

Here, I apply the voice, signaling, personalization, and temporal contiguity principles. I use animation and signaling cues in various ways to hint to the child that something needs to be done: If the child does nothing, then the angry meter goes up, getting closer to the angry face icon that's seen at the top. As the meter rises, the color of the meter becomes a darker red including the gradient background. Aside from color and the meter rising, other visual cues such as Dragon's facial expressions and body language also indicate that he is getting angrier if nothing is being done. In short, the more the meter goes up, the angrier Dragon becomes (Figure 9). Additionally, if the child does not help Dragon calm down, the meter will continue to rise all the way to the top and the idea is that the child will 'lose' the game. To better guide the child on what to do, visual hints appear around the bubble bottle (Figure 10) and narration instructs the user to "Help Dragon calm down by blowing a bubble."

Figure 9: Dragon Becomes Angrier if Nothing is Done



After the user touches the bottle, a bubble wand appears hinting for the child to tap on it as well, and thus, the initiation for mindful breathing commences as Dragon begins to inhale and exhale out. As seen in Figure 11, a bubble begins to take shape on screen. The more the user taps on the bubble, the more Dragon takes a deep breath, and the bigger the bubble becomes. As the bubble gets bigger, the angry meter goes down, and Dragon's facial expression begins to transcend from angry into a more calm, happy state. The color of the meter also fades into more of a green, indicating that Dragon is achieving a state of happiness. The background gradient becomes a lighter color as well. As this is happening, the narrator says, "Look! Dragon is getting calmer," as a form of supportive motivation for the child to keep going.

After the big bubble has taken full form, Dragon's anger has completely subsided while smiling happily. The bubble engulfs Dragon's body as the words 'Nice job!' animate on-screen, and Dragon begins to float up into the sky towards the mountains (Figure 12). As Dragon floats up into the air, the child has to help him collect the gold coins that leave a trail all the way to the top. At this point, the child's goal is to help Dragon reach the very top of the mountain while collecting the gold coins of his treasure. However, there is another obstacle for the child as well. This obstacle ties into the design strategy of applying reinforcement for mindful breathing.

Figure 10: Visual Cues for Child to Click on Bubble Bottle

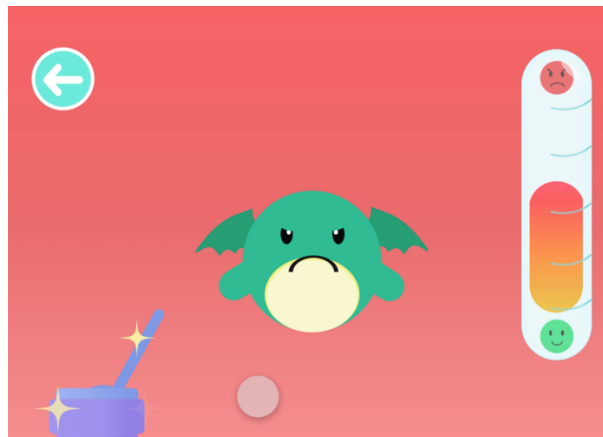
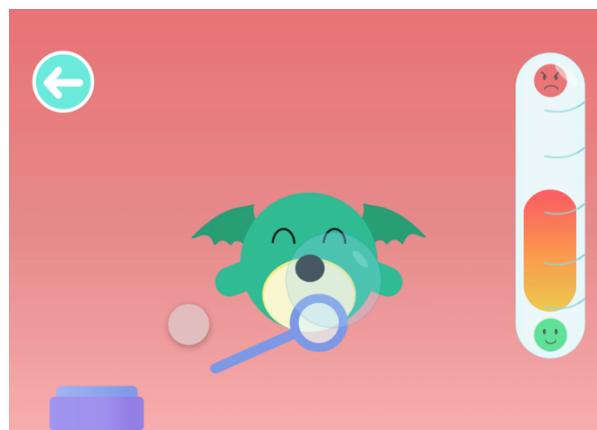


Figure 11: Mindful Breathing Being Applied to Blow Bubble



5.4.2 Reinforcement of Mindful Breathing:

When considering the design goals for children, there should be appropriate challenges in order for children to learn (Diederich, Hourcade, & Pantoja, 2019). My end goal as the designer is to have the importance of mindful breathing become reinforced to the child as a means to learn about how to calm down when angry. This means that the child would somehow need to come back to the beginning of gameplay where they are first introduced to mindful breathing. To do this, I apply an obstacle in which the child

faces the possibility of Dragon's bubble being popped if a bird passes by and touches it. The user has to help Dragon navigate up the mountains into the sky to collect the gold coins, but also has to make sure to avoid the many birds that are flying left and right so that the bubble does not pop (Figure 13).

Figure 12: Child Successfully Helps Decrease Dragon's Anger

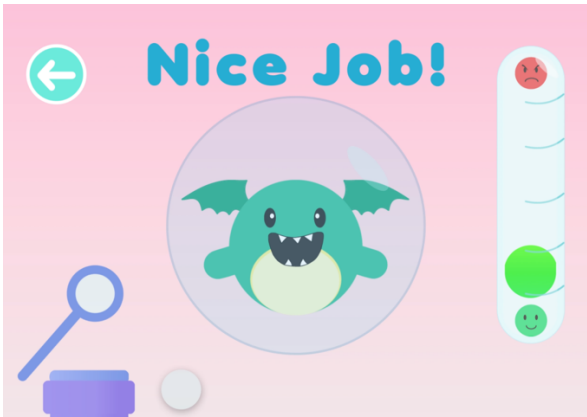
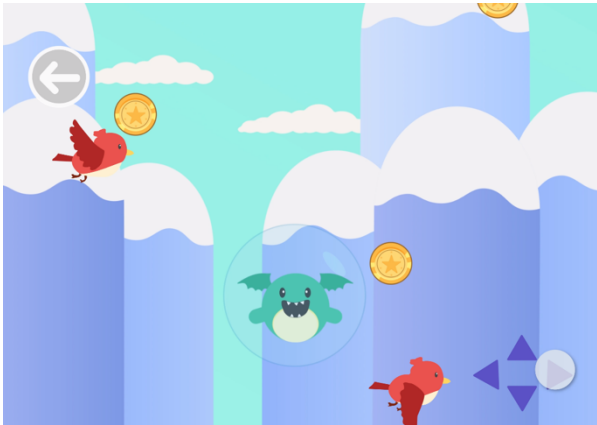


Figure 13: Child Helps Dragon Avoid Bubble Being Popped and Collects Stolen Gold



If the bubble does pop, then the child has to start over at the beginning to help Dragon calm down again. In doing so, the concept of mindful breathing is emphasized and reiterated more to the child. This may also help the child better understand why/how the emotion of anger is being decreased. In contrast, if the child is able to reach the top of the mountain without having the bubble being popped, the idea is that they win the game (Figure 14). By winning the game Dragon is able to retrieve his stolen pot of gold, and in addition, a short story at the end depicts a lighthearted message that explains the importance of breathing in and out when angry.

Figure 14: Child Helps Dragon Calm Down, Collect Gold, and Win the Game



6. CONCLUSION: LOOKING AHEAD

Smart mobile devices and especially tablets can be supportive tools for the cognitive development of young children when combined with applications that have the appropriate content and design (Kalogiannakis & Papadakis, 2017). Furthermore, leaders in mental health research also suggest that user-experience design methods centered upon mental health applications should focus on an intended user audience as well as usability and effectiveness (Torous et al., 2019).

In this work, I presented a mid-fidelity, interactive prototype of a tablet application that encourages children ages 5-7 how to learn about regulating their emotions. Although still in its preliminary stage, my design exemplifies working gameplay, utilizing multimedia design principles, cognitive design principles, and the application of regulation strategies to present an effective approach in helping children learn about emotion regulation. However, in order to truly realize the effectiveness of my application, this research design is to be implemented in a preschool classroom setting for future user studies.

For future work, this application will first be tested for user feedback through a small pilot study. Because children can understand and describe basic emotions around the age of five and can also describe complex emotions by age seven (Wallbaum, et al., 2017), the desired age group for child participants will range from at least 5-7 years. However, the overall childlike look and feel of this application design might be more catered towards an even younger audience, so I will ultimately be looking at children ages 4-7 (with a primary target of 4-6 years) for future user studies.

Ultimately, my goal for this research design is to investigate whether my application may prove to be an effective approach in helping children to learn about self-regulating their emotions. This approach is a mere steppingstone towards investigating other central questions that may expand on the core effectiveness of this application. It is important to further test the quality and suitability of this application being a potential product for the targeted age group and expand more on the utilization. For example, other key questions to consider are: Can this application be effective on its own as compared to having it be included within a teaching environment? Can this application be used for educational purposes and/or solely for commercial use? These are questions that I intend to address throughout future work for this research design.

Testing the efficacy of this application design in low-income school districts would also be a possible future goal for user testing. Research suggests that children from low-income families or from more disadvantaged backgrounds are more likely to struggle with their behavioral competence for school readiness, and therefore may struggle in academics as compared to their more economically advanced peers (Evans & Rosenbaum, 2008; Diamond et al., 2007; McClelland & Tominey, 2011; Raver et al., 2009). Personally, it would be a meaningful goal of mine to provide mental tools for self-regulation in young children from low-income families through the power of play with hopes to encourage their academic competence. This is mainly in part to me also having somewhat of a similar socioeconomic background with a lack of school readiness as a young child. It is my hope that my application design may be applied in ways to

induce social and emotional well-being for children and be used as a novel means for combining play and education.

REFERENCES

- Adolphs, R., Barrett, L., Marsella, S., Martinez, A., & Pollak, S. (2019). Emotional Expressions Reconsidered: Challenges to Inferring Emotion from Human Facial Movements. *Psychological Science in the Public Interest*, *20(1)*, 1-68.
- Barnett, W.S., Diamond, A., & Thomas, J. (2007). Preschool Program Improves Cognitive Control. *Science*, *318(5855)*, 1387-1388.
- Bashrin, S.D. (2015). Piaget's Pre-operational Stage in Children: A Comparative Study.
- Batty, M., & Taylor, M. (2003). Early processing of the six basic facial emotional expressions. *Cognitive Brain Research*, *17(3)*, 613-620.
- Blair, C. (2002). School Readiness: Integrating Cognition and Emotion in a Neurobiological Conceptualization of Children's Functioning at School Entry. *American Psychologist*, *57(2)*, 111-127. doi: 10.1037/0003-066X.57.2.111
- Blair, C., & Diamond, A. (2008) Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Developmental and Psychopathology*, *20(3)*, 899-911. doi: 10.1017/S094579408000436
- Blair, C., Douglas, R., & Razza, R. (2005). Cortisol Reactivity is Positively Related to Executive Function in Preschool Children Attending Head Start. *Child Development*, *76(3)*, 554-567.
- Bordova, E., Germeroth, C., & Leong, DJ. (2013). Play and self-regulation: lessons from Vygotsky. *American Journal of Play*, *6(1)*, 1-14.
- Brown, R., & Gerbarg, P. (2005). Sudarshan Kriya Yogic Breathing in the

- Treatment of Stress, Anxiety, and Depression: Part 1-Neurophysiologic Model.
The Journal of Alternative and Complementary Medicine, 11(1). doi:
10.1089/acm.2005.11.189
- Buckley, M., & Saarni, C. (2006). Skills of emotional competence: Developmental implications. *Journal of Adolescence*, 31(5), 51-76.
- Burke, C. (2010). Mindfulness-Based Approaches with Children and Adolescents: A Preliminary Review of Current Research in an Emergent Field. *Journal of Child and Family Studies*, 19(2), 133-144.
- Burke, C. (2014). An Exploration of the Effects of Mindfulness Training and Practice in Association with Enhanced Wellbeing for Children and Adolescents. *Intervention and Policies to Enhance Well-Being Part 1*, 6. doi:
10.1002/9781118539415.wbwell039
- Carlson, S., & Wang, T. (2007). Inhibitory control and emotion regulation in preschool children. *Cognitive Development*, 22(4), 489-510. doi:
<https://doi.org/10.1016/j.cogdev.2007.08.002>
- Cho, H., Lee, J., Noh, J., & Ryu, S. (2016). The Effectiveness of Daily Mindful Breathing Practices on Test Anxiety of Students. *PLOS One*, 11(10). doi:
<https://doi.org/10.1371/journal.pone.0164822>
- Clements, D., & H. Sarama, J. (2000). Young children's ideas about geometric shapes. *Teaching Children Mathematics*, 6(8), 1-6.
- Cole, P., Martin, S., & Dennis, T. (2004). Emotion Regulation as a Scientific Construct:

- Methodological Challenges and Direction for Child Development Research.
Child Development, 75(2), 317-333.
- Costello, E., & Lawler, M. (2014). An Exploratory Study of the Effects of Mindfulness on Perceived Levels of Stress among school-children from lower socioeconomic backgrounds. *The International Journal of Emotional Education, 6(2)*, 21-39.
- Cote, S., Gyurak, A., & Levenson, R.W. (2010). The Ability to Regulate Emotion is Associated with Greater Well-Being, Income, and Socioeconomic Status. *Emotion, 10(6)*. doi: 10.1037/a0021156
- Cowen, A. Keltner, D. Sauter, D. Tracy, J. (2019). What Basic Emotion Theory Really Says for the Twenty-First Century Study of Emotion. *Journal of Nonverbal Behavior, 43(2)*, 195-201.
- Delis, I. Garrod, O.G.B. Jack, R.E. Sun, W. Schyns, P.G. (2016). Four not six: revealing culturally common facial expressions of emotion. *Journal of Experimental Psychology: General, 145(6)*, 708-730.
- Diamond, A. (2016). Why improving and assessing executive functions early in life is critical. doi:10.1037/14797.002
- Djambazova-Popordanoska, S. (2016). Implications of emotion regulation on young children's emotional wellbeing and educational achievement. *Educational Review, 68(4)*. doi: 10.1080/00131911.2016.114459
- Domitrovich, C., Cortes, R., & Greenberg, T. (2007). Improving Young Children's Social and Emotional Competence: A Randomized Trial of the Preschool "PATHS" Curriculum. *The Journal of Primary Prevention, 28(2)*, 67-91.

- Dumont, F.M. Sylvestre, A. Tarabulsky, G. Voisin, J. (2019). Children's Emotional Self-Regulation in the Context of Adversity and the Association with Academic Functioning. *Child Psychiatry & Human Development*, 50(5), 856-867.
- Easterbrooks, M., Ginsburg, K., & Lerner, R. (2013). Resilience among Military Youth. *The Future of Children*, 23(2), 99-120.
- Eckman, P., & Wallace, V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, 17(2), 124-129.
- Edossa, A.K., Schroeders, U., & Weinert, S. (2018). The development of emotional and behavioral self-regulation and their effects on academic achievement in childhood. *International Journal of Behavioral Development*, 42(2). doi: 10.1177/016502416687412
- Eggum, N., Eisenberg, N., & Spinrad, T.L. (2010). Emotion-Regulated Self-Regulation and Its Relation to Children's Maladjustment. *Annual Review of Clinical Psychology*, 6, 495-525.
- Eisenberg, N., & Spinrad, T. (2004). Emotion-Related Regulation: Sharpening the Definition. *Child Development*, 75(2), 334-339.
- Eisenberg, N., Sadovsky, A., Smith, C., & Spinrad, T.L. (2004). Effortful control: Relations with emotion regulation, adjustment, and socialization in childhood. *Handbook of self-regulation: Research, theory, and applications*, 259-282.
- Espy, K. et al. (2004). The Contribution of Executive Functions to Emergent

- Mathematic Skills in Preschool Children. *Developmental Neuropsychology*, 26(1), 465-486.
- Evans, G., & Rosenbaum, J. (2008). Self-regulation and the income-achievement gap. *Early Childhood Research Quarterly*, 23(4), 504-514.
- Fishbein, D. et al. (2016). Short-Term Intervention Effects of the PATHS Curriculum in Young Low-Income Children: Capitalizing on Plasticity. *The Journal of Primary Prevention*, 37(6), 493-511.
- Gagne, J. & Nwadinobi, O. (2018). Self-Control Interventions That Benefit Executive Functioning and Academic Outcomes in Early and Middle Childhood. *Early Education and Development*, 971-987. doi: 10.1080/10409289.2018.1496721
- Goldberg, L. et al. (2015). Promoting prosocial behavior and self-regulatory skills in preschool children through a mindfulness-based kindness curriculum. *Dev Psychology*, 51(1), 44-51.
- Graziano, P. et al. (2007). The Role of Emotion Regulation and Children's Early Academic Success. *Journal of School Psychology*, 45(1), 3-19. doi: 10.1016/j.jsp.2006.09.002
- Greenberg, T. et al. (2017). Social and Emotional Learning as a Public Health Approach to Education. *The Future of Children*, 27(1), 13-32.
- Gross, J. (1998). The Emerging Field of Emotion Regulation: An Integrative Review. *Review of General Psychology*, 2(3), 271-299.
- Gross, J. (2012). Redefining Hick's Law. Smashing Magazine. Retrieved from:

<http://www.smashingmagazine.com/2012/02/redefining-hicks-law/>

- Gross, J. (2015). Emotion Regulation: Current Status and Future Prospects. *Psychological Inquiry, 26(1)*, 1-26.
- Hiniker, A. et al. (2018). Let's Play: Digital and Analog Play between Preschoolers and Parents. doi: 10.1145.3173574.3174233
- Hourcade, J. et al. (2019). Child Development. In Child-Computer Interaction. Retrieved from scholar.google.com
- Huen, et al. (2016). Evaluation of a Digital Game-Based-Learning Program For Enhancing Youth Mental Health: A Structural Equation Modeling of the Program Effectiveness. *JMIR mental health, 3(4)*. doi: 10.2196/mental.5656
- Ikedda, S. (2019). Influence of Color on Emotion Recognition Is Not Bidirectional: An investigation of the Association Between Color and Emotion Using a Stroop-Like Task. doi: 10.1177/0033294119850480
- Jacobs, K. Sues, J. (1975). Effects of Four Psychological Primary Colors on Anxiety State. *41(1)*, 207-210.
- Jerath, R. et al. (2015). Self-Regulation of Breathing as a Primary Treatment for Anxiety. *Applied Psychophysiology and Biofeedback, 40(2)*, 107-115.
- Jonauskaite, D. et al. (2019). What color do you feel? Color choices are driven by mood. *Color: Research and Application, 44(2)*, 272-284.
- Jones, et al. (2015). Early Social-Emotional Functioning and Public Health: The Relationship Between Kindergarten Social Competence and Future Wellness. *Am J Public Health, 105(11)*. 10.2105/AJPH.2015.302630

- Kabat-Zinn, J. (2003). Mindfulness-Based Interventions in Context: Past, Present, and Future. *Clinical Psychology: Science and Practice, 10*(2), 10.1093/clipsy.bpg016
- Kapp, K. (2012). What is gamification. In *Gamification: Separating fact from Fiction*. 1-5.
- Karafillis, A. (2012, December 12). When You Shouldn't Use Fitts's Law to Measure User Experience. Smashing Magazine. Retrieved from: <http://www.smashingmagazine.com/2012/12/04/fittss-law-and-user-experience/>
- Kazdin, A. (2019). Annual Research Review: Expanding mental health services through novel models of intervention delivery. *Journal of Child Psychology and Psychiatry, 60*(4). doi: 10.1111/jcpp.12937
- Kim, S. Holloway, S. (2018). Parenting and young children's emotional self-regulation in urban Korean families. *Journal of Early Childhood Research, 16*(3). doi: 10.1177/1476718X18775759
- Keenan, K. et al. (1998). Evidence for the Continuity of Early Problem Behaviors: Application of a Developmental Model. *Journal of Abnormal Child Psychology, 26*(6), 441-452.
- Key Findings: Child Mental Health Report. (2019, March 12). Retrieved from <https://www.cdc.gov/childrensmentalhealth/features/kf-childrens-mental-health-report.html>
- Killi, K. (2005). Digital game-based learning: Towards an experiential gaming

- model. *The Internet and Higher Education*, 8(1). doi:
10.1016/j.iheduc.2004.12.001
- Kochanska, G. Murray, K. Harlan, E. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*, 36(2), 220-232.
- Kopp, C. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology*, 18(2), 199-214.
- Ma, X. et al. (2017). The Effect of Diaphragmatic Breathing on Attention, Negative Affect and Stress in Healthy Adults. *Front, Psychology*, 8. doi:
<https://doi.org/10.3389/fpsyg.2017.00874>
- Mayer, R. (2002). Multimedia Learning. *Psychology of Learning and Motivation*, 41, 85-139.
- Mayer, R. (2005). Introduction to Multimedia Learning. In *The Cambridge Handbook of Multimedia Learning*. Retrieved from scholar/google.com
- Mayer, R. Moreno, R. (2007). Interactive Multimodal Learning Environments. *Educational Psychology Review*, 19(3), 309-326.
- Mayer, R. (2014). Principles for Reducing Extraneous Processing in Multimedia Learning: Coherence, Signaling, Redundancy, Spatial Contiguity, and Temporal Contiguity Principles. In *The Cambridge Handbook of Multimedia Learning*. Retrieved from scholar/google.com
- McClelland, M. et al. (2010). Integration of Cognition and Emotion. Self

- Regulation. *The Handbook of Life-Span Development*. doi:
10.1002/9780470880166.hlsd001015
- McClelland, M. Tominey, S. (2011). Red Light, Purple Light: Findings From a
Randomized Trial Using Circle Time Games to Improve Behavioral Self-
Regulation in Preschool. *Early Education and Development, 22(3)*, doi:
10.1080/10409289.2011.574258
- McClelland, M. Cameron, C. (2016). Self-regulation and academic
achievement in elementary school children. *New Directions for Child and
Adolescent Development, 29-44*. doi: 10.1002/cd.302
- McClelland, M. et al. (2015). Strengthening school readiness for Head Start
children: Evaluation of a self-regulation intervention. *Early Childhood Research
Quarterly, 30(A)*. doi: 10.1016/j.ecresq.2014.08.001
- McClelland, M. et al. (2011). The Influence of Demographic Risk Factors on
Children's Behavioral Regulation in Prekindergarten and Kindergarten. *Early
Education and Development, 22(3)*. doi: 10.1080/10409289.2011.536132
- Mika, A. et al. (2000). Chronic Stress Impairs Prefrontal Cortex-Dependent
Response Inhibition and Spatial Working Memory. *Behavioral Neuroscience,
126(5)*, 605-619.
- Moller, S.J. (2015) Imagination, Playfulness, and Creativity in Children's Play
with Different Toys. *American Journal of Play, 7(3)*, 1-26.
- Moreno-Gomez, A. Cejudo, J. (2018). Effectiveness of a Mindfulness-Based

- Social Emotional Learning Program on Psychosocial Adjustment and Neuropsychological Maturity in Kindergarten Children. *Mindfulness*, 10(1), 111-121.
- Niditch, L. Varela, E. (2018). A longitudinal Study of Inhibited Temperament, Effortful Control, Gender, and Anxiety in Early Childhood. *Child & Youth Care Forum*, 47(4), 463-479.
- Nietfeld, J. Shores, L. (2011). Self-regulation within game-based learning environments. *Journal of Educational Psychology*. doi: 10.1037/a0037116
- Papadakis, S. Kalogiannakis, M. Mobile educational applications for children: What educators and parents need to know. *International Journal of Mobile Learning and Organization*, 11(3). doi: 10.1504/IJMLO.2017.085338
- Park, JG. (2007). Environmental color for pediatric patient room design.
- Payton, J. et al. (2000). Social and emotional learning: A framework for promoting mental health and reducing risk behavior in children and youth. *The Journal of School Health*, 70(5), 179-185.
- Ponitz, C. E. et al. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly*, 23(2), 141-158.
- Presnky, M. (2003). Digital game-based learning. *Computers in Entertainment (CIE)-Theoretical and Practical Computer Applications in Entertainment*, 1(1). doi: 10.1145/950566.950596
- Raver, C. et al. (2009). Targeting children's behavior problems in preschool

- classrooms: A cluster-randomized controlled trial. *Journal of Consulting and Clinical Psychology*, 77. doi: 10.1037/a0015302
- Reagan, A.J. et al. (2016). 5(31), The emotional arcs of stories are dominated by six basic shapes. *EPJ Data Science*, 5(31). doi: 10.1140/epjds/s13688-016-0093-1
- Riggs, N. et al. (2006). The Meditational Role of Neurocognition in the Behavioral Outcomes of a Social-Emotional Prevention Program in Elementary School Students: Effects of the PATHS Curriculum. *Prevention Science*, 7(1), 91-102.
- Rosanbalm, KD. Murray, DW. (2017). Promoting Self-Regulation in the First Five Years: A Practice Brief.
- Schonert-Reichl, K. (2017). Social and Emotional Learning and Teachers. *The Future of Children*, 27(1), 137-155.
- Simatwa, E. (2010). Piaget's theory of intellectual development and its implication for instructional management at pre-secondary school level. *Educational Research and Reviews*, 5(7), 366-371.
- Sylva, K. et al. (2017). Play and its Role in the Mental Development of the Child. In *Play: its role in development and evolution*, pp. 53.
- Tarrasch, R. (2018). The Effects of Mindfulness Practice on Attentional Functions Among Primary School Children. *Journal of Child and Family Studies*, 27(8), 2632-2642.
- Thompson, R. (1994). Emotion Regulation: A Theme in Search of Definition.

- Monographs of the Society for Research in Child Development*, 59(2/3), 25-52.
- Torous et al. (2019). Towards a consensus around standards for smartphone apps and digital mental health. *World Psychiatry*, 18(1), 97-98.
- Valdez, P., & Mehrabian, A. (1994). Effects of color on emotions. *Journal of Experimental Psychology*, 123(4), 394-409.
- Van Eck, R. (2006). Digital game-based learning: It's not just the digital natives who are restless. *EDUCASE Review*, 41(2), 1-17.
- Waddell, C. et al. (2018). Making Children's Mental Health a Public Policy Priority: For the One and the Many. *Public Health Ethics*, 11(2), 191-200.
- Wallbaum, T. et al. (2017). Towards a Tangible Storytelling Kit for Exploring Emotions with Children. doi: 10.1145/3126686.3126702
- Widen, S., & Russel, J. (2015). Differentiation in preschooler's categories of emotion. *Emotion*, 10(5), 651-661.
- Widdicombe, JG, et al. (1970). The Autonomic Nervous System and Breathing. *Arch Intern Med*, 126(2), 311-329.
- Wilson, B. Ray, D. (2018). Child-Centered Play Therapy: Aggression, Empathy, and Self-Regulation. *Journal of Counseling & Development*, 96(4). doi: 10.1002/jcad.12222
- Wyman, P. et al. (2010). Intervention to Strengthen Emotional Self-Regulation in Children with Emerging Mental Health Problems: Proximal Impact on School Behavior. *Journal of Abnormal Child Psychology*, 38(5), 707-720.

- Zenner, C. (2014). Mindfulness-based interventions in schools – a systematic review and analysis. *Frontiers in Psychology*. doi: 10.3389/fpsyg.201400603
- Zhu, B. et al. (2017). Designing, Prototyping and Evaluating Digital Mindfulness Applications: A Case Study of Mindful Breathing for Stress Reduction. *J Med Internet Res*, 19(6). doi: 10.2196/jmir.6955
- Zoogman, S. et al. (2015). Mindfulness Interventions with Youth: A Meta Analysis. *Mindfulness*, 6(2), 290-302.