# Analyzing the Design, Regulation, and Evaluation of "Educational" Apps for Children: Present Challenges and Possible Solutions

A senior honors thesis for the

Department of Child Study and Human Development

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Tufts University, May 2016

**Abstract**

Today, 80,000 apps available for purchase on the App Store are marketed under the "Education" category, and the majority of these apps are marketed to children. Parents, policy-makers, and practitioners wonder what this influx of "educational" apps means for children's learning. Is there really any value in these educational apps? How can we design interactive media experiences for all children from diverse social and economic backgrounds? Who is to say what makes something educational? This thesis attempts to answer these questions by examining educational apps from the perspectives of design, regulation, and evaluation. First, I explore the challenges facing app developers today and strategies they might use in order to design effective educational apps. Second, I explain why regulating the market of educational apps has proven to be difficult, and suggest several solutions in order to ensure quality while not hampering free-markets. Third, I turn to evaluation, and discuss how the term "educational" in itself raises differences of opinion on what is best for children, and how we might come to a new, more inclusive understanding of this term. To conclude, I discuss how issues of socio-cultural diversity and economic inequality, debates surrounding the construction of childhood, and challenges of putting theory into practice influence all three domains of the educational app industry and how we can effectively address each concern.

**Acknowledgments**

This thesis would not have been possible without the support and mentorship I have been lucky to receive throughout the process.

First, I would like to thank all of the individuals who gave me their time to talk about their experiences in children's media and technology. The conversations we had were informative, thought provoking, and ultimately indispensable for this current thesis. Thank you to Amanda Strawhacker and Amanda Sullivan from the Tufts Developmental Technologies Research Group, to Mike Robb at Common Sense Media, to Michelle Kaplan and Courtney Wong from Sesame Workshop, and to Josh Golin from Campaign for a Commercial Free Childhood.

Next, thank you to the encouraging faculty and professors I have met at Tufts, including my advisor Tama Leventhal and Leslie Goldberg from the CMS department.

I owe some special thanks to the following professors:

> Thank you to Chip Gidney for engaging me on my first day at Tufts in CD 1, and inspiring me to pursue Child Development as a major. My experiences working with the Children's Television Project and as your TA were some of the most intellectually and personally rewarding moments of my time at Tufts.
>
> My gratitude also goes to Mary Casey, whose course on Inquiry and Analysis pushed me to think deeply about how we ask questions and how to get to the heart of what you really want to know. My learning in that course has informed each stage of this thesis process, and I am grateful to have her as one of my readers.
>
> Finally, a huge thanks to Julie Dobrow for your continuous encouragement over the past few years. You have always believed in my ideas, while always pushing me to challenge my own assumptions and think critically about children and media. My confidence in myself has grown because of your support and advice. Thank you for being my mentor, and for relentlessly advocating for me.

A last thank you to my friends and family for always entertaining my big ideas, supporting me in my pursuit to do whatever it is that makes me happy, and reminding me to have fun along the way.

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# Chapter 1: Introduction

## Problem Statement and Significance

When Apple debuted the App Store in 2008, mobile application (apps) sales boomed with unprecedented growth (Ingraham, 2015). Apps, computer programs specifically designed for mobile devices, revolutionized the way we use our tablets and smartphones (Böhmer et al, 2011). Games, music platforms, and social media applications quickly flooded the App Store. What Apple did not anticipate, however, was that children would become the largest targeted market for app consumption. By 2012, children were the audience for more than 80% of the top selling paid apps within the App Store's Education category, and 72% of the top selling apps targeted our youngest consumers in preschool and elementary school (Shuler, 2012). Today, 80,000 apps in the App Store are filed under the "Education" category, while 80,200 are categorized for "Kids" (Apple, 2015).

Children today are spending a lot of time in front of screens, from televisions to tablets. Children spend about an hour a day watching television, and Common Sense Media reported in 2013 that 75% of children ages 8 and younger use tablet devices, and that time spent using these devices had tripled in the preceding two years (Victoria, 2013). On a typical day, 79% of children play games on electronic devices, and children ages 8 to 12 spend six hours on average using media (Pew Research Center, 2015). Parents, educators, and policymakers are concerned with how young children are interacting with new technologies and how to make sure students are prepared for learning in a 21st century classroom. While children continue to consume this media at increasingly rapid rates, however, few scholars have addressed the issues inherent in the

design, evaluation, and regulation of educational apps. Many question what it is that makes an app "educational" at all. When it comes to apps that claim to promote learning and cognitive development, it can be difficult for average consumers to know what they are really buying into, especially when the criteria for publishing such an app is loosely defined (Apple 2015), and when metrics for evaluation are neither clear nor easily accessible to parents and educators. Marketing of "educational" apps can be deceiving—in fact, the Campaign for a Commercial-Free Childhood has launched a movement to ban language that suggests educational value in advertising apps for infants (Golin, 2013).

Children today spend less than 20% of their waking hours in formal educational settings, meaning that a lot of learning happens outside the classroom. Every day, children across the globe participate in informal learning settings that include exposure to these allegedly educational apps (LIFE Center: Learning in Informal and Formal Environments, 2005). We also know that later achievement is predicted by early strong school readiness skills (Duncan et al, 2007) like executive function (Diamond, 2013). And, apps have been shown to contribute to these skills: Goldin (2014) found that carefully designed educational games provided to children in low-income areas of Argentina through the One Laptop per Child program led to increased school readiness. As positive as these outcomes are, the oversaturation of "educational" apps raises issues of quality versus quantity. How many apps were developed through formative research and tested for efficacy with their target audience? If children are consuming interactive media at these rates, and a majority of this media is labeled "educational," are children actually gaining educational benefits from their screen time? These questions have yet to be answered, but are essential if we want to ensure that children are consuming high

quality media.

Apps are unique in that they provide an opportunity for active engagement, through which a child can play a role in his/her own learning instead of passively viewing a television program. The National Association for the Education of Young Children notes that apps can support children's learning if they are developmentally appropriate, meaning that the app is responsive, customizable to the individual child, challenging, and easy to navigate (Buckleitner, 2015). Yet, there is a lack of research-based, kid-tested, carefully designed educational apps and a lack of regulation in place to ensure that products marketed to children are developmentally appropriate.

**Purpose**

This thesis is an overview of current issues facing the educational app industry, synthesizing concerns of design, regulation, and evaluation. Ultimately, I suggest solutions for industry, policy, and academia to respond to these issues, particularly those related to socio-cultural diversity and economic inequality. Educational, for my purpose, will be defined as causing learning. Learning may take the form of cognitive or academic outcomes. Plowman, Stephen, and McPake (2010) define learning as "changes in children's level of skill, confidence, or knowledge," including cognitive and academic domains (p. 35). The demographic under consideration is children ages 3-5 (preschool and kindergarten age). Although apps can also be purchased on the Google Play Store, this thesis uses Apple's App Store as its primary case because more research and data about it is presently accessible. This thesis seeks to address the current gap of research exploring the realities of the app industry at present and providing potential solutions.

## Research Questions

This thesis seeks to address the following questions:

(1) What are the current concerns relating to the design, regulation, and evaluation of educational apps for young children?

(2) Knowing what we do about how children learn best and the current landscape of the interactive media industry, what are the best practices for designing, regulating, and evaluating educational apps for young children?

(3) How does socio-cultural diversity and socio-economic inequality influence the educational app industry, and what strategies for design, regulation, and evaluation might meet the needs of children from all backgrounds?

## Overview

Chapter two reviews the relevant literature related to the underlying theoretical perspectives and applied issues regarding educational media for children. Chapter three examines matters of designing educational apps, considering the developer's responsibilities and limitations while suggesting possible solutions to their challenges. It also delves into questions of what constitutes an educational app, and offers new perspectives on the traditional understanding of "educational." Chapter four tackles regulation issues, and explores options for how we can monitor and control unsubstantiated claims of educational value. This chapter considers possible government interventions, private organization efforts, and the roles of parents and children in regulating their own app consumption. Chapter five addresses evaluation, highlighting the different perspectives evaluators must take in order to place value on an educational app. This chapter emphasizes that there is no 'one-size fits all' approach to evaluating

educational apps, as context and culture play a large role in determining how a child receives an app. Finally, in the Discussion and Conclusions section, I synthesize all three issues (design, regulation, evaluation) and point out common themes.

**Methodology**

This thesis draws on the large body of academic work written about digital media for children, ranging from quantitative studies measuring learning from apps to qualitative analyses of the current landscape of the digital media industry. In addition to peer-reviewed literature, I use popular press publications, blog posts, and materials published by companies in the industry to provide cases that highlight the way in which this subject plays out in the public-arena. Throughout the research, I consulted with experts working in a variety of settings related to children's media, including research directors at non-profit organizations, experts in learning design, university researchers, and consultants working for private children's technology companies. These conversations informed the organization of the literature review and contributed to an understanding of the overarching themes concerning the current state of the educational interactive media industry. No data was collected from these conversations. Opinions stated are my own, citing relevant published research findings as rationale for such opinions.

## Chapter 2: Literature Review

This literature review covers theories of how we learn through media and theories of how children learn. It provides an overview of how educational products for children have fared in the past, including home videos, toys, and computer games. Finally, this literature review demonstrates the potential power of new media and technologies through applied examples where learning was made possible through educational apps.

### Media and Technology Learning Theory

In his Cognitive Theory of Multimedia Learning, Mayer (2014) argues that media can play a significant role in active learning. His premise is that humans process information using both visual and auditory stimuli, and material presented through a combination of these two cognitive processes is more likely to be retained than one or the other on its own (this is known as the multimedia principle). Mayer advocates for media design that exploits this relationship between visual and verbal processes by balancing the cognitive load on each domain in order to promote more meaningful learning. When designing media for children in particular, it is imperative to consider closely the developmental appropriateness of the cognitive load placed on users, since the processing capabilities of preschoolers are certainly less refined than those of mentally mature adults.

Seymour Papert (1980) presents a child-centric view of learning from media in *Mindstorms: Children, Computers, and Powerful Ideas*. He notes that "in many schools today, the phrase 'computer-aided instruction' means making the computer teach the child…In my vision, *the child programs the computer* and…acquires a sense of mastery over…technology and establishes an intimate contact with some of the deepest ideas

from science, from mathematics, and from the art of intellectual model building" (p. 5). Papert's (1991) theory of Constructionism, inspired by Piaget's (1971) constructivist model of child development, advocates for student-centered, inquiry-driven, project-based learning. Students learn by doing, with teachers available to provide assistance but not lecture or directly instruct. Pairing constructionism with technology has become popular in classrooms, as new technologies are ideal for "learning by making." Papert himself has been involved in many projects to develop coding languages for schools, and began the One Laptop Per Child program to democratize access to these new learning technologies (Goldin, 2014). New technologies provide opportunities that have the potential to go beyond shallow learning of content into deep understanding of conceptual and theoretical material (Papert, 1980).

**Child Development Learning Theory**

There are many theories that attempt to explain how children's learning changes throughout the course of childhood. One relevant theory when studying younger populations is Vygotsky's (1997) Sociocultural Theory of Cognitive Development. This theory addresses natural biological development, socially mediated development, and the active role children play in their own development. Vygotsky suggests that children learn through interaction with their environment, particularly social interaction with adults and more knowledgeable others, all within the context of culture. Children actively participate in constructing their own development, guided by those in their environment, through a process termed 'scaffolding.' The idea of scaffolding is that adults assist children through problem-solving tasks or learning new information by adjusting the difficulty level of the situation to be just beyond what they are capable of doing on their

own. With a more knowledgeable other's assistance, the child can successfully complete this task. It is these moments of microgenetic development that boost cognitive abilities to a higher level and allow the child to complete tasks with more independence (Burns, 2000). This space between the child's current abilities and what they are capable of when assisted is termed the 'zone of proximal development,' or ZPD. Vygotsky (1934) also postulates that children's cognitive development progresses as they acquire more 'mental tools,' for example trial-and-error problem solving and language. Children observe the way individuals operate in their specific culture, and adopt the tools that seem adaptive into their own codes of behavior.

Scaffolding in media occurs through the incorporation of formal features such as visual cues, audio techniques, and overall pacing and presentation of the scenes (Wartella et al, 2000). Formal features range from using repetition, animations on screen, or situating characters on screen so that they appear to speak to the viewer. Formal features are used to direct children to the most relevant information and help them process such information. Preschoolers have much to learn about the rules that govern their environments, and Vygotsky's (1997) theory provides a reasonable explanation for how they come to understand their world: through direct interaction with it and learning from more knowledgeable individuals in their community. Considering the role of digital worlds on children's development, Subrahmanyam (2009) wrote that, as "youth are growing up enmeshed in media, it is evident that interactive media must be viewed as an important social context for development" (p. 1069). Interactive media then, designed by individuals within a particular time and space in a certain community, are embedded with implicit and explicit cultural meaning that may be transmitted to users. It is then key to

consider the implications of both the content and form of interactive media for children, since they may be learning societal norms and valued ideologies through them.

Bandura's (1971) Social Learning Theory is relevant to this thesis as it argues that children learn through imitating models in their environment. Models can range from caregivers to friends to characters on a favorite television show. Under a classical and operant conditioning behaviorist model, through careful observation, children track models' behaviors and pay attention to whether each behavior is received positively or negatively by others in the environment (termed *vicarious reinforcement*). Children then may imitate these behaviors themselves, which will be met with either positive or negative reinforcement. Depending on the result, children may continue or discontinue the behavior.

Similar to Vygotsky's (1997) theory, under Bandura's Social Learning Theory (1971) children may learn behaviors and modes of thought through media consumption. Cohen (2006) explains that in entertainment-education contexts, social learning can be particularly powerful, especially if individuals develop parasocial relationships in which they strongly identify and feel they have a relationship with a character. For example, children watching *Dora the Explorer* may see Dora as a role model and friend because she is scripted to appear responsive to the viewers. She pauses after asking a question and provides words of encouragement like, "*Great job!"*. Apps that encourage social interaction or mimic social relationships (models) have the potential to create meaningful learning experiences.

The interdisciplinary Science of Learning perspective focuses on *how* children learn skills and strategies to thrive in an educational setting, rather than exactly *what* they

are learning (Hirsh-Pasek et al, 2015). Advocates of this approach hold that to create educational materials for children, whether in classroom curricula or interactive media, we must understand the optimal conditions for learning to evoke certain ways of thinking, or cognitive strategies, in children. Pedagogy influences the type of learning that follows. Drilling facts may result in one type of superficial learning where students can regurgitate information, but this differs from collaborative, interactive learning where students must think abstractly and creatively (Mayer, 2011). Science of Learning research suggests that the most successful educational materials are those that require children to be active, interactive, engaged with content that is meaningful to them, and working towards a clear goal (Duckworth, Easley, Hawkins, & Henriques, 1990).

## History of "Educational" Products for Children

**Toys.** Toys have been studied extensively in their relationship to play because they are seen as tools that allow children to construct knowledge of themselves and the world around them (Goldstein, 1994). Companies like Fisher-Price and Hasbro have lines of toys marketed as "educational," and claim to conductive formative assessments with children and researchers to ensure educational value. For example, Fisher Price writes that their baby toys "stimulate growth and learning" (Toys & Baby Gear, 2015). Still, neither the Federal Trade Commission nor the United States Consumer Product Safety Commission has regulated guidelines (beyond safety standards) to standardize what constitutes an "educational" toy (DeCortin, 2015). The U.S. Consumer Product Safety Commission defines educational toys as "toys designed and marketed specifically for academic gains. The appropriateness of these toys depends on the level of cognitive ability necessary to engage in an intended educational way, and the type of material, size,

and number of parts" (Smith, 2002). This definition is unclear in its specification of what constitutes an "academic gain," how companies might evaluate the "cognitive ability" of their intended consumer, and any specifics about how the "material, size, and number of parts" is linked to its educational value. Most educational toys on the market today are so specific in the way they can be used that they do not encourage imaginative use, while more open-ended toys like blocks may contribute to greater creativity and more positive academic outcomes (Trawick-Smith, Wolff, Koschel, & Vallarelli, 2014).

Recently, Fisher-Price has come under scrutiny for their Laugh & Learn brand, which involves physical toys that correspond with iOS apps for iPad and iPhone. For example, the Laugh & Learn Learning Letters Monkey consists of a plush monkey whose stomach is a built-in case for an iPhone. By squeezing the monkey's hands and feet, the child can load different alphabet, counting, shapes, and color games onto the iPhone. Over three million Laugh & Learn brand apps have been downloaded as of 2012 (LaPorte, 2012). Fisher-Price claims to perform rigorous research for its products, but such proprietary research cannot be accessed by the public and therefore it is impossible to know the standards by which the company measures its products. The Campaign for a Commercial Free Childhood (CCFC) has filed a claim against Fisher-Price for this line of toys, citing misleading marketing as its primary grievance. CCFC believes that the educational claims made by Fisher-Price are unsubstantiated, and that the Laugh & Learn brand is more concerned with making a profit than it is educating young children (CCFC, 2013). This case highlights the increasingly integrated nature of "educational" products for children: stuffed animals are no longer static objects, and have become intertwined with new technologies. Already, no industry standards for educational toys are in place,

which is further complicated when technology is thrown into the mix. It has become increasingly important for parents, educators, and researchers to establish methods to evaluate effectively these multimodal products for children, yet no systems are in place to do so.

The LEGO brand models successful educational toys. Through its LEGO Education programs, this company offers, "educational sets, lesson plans and curriculum material, assessment tools and teacher training and support" to bring LEGO building bricks into classrooms of all ages. Their "4C" educational framework makes LEGO successful in educational settings: students (1) connect to the topic with what they already know, (2) construct something with the LEGO bricks, (3) contemplate what they have just learned, and (4) continue by beginning a new task that adds onto what they just did (LEGO, 2016). With this explicit educational framework, the LEGO Learning Institute carefully develops curricula, partnering with schools and researchers, to be meaningful, interactive, and developmentally appropriate. Strawhacker notes, "Although children are *technically* free to build whatever they want with play sets, there is a clear correct way, shown on the front of the box. By extension, the robotic kits and even loose-brick bins, which would seem to offer more flexibility, can sometimes overwhelm children (and educators) who are not used to LEGO without a manual, or who simply find the hardware too confusing to explore without a guide." [1] To ease these challenges, LEGO Education provides lesson plans and guides for educators so that the bricks can be used effectively without minimizing student's ability to play creatively. Lessons span from social-emotional development for preschoolers, to engineering training for college-

[1] A. Strawhacker, personal communication, March 27, 2016

aged students. Notably, LEGO building bricks are the type of open-ended toy praised by Duckworth, Easley, Hawkins, and Henriques (1990), and it is an exemplary educational toy because of its ability to be utilized in a multitude of environments towards different curricular ends. Still, Strawhacker (2016) notes that like any commercial product, "LEGO faces the challenge of weighing its obligation as a world leader in educational experiences against its commercial bottom line." This tension between profit-making and company values reminds us that although a company may have earnest intentions to develop educational products for children, constraints like time and money can force them to make tough decisions about where to invest their efforts—non-profit formative research, or profit-making play-sets partnered with the Harry Potter or Star Wars brands?

**Television and videos.** In 1997, *Baby Einstein* was born. Backed by the Walt Disney Company, *Baby Einstein* home videos presented themes from the humanities, such as classical music, art, and language (Wartella, Richert, & Robb, 2010). The marketing of the videos touted remarkable effects for your children. For example, one video claimed that viewing "will foster the development of your toddler's speech and language skills" (Walt Disney Company, 2006). *Baby Einstein* was just the first of a host of baby-genius video series, which claimed to have educational benefits. These claims, however, were debunked by academics. Zimmerman, Christakis, and Meltzoff (2007) found that viewing such types of baby-videos actually resulted in decreased vocabulary acquisition, while another study found "no evidence that exposure to this [Baby Einstein] DVD over 6 weeks either helped or hindered children's general language learning" (Richert, Robb, Fender, & Wartella, 2010, p. 436). In a study titled "Do Babies Learn From Baby Media?," researchers found that parents often overestimated the extent to

which their babies were learning from watching baby DVDs, and that baby learning in these contexts was ultimately negligible (DeLoache et al., 2010). Consequently, the Campaign for a Commercial-Free Childhood (CCFC) filed a complaint with the Federal Trade Commission against The Baby Einstein Company and The Brainy Baby Company, LLC. The CCFC argued that these companies' claims were deceiving consumers into thinking that their products had educational benefits, when the research suggested the opposite. The FTC responded, agreeing, "advertisers must have adequate substantiation for educational and/or cognitive development claims that they make for their products"; however, the FTC did not demand any action from Baby Einstein (Koelbel, 2007). Still, responding to public pressures, the two companies changed their marketing tactics to ensure that no explicit claims of educational value were made. Instead, they now advertise their products with language about *exposing* children to material, instead of *teaching* it. The Walt Disney Company also started offering refunds to parents who had purchased *Baby Einstein* videos.

The *Baby Einstein* debacle highlights many issues surrounding educational television for children. First, the marketing of these products can be misleading to parents and can garner great success for the production companies. Josh Golin, executive director from the CCFC, commented on companies that use unsubstantiated claims about educational benefits to sell their products:

> [They] exploit parents' natural inclination to want what's best for their children. This often leads to consumers wasting money on products that are completely unnecessary. When CCFC filed its FTC complaint against *Your Baby Can Read!,* a pediatrician told us of a homeless mother whose parents were planning to buy

> the $200 video series for their grandchild – money that could have obviously been spent on more pressing needs. Beyond wasted money, unsubstantiated marketing claims may also mislead parents about child development. Marketing often mimics the look and language of real academic research – *Your Baby Can Read!* talked about a window of opportunity for learning, and *Baby Einstein's* original marketing looked very much like real scientific research about babies' brain development.[2]

Garrison and Christakis (2005) also agree that claiming educational value on screen media products for babies is a way for companies to take advantage of parents' fears that their child is falling behind their peers. The Kaiser Family Foundation (2003) found that a majority of parents (58% of those surveyed) thought that "educational" television was *very* important for children's intellectual development. This belief, coupled with the persuasive marketing behind educational media for children, reveals why these products are so commercially successful: in 2003 in the United States, 32% of newborns had a *Baby Einstein* video in their home (Lewin, 2003).

Second, the content of allegedly educational media for children is not always supported by the research. In a content analysis of 56 baby videos similar to *Baby Einstein*, Fenstermacher and Barr (2009) concluded that baby videos were deficient in both educational content and developmental appropriateness. The curricula were lacking, and the way in which the material was presented was not aligned with any infant learning theory. On commercial broadcast television stations, only one in eight television shows labeled as "educational-informational" were found to actually have high educational

[2] J. Golin, personal communication, April 1, 2016

value by researchers Wilson and Kunkel (2008). Not only are these products capitalizing on parents' anxieties for profit, but also the product itself may not be addressing the issues concerning parents.

In contrast, research on the television program *Sesame Street* provides empirical evidence that children can and do learn from exposure to educational television that has been carefully designed. The researchers at *Sesame Street* pride themselves on conducting formative and evaluative research for all of the media they distribute to ensure quality. In the "Recontact Study" by Huston and Anderson et al. (2001), researchers re-located 570 teenagers who had watched the show as children to answer "How do adolescents who were frequent viewers of *Sesame Street* at age 5 differ from teens who had viewed the program rarely in their preschool years?" (p. 136). Frequency of viewing was used to examine the long-term relationship between watching as a child and later academic achievement, motivation, creativity, and attitudes. The results showed that teens who watched more as preschoolers had better grades in each core academic subject, read for leisure more, perceived themselves as more competent, and predicted lower levels of aggression in boys. The researchers note "all of these patterns occurred when groups were statistically equated for parent's level of education, birth order, site, and sex." (p. 140). Therefore, early exposure was the most significant factor in later outcomes. Television, then, *can* be valuable to children's development—but content and form are deciding factors in whether or not a program has educational value.

**Computer and video games.** Computer and video games for children have the potential to be educational because they require interaction, can be motivating and satisfying, and can accommodate many types of learning styles (Kebritchi & Hirumi,

2008; Gee, 2003). Papert (1998) writes, "serious players of videogames get their glory largely from being the first on the block to master the game that just came out, and this means that kids have a powerful incentive to get good at learning well and quickly" (p. 88). Educational value, however, is really contingent on design. Fisch (2005) notes that "the simple presence of educational content in a game does not guarantee its efficacy," and suggests three guidelines for designing educational computer games (p. 56). The guidelines are (1) match curriculum to the most appropriate medium, (2) educational content should be at the heart of game play, and (3) games should be scaffolded with feedback and hints to support children's learning. Many educational games, however, have no pedagogical foundations for learning: in an analysis of 55 educational video games, only 22 were grounded in learning theory (Kebritchi & Hirumi, 2008). Moreover, less than half of designers responsible for the 55 video games studied made available any information about the pedagogical basis for their games. This lack of inforation is problematic for games that market themselves as "educational," as consumers do not know what research went into the development, and difficult for academics who want to isolate variables and evaluate the effectiveness of the games on learning.

Webkinz World, an online virtual world website, encourages elementary aged students to purchase a stuffed animal and register it online. Once registered, users gain access to Webkinz World, where they can play games and activities to earn KinzCash. KinzCash can buy food, toys, and other objects to take care of your virtual pet. Webkinz calls itself "educational," "age-appropriate, [and] curriculum-based" (Ganz, 2010, Take a Tour; Ganz, 2011, FAQ). As Fisch (2005) noted, however, educational content does not always equate to learning. Reich and Black (2012) found that despite Webkinz's

alignment with age-appropriate curricula, the pedagogical approach is not developmentally appropriate considering their target audience. The activities on Webkinz demand class-inclusion and perspective taking capabilities that are beyond the typical cognitive ability of an elementary-school student, "without offering feedback, scaffolding, or guidance to support children's skill in these domains" (p. 136).

Still, children as young as preschool aged may be able to develop cognitive skills through playing well-designed computer games. For example, over five weeks Thorell (2009) studied preschoolers playing CogMed software, designed to train visuo-spatial working memory. CogMed is made up of a series of increasingly challenging tasks meant to train executive function (EF) skills, such as showing items on screen and asking users to remember both the location of the item on the screen *and* in what order the items appeared, targeting working memory. Working memory training had significant effects on preschoolers' performance on the same executive function tasks over time. Also, research suggests that training in EF may increase task-performance, but that these improvements may not always transfer to gains in areas like fluid intelligence (Harrison et al, 2013). Still, the finding that working memory training *can* have an effect shows that not just content information, but cognitive processes can be taught and improved through interactive media and technology.

**Potential of Educational Apps**

Despite the many complications that arise when trying to develop an educational app, it is not impossible. In fact, educational apps can be used to benefit some of our most in-need populations. Although it is difficult to prove any direct causation of academic or cognitive outcomes, researchers can study correlations and trends amongst children who

use educational apps versus children who do not. Still, there is a lack of research that has sought to do either of these types of studies. Much of the evidence is anecdotal, and there has been little systematic review to evaluate whether or not these "educational" apps are really educating children at all. Despite this issue, developers and researchers continue to believe in apps' potential because of the unique affordances for learning they offer, including interactivity, portability, usability, and customizability (Gee, 2003; Judge, Floyd, & Jeffs 2015). To highlight the potential for educational apps, here I examine several examples in which apps have been used successfully towards mathematics and literacy education.

**Mathematics learning with apps.** Children have been shown to improve their mathematics understanding through playing educational apps. Zhang, Trussell, Gallegos, and Assam (2015) conducted pre- and post-tests with an inclusive fourth grade classroom. Some had disabilities ranging from dyslexia to autism, or were identified as at-risk due to financial or behavioral circumstances. The researchers measured whether playing math applications that used scaffolding would support decimal and multiplication learning. All students' improvements in the post-test were statistically significant, and the achievement gap between the typical and the struggling learners was lessened. Kiger, Herro, and Prunty (2014) conducted a mobile learning intervention (MLI) where math applications on the iPod touch were integrated into third graders' daily multiplication review. Students who received the MLI out-performed other students in math achievement, controlling for variables like home iPod touch use and prior achievement. The MLI was also found to be a statistically significant variable on the most challenging multiplication problems.

**Literacy learning with apps.** Several studies have also examined educational apps that benefit literacy skills. Kucirkova, Messer, Sheehy and Panadero (2013) found that Spanish 4-5 year olds had high engagement while playing a story-making app, and exhibited joint problem-solving and collaborative engagement. Story-making apps may promote pre-literacy skills, and the researchers argued that the open-ended nature of such apps stimulates creativity. For PBS Kids and WGBH, Rockman et al (2010) evaluated *Martha Speaks: Dog Party* and *Super Why*, both educational literacy apps. For their assessment, they had 90 children (ages 3-7) play the apps over two weeks. In comparing pre- and posttest results, a majority of children improved on reading skills and content knowledge, and all ages made vocabulary gains (Judge, Floyd, & Jeffs, 2015; Chiong & Shuler, 2010). Neuman (2015) used the literacy app *Learn with Homer* in 10 Head Start preschool classrooms, and found that playing the app significantly increased phonological awareness and understanding of print concepts. This app attempted to address the 'app gap', referring to the lack of access that low-income families have to educational apps. The study showed that implementing early digital interventions in the classroom might address some of the challenges children from low-income backgrounds face by increasing school readiness.

**Defining "educational" apps.** Historically, the term "educational" has been widely applied to children's products as a marketing tool, yet our understandings of what "educational" really means are diverse and divergent. Chau (2014) collected definitions of "educational" from a multitude of academic and industry sources, finding understandings ranging from a product that "engages children in learning and applying skills to real-world problems" to products focusing on "learning" instead of "winning."

Even within these definitions, many questions arise: what "skills" do they mean, and how do we measure "learning"? To some, "educational" is a label restricted to something that teaches academic content like mathematics or science. To others, "educational" might mean something that inspires curiosity and engagement with a subject, academic or not.[3] Throughout the thesis, I will discuss the implications of the term "educational" on developer's own interpretations, how our understanding of this label might change depending on the specific child, and if we can possibly come to a universal understanding of what constitutes an "educational" product in light of all this variance.

[3] M. Robb, personal communication, February 16, 2016

## Chapter 3: Designing Educational Apps

Before strategizing on how to evaluate and regulate educational apps, one must understand the design and development process. With the upsurge of interest in coding and Apple's openness to independent developers, publishing an app has become feasible for an increased number of individuals, regardless of affiliation with a major production company. The Joan Ganz Cooney Center reported that in a study of the 196 most popular paid-apps available, 109 different publishers were represented, revealing a difference between television or toy markets where a small number of companies produce the majority of popular products (Shuler, 2012). Because the process of production has been democratized in this way, there has also been a notable increase in the number of apps being developed. In May 2015, 53,942 apps and games were submitted for approval by the App Store, which was growing by 1000+ apps per day (App Store Metrics, 2015). With a growing number of separate entities producing apps at such accelerating rates, streamlining standards of design and development becomes nearly impossible, as each producer has its own unique intentions, resources, and constraints. In addition, the process of developing an *educational* app for children, as opposed to something like a productivity app for adults, is even more tasking on developers at all stages. To mark an app as educational means that the developer has, hopefully, the intention of providing a learning experience for the user; however, developers may not always have these intentions in mind (and instead be interested in simply making a profit) when labeling their apps "educational." Even well meaning developers may not have put the time or resources into making sure their app actually has educational value. This chapter presents some of the recurring themes related to issues of educational app design that emerged in

both my discussions with experts and my research of existing literature. Within each theme, I explore the related conflicts facing developers and potential solutions to improve the quality of design for educational apps for children.

**Situating the Developer**

Educational app developers are at the crux of design issues. They are ultimately responsible for what an app is, and are the reason why the market has become so inundated with products of varying quality. We cannot generalize who developers are— some are working at high-tech software development companies for contracted clients, while others are independently working out of their own apartments, financing themselves with their own capital. All developers have their own motivations for putting out an educational app, and different resources at their disposal. Still, all developers have a responsibility to their product. If we want the educational app market to be populated with good choices, it is essential for developers to hold themselves accountable to standards of excellence. Of course, 'good' is a subjective term, but for my purposes I will consider a 'good' educational app as one that does, in fact, have educational value as marketed. Educational, as defined previously, will be understood as a product contributing to learning through improved cognitive or academic outcomes.

If we assume that most developers have intentions of actually putting out a good educational app, then one solution might be to ensure developers are testing their apps before putting them on the market to test the legitimacy of their educational claims. This task is easier said than done. Unfortunately, the reality is that many developers do not have the resources— time, money, or research expertise— to evaluate their own apps. 55% of developers are making merely $1000 per month, with independent developers

making the least money, at around $1500 a month (InMobi, 2016). For context, one consulting group charges $399 for four hours of user testing, a written report on strengths and weaknesses, and two email or phone conversations (Clare, 2014). Also, short development timelines in industry do not provide the luxury of time to test many versions of one app to ensure perfection before placing it on the market.[4] Then, there is the larger problem of proving educational value at all, considering the many variables at play when a child uses an app. This problem includes the fact that children play apps at home, in school, with or without adult presence, with or without previous exposure to similar technologies, and more. It seems then, that we may never be able to isolate exactly what it is about an app that makes it successful or unsuccessful. Taking all of these difficulties into account, how can developers possibly begin to take on the task of creating a good educational app?

**The Role of Outside Institutions**

One solution to the developer's challenges may be found in collaborations with institutions such as universities, schools, and non-profits. While contracting a consultant through a private research firm may be costly, partnerships often come for free. Developers and academic institutions may form synergetic, mutually beneficial relationships through collaboration.[5] Working with academics and educators, developers can receive guidance related to both form and content throughout each stage of app development. Academics may provide insight into learning science and developmentally appropriate practice, while educators may provide an understanding of appropriate curricula and content for the targeted audience. Developers can then cite their educational

[4] C. Wong & M. Kaplan, personal communication, February 29, 2016
[5] A. Sullivan & A. Strawhacker, personal communication, February 19, 2016

goals, with evidence that they worked with sources of authority on the matter to try to achieve them. These partnerships with experts can help legitimize educational labels, even if causational proof cannot be found. By working with partners along the way, the app itself will have educational principles built into its core, which is already an improvement from no consideration of pedagogy at all. With collaborations comes a need for transparency about any funding sources and key stakeholders or players involved, and documentation of the steps taken to try to make the app educational. Although not a flawless solution towards improving the quality of educational apps, since it would not necessarily result in empirical evidence, it may be the most realistic option for developers on a budget.

Aside from providing validity to developers' work, collaborations would benefit the entities with whom they partner. If developers want to cut costs, they need to make their partners feel that they are equal stakeholders in the product so that they will consult and evaluate for little to no cost. Acting as free consultants to app developers is potentially feasible for academics and educators since they already have a primary source of employment, so perhaps it would not seem like sacrificing a profit by providing this service for free. Rather, this work might be seen as supplementary to their professional careers and come with non-monetary benefits. The incentives for university academics to go in on these collaborations could include the opportunity for increased recognition, access to data for research publications, and the occasion to put their theory into practice. Nelson (2016) writes that these "models enable university-based researchers to partner with established organizations, the university researchers offering radical new ideas and established enterprises bringing expertise in product development, marketing and other

skills… university researchers tend to share for the inherent rewards tied to sharing itself, such as their passion for seeing a field of research grow or the positive reputation they may build as others learn of their work" (p. 1). Nelson also notes that because universities exist to produce research while educating students, many professors may enjoy collaborating on these types of projects because they present the chance to involve their undergraduate and graduate students in applied work. These students will then carry the knowledge they gain from these hands-on experiences to their careers post-graduation.

Regarding teachers working in schools, the chance to bring technology into their classrooms and to bring a voice to their students needs may incline educators to join these partnerships as well. There are groups that exist to foster these types of collaborations by contributing funding from private donors or public foundations to remove cost barriers. The Sprout Fund in Pittsburgh seeks to connect educational technology developers with educators and their students in order to conduct user testing and develop curriculum design around their products. The services provided by The Sprout Fund to educational technology developers can amount to $10,000, while educators involved receive training on how to implement the technologies into their classroom lesson plans (Sprout Fund, 2015). Groups like The Sprout Fund benefit all parties involved, though these groups themselves rely on outside funding support—but perhaps apps developed through cooperation between industry, academia, and schools are likely to have more educational potency and attract interest from those with funding. Edward Metz from the Department of Education notes, "10 years ago, the question was, 'Are games appropriate for education?' Now, that question has been replaced by, 'How can games be optimized to impact learning — both in providing individualized learning opportunities for students

and in being integrated into classroom practice and providing real-time data that teachers can use to guide instruction'… developers are partnering with education researchers to iteratively develop the games based on feedback from initial student and teacher users" (Crawley, 2015, p. 1). As more developers begin to understand the need to root educational app design in learning theory and turn to professional educators and researchers for advice, better apps will populate the market. Now, I turn to the specific considerations regarding content and form that shape whether or not an app has educational value.

**Designing Playpens or Playgrounds?**

In her book *Designing Digital Experiences for Positive Youth Development*, Bers (2012) distinguishes between two camps of digital media and technologies for children, the Playpen and Playground. This perspective may be useful to developers as they clarify their intentions while designing an educational app. Bers builds on the work of developmental psychologist Erik Erikson (1994), who posited that the primary conflict of preschool aged children is to develop a sense of autonomy while avoiding shame and doubt, and that for kindergarteners it is to develop initiative without feeling guilt. Using this framework for development, Bers (2012) argues that some digital spaces encourage play that contributes to autonomy and initiative while others act as a hindrance. Digital spaces that are "playpens" place restrictions on the types of interactions children can have that do not encourage the most important skills needed at this age. While many educational technologies marketed to children seek to teach pre-academic content like shapes, colors, or numbers, Bers contends that these "are not the most important milestones for children in this age range…a time for free exploration, for testing

boundaries…taking risks in a safe way, for engaging in pretend play…[and] for solving problems" (p. 23). She does not believe these types of digital experiences are harmful, but rather that they may have less developmental value. In contrast, a "playground" digital space allows children to imagine, explore, create, and take risks within safe boundaries. Children are given control of play aspects such as what to do and the pace at which they want to do it within the fences of the program's limitations. For example, in many art maker apps, children are given an abundance of tool options to make their creations—they can choose their medium (paint, crayon, pencil, etc.), the width of the lines, the colors. They can add stickers or animate their drawings, or add in background images and sounds (see *Sesame Street Art Maker*, *Nick Jr. Draw & Play*, or *Disney Creativity Studio* for examples). From Bers' view, this type of app is more developmentally appropriate for a preschooler or kindergartener than an app designed to drill math skills or teach shapes because they promote autonomous decision-making and initiative taking through creative play. For a child this age, apps that encourage these behaviors *are* educational, even though the type of learning they promote goes beyond traditional notions of what educational means.

Thus, when designing educational apps for young children, developers must take into consideration the developmental stage of their target consumer and their specific learning goals. There may be some cases where a digital playpen is appropriate for a certain context when a child has already mastered a skill and the game is simply for rapid review; however, to promote positive child development, academic curriculum like letters and numbers can be incorporated into a digital playground experience where learning is made meaningful, and socio-emotional development is simultaneously stimulated.

**The Relationship Between Educational Content and Learning**

It is also essential for educational app developers to understand that the inclusion of educational content in an app does not automatically equate to learning, and that learning can still occur when content does not appear specifically educational from a conventional perspective. For example, a racing game that asks children to collect all the number threes they see as they drive may not actually teach the child anything about counting. Learning comes from social, meaningful, and engaging experiences where the material presented is connected to our previous knowledge and is made compelling enough to keep the learner on task (Hirsh-Pasek, 2015). Conversely, an app without explicit "educational" content may contribute to learning. Or, consider a seemingly meaningless app like My Talking Tom, the top selling game in 135 countries, which allows users to poke and prod at a cartoon cat to elicit goofy facial reactions and sound effects (My Talking Tom, 2016). When the cat is tugged on or poked, he responds with an unhappy reaction. If fed a treat, he responds with joy. One could argue that children playing this app may be learning appropriate social behaviors and how to read emotional cues. Might Talking Tom be considered educational by simulating social interaction and engaging users?

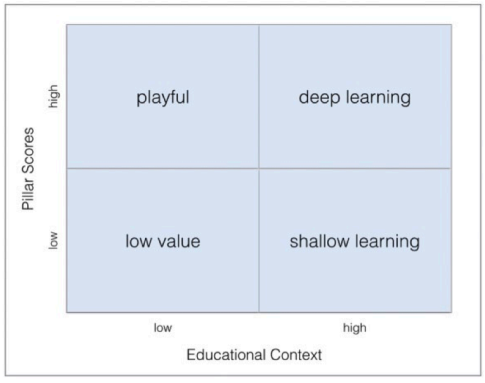
Therefore, developers should understand that if they intend to design an educational app, simply tossing in the ABCs or 123s is not enough. If they want apps that are genuinely educational, they must root their design in the learning sciences. Jean-Baptiste Huynh, an educational app designer, says:

> You don't start with a story…you start really with pedagogy. First, you take what you want to teach or what you want kids to learn, and you create what I call a digital manipulative. You design a virtual object with the characteristics, the

> features, of the real objects. If you want to manipulate triangles, then you have to design a way kids can manipulate triangles. It's an engineering problem (Crawley, 2015, p. 1).

Building around pedagogy and considering how the subject would be taught in a classroom may be a valuable first step in planning how to deliver educational content through a technological medium.

Hirsh-Pasek (2015) has designed a matrix using learning science to evaluate the "pedigree" of an educational app, which may also be a useful resource for developers. The system rates apps on the four core pillars of learning under the Science of Learning perspective: active involvement, engaged learning, meaningful experiences, and socially interactive. Then, context is considered. Apps that are designed to have scaffolded exploration towards a defined learning goal are considered more educational than those that do not have explicitly defined learning goals. Considering both the pillar scores and the educational context, four rankings can be assigned, as shown in the figure below: low educational value, playful, shallow learning, and deep learning. If developers design around these principles and take careful consideration of what their learning goals are, then they can produce an educational app more likely to result in real learning.




Hirsh-Pasek's (2015) Matrix; See also Appendix Figure 1

There is, however, tension between this evaluation system and Bers' Playpen v. Playground theory (2012). Hirsh-Pasek (2015) reveals her conception of what "educational" means in her suggestion that when designing towards a learning goal, "one of the easiest ways for app developers to make the claim that an app is educational is to make sure that it includes 'educational' content such as *numbers* and *letters*" (p. 25, emphasis mine). If deep learning occurs when there are explicit learning goals, then how do we account for the value of digital playgrounds, which are, by definition, open-ended and non-explicit? This calls for a reconceptualization of what learning goals can look like: perhaps they can become understood as dependent on the developmental stage of those working towards them. It is possible to define a learning goal within a digital playground environment; the challenge is that most of these goals support learning that may be difficult to measure, such as increased creativity, curiosity, or independence. Are these skills any less valuable than knowledge of letters and numbers? Remember that in Erikson's theory (1994), the principal task for a 3-5 year old is the development of autonomy and initiative. If an educational app contributed to the resolution of this age group's primary developmental conflict, then it would certainly be fair to call that a learning experience, even though the change may not be overtly quantifiable. There needs to be a looser definition of "learning goal" in order to accommodate the different types of learning that are salient to particular developmental stages. This may also contribute to a broader shift in our cultural conception of what content knowledge or skills are valued. Ideally, we can move towards a whole child approach that goes beyond using measurements of academic performance as the only indicators of successful development.

**Play for Play's Sake**

Looming over the design process are anxieties about children's education and the future of American society. Schuler (2012) reported that apps for toddlers and preschoolers account for 58% of the top 25 apps for sale, with this percentage increasing by 20% from 2009 to 2011, and the numbers continue to grow. Why are so many developers eager to produce "educational" apps? The surface-level answer to that question is that educational apps sell, so developers are very interested in making them.

Then, we must answer *why* do they sell? In the age of Common Core standards and high-stakes testing, we have seen an increase in anxieties surrounding the preparation of our children for an uncertain future. Popular press articles blast headlines like, "American Students Fall in International Academic Tests, Chinese Lead the Pack," "U.S. math and science scores rank 'at the bottom' of industrialized countries," and "U.S. Millennials Come Up Short in Global Skills Study" (Bidwell, 2013; Madsen, 2014; Sparks, 2015). The NORC Center for Public Affairs (2013) found that surveyed parents "report[ed] generally favorable views of their local schools, but when asked specifically about outcomes, less than half think the schools do a good job preparing students for the workforce or giving students the practical skills they will need as adults," and most felt that preschool was an extremely important influence in a child's later success (p. 1). This fear of children falling behind has parents scrambling early to provide extra supports to their children's education, from after-school programs to educational technologies. Joshua Sparrow (2014) from Harvard Medical School notes that parents who are "naturally anxious to do everything in their power to maximize their children's potential and raise them to be successful adults in a highly competitive global marketplace… will

err on the side of exposing their infants and toddlers to products claiming to accomplish [educational] goals" (Linn, 2014).

Nevertheless, when we look at the international picture, many other countries appear to be far less preoccupied with these concerns, and they are actually performing better. In Finland, where students consistently outperform US students in mathematics, literacy, and science, preschool and kindergarten curricula focus on play. In Denmark, another country producing high academic achievers, "there is a deep-seated belief that play somehow *is* learning, and it is the work of children to play in whatever way makes sense to them. To derail them from their activities to explain something or offer advice would simply be to stop them in their unique pathway to knowledge, and they believe that rigid instruction is a potentially harmful way to interact with a young child".[6] Research supports the idea that play has short and long term benefits on children's socio-emotional, cognitive, and physical development because it allows for trial-and-error, role-play, and exchange of cultural norms and values (White, 2013; Vygotsky, 1978). Similarly, Chinese and Japanese preschools have play-based, open curricula, and their students go on to have some of the world's highest math and science scores (Tobin, Hsueh, & Karasawa, 2009; Stevenson, Chen, & Lee, 1993). Plowman, Stephen, and McPake (2010) note that play is "fundamental to intellectual development" (p. 49).

Knowing this, perhaps our fascination with educational media and technologies for young children has transgressed the border from well intentioned to needlessly obsessive. With all of the dialogue on what is or is not preparing our children for the 21st century workplace, maybe we have lost perspective on what childhood should be. We

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[6] A. Strawhacker, personal communication, March 27, 2016

understand, and the evidence shows, that play for play's sake is not harming children's future academic performance. In fact, it is probably positively contributing to it. Yet, at the same time, when all play is considered learning, it becomes difficult to draw the line: Strawhacker noted from her work in Danish schools that in play-centered curricula she "did not observe any decrease in children's obsessive tendencies around mass-media symbols" such as *Star Wars* or Disney's *Frozen*, whose commercial products were placed in the classroom's learning centers alongside manipulatives and building blocks.[7] How do we allow children to be children while also preparing them for the challenges ahead?

Striking a balance between play and curricula is the type of learning environment advocated by Bers (2012) in her Playpen v. Playground theory. Developers who want to positively contribute to the market may then want to reevaluate their own understanding of what is appropriate and beneficial to young children's development. As noted, while apps that do target specific educational goals have great value, they are not the only types of apps that should exist for children. Instead, children should have access to a variety of digital experiences that range from structured learning to informal play. There is no one-size-fits-all when it comes to what is best for children's learning, and if we want to combat the achievement gap between United States and international students then perhaps we should learn from their example and move towards a more play-based curriculum, with some structured academic experiences, in early childhood education.

[7] A. Strawhacker, personal communication, March 27, 2016

## Chapter 4: Regulating Educational Apps

As discussed in Chapter 3, new apps continue to populate the App Store at increasingly quick rates, which has some individuals and organizations concerned about the quality of products being introduced to the market. Educational apps have fallen victim to many of the same challenges as educational toys, videos, and computer games. With the label of "educational," certain attributes are implied about a product. To call one's product "educational" is to claim that it has been tried, tested and proven to have learning outcomes; but, as we know from reviewing the issues during the design process, this simply is not true of many "educational" apps. Thus arises the idea of regulation: is there a way to place restrictions on the market in order to ensure that only legitimately educational apps are made available for purchase? The Federal Trade Commission prohibits deceptive acts or practices that involve a product's "failure to perform promised services," yet laws are currently only in place regarding "food, drugs, devices or cosmetics" (FTC Policy Statement on Deception, 1983, p. 1). The FTC applies these rules in cases where it seems the deception may be likely to sway the consumer's choice whether or not to buy a product. Considering that 50% of parents believe that apps have the potential to be educational, and that the top selling apps for children fall under the App Store's Education tab, it seems that parents are buying into the marketing of educational apps when making choices about their children's media consumption (Chiong & Shuler, 2010). Therefore, if apps are marketed as educational, and this unsubstantiated claim is swaying a parent's choice to purchase the product, then under the FTC's logic, this practice is an act of deception. With another type of product, this

same practice would be illegal. The question becomes, is there anything we can do about it?

**Marketing Practices and Point of Sale Information**

The strictest response to unregulated educational apps for children would be to assess each app's claims before allowing it to go to market. However, no public or private organization has the resources to take on such a task. The unique challenge posed by apps that makes putting this into practice nearly impossible is the sheer volume of apps available for purchase-- 1000+ apps are approved to sell on the App Store per day, adding to the 80,000 "Education" apps already available for purchase (App Store Metrics, 2015). Also, to try and approve each app as it is introduced to the market would be a monumental task for which no agency or individual has the resources or time.

The next response then, that is more realistic, is to expand and enforce stricter Consumer Protection Laws to attempt to regulate deceptive marketing of products. Instead of hampering individual freedom to create and share apps, we might instead take a more serious stance on the way in which "educational" apps are advertised to consumers. App developers have every right to make whatever app they choose, but when unproven claims are made, it seems fair to have measures in place to regulate this. As discussed, the Federal Trade Commission prohibits deceptive marketing practices with any other commercial product, so there is no reason why apps should be excused from these same regulations, especially considering the massive nature of the app economy-- Apple makes $20 billion in revenue yearly through the App Store (Apple, 2015). This huge part the United States economy has thus far gone fairly unregulated. In Apple's own App Store Review Guidelines (2016), Section 2.3 states, "Apps that do not

perform as advertised by the developer will be rejected." Despite this, the App Store continues to have 80,000 "Educational" apps available for download, and the likelihood that all 80,000 apps actually have proven educational value is minimal. Because we cannot regulate the production of educational apps, we should regulate the language with which educational apps are marketed.

There are several avenues through which regulation can be accomplished. First, the Federal Trade Commission can update its guidelines to include app-specific regulations. These regulations can specifically target the wording of descriptions and advertisements for apps. App developers should not be able to use the term "educational" if no testing with explicitly positive outcomes has been performed. Note that this is essential because many apps might claim to have done research on their product, but do not provide the results of such research (e.g., Fisher Price Laugh & Learn "educational" toys). Thus, developers could say they are research-based, but without access to the research the consumer is left to wonder whether the results actually confirmed educational value or not. Also, language that claims that the app "teaches, "improves," "develops," "trains," or any other synonyms implying causality should be prohibited in the FTC guidelines. Instead, marketing efforts may suggest that the app "exposes" children to certain content or allows them to "practice" educational concepts, thus the implication is not "if your child plays this app they will absolutely learn this concept." The challenge to this approach is that individuals or organizations would still have to notice this type of behavior and file claims with the FTC in order for an investigation to be conducted, which means many apps may slip through the cracks and that processing time may lead to significant backup in addressing each claim. Individual cases may be

brought to the FTC for review, as it happened with the *Baby Einstein* franchise, but this was in large part successful due to its debunking through academic research. Again, the challenge of under-staffing occurs. The FTC might put these regulations in place, but enforcing them would be difficult. The idea of government intervention in general may be unrealistic and idealistic. Still, putting such regulations in place may discourage this type of language in the first place, as developers may be afraid that they will be the ones to be exposed. Also, there are ways for distributors, private organizations, and caregivers to play a role in regulating the app market through other strategies so that consumers know if what they are purchasing has real educational value.

Another, perhaps more feasible, solution is that distribution platforms like the App Store or Google Play Store could attempt to institute stricter vetting processes for the apps they choose to approve for sale on their stores. If these platforms want to maintain their reputations of excellence and high-quality products, then they certainly do not want to face backlash for promoting apps that make false claims and deceive consumers. In a Charles Darwin University survey of 80 parents about their attitudes surrounding educational apps for preschoolers, most agreed that they were assistive to children's learning, appropriate for preschoolers, and that educational media was useful for teaching "literacy, numeracy, science, and art" (Disney & Geng, 2014, p. 5). As the educational app market continues to boom, ensuring quality will become more essential to meet parent's performance expectations for these types of products. Currently, the App Store's existing guidelines for Kid's apps are limited (see Appendix Figure 2), only concerning themselves with privacy and advertising. Section 24.4 does say that "Apps in the Kids Category must be made specifically for kids ages 5 and under, ages 6-8, or ages 9-11,"

but what criteria developers are intended to use to determine the age demographic of their app are left unstated (Apple, 2015). The app distributors might increase the rigor of their internal review processes, and make their criteria available at the point-of-sale for consumers. For example, if an app has been research-backed, this information could be included on the download page, or a certain "Seal of Approval" could be displayed to show that the app has met their quality standards. Similarly to The Children's Advertising Review Unit (CARU), the children's app industry could attempt a type of self-regulation in which a bureau is established, managed by experts in the fields of education and child development, to investigate claims made by educational app developers. The CARU makes note that their "guidelines are deliberately subjective, going beyond the issues of truthfulness and accuracy to take into account the uniquely impressionable and vulnerable child audience" (About CARU, 2012). This same idea should apply to any type of organization planning on regulating apps for children, considering that both parents and children may take claims of educational value as truth without question.

Because any of these strategies would take a large amount of personnel and time, another answer could be to require a submission of more detail from the app developers about the steps they have taken to make their app educational, including their design process, with whom they consulted, whether they received funding from any groups, and what their curricular goals are. The distribution platforms could then make this information available to consumers for their own viewing when they are deciding to purchase an app for their child. The downside to this solution, however, is that it places a large burden on parents to do the work of deciding what is a quality app on their own,

and as I will show, many parents are not confident in their ability to make these choices for their children.

**Parents As Gatekeepers**

In a survey of over 2,000 parents, representing more than 4,000 children, researchers found that the majority of parents believe that mobile devices can help their children learn academic skills and content in a fun way. Parents of the youngest children seem to feel the most strongly that there is educational value in the mobile apps they purchase for their children (Grunwald Associates, 2013). Revealing a disconnect, many parents report that they feel unsure about the educational value of many apps: parents believe that they apps *they* choose for their children are educational, but as a whole have some distrust of the industry. Additionally, many parents, particularly from lower-income families, report that they turn to educational television or digital technologies because they feel it will have a "very positive" benefit to their child's reading, speaking, and math skills (Wartella & Lauricella, 2013). Parents feel concern that their child will fall behind if they do not become competent in new technologies, as highlighted by one mother who commented about her toddler, "Sometimes I wonder if my daughter is losing out because she doesn't know how to use an iPhone" (p. 23). Ultimately, parents are the gatekeepers when it comes to their children's media use. They have the purchasing power, and the survey data indicates that most parents believe that technology can have positive educational effects. But how do we make their jobs easier and ameliorate some of the anxieties that come with a rapidly changing tech-landscape and a seemingly endless supply of options?

If distribution platforms do increase the information available about the development of an educational app, that does not necessarily translate to parents piecing through this abundance of information to make the most informed choices for their children. Many parents do not have the luxury of time to read through lengthy reviews, or they want to do the research but do not have the background education to know how best to do this. Perhaps regulation is partially a parent's responsibility, since they are ultimately the ones bringing educational apps into their children's lives, but this does not account for either the varied understandings different parents have about what is beneficial to children, nor the exposure children might have to educational apps outside of the parents' domain at school, child-care, or from their peers. Also, each parent might have his/her own definition of "educational," or different perspectives on what constitutes "moderation" in consumption. Survey results from Wartella & Lauricella (2013) highlight the differences amongst parents in their attitudes about media and technology; for example, there are 'media-centric' parents who both use media themselves and believe media has an important place in their children's development, 'media-moderate' parents who only sometimes use media and allow it for their children, and 'media-light' parents who spend very little time using media and have less media in their homes. Notably, 'media-light' parents were the most economically advantaged, politically and religiously conservative, educated, and white. I will address the social, economic and political dimensions of media use in the next section.

To reiterate, this situation may be addressed through participation of academics, educators, and non-profit organizations devoted to understanding and evaluating children's media. Later, I will discuss ratings systems for evaluating the quality of

educational apps. What is essential about these ratings systems regarding regulation is that they are clear, concise, and accessible in order to assist parents in regulating their own children's media use. Esoteric curriculum language such as "executive function," "phonological awareness," or "spatial relations" may feel like a foreign language to parents who just want to know if their child is being exposed to developmentally appropriate concepts for their age. If those with expertise in early childhood education can publish ratings and reviews that parents can easily understand and trust, maybe they can help to lighten the load. Although parents may be tasked with the final say in deciding what to purchase for their child, these types of resources may help them to regulate their purchasing and child's media consumption by allowing them to make informed choices.

**Democratizing Usage**

As mentioned previously, low-income and minority parents are most likely to consider educational media and technology as effective "teachers" for their children, raising questions about how we can increase access to resources for the families in the most need. Some parents are not present for their children's app usage and some do not know that some apps may have educational value while others do not. Wartella and Lauricella's (2013) survey showed that media-centric parents are overwhelmingly single and have lower-incomes than media-moderate and media-light parents. The researchers suggest that these factors may contribute to a parent's greater reliance on screen media to babysit their children, since the parents may be able to spend less time with their child. Reading reviews on the App Store or on Common Sense Media may not be a priority or be feasible for parents who are single, working multiple jobs, or who do not speak

English as their first language. I have also discussed how educational apps may promote non-traditionally academic types of learning, which to many parents, may not be seen as educational. A parent does not necessarily understand that socio-emotional learning and creative play may be more beneficial to early childhood development than learning academic content, especially considering parent's anxieties that their children may be falling behind on the competitive international landscape. While the term 'App Gap' has historically referred to socio-economic discrepancies in access to interactive technologies, prices have decreased and access has actually become relatively democratized: what still remains are disparities in usage (Kabali, 2015). While low-income parents believe in the power of educational media for their children, the way they are utilizing it is not, in practice, always ideal for learning. Shuler (2010) has commented on the 'passback' effect where parents hand their children devices (that were not necessarily designed for them) in order to occupy them "in grocery stores and on the subway…at shopping malls and in coffee shops." In these instances, the device is being used as a distraction so that the caregiver can focus on their own task at hand. But, based on what we know from child development theory, placing a child in front of a television screen as a babysitter is not going to be as educationally effective as scaffolding an interactive app experience with the child (Vygotsky, 1997). We need to democratize usage of educational apps so that all children can benefit from their potential for learning.

It may be useful, therefore, for organizations to publish multi-language resources that provide suggestions for ways of interacting with the app and how to extend the activities outside of the screen-experience. Sesame Workshop has collaborated with PBS in the past to publish "View and Do" activity worksheets, which connect the curriculum

from one episode to hands-on activities the parent and child can do together after viewing. For example, one activity suggests, “Elmo explains the idea of same and different. Help your child to appreciate differences and similarities by listing three things that make you the same, and three things that make you different. Talk together about how our differences make us unique!” (Louison, 2015). These activities would also be translated into Spanish and distributed for free on the Sesame website. These simple activities put curricular concepts into family-friendly terms and show parents how they can extend their child’s learning at home. If app developers collaborated with non-profit organizations to include these strategies on how to engage with your child through apps, parents may be more likely to take advantage of the resource than they would with a jargon-filled, dry document explaining the pedagogy behind the app’s design.

Schools may also take a more active role in helping parents regulate their children’s app use. Parents strapped for time, but who still want to download quality educational apps for their children, may benefit from school suggestions on teacher-approved apps. Perhaps in the form of a newsletter, teachers could submit their choices for (ideally free) apps that reinforce the concepts they are teaching in their classroom. They might also suggest apps that can stand-alone and do not need a parent to be present to use it with their child. This might help narrow the selection pool for some parents who are not sure what they should be looking for in an educational app, and who do not have the time to work with their children on the apps. While it may not be educationally ideal to have no adult supervision to help scaffold a child’s experience in an app, this may be the most realistic situation for many families. Again, it falls on developers to carefully

design intuitive, safe, and easy-to-use educational apps for children, so that they have value whether or not a parent is present.

**Digital Media Literacy**

Although this is a chapter devoted to regulation, it should have become evident that the concept of educational app regulation is a controversial, multi-faceted, and an enormously difficult task to undertake. What we have seen is that perhaps we will never be able to fully regulate the educational app markets, and nor should we. While we can try to incentivize quality, hold developers accountable for their claims, and get parents the resources they need to serve as regulators for their own children's app consumption, what is perhaps most essential and practical is to instill digital media literacy in children themselves, so that they can be smart consumers of educational apps. Media literacy and digital literacy have historically been viewed as separate domains, where "media literacy generally focuses on teaching youth to be critically engaged *consumers* of media, while digital literacy is more about enabling youth to *participate* in digital media in wise, safe and ethical ways" (Hobbs, 2010). With the evolving technological landscape, new digital media requires an integration of both of these perspectives. Within one digital media experience, a child might be simultaneously a consumer and a participant. For example, imagine playing *Mickey's Magical Arts World*, published by *The Walt Disney Company,* which has opportunities to create art, but also incorporates familiar characters that might tacitly promote Mickey Mouse products. We also can predict, based on the ever-increasing rates of access to media and technology, that digital media experiences are here to stay and will continue to evolve. It is then essential that we equip children with

both the critical thinking abilities and hands-on skills required for them to become regulators of their own digital media experiences.

There are a few avenues through which digital media literacy could be taught, including at home and in school. Similar to the ideas for at-home activities, non-profits or academics could develop curricula for parents to use with their children. This still relies, however, on parent's own time, interest, and ability to do these exercises and activities with their children. A better solution, then, might be to incorporate digital media literacy lessons into daily school curriculum. The Common Core standards, which have been adopted by 42 of the US States, lay out learning goals for each grade in English language arts/literacy (ELA) and mathematics. In the ELA standards, it is noted that "critical-thinking, problem-solving, and analytical skills… are required for success in college, career, and life," and that these skills are a part of "what it means to be a literate person who is prepared for success in the 21st century" (Common Core State Standards Initiative, 2016). These skills are also necessary for a digital media literate person, and schools may incorporate digital media into their classrooms as a way of reaching these goals for their students in an engaging and important way. Also, literacy is not restricted to actual literary texts— children encounter text in formal and informal settings, on paper and on screens. Common Sense Media (2016) has digital citizenship resources available on their website, including lesson plans, games, professional development kits, and family resources. Howard Gardner at the Harvard Graduate School of Education developed this curriculum, highlighting an instance where academia and industry met to create quality educational products. Schools can become certified in this curriculum, and participate in webinars and other types of trainings so that they can effectively implement it in their

classrooms. An example of one lesson's primary question is: "How do some websites try to get you to buy things?" For each grade level, Common Sense includes the Common Core standard with which the lesson aligns. Making these types of resources available for free to parents and educators is one step towards helping children become smart consumers of digital media. On children's media use, Common Sense Media's (2016) third core beliefs states, "We can't cover their eyes, but we can teach them to see." If we cannot regulate what educational apps are out there, we can at the very least educate children about what it means to be a consumer of and participant in interactive digital media experiences.

## Chapter 5: Evaluating Educational Apps

Underlying all of the discussed issues of design and regulation is the assumption that some apps are educational while others are not, and that it is important to determine what is true so that we can provide the best experiences for children. Within this, there also may appear to be the assumption that "non-educational" apps have less value than "educational" ones, and that playing with apps of either camp has consequences for children's development. The truth is, however, that what is educational for one child may not have value for another, and that any product, depending on its usage context, might become educational if put in the right hands. Certainly, caregivers and educators want to provide quality interactive media experiences to their children, because such media has been shown to contribute to pro-social behavior, academic improvement, and cognitive gains (Fisch, Truglio, & Cole, 1999; Huston & Anderson et al. 2001; Thorell, 2009; Judge, Floyd, & Jeffs, 2015; Chiong & Shuler, 2010). But to say that there is no value in what seems to be a "non-educational" app would be to equate the term educational with strictly measurable outcomes, and as discussed, the power of play for play's sake in early childhood development cannot be underestimated.

We have to avoid extremist, fatalistic thinking: that there is a right and a wrong way to 'do' childhood and that exposure to something non-research based will devastate a child's academic and socio-emotional future. It is not wrong that there are apps out there that exist simply for fun, and occasionally playing with an app that does not have proven educational value will not dramatically stunt a child's development. Rather, issues arise when caregivers and educators' emotional investment in their children is taken advantage of in order to make a profit through deceptive marketing means. To return to

the purpose of this thesis, throughout each discussion of design and regulation, the question has really been about transparency and legitimacy. We want to know if the apps we are purchasing really do what they say they do, and we want to know how the people making those claims have come to know that. Because so many adults are invested in their children, they should know what they are getting, and they should be equipped with tools and resources to improve their children's media experiences.

Turning to the issue of evaluating apps, then, the point is not to say that because an app has educational value on paper that it is infallible, and that apps that fall outside of what we define as educational are irrelevant. When trying to evaluate apps to determine their educational value, there is no one correct system. We must consider where the app is going, who will be using it, and what their own expectations are for its outcomes. From there, we can determine if, for that context, an app is educational. Much of this thesis has looked to solutions that require participation from "experts" in the fields of child development and education, placing great value on their opinions, knowledge, and evaluations. What I have yet to discuss, however, is through which methods these experts might form their educated perspectives. What are some of the questions researchers and practitioners must keep in mind when developing their opinions on best practice? This chapter considers these issues in more depth and notes potential methods for appropriately evaluating educational apps.

**Definitions, Culture, and Context**

Dictionary definitions of the term "educational" do not provide much detail about what constitutes education. Merriam-Webster defines educational as "offering information or something of value in learning," while the Oxford-English dictionary

defines educational as “serving or intended to educate or enlighten.” For the purposes of this thesis, I have defined educational as “stimulating learning,” with the added note that learning may come in the form of either cognitive or academic outcomes. Even this definition perhaps feels too limited after discussing the benefits of open-ended play on creativity and autonomy. The fact is that we do not have, and probably never will have, a universal meaning of what makes something “educational”. Beyond context, this issue is embedded in culture and class. Certain content knowledge, communication styles, and cognitive abilities are privileged by the dominant groups of society, which in the United States have historically been composed of white, wealthy, native-English speaking, heterosexual men. Those in powered positions control the curriculum in schools, fight to maintain the status quo when it comes to who occupies what types of jobs, and decide what parts of culture are ‘highbrow’. This trickles into the app industry: in 2013, 94% of app developers were men, and Nankani (2015) from the Joan Ganz Cooney center writes, “a glance through the iTunes store reveals that most apps are created with a monocultural child in mind—the white, middle-class child” (Austin, 2013).

Taking this assortment of definitions into account, trying to define “educational” becomes a truly impossible task, and assumes that there is a right and wrong way to raise a child. This is where we must take into account the whole child, and remember that “educational” can encompass more than academic outcomes. To understand what might make something educational, we have to move beyond privileging specific content knowledge and ways of thinking, acknowledging that these may vary across culture, racial/ethnic backgrounds, and socio-economic status. We can say, nevertheless, that there are certain areas of development critical to every child. These traditionally include

motor/physical development, socio-emotional development, cognitive development, communication development, and adaptation development (Aiger, 2015). No matter the background of the child, these domains of development are essential for typical functioning. Thus, those looking to evaluate apps might first consider the social and political contexts of the app: Who is the target audience? What values are being privileged? How might different types of people use this app? Then, considering the essential domains of child development, they might look to see which one this app seeks to improve, and from their understanding of its intended usage context, make an evaluation of whether or not this app will have educational value. Again, the appearance of seemingly educational content does not necessarily equate to educational value. Thus, evaluators need to take this multitude of variables into account when determining the value of an app. And, like with any opinion, a person's evaluation of an app cannot be entirely removed from subjectivity, just as one child's experience playing an app might be completely unique from another child's. An app that has educational value in one setting may not suit the educational purposes of another. The expectations parents have for an app may differ from the expectations of a teacher wanting to use the app in her classroom. Educational apps for formal learning environments and informal learning environments are different from each other, as are educational apps intended for solo-use versus multiple-users. For example, an app intended for classroom use may be educational because it connects with the curriculum, allows children to work in groups, or helps teachers monitor their student's progress. These qualities may not be essential to an app that is meant to be educational at home. Thus, we also have to evaluate within intended usage context.

**Social Nature of Learning**

When evaluating educational apps, we cannot overlook the social nature of learning. Bandura's (1971) Social Learning Theory pointed out the potent influence of social relationships on children's learning processes. Through observation and imitation of those around them, children explore new behaviors and adapt their actions based on positive or negative reactions. When a child uses an app with a parent or teacher, it is an inherently social process. Adults provide commentary on what they are doing on-screen (e.g., "Now I'm pressing the blue button!"), and react to what the child does (e.g., "Try tapping on the shape instead."). Through these types of social interactions, the adult is helping the child make meaning out of their digital experience. They are learning what behaviors are rewarded and which ones do not get the results they want. This is important for the child to eventually be able to navigate these experiences independently and become digital media literate. However, while 32% of parents report that they participate in joint television watching with their child, only 20% report that they co-view/co-play when their child is using an iPad or other touchscreen device (Wartella & Lauricella, 2013). Perhaps this absence of participation is because parents are assuming that the interactive nature of touchscreen devices replaces the need for adult participation as well. Again, we see the belief that digital media devices can be babysitters. However, Stevens and Penuel (2010) have commented that actually, joint media engagement (JME) "can support learning by providing resources for making sense and making meaning in a particular situation, as well as for future situations." Similarly, Takeuchi and Stevens (2011) report that with JME, "parents can provide explanations spontaneously or in response to questions, children can learn through observation, perspectives can be shared, and performances can be scaffolded." Therefore, an app on the surface may appear to

lack educational value—maybe it does not have a responsive interface or a helpful wrong-answer structure. But, when used with an adult present, maybe this app could be very educational if the adults provide their own responses and guidance. This is another factor to keep in mind when trying to evaluate whether an "educational" app is good or bad because again, what canot be overstated enough, is that what is educational for one child in one setting may not be for a child in another.

**Rating Systems**

Earlier, I discussed how app developers could take measures to bolster the educational quality of their apps during the design process; however, once an app is introduced to the market, developers themselves cannot necessarily evaluate their own apps because of bias concerns. Still, many developers want to know if their app accomplished what they wanted it to, and parents, educators, and other stakeholders want access to an impartial review of the app. Evaluation might serve many purposes: it might be used in academic circles to study how theoretical issues play out, it could be used by developers themselves to improve their own products, or it might be used by parents deciding what apps to purchase for their children. While an academic might be more concerned with quantitative data relating to the effectiveness of an educational app, a parent might only be interested to know if the app contains developmentally appropriate content. Thus, different methods of review are required. Although developing standards for each type of evaluation is beyond the scope of this thesis, I will highlight two popular rating systems already in use and consider the audiences they benefit.

First, Common Sense Media is a non-profit organization that provides resources and ratings for parents about a variety of issues regarding children's media and

technology use. They provide reviews of media from a variety of platforms, including movies, apps, and books. Their website also has parent guides to issues affecting today's children, including cyberbullying, marketing to kids, and violence in the media. Common Sense Media believes that "ratings systems should be independent and transparent for all media," taking unbiased opinion very seriously, and thus they operate independently, not accepting payment for reviews. A large part of their practice also builds on the motto, "we believe in sanity, not censorship." Taking a practical approach to children's media and technology use, they understand that different families and children have diverse needs, and that their most essential task is to provide what information they can so that families can be empowered to make their own choices.

Common Sense Media rates digital media on two dimensions: age-appropriateness and learning potential. Age-appropriateness is determined by the content (e.g., positive role models, language, violence) and age-specific guidelines for development (e.g., ease of play, privacy and safety). Reviewers gauge learning potential by dimensions of engagement, learning approach (i.e., pedagogy), and support and extensions (i.e., scaffolding). For each title, the review also includes the subjects and skills a child might learn. Subjects include science, arts, and reading, while skills include collaboration, emotional development, and creativity. Notice that this system of review for educational apps falls in line with the expanded conception of traditional learning goals suggested for both developers and evaluators in Chapter 3. The extensive resources provided by Common Sense Media are an exemplary example of making information easily digestible and accessible for parents, by providing simple star rating-scales for those who prefer the quickest review, but more detailed analysis of the content if desired.

Resources are also made available in Spanish. One way in which Common Sense Media might improve is to make explicit what theories of child development they use to evaluate media, and give more transparency about who their raters are and what biases they might have.

Another group reviewing interactive media for children is the Children's Technology Review (CTR) developed by Warren Buckleitner. CTR notes that their group is run by "clean money" in the form of subscriptions, publications, and conference registrations. The most notable difference between CTR and Common Sense Media is that full access to CTR is sold as a paid subscription for $60 a year. This constructs an accessibility barrier to families most in need. There is a free online database called the Children's Technology Review Exchange; however, it does not provide access to full reports and its forum-style user interface can be fairly challenging to navigate if one does not know the specific app for which they are searching.

The four questions that make up the framework for CTR's evaluation are: (1) What does the child walk away from the experience(s) with that they did not have when they first came to the experience(s)?, (2) How does the experience empower (or dis-empower) a child, (3) Does this experience leverage the potential of technology in a way that traditional, non-digital or non-linear experiences cannot?, and (4) Dow does this product compare with similar products? These criteria consider both the content and form of the product, and seek to understand the potential for each product from the child's perspective. CTR provides a disclaimer on their website that:

> No review system is free of bias. We are no exception. Our evaluation instrument (and resulting ratings) was/is designed to reward settings that empower children,

> fostering an active, responsive, child controlled setting. This bias comes directly from our instrument, which was inspired by Jean Piaget (and others) ideas about constructivism (Children's Technology Review, 2016).

Acknowledging the limitations of their reviews is one of the traits that contribute to CTR's positive reputation. No one entity can possibly evaluate all apps from every possible theoretical approach.

While Common Sense Media and Children's Technology Review provide quality reviews, it would still be ideal to have more than just two reputable bodies reviewing educational apps. Different evaluative approaches can provide parents with multiple lenses through which they can review a product; this spread of evaluative approaches provides a more comprehensive review of the one app.

**Developer's Position**

Developers can also benefit from summative evaluation of their apps, which can provide information on what they did well and where they could improve. Because of potential for bias, developers should not necessarily perform these evaluations of their own apps, particularly if they want to use these evaluations on the market to bolster their own claims of educational value. Internal evaluation for proprietary use may be less likely to result in biased results since the data will not be used to try and sell the product, but there is still the risk. Subjective opinion and attachment to the product may cloud a developer's judgment of how well the app performed what it set out to do. Thus, developers rely heavily on impartial third parties to do these evaluations. But, there are still ways for developers themselves to collect objective data that may allow them to gain some insight. For example, Google Analytics provides promise for developers who want

to measure the performance of their applications. It works on any platform, and can track user-interactions at each stage of use. For example, an app developer can see where users succeeded and struggled, and use this data to modify later iterations. Educational app developers might find a way to harness the power of software such as Google Analytics by intentionally designing moments for measurement in apps. With some foresight, a developer might note that performance at a certain checkpoint will be the indicator of whether or not through the course of gameplay the user has mastered the required content or skill to succeed. With this information, developers may make some estimates of where learning might be occurring. They can see how many tries it took a user to get something right, or how much time they spend on a certain task. This data can inform future versions of the app and new projects, and give developers some sense of whether their app has educational value. In this way, developers can evaluate their own apps using stricter variables, but this type of data could only suggest correlation and not causation, since the developer cannot see the specific context and potentially confounding variables in which their app was being played.

# Chapter 6: Discussion and Conclusions

This thesis highlighted the current status of designing, regulating, and evaluating educational apps for children, noting the challenges for the industry and suggesting possible solutions. Within each of the three domains discussed, common themes emerged. Exploration of each separate issue (design, regulation, and evaluation) illuminated shared concerns about diversity, debates surrounding the structuring and mediating of childhood, and challenges to the application of theory in practice.

## Diversity Concerns

At a recent conference held by the Joan Ganz Cooney Center, developers and investors discussed building games for low-income children in the United States. Some producers argued that the content must be easily translatable to other languages so that more children could access to the product. This was countered by one producer who stated, "We don't believe in translation so much, we believe in building authentic content… I almost find it offensive to argue that a cheap translation is going to connect to a child. Just by making the kid brown and translating it into Spanish does not mean it is going to be culturally relevant" (Banville, 2016, p. 1). Another producer chimed in, "When you translate something, the translation you use matters. Are you using Mexican Spanish or South American Spanish? For a lot of us this goes right over our heads. We think, 'well, it's Spanish.' But this connotes culture. A lot of times developers don't understand the impact of their choices" (Banville, 2016, p. 1). This discussion highlights one of the big challenges for the app industry at present, which is that not everyone has the same perspective on the best way to create good content, and that issues of race, class, language, and culture need to be considered in every aspect of app development.

Nankani (2015) noted that the "monocultural child" (white, middle-class) appears to compose the intended audience of most children's apps; however, the composition of the market does not reflect the reality of who the consumers are. Responding to the 1990s panic instilled by the term "digital divide," reflecting the idea that only the wealthy had their hands on new technologies, a push to get digital devices into the hands of all children resulted in monumentally increased access. Richtel (2012) reports that lower-income children spend 90 minutes more per day exposed to media than their higher-income peers, and that most of this time is spent on entertainment pursuits. Children from low-income families or minority backgrounds are more likely to live in media-centric households, but access does not equate to quality (Wartella & Lauricella, 2013). The cultural issues embedded within this topic cannot be overstated enough. When we seek get resources to the families who are most in-need, we make assumptions about what is best for the child. Getting iPads into the hands of all preschoolers in Head Start programs has no value if the content they can access through these devices has not been designed with them in mind. Race, language, and socio-economic class all contribute to a child's media experience. When 94% of app developers are men, and almost all are based in North America, then very little cultural diversity makes its way into the content and form of educational apps for children (Austin, 2013). What is "educational" varies by background, and when only one background is represented in the media, not all children can see their own experiences and cultural values reflected. At each level of consideration, from design to evaluation, we need restructuring. The easy solution would be to get developers to produce more diverse apps. But, this problem goes much deeper. Current developers were, for the majority, that "monocultural child," and may not have

the experience necessary to produce apps for children from low-income or non-White racial/ethnic backgrounds.

So, how do we diversify developers? This raises questions about who we are encouraging to enter fields of technology, coding, and design, and whom investors back to make successful. This issue bleeds into issues of class, gender, and race, and there is no single answer to this multifaceted problem. But, there are some questions we might raise in order to bring attention to this issue. When cultural monoliths like Disney are dominating the children's app industry, whose voices are they seeking to represent? When Apple highlights apps on the App Store front page, what type of customer are they trying to attract? One might assume that companies seeking to make a profit would try to attract the consumers who are most likely to be able to afford their products, yet, this is complicated by the fact that much of the misleading marketing for educational children's products actually appears to target more vulnerable populations. The 'media-centric' parents discussed previously, who tend to have less education and lower incomes, are the ones more likely to buy into the idea of educational products. By modeling advertising after the style of scientific research, educational app developers take advantage of parents' desires to make sure their children don't fall behind. It is the responsibility of developers to understand the implications of their marketing tactics for diverse populations. Neuman (2015) showed that introducing apps in low-income preschool classrooms could be an effective intervention for decreasing the achievement gap, but unfortunately, in practice not many parents or educators in these communities are being provided the resources they need to effectively use these tools in their homes and classrooms. The educational app industry must, at every level, begin to take concerns of

diversity and representation much more seriously, and it is the responsibility of those with the proper background in child development and education to seek to implement reform in this area.

**Constructing Childhood**

Another common theme present in this thesis' analysis has been the concept of constructing childhood and what experiences are important for children's development. Although all children's cultural context varies, there are developmental tasks essential to all children. Yet, we inevitably make value judgments about what is the best way to raise a child when we expose them to certain media and technology experiences over others. The mere fact that caregivers, educators, and practitioners are concerned with educational apps in the first place reveals the pervasive cultural perception that we need to be providing extra supports for children's learning during all of their activities, turning play into practice. The cultural dialogue surrounding development of children's products often sounds something like, "We need to trick kids into learning," which assumes also that children have no inherent desire to learn, but rather we have to disguise learning experiences into fun. Even though one primary developmental task of early childhood is to learn autonomy, creativity, and curiosity through play, play itself has become a calculated opportunity for learning, turning the spontaneous into something more akin to clinical intervention. This desire to inundate children with educational content, yet not wanting them to realize we are doing so, reveals the common belief that adults know what is best for children and are therefore entitled to mediate their experiences.

When we look to child development theory, researchers like Vygotsky (1997) and Bers (2012) stress the importance of social, active, learning experiences that are mediated

by adults. Vygotsky might argue that an educational app for children would be most effective if it integrated scaffolding elements that mimic the presence of a 'more knowledgeable other,' and was sensitive to children's abilities in order to present tasks in their zone of proximal development that were achievable through scaffolding. Bers values the Playground Model of digital experiences for children, where open-ended play and exploration are encouraged within carefully designed limitations in order to maximize autonomy while still targeting the skills important for children's development. Both of these approaches find importance in adults' role in children's learning. Without the intervention of adults, children may roam too free from their developmental tasks to effectively learn, yet with too much guidance, children may be stifled and fail to move towards independence.

When designing digital media experiences for children, it is certainly important to begin with a pedagogical and theoretical framework for how children learn best (Crawley, 2015). But, I would also advocate for more of a bidirectional relationship between those designing apps and the audience they actually intend to serve: the children themselves. Children, ultimately, are the ones who can say whether they enjoy an experience, who can articulate what they did or did not learn from it, and how they would change it. Of course, very young children may not have the language capacity to convey this. But, there is still plenty to be learned about children's reactions to an app from observation. Regardless, whenever possible, developers and evaluators should seriously take children's perspectives into account and remember that children are autonomous and thoughtful, and have a voice to contribute to this conversation.

**Theory to Practice**

The third topic that arose from my research was the challenge of putting theory into practice. From the academic's perspective, it is easy to say that all educational media for children should be grounded in pedagogy and theory. We demand that developers conduct formative assessment and refine their products until they have exemplary educational value. But, many times, we fail to consider the practicality of executing these ideas. As noted in the Literature Review's section on educational toys, even companies like LEGO who care deeply about children's education still have to consider the 'bottom line'. Those actually working in the industry on creating educational products for children comment that their timelines for development do not leave much room for testing—if they are lucky, they will get one prototype out to a handful of children for initial feedback, but having the time to test multiple iterations is rare.[8] Non-profit organizations face extra challenges when trying to develop educational content for children. For non-profits like Sesame Workshop, who have historically sought to serve the populations in the most need, tensions arise between holding true to organizational values and making enough profit to sustain their activities.

This is not to say that we should be complacent on these issues, but rather that we need to have a greater understanding of the realities facing app developers today. While companies do have a moral obligation not to intentionally deceive consumers, we should not assume that a developer who labels their app "educational" without conducting formal research has malicious intentions to trick parents into buying their product. Many simply do not have the time or child development background to sift through jargon-filled research studies and try to apply it to their own work. The burden should not solely

[8] C. Wong & M. Kaplan, personal communication, February 29, 2016

be on developers. While developers must work to identify their audience's specific needs to ethically produce and market their products, it is also the academic community's responsibility to seek out avenues through which we can share research in an accessible, user-friendly way so that we can begin to see more theory put into practice.

**Conclusions**

At the outset of this thesis, three research questions were posed: (1) What are the current concerns relating to the design, regulation, and evaluation of educational apps for young children?, (2) Knowing what we do about how children learn best and the current landscape of the interactive media industry, what are the best practices for designing, regulating, and evaluating educational apps for young children?, and (3) How does socio-cultural diversity and socio-economic inequality influence the educational app industry, and what strategies for design, regulation, and evaluation might meet the needs of children from all backgrounds? Each of these questions, as it turned out, opened the door to more and more questions that could each constitute an entire thesis of their own. An abundance of past research has examined the effects of educational media on children's development, and studied the nature of the content presented in such digital experiences, focusing on television and computer games (DeLoache et al, 2010; Richert, Robb, Fender & Wartella, 2010; Zimmerman, Christakis, & Meltzoff, 2007; Fenstermacher & Barr, 2009; Kebritchi & Hirumi, 2008; Wilson & Kunkel, 2008; Huston & Anderson et al, 2001). For apps, the amount of research on content and effects is much more scarce (Kucirkova, Messer, Sheehy & Panadero, 2013; Rockman et al, 2010; Kiger, Herro, & Prunty, 2014; Zhang, Trussell, Gallegos, & Assam, 2015). Only very little research has looked at the factors influencing the developers creating these experiences, and a select

few have developed specific policy and practice recommendations for improving this industry (Shuler, 2007; Shuler, 2012; Hirsh-Pasek et al, 2015). This thesis sought to fill this gap by highlighting the intersectional nature of educational app design, regulation, and evaluation. To best serve children's interests, we have to go beyond content and form to consider the broader structural factors influencing each domain of this industry, including economic, social, and political variables. If anything, I hope that this thesis has conveyed the complexity of the educational app industry, and shown that there is no one solution to ameliorate the challenges it faces. This survey of the current state of the industry means to serve as a starting point for those interested in making real changes to the way developers, parents, educators, and policy-makers approach educational apps.

**Limitations and Directions for Future Research**

While this thesis was largely descriptive and analytical in nature, I hope that future research delves into more systematic study of issues surrounding educational apps. Because of the limited published research on educational apps, this thesis' analysis relied heavily on my own research conducted through reading government agency and non-profit's primary source documents, speaking with experts working in the field, and popular press publications. The suggestions made were based on examples of strategies that have succeeded in other industries in the past, yet it is difficult to know exactly how they would work with apps specifically. There are also certainly many more actions beyond what this thesis suggested that non-profits, government, educators, and app developers might take to benefit the educational app industry. While this thesis sought to provide a broad overview of these issues, each topic itself contains many unresolved questions that provide material for future research. Research on the role of apps in formal versus informal learning spaces, studies that examine specific age-groups' relationships to educational apps, more investigation of parent's, teacher's, and developer's attitudes towards educational apps, and further inquiry into the social, political, and economic dimensions of educational app development are all areas with the potential for robust future research.

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# Appendix

Figure 1: Hirsh-Pasek's (2015) matrix for evaluating the pedigree of educational apps

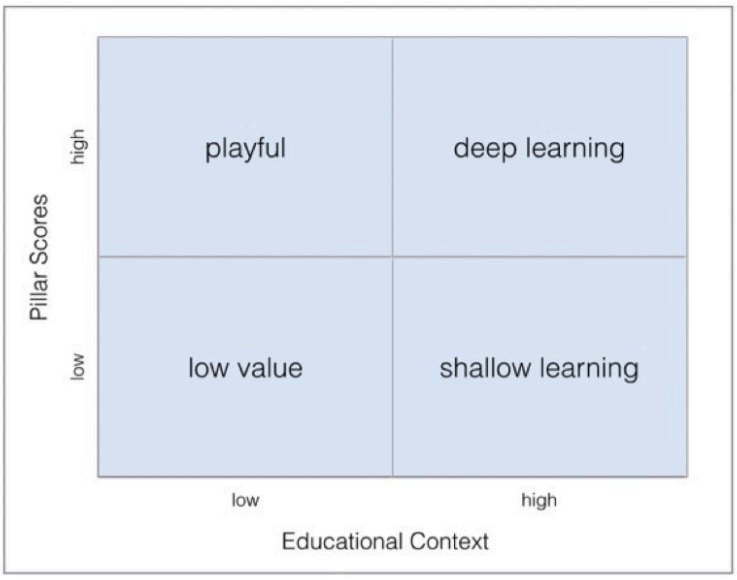


Figure 2: Apple's App Store Review Guidelines for Kid's Apps

**24. Kids Category**

**24.1** Apps in the Kids Category must include a privacy policy and must comply with applicable children's privacy statutes

**24.2** Apps in the Kids Category may not include behavioral advertising (e.g. the advertiser may not serve ads based on the user's activity within the App), and any contextual ads presented in the App must be appropriate for kids

**24.3** Apps in the Kids Category must get parental permission or use a parental gate before allowing the user to link out of the app or engage in commerce

**24.4** Apps in the Kids Category must be made specifically for kids ages 5 and under, ages 6-8, or ages 9-11