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# Exploring a Culture of Learning with Technology: An Ethnographic Content Analysis of the Activity of Learning with Educational iPad Apps

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EXPLORING A CULTURE OF LEARNING WITH TECHNOLOGY:
AN ETHNOGRAPHIC CONTENT ANALYSIS OF THE ACTIVITY
OF LEARNING WITH EDUCATIONAL IPAD APPS


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ABSTRACT

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This study explored the culture of learning with educational iPad apps using activity theory as a guiding framework. First, the top nine educational apps were tracked in the Top Charts section of Apple's App Store for a duration of four months. The nine sampled apps, selected based on their frequency of appearance, included Toca Hair Salon 2, Stack the States, Endless Alphabet, Mickey Mouse Clubhouse: Wildlife Count Along, Wild Kratts Creature Power World Adventure, Wallykazam! Letter and Word Magic, Starfall Learn to Read, Dr. Panda's Restaurant 2, and Bug Art. The descriptions, version updates, app content, and customer reviews for each app were digitized, coded, and analyzed in Dedoose using the Activity Checklist. Additionally instructional analysis diagrams were developed to provide insight into the user interface and actions. Results of the study were presented in the form of nine portraits. The overview and relevant instructional characteristics were detailed for each app. The final chapter examined the broader implications of the app experience. The technology, the instruction, the adult guide, and the App Store were identified as mediating factors that contributed to the dynamic app culture.

## ACKNOWLEDGEMENTS

Who's Reading This Book Anyway!

I need to write an acknowledgement
Put an end to these years of my torment
Reading updates, reviews
Oh, and app content too
Midnight phone calls I now lament.

I suppose I must start somewhere
So hard this task, I swear
Ended up at the end!
Didn't I help you, friend?
This bit in this book is unfair.

How about starting a list?
Embrace those that helped you persist
Professors and staff
Even friends who shared a laugh
Report family that were there to assist.

Some people, online and direct
Offered to call me to help me reflect
Never letting me be lazy
Though, the data got a bit crazy
How those road trips helped me disconnect.

I'd be remiss if I do not mention
Some of the human and doggy interventions
Burning soup, buying wigs
Or the late night swigs
Oh, this part should be written with apprehension.

Kind acts were sometimes consistent
Include the administrative assistant
So many different Bears
Dedicated to my affairs
Even from afar, helped me feel existent.

Deep down, I think this all began
In thanks to my closest clan
Chicago, Illinois
And a Final Cut toy
Turtle baby and sheep helped the plan.

Eight years is a very long time
Devising thanks through a short little rhyme
The extraordinary inspiration
Of computer art creation
That was worth every penny and dime.

How the debates made the high goal set
All the meetings attended with a sweat
The rare praises made me cry
I grew the confidence to try
Would become experiences I'd never forget.

Or the five-hour readings to assist
Unfettered guidance with an itty-bitty twist
Like design being a mess
Dissertation was like chess
What came together, clearly constructivist.

Remember all the times I got to share
In the daily phone calls, initially rare
The endless analyzing
Even in recognizing
That the honey badger does, indeed, care.

Help from my bosses at work
Every one had its own little perks
Working 20 hour days
Or a presentation gone astray
Resume builders all have their quirks.

Don't forget McKee's first floor
Particularly, that very full drawer
Every wish for success
Not to settle for any less
In the ET program I came to adore.

So much relief from the permissions I got
Including developers who were a long shot
Never mind the beer and wine
My friends were divine
You never know who will help you a lot.

Did you get to thank your committee?
In letting you explore your creativity?
So fun was the defense
Sometimes a little bit tense
Every second, a practice in humility.

Remember who helped the writing stop
Told you to meet at a coffee shop
A stealth ninja like reading
To help you in succeeding
I should remember to put that at the top.

Of course, my mom and dad
Never ending support that I had
Thinking of the huge debt
How about a post-doctorate?
An extra year or two can't be too bad.

Now that this list is through
Keep the writing short and on cue
You can't be a critic
Of a silly limerick
UNC, this is my final adieu.

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**CHAPTER I**

**INTRODUCTION**

Thanks to the rapid advancement of technology, there is a widespread availability of tools, strategies, theories, and resources for creating new and innovative educational environments that support learning (Shuler, Levine, & Ree, 2012). Modern technologies, such as Apple's iPads, have blurred the once well-defined border between academic and personal life. Schools are not the exclusive environments for educational experiences; more informal opportunities to learn and develop are becoming increasingly mobile and accessible. The dramatic influence of social, technological, and philosophical changes have generated new conceptions of what it means to learn and how we should approach research on educational technology (Saettler, 2011; Sam, 2012; Shareski, 2011).

**Educational iPad Apps**

A growing interest in the topic of iPads, as it relates to education, is evidenced in qualitative explorations of educators' and students' use of iPads (Alyahya & Gall, 2012; O'Loughlin, Barton, & Ngo, 2013) as well as experimental investigations on the effectiveness of iPad use versus non-iPad use on attitudes and learning achievement in schools (Houghton Mifflin Harcourt, 2012; Martin & Ertzberger, 2013). At the same time, research on the educational content of applications (apps) remains sparse (Goodwin & Highfield, 2012). Although the creation of instructional apps is largely unfettered and access to publishing apps is becoming ubiquitous, there are growing concerns over

whether or not recent portable digital devices live up to their cited educational potential (Brady, Sauers, & Kruse, 2012; Hu, 2011; Kang, 2012b; Richtel, 2013; Shuler et al., 2012).

Existing content analyses identified or classified educational iPad apps by instructional value and developmental appropriateness (Watlington, 2011), by the marketing techniques of apps to children (Shuler et al., 2012), and by pedagogical classification (Goodwin & Highfield, 2012). The data from these studies were derived from various distinct sources such as the app descriptions, ratings, and the content of the apps. These earlier studies provided piecemeal examinations of the technology as they related to instruction, attitudes, achievement of goals, and context; however, a more holistic analysis of apps recognized as "educational" had not been taken into account prior to this research.

Apple's definition of "education" insofar as it relates to education-labeled apps is contextualized within the App Store environ. The iOS Developer Library (n.d.) emphasizes the importance of developers carefully choosing a primary and/or secondary category "that best describe the main function of [the] app," adding that Apple performs a review of the final category submission before being published. Thus, Apple ultimately approves the categorical term, "education," that developers initially select from a list; however, the construct of "education" is promoted or demoted based on the reviews and ratings of individual apps by the customers and users. Essentially, the actions of Apple, app developers, and customer reviewers and raters impact the categorical definition of "education." This stands in stark contrast to academic definitions in that the "education"

in an app environment is characterized by continual changes in social, cultural, and historical conceptions of instruction and learning.

## Activity Theory and Research

The current study considered activity theory (also known as cultural historical activity theory, or CHAT) as a theoretical lens from which a broader, less fragmented view of education-oriented concepts and technology could be more fully explored. Kaptelinin and Nardi (2006) define activity theory as

> an approach in psychology and other social sciences that aims to understand individual human beings, as well as the social entities they compose, in their natural everyday life circumstances, through an analysis of the genesis, structure, and processes of their activities. (p. 31)

Activity theory was initially developed in the early 20th century by psychologists, such as Lev Vygotsky, Alexander Luria, and Alexei Leontiev[1], as an anti-dualist reactionary response against the fragmentation of human consciousness from its relationship to the social environment (Leontiev, 1978; van der Riet, 2010). As a vocal critic against the pervading emphasis on reflexology in understanding the complexities of human behavior, Vygotsky believed that the complexity of human psychology could not be explained by animalistic, defensive, motor, or conditional reflexes. He believed human behavior should not be reduced to a study of "elementary connections between a living being and the world" (Vygotsky, 1925, para 2).

Vygotsky (1930) posited that an individual's existence was dependent upon his/her membership to a social group and paralleled the group's historical process of continued change and development. Likewise, the development of society was realized

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[1] Leontiev's name (Леонтьев) is transliterated in multiple ways in English. Other spellings include Leont'ev, Leontev, or Leontyev. The spelling used within this study is "Leontiev." However, citations and references utilized the form from the distinct publications.

through the activity of individuals of that group. Because the social and historical experiences of individuals were interconnected, a theoretical approach that viewed human consciousness as a passive receptive system, unilaterally determined by external influences, was limited and inadequate in understanding human activity. Leontiev (1977) wrote,

> in society man finds not only his external conditions to which he must adapt his activity, but also that these very social conditions carry in themselves the motives and aims of his activity, the ways and means of its realisation; in a word, that society produces human activity. (para 13)

Thus, rather than breaking down complex psychological processes into fragmented laboratory studies, Vygotsky indicated a need for a broader frame to examine human activity: "We ought to study not reflexes, but behaviour, its mechanism, its component parts, and its structure" (Vygotsky, 1925, para 22).

**Five Principles of Activity Theory**

The basic unit of analysis in activity theory is the activity of an individual. According to Kaptelinin and Nardi (2006), "what sets activity theory apart is its fundamental insight about the primacy of activity over the subject and object" (p. 31). This more holistic understanding of psychology considers the actual life of individuals who are oriented in an objective world (Leontiev, 1977). According to Kaptelinin, Nardi, and Macaulay (1999), there are five major principles of activity theory: (a) object-orientedness, (b) hierarchical structure, (c) externalization and internalization, (d) tool mediation, and (e) development. Object-orientedness suggests that a subject directs his/her activity toward an object in order to fulfill a need. Activity is at the highest level of a hierarchy, and there are actions and operations below it that offer further insight. Externalization and internalization emphasize how physical activity shapes mental

cognitive processes and vice versa. Tool mediation emphasizes that tools or artifacts

mediate the relationship between the subject and the object. Finally, the principle of

development involves the need to examine the social and historical evolution of the

activity. Bellamy (1997) states that "technological innovation [are] a part of a general

process of cultural evolution in which artifacts mediate human activity" (p. 123).

**Applications of Activity Theory**

The present research utilized activity theory as a theoretical lens for exploring the

learning space to deepen the understanding of educational iPad apps. Modern

applications of activity theory-related research on technology illustrate a growing interest

in descriptive analysis in a wide range of areas such as human-computer interaction

(Kaptelinin & Nardi, 2012), product design (Hyysalo, 2005), and adaptive e-learning

systems design (Peña-Ayala, Sossa, & Méndez, 2013), among others. This study

considered not only the design of the instruction, but also the mediating technology and

the social elements that interact among one another. Additionally, by expanding the scope

analysis from individual actions to the activity, the research allowed for the examination

of the ongoing change and development.

**Activity Checklist as**
**a Research Guide**

Due to the dynamic and evolving nature of activity theory, there is no single

correct prescription or standard by which activity theory can be used or implemented in

research. Nevertheless, the Activity Checklist was developed to analyze, design, and

evaluate how a tool is used and to identify problematic "trouble spots" or limitations of

the tool within a given context (Kaptelinin & Nardi, 2006). Technology, the mediating

artifact, is at the core of the Activity Checklist. The role and purpose of technology

within the Activity Checklist is to provide general guidelines for examining human-computer interaction within a "contextual design space" from an activity theoretical perspective (see Appendix A).

Kaptelinin, Nardi, and Macaulay (1999) describe the Checklist as a tool to examine human-computer interaction and identify it as "a guide to the specific areas to which a researcher or practitioner should be paying attention when trying to understand the context in which a tool will be or is used" (p. 28). The Activity Checklist identifies four principles with a fifth (tool mediation) that is applied and systematically integrated with the other categories: means/ends (hierarchical structure); social and physical aspects of the environment (object-orientedness); learning, cognition, and articulation (externalization/internalization); and development (development); tool mediation.

**Research on Educational
iPad Apps**

The popularity of educational iPad apps stimulated investigation into the development and use of mobile technologies, and there has been a growing interest in apps with an educational bent. The Internet is satiated with anecdotal recommendations on "the best apps" for learning in a variety of settings for diverse learners. Yet, many of these endorsements have lacked any methodical attempt to thoroughly analyze the app content from a research perspective that is grounded in theory and practice (Shuler et al., 2012). Some analyses of educational iPad apps categorized the design of instruction or examined the content to determine an intended audience. However, they failed to analyze the instructional context, and they overlooked potential social and technological relationships and interactions (Goodwin & Highfield, 2012, Shuler et al., 2012; Watlington, 2011). Additionally, in a school setting where iPads are increasingly

adopted, educators have tended to focus their interest on the selection of the "best" technology—defined as the tool with the greatest perceived potential to help students reach learning objectives, effectively and efficiently (Alavi & Leidner, 2001). Traditional methods of research in the academic classroom studied the learning benefits of new instructional media through experimental research (Dillon & Gabbard, 1998). Some studies compared learning outcomes between learners who received instruction with or used a given technology (i.e., the medium) and those who did not (Ainsworth, 2008; Brown, 1992; Hoover & Valencia, 2011; Kelly, 2004; Reeves, 2007). Beyond these investigations, critics and reviewers have evaluated iPad apps from a standpoint of technological capabilities, cost/benefit ratios within school environments, and the various types of and reasons for iPad use and app selection. Alyahya and Gall (2012) suggested that graduate students typically utilized productivity-related apps, based on what they could afford and their access to various resources and tools to support their studies. DiVall and Zgarrick (2014) examined the academic and clinical uses of iPads by faculty in the School of Pharmacy. Such research has provided some valuable insight into general school and/or work-related uses of iPad technology, but focused on very distinct applications and attitudes.

Earlier content analyses quantified and identified educational iPad apps based on developmental appropriateness or for their educational value (Watlington, 2011). Watlington used the Haugland Developmental Software Scale as a guide to determine the developmental acceptability of the top 129 free educational apps for the iPad. However, he did not identify instructional strategies, acknowledge cognitive demands on learning processes, or explore in depth the learning environments/contexts of the apps. Goodwin

and Highfield did examine the instructional approach in educational apps in their 2012 longitudinal study of the "Top Ten" paid education apps from App Stores in the United States, United Kingdom, and Australia. They collected data on age, subject, and pedagogical classification. The researchers initially classified the pedagogical nature of the apps as instructive, manipulable, and/or constructive. During the course of study, they discovered hybrid designs and categorized them as either constructive/manipulable or manipulable/instructive. They hypothesized that the developers of apps "may have an entrenched philosophical view of what constitutes learning" (Results and Discussion section, para 3) based on an easier to develop, linear, and prescriptive design. Goodwin and Highfield established a basis for considering the design of the learning environment within a theoretical framework. However, they too failed to take into account instructional strategies, goals, and corresponding learning processes.

Shuler et al. (2012) of the Joan Ganz Cooney Center at Sesame Street Workshop also conducted a content analysis of top selling paid educational apps with the stated intent of "understanding the market dynamics, areas of innovation, and emerging opportunities within the market for apps labeled as educational" (p. 6). These researchers followed up on an earlier study examining the target age of users, subject areas of interest, and price lists of the top 100 paid apps from the education section in the Apple iPad App Store (Shuler, 2009). The 2012 extension considered age, subject (and skill-set), school usage, brand of device, publisher, and ratings. They discovered that 80% of the researched apps targeted toddlers and preschoolers, despite the fact that roughly half of the top sellers indicated an appropriateness for elementary school age children. Ultimately, Shuler et al. (2012) noted the absence of "firm and independently verified

standards of educational value in the app market, and there is a dearth of empirical evidence about the effectiveness of apps for learning" (p. 24).

## Rationale for the Study

Given the mobile, interactive, and intrinsically motivating nature of iPads, as well as the numerous corresponding applications and unique learning context, there was a need to explore the culture of the iPad app learning space, as a basic unit of analysis (Jenkinson, 2009). The rationale for this study was based on this call to investigate thoroughly and holistically the interactions, characteristics, and features of iPad apps. Jenkinson recommended researchers make use of "evaluative tools capable of capturing the learning process that occurs when students interact with technology" (p. 278). Activity theory was the theoretical framework used to conduct analyses of and inform on the cultures or environments of the selected educational iPad apps "to support more complex involvement with the learning material...by focussing [sic] less on knowledge outcomes and increasingly on the process by which understanding develops" (p. 278).

## Purpose of the Study

The purpose of this ethnographic content analysis was to recontextualize Apple's iPad App Store as a non-academic learning space, as a starting point in discussing how the actions of developers and consumers/users contribute to the dynamic social and cultural understanding of what is "educational." The goal of exploring the learning space of the top nine commercial iPad apps in the educational section of the App Store and describing the various components in and related to the apps was accomplished by examining instructional characteristics (from the developed app content, developer-stated

histories, and developer-stated descriptions) and reflections by consumers (from customer reviews).

App developers created three of the data sources for this research: (a) app content, (b) version histories, and (c) app descriptions. The app content provided visual (e.g., appearance), structural (e.g., available actions and interactions, sequencing of tasks), and functional (e.g., decision making points, feedback and support) information. Version histories revealed reports about bugs, fixes, updates, and other changes in the educational app experience. Because developers designed and marketed their apps, based in part on the recommendations found in the iOS Developer Library (n.d.), the app descriptions formed a significant source of data. App descriptions were to be written in consideration of the end-user's viewpoint and were to include information, such as a clear product definition, a list of main features, information regarding suitability for end user (age), an emphasis on core values of the developer, accolades and testimonials, information regarding the newest version, characteristics of the environment (e.g., 3D interface), information on characters or the story, and/or the name of company. Customer reviews, the fourth data source, were the reflections posted by the customers who paid and downloaded the app. This data source provided information regarding customers' evaluation of the experience or interactions within the educational app.

The theoretical lens of activity theory facilitated the process of gaining a cultural-historical perspective toward identifying the elements in the educational app learning space and how the various components within that space interact. The Activity Checklist, developed by Kaptelinin et al. (1999), directed the focus of the study within activity theory's five basic principles: (a) object-orientedness, (b) hierarchical structure,

(c) externalization and internalization, (d) tool mediation, and (e) development. Data were coded with Dedoose, an online qualitative data analysis software, and analyzed for themes. Resulting analyses were reported in Chapter IV, via the nine individual app portraits along with a discussion of the various strategies, criticisms, and learning environments/experiences.

## Significance of the Study

Technology-related research is important because it "helps us to clarify who we are, what we are trying to do, what we know, and how we might best invest the limited resources devoted to future research" (Shrock, 1994, p. 49). The learning potential of educational iPad apps is still in the early stages of investigation in both commercial and academic realms: "iPad apps are emergent technologies that require research to analyze their educational potential" (Merges, 2012, para 1). Rather than isolating variables to generalize surface characteristics from a large number of apps, this research sought to examine a smaller number of apps in an effort to reveal relationships between media and learning and to identify some of the pedagogical possibilities toward understanding the potential learning benefits created with these educational iPad apps.

## Research Questions

The following research questions were explored in and guided this study:

Q1    Within an Activity Theory framework, what instructional characteristics can be identified through the ethnographic content analysis of top commercial educational iPad apps (including their content, developer descriptions, and update histories)?

Q2    Within an Activity Theory framework, what attributes of the learner and the learner experience can be identified through the ethnographic content analysis of customer reviews of top commercial educational iPad apps?

**Definition of Terms**

**Activity Checklist.** "A guide to the specific areas to which a researcher or practitioner should be paying attention when trying to understand the context in which a tool will be or is used" (Kaptelinin et al., 1999, p. 28). See Appendix A for the Activity Checklist.

**Activity Theory.** "A philosophical and cross-disciplinary framework for studying different forms of human practices as development processes, with both individual and social levels interlinked at the same time" (Kuutti, 1996, p. 25).

**Action(s).** "Actions are conscious goal-directed processes that must be undertaken to fulfill the object. Different actions may be undertaken to meet the same goal" (Kaptelinin & Nardi, 2006, p. 67).

**Activity.** "Activity in a narrow sense is a unit of life, a subset of all possible processes related to the interaction of the subject with the world" (Kaptelinin & Nardi, 2006, p. 62).

**App.** "A self-contained program or piece of software designed to fulfill a particular purpose; an application, especially as downloaded by a user to a mobile device" (App, n.d.).

**Artifact(s).** "Artifacts are special agents that are the product of cultural needs…artifacts empower people through the use of technical and psychological tools. Activity theory conceptualizes the potency of human agency in part through the principle of mediation" (Kaptelinin & Nardi, 2006, p. 248).

**Development.** "In activity theory development is not only an object of study, but also a general research methodology. Activity theory sees all practice as the result of certain historical developments under certain conditions" (Kaptelinin & Nardi, 2006, p. 71).

**Externalization.** "Transformation of internal activities to external activities is often necessary when an internalized action needs to be 'repaired' or when a collaboration between several agents requires their activities to be performed externally in order to be coordinated" (Kaptelinin, Kuutti, & Bannon, n.d., p. 192).

**Internalization.** "Transformation of external activities to internal activities. Provides a possibility for human beings to simulate potential interactions with reality without performing actual manipulations on real objects" (Kaptelinin et al., n.d., p. 192).

**iPad.** "A touch-screen tablet computer, roughly the size of a magazine" (Bell, 2010).

Object. "Prospective outcomes that motivate and direct activities, around which activities are coordinated, and in which activities are crystallized in a final form when the activities are complete" (Kaptelinin & Nardi, 2006, p. 66).

**Operation(s).** "The automatic processes according to activity theory terminology, are *operations,* which correspond to the way the action is actually carried out. Operations may emerge spontaneously, but a more common source of operations is the automatization of actions, which become routinized and unconscious with practice" (Kaptelinin & Nardi, 2006, p. 68).

**Subject.** "An agent who acts" (Kaptelinin et al., n.d., p. 191).

**Chapter I Summary**

This chapter recognized the prominence of iPad apps as an emerging technology with underexplored educational potential. Activity theory was presented as the theoretical framework used to facilitate a more holistic exploration of the educational learning spaces in nine of the top paid apps. The rationale and purpose for the research on the top educational iPad apps in Apple's App Store were provided and based on the recommendations of a number of scholars and experts that the app's distinct educational significance has yet to be fully examined. The significance of this study, as an opening and in depth discourse on this unique environment, was noted. Chapter II provides important background and historical information, as well as a review of the most relevant literature on the related technology and theory.

**CHAPTER II**

**REVIEW OF LITERATURE**

The literature reviewed in this chapter confirmed the rationale for the study and established the methodology for examining the learning spaces of top educational apps in Apple's App store. The foundation of the actual investigation was set by means of the subsequent historical analysis of educational media, the investigation of iPads in education, and finally, the more detailed reflection on activity theory and the Activity Checklist, as they related to this research.

**Evolution of Educational Media**

Twentieth century scholars characterized instructional media as "the physical means via which instruction [was] presented to learners" (Reiser, 2002b, p. 7). Instructional media was perceived as a remedy for the limitations of verbal or textual instruction toward the purpose of transforming abstract concepts into more concrete and usable information (Saettler, 2011). What began as a visual movement in transmitting and acquiring knowledge in the 1910s and 1920s, eventually, became the audio-visual movement of the late 1920s through the 1940s. During its initial visual phase, students visited museums to supplement their learning experiencing and interacting with visual instructional media, such as photographs, dioramas, films, and slides. Interest in utilizing visual materials in schools gained momentum in the 1910s and 1920s. Lantern slide projectors were among the instructional media featured in many schools and classrooms

across the United States. This technology tool was, initially, a common instructional component in the form of educational films in adult education classes (Spring, 2010). Though slide projections had been developed in the 17th century, it was only after Edison's invention of the incandescent light in the 1890s that the cost of slide projections decreased enough to see magic lanterns commonly adopted for instructional purposes (Molenda, 2008).

Innovations in audio technology in the late 1920s allowed for the addition of a soundtrack to film. As talking pictures became more and more popular for entertainment purposes, educators began to contemplate both the content and purpose of media usage in the classroom. Still, relatively few films were made for classroom use and these educational films did not achieve the desired aim in the classroom context (Saettler, 2011). Overall, these films were advertising excerpts; older theatrical clips; or government training, welfare and health-related movies from large corporations; however, "not one of these pictures represent[ed] a systematic effort to supply a definite series of pictures for a definite purpose" (Saettler, 2011, Beginnings of the Educational Film section, para 11). Technology progressed and sound films became prevalent in Hollywood. However, the high cost of replacing existing silent projectors and a pedagogical preference that teachers narrate live over silent films to "add a level of customization and personalization to film showings" impeded widespread instructional implementation of talking films (Molenda, 2008, p. 7).

Next, Saettler (2011) pointed out that teacher education programs at the time did not emphasize training on the use and value of media. Additionally, while the first official visual education course was administered as early as 1918, by 1924

approximately only half of the 82 normal schools surveyed trained teachers on the instructional value of the slide with fewer than half of the teacher education programs offering training with the stereopticon. Twelve of the surveyed institutions of teacher preparation reported promoted the use of film in the classroom, and only 5 of the 82 offered instruction on the value and operation of a motion picture projector (Saettler, 2011, The Balcom Survey section, para 1). Communication issues between educators and commercial producers of films, the high cost of motion picture film and production, and the low quality rendered in early motion pictures may have contributed to the lack of administrative support and teacher implementation of this media in the early 20th century classroom (Saettler, 2011).

Reiser (2002a) identified World War II as a period of significant advancement and promulgation of media for instructional and training purposes. He recalled that it was during WWII that Hollywood directors began collaborating with the United States military, producing silent and sound films to train millions of military personnel through the Division of Visual Aids for Military Training. Training films were used not only to help soldiers prepare for war, rapidly transmitting knowledge and skills on a large scale, but also to help distinguish among the soldiers who quickly absorbed content in the films, thereby qualifying them for pilot training. Psychologists used experimental research and testing of knowledge and skills gained from the training films to predict the future success of an individual in a training program (Reiser, 2002a).

War-training efforts were a precursors or indicators to the contemporary understanding of instructional systems design. The Educational Testing Service began in 1947 as a multiple-choice mental test to predict the success of potential college students.

There are parallels between the notion of military selection via performance testing during the war and efforts to determine future success via assessments that took place after the war. The war impacted the field of educational technology to such a degree after the war that there was a notable shift even in how it defined itself. Instructional designers began to reduce the importance of media as a product, and they started to conceptualize and emphasize instructional technology as a process of problem identification and problem solving (Reiser, 2002b). The change necessitated an intentional design in instruction, which created and brought about the now standard protocols that include analysis and evaluation of learners to optimize learning efficiency and effectiveness.

Newer technologies, such as televisions and overhead projectors, became more common classroom components by the late 1950s and early 1960s. However, popularity in instructional television subsided by the mid-1960s due to growing criticism about replacing instructor-guided lectures with mediocre television programming (Reiser, 2002a). Two problems associated with the integration of instructional television were the lack of teacher support and the association of television with entertainment as opposed to instruction (Saettler, 2011).

Due to the advent of the mainframe and microcomputer, the educational computing movement succeeded the instructional television movement. Research by IBM on computer-assisted instruction (CAI) began in the 1950s and continued throughout the development of the CAI authoring language and subsequent CAI systems, such as the University of Illinois' PLATO (Programmed Logic for Automated Teaching Operations) project and the Mitre Corporation's TICCIT (Time-shared, Interactive, Computer-Controlled Information Television) project in the 1970s.

Despite the fact that microcomputers were available from the late 1970s and personal computers had become more and more accessible in classrooms since their initial years, mainstream computer use stagnated with drill and practice. Furthermore, instructor implementation of computers in teaching was minimal (Alessi & Trollip, 2001; Molenda, 2008; Reiser, 2002a). Alessi and Trollip (2001) claimed that the invention of the Apple Macintosh in 1983 revolutionized the adoption of computers in the classroom. Factors such as lower cost, graphical interface, voice and music capabilities, and a mouse to facilitate on-screen interaction contributed to the heightened adoption of computers in the classroom.

**The iPad and its Applications**

Apple captivated academic and mainstream users in 2010, introducing their tablet computer, the iPad. The new technology changed the educational climate (Barack, 2010; Engelbrecht, 2010; Learmonth, 2010; Waters, 2010). Publishers, such as McGraw-Hill, Harcourt Mifflin, Pearson, and Kaplan, began negotiations to develop textbooks specifically for the iPad within one month of the release of Apple's new product (Trachtenberg & Kane, 2010). Apple officially announced its aim to enter the educational and textbook market in January of 2012, introducing iBooks 2, iTunesU, and iBooks Author in the iPad App Store (Kang, 2012a; Tsukayama, 2012). Universities responded by adding app development courses to their computer programming curricula and by providing professional development programs on the topic of tablet apps for learning (Stone, 2010; Wiggins, 2012).

Developers began creating education-oriented apps to prepare students for standardized tests (Tedeschi, 2011), to assist the needs of special student populations

(Williams, 2012), and to replace hardware, such as graphic calculators with more advanced apps for math classes (Samuels, 2011). The New Media Consortium predicted that tablet computing mobile devices and apps would be among the educational technology trends most likely to succeed in the mainstream market (Johnson, Adams, & Cummins, 2012).

As of March 2015, there were over 80,000 education-related apps for the iPad platform (Apple, n.d.). Proponents of iPads in education identified the technology's potential in facilitating the skills that would be required of future learners (Kang, 2012b). Experts anticipated that the iPad and corresponding apps would provide users with access to a wealth of information (Brady et al., 2012) and that they would improve efficiency in instructional strategies and learning management (Cooper, 2012; Statucki, 2012). Kang (2012a) focused on the potential reduction in administrative and student expenditures through in-house course material development. Shareski (2011) identified the potential in promoting creativity through the construction of products in the classroom, and Brady et al. (2012) perceived increased opportunities for collaboration among students. A number of scholars, including Wiggins (2012), made the engagement of young learners the point of interest. Wiggins insisted that engagement of children was inevitable due to their everyday exposure to and use of the media. Connecting and adding mobility to the learning experience in and out of the classroom (Cochrane, 2010), engaging the learner by personalizing the learning experience (Brady et al., 2012), and minimizing social and academic disparities by leveling the playing field for all students through technology access (Shareski, 2011; Wiggins, 2012) have motivated important research and stimulated serious debate about iPads and iPad apps in education.

**Reconsidering Educational**
**iPad App Research**

While the discussion on the history of educational media illustrated the

convergence of technology and education from an academic perspective, the actual use of

media in the classroom was occasionally short-lived. Many of the wartime experimental

studies focused on behavioral achievement via technologies like film, post-hoc analyses

of early educational media research suggest that outcomes/results were not the only

considerations of value in the examination of these studies. For example, the Johns

Hopkins University Studies in 1919 indicated that film was effective in disseminating

information. This study "also indicated that a single film may not be effective in bringing

about basic attitude changes" (Saettler, 2011, Johns Hopkins University Studies section,

para 3). The Ohio evaluation of radio broadcasts detailed the experiences of teachers and

students' reactions toward the technology, and the Princeton Project examined the type of

individuals and social groups who listened to the radio. The Wisconsin Research project

of the late 1930s revealed the "limitations of radio as a medium of communication and

instruction" (Wisconsin Research Project section, para 1).

What sets apart educational iPad research from aforementioned studies may be in

the interactive nature of the technology. The learning space or instructional environment

in this study was defined, first, by the actions of the developers, who created the medium

through which the information was presented to the learner so that he/she could interact

with it or benefit from it in some way. Second, the educational environment was defined

by the consumers and users who purchased and promoted (or demoted) the app via their

customer review. Goodwin and Highfield (2012) suggested a few different reasons for

purchasing and using an app; one of the most obvious and impactful reasons involved

users' prior conceptualizations of what the learning space or the instructional design of a given app might be, based on what they saw others purchased, popularized, and promoted/demoted.

The current research was conducted with an assumed existence of a social dimension in newer technologies. It was understood that users and customers gave ratings and feedback regarding their experiences in the App Store's customer review forum. Future customers were able to read about these experiences of and use them to base their purchasing decisions. Designers and developers of the app were able to utilize the feedback to meet user needs and to improve their product, providing a summary in the version history (Sorrell, 2009). Essentially, the conception of education is established through the interdependent relationship between developers and consumers regarding the values they hold about learning and the goals they attempt to gain from the experience which is shaped, altered, and advanced through their interactions with the media.

As consumers, we often assume that the categorical label, "education," is one that is evaluated or appraised by an educational or academic community. Garg and Telang's 2013 study, analyzing paid and top grossing apps, inferred that a top paid app (ranked first) generates 120 times more downloads when compared to a paid app ranked 200th. Although browsing and searching for apps is continually being improved, Apple does not disclose actual download data. Therefore, educators, researchers, and even the interested general public have difficulty grasping the ranking system of the apps that are visible in the App Store. The lack of full disclosure or transparency has made it challenging for researchers to fully comprehend how the visible/ordinally ranked apps impact, shape, and/or perpetuate conceptions of "education" in the iPad learning space. According to

Edwards (2014), Apple determines the selection and ranking of apps through the participation of all actors in the learning space, including the consumers who review and provide feedback on their experiences. Given the lack of a published and/or strict algorithm, systematic research about and methodology on how educational apps are studied should include social, cultural, and historical interactions, as was done in this research.

**Activity Theory**

According to Kuutti (1996), activity theory is "a philosophical and cross-disciplinary framework for studying different forms of human practices as development processes, with both individual and social levels interlinked at the same time" (p. 25). Activity theory should not be seen as a prescriptive theory but as a descriptive means of analysis or "…a clarifying, orienting framework" developed by psychologists (Nardi, 1996, p. 7). Stetsenko (2005) identified the acknowledgement of collaborative processes, as one of the most significant contributions of activity theory. These collaborative processes facilitate change in both humans and their environments; "human development is based on active transformations of existing environments and creation of new ones achieved through collaborative processes of producing and deploying tools" (Stetsenko, 2005, p. 72). Jonassen and Rohrer-Murphy (1999) define activity theory as "a powerful socio-cultural and socio-historical lens through which we can analyze most forms of human activity" (p. 62). It seeks to understand human consciousness through the synthesis of "intentionality, history, mediation, collaboration and development" (Nardi, 1996, p. 7).

However, activity theory is neither a theory, in the traditional usage in the natural sciences, nor is it a study of activities in the general sense of the term (Kaptelinin & Nardi, 2012; Kuutti, 1996). Whereas most psychological theories conduct laboratory studies of cognitive inputs and outputs, activity theorists argue that without a consideration of context, analyses that involve human actions tend to produce results that disassociate human behavior from real-life settings. Integrating context and actions, as the unit of analysis, distinguishes activity theory, and defines activity as "a relationship between the subject (that is, an actor) and the object (that is, an entity objectively existing in the world)" (Kaptelinin & Nardi, 2012, The General Notion of Activity section, para 1). Leontiev (1977) conveys a very similar, albeit far more philosophical definition of activity, stating that it is a "unit of life, mediated by mental reflection, by an *image*, whose real function is to orient the subject in the objective world" (para 11). A major focal point of the framework, according to Leontiev (1977), is the role of consciousness as having an interdependent relationship with the context.

**Brief Historical Background
of Activity Theory**

Inspired by the works of Hegel and Marx, activity theory stemmed from a time during the early 20th century when the field of psychology was largely divided between those who viewed human consciousness as an independent actor, separate from its material environment, and those who focused on the effect of the objective world on the passive/receptive subject (Leontiev, 1977). The former group of psychologists used introspection to interpret an individual's "inner world and stream of consciousness" (Leontiev, 1977, para 103). These psychologists perceived the mind as active with regard to observable physiological responses, but without influence in it of itself on the objective

world. The latter group of psychologists, grounded in reflexology and behaviorism, attempted to explain nervous mechanisms through the study of stimulus-response patterns (Miettinen, 1999). A "stimulus-response" or "object-subject" type reductionist understanding of human reflexes emphasized the effect of the objective world on the passive and receptive subject (Leontiev, 1977). Pavlovian studies of classical conditioning and behavior modification exemplify this emphasis on the immediate physiological responses of the sense organs, resulting from external stimuli on the subject. Both views followed a Cartesian differentiation between the subject and object and of people and society; both failed to accommodate any potential relationship between a subject and his/her objective world (Leontiev, 1978).

**Basic Principles of Activity Theory**

Karl Marx's dialectic materialism directly influenced activity theory, as evidenced in his "Theses on Feuerbach," written in 1845, and published post mortem by Friedrich Engels in 1924. While those aligned with Ludwig Feuerbach acknowledged the active (as opposed to a passive) role of human cognition, they attributed a greater role to inner psychological conditions (or "special forces") responsible for "active apperception, inner intention or will" (Leontiev, 1977, para 3). Marx criticized this materialist understanding of reality and argued that it further confounded the role of human consciousness and failed to take into account the subjective interdependence of human activity in the objective world.

Thus, on one hand Feuerbach's idealism established the notion that objective truth resulted from the cognitive processes of human reflection and contemplation. However, on the other hand champions of Feuerbach's view limited the cognitive nature of the

individual and did not adequately explain change in human activity beyond abstract and reflective measures. Feuerbach and other proponents of a materialist understanding of reality at the time were champions of a unidirectional cause and effect relationship between the environment and the individual. Marx concluded that "[t]he main defect of all hitherto-existing materialism – that of Feuerbach included – is the Object [*Objekts*], or of contemplation [*Ansehauung*] but not as human sensuous activity, practice [*Praxis*], not subjectively" (Marx, 1845, para 1). Marx expressed appreciation for Feuerbach's groundbreaking attempt to understand sensory activity. He also denounced the resulting fragmentation of human consciousness with the object and attributed the limitation in Feuerbach's argument to his failure to identify "human activity itself as objective [*gegenständliche*] activity" (para 2).

Marx conceptualized activity as both "sensory" and "practical" because "people enter into a practical contact with objects of the surrounding world, test their resistance, and act on them, acknowledging their objective properties" (Leontiev, 1978, The General Bases of Marxist Psychology section, para 10). Marx perceived human activity as a mutual interaction between the mind and its context and referred to it as the objective activity. As a result, he did not separate subjective and objective phenomena because he believed that human activity existed only within a social context and could not be isolated from it (see Figure 1).



*Figure 1*. Marxist relationship between subject and object.

Thus, according to Leontiev (1977), an individual's need to adapt to social conditions shaped human activity, and social conditions, correspondingly, shaped human activity. Leontiev (1977) did not focus attention on either the autonomous nature of human consciousness or the relationship between stimulus and response (i.e., the object-subject pattern). Instead, he emphasized the processes that "realise a person's actual life in the objective world by which he is surrounded, his social being in all the richness and variety of its forms" or the "subject-activity-object" pattern (Leontiev, 1977, para 5).

Modern researchers of activity theory identify five basic principles: (a) object-orientedness, (b) hierarchical structure, (c) internalization-externalization, (d) tool mediation, (e) development (Kaptelinin & Nardi, 2006). An explanation of these principles follows, based on the work of Leontiev (1977, 1978).

**Object-Orientedness.** Object-orientedness refers to the notion that every activity is oriented toward an object. An example of this principle in practical application for this study was the investigation of the iPad apps as objects of the distinct developers' activity in creating, programming, testing, fixing bugs, etc. According to Leontiev (1977), "…the very concept of activity (doing, *Tätigkeit*) implies the concept of the object of activity" (para 14). Thus, there can be no such thing as an objectless activity because "the scientific investigation of activity necessarily demands the discovery of its object" (Leontiev, 1977, para 14). Leontiev (1977) defined the notion of the *object* in two ways:

> …first in its independent existence, commanding the activity of the subject, and second, as the mental image of the object, as the product of the subject's 'detection' of its properties, which is effected by the activity of the subject and cannot be effected otherwise. (para 14)

Kaptelinin (2005) attributes the confusion of the dual interpretation of "the object of activity" to the linguistic limitations of converting two similar Russian terms *objekt* and *predmet*, resulting in the overly broad English word, "object." The first general application of the word (as illustrated above) describes the objective material reality, the existence of things, or the setting apart of the object from the subject in the subject-object dichotomy (Kaptelinin, 2005). The second, narrower definition, of "object" in the context of activity theory is in reference to the "object-related" activity, described as "a specific level of subject-object interaction at which the object has the status of a *motive*" (Kaptelinin & Nardi, 2006, p. 59). This latter meaning relates to a motive that is "intentional, social, meaningful, and integrated qualities" (Kaptelinin, 2005, p. 8). The principle of hierarchical structure clarifies this relationship, described by Nardi (2009) as a "system of motive-object" (p. 39) and by Kaptelinin (2005) as "the target or content of a thought or action" (p. 6).

The object of activity describes *what* and *why* in relation to some phenomenon. Kaptelinin et al. (1999) state that activity theory does not restrict an object merely to "the physical, chemical, and biological properties of entities" (p. 29). Social and cultural aspects are also valid objects that may be researched. Further describing object-orientedness, Kaptelinin and Nardi (2006) indicate that objects can be both external (i.e., material) and internal (i.e., ideal) and that our efforts or activities meet with "resistance and affordances," such that these "objects constrain and direct what we do" (p. 66).

This notion was applied conceptually in the context of the current study in considering the activity of a developer or an instructional designer, working on an educational iPad app (i.e., the object). During the process of creating the app (the object),

he/she directs all of his/her emotions and efforts (the activity) toward the objective of facilitating learning (i.e., the objective, writ small). As the process of development nears completion, the developer/designer may encounter difficulties (resistance) and/or opportunities (affordances) that prompt change, resulting in a final product that differs from the initial design. Examples of difficulties or opportunities that may have altered an activity in this study included restrictions imposed by Apple on the limits of technical functionality or consumer feedback related to desired choices or options within an app. Ensuing changes necessarily would affect the subjects of the activity (the developer, the app consumer as well as the community using the product). The selective motives of human consciousness are the actions that influence society that, in turn, is also changed. This mutually reactive nature of object-orientedness broadens the traditional definition of objective reality.

**Hierarchical Structure.** Leontiev expounded upon Vygotsky's theory on individual action, emphasizing "the relations which characterise that activity" and clarifying the dynamic relationship between human beings and the environment through a hierarchical structure involving analyses at three levels: activities, actions, and operations (see Figure 2). Since an activity is oriented toward a motive and is considered "the minimal meaningful context to understand individual *actions* belonging to it," actions can be perceived as subordinate to activities (Koschmann, Kuutti, & Hickman, 2005, Leont'ev: Activity Theory and Breakdown section, para 2). Actions amount to a series of intentional conscious behaviors that are directed toward a goal, but separate from the greater activity that is directed toward the motive. One activity may incorporate numerous actions and one action may be part of a number of activities. Yet, traditional

psychological research has focused most often on what takes place at the action level (Koschmann et al., 2005).

Operations fall below actions, as the lowest level of activity. They are unconscious or automatic behaviors that lack a specific goal, but get carried out under specific conditions. Actions may become operations when consistent practice causes a behavior to become routine. Similarly, operations may become actions when some unique situation or special circumstance demands that an individual perform a routine behavior, consciously. This principle of activity theory was conceived for the purposes of this study in relation to the automation of an iPad user's actions within an app due to repeated "play" and correspondingly consistent app response/reaction, resulting in the transformation of the action into an operation. Conversely, an operation in the form of a swipe or tap on an iPad touch screen can become an action if the user needs to do something new or perform with precision, such as drawing a picture, controlling a slider, or dragging an element on the screen with his/her finger.
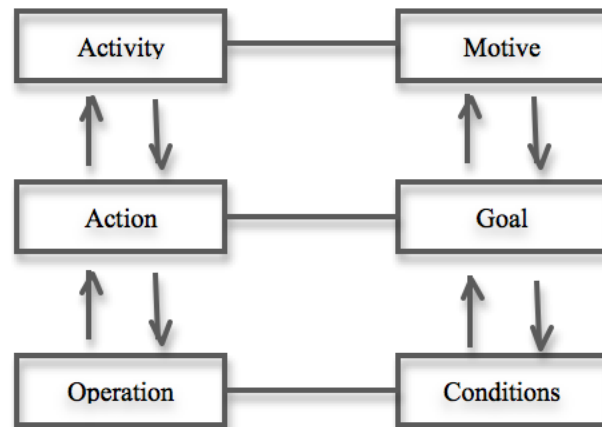


*Figure 2*. Leontiev's hierarchy of activity.

Leontiev provided a now famous example of hierarchical structure that involved two groups, performing two very different actions, in order to accomplish a mutually beneficial goal. The groups—the beaters and hunters—were participants in a primeval hunt for the collective interest of their tribe. Beaters would chase animals toward hunters so that the hunters could, more easily, kill the prey (see Figure 3). Beaters and hunters were driven by a shared motive of getting food. However, the actions of the distinct groups were vastly different and based on the division of labor within the tribe. The beaters' seemingly contradictory actions of scaring the animals contributed to a larger, shared, motive: "…in order to satisfy the need for food he must perform actions that are not directly aimed at obtaining food" (Leontiev, 1977, para 28).
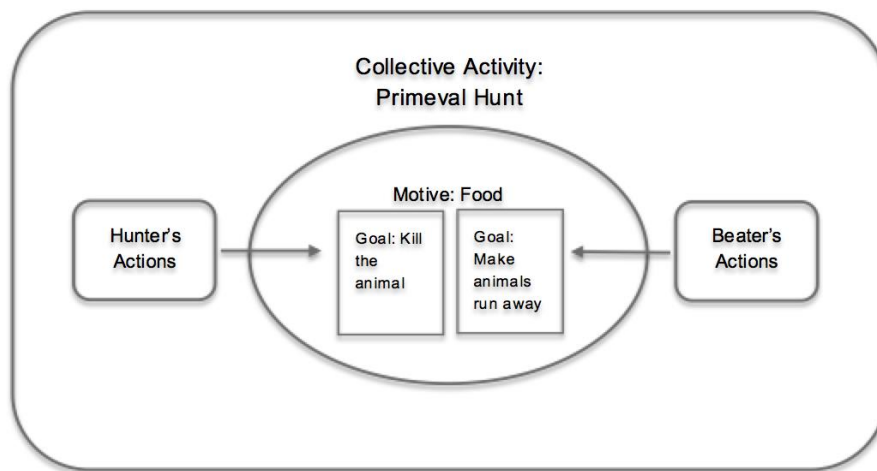


*Figure 3*. Leontiev's primeval hunt. Example illustrating the hierarchy in activity theory.

**Internalization-Externalization.** Internalization-externalization refers to the internal and external aspects where an activity may take place, respective to an individual. While these two elements are distinct, it is not possible to separate them within the constructs of an activity theory framework. This principle of activity theory concerns understanding the development of higher psychological processes. Internal

activities are mental or cognitive processes, "the genetically initial and *fundamental* form of human activity, practical activity" (para 16).

Vygotsky (1978) considered internalization as "the internal reconstruction of an external operation" (p. 56). His example of a child pointing emphasizes the importance of the "parental" response. Initially, a child may be attempting to grasp an object just beyond reach; but, when a parent or adult sees the child's movement, he/she interprets the gesture and responds to the child. Vygotsky pointed out that "the situation changes fundamentally" due to the child's signaling because the "point becomes a gesture for others" (p. 56). It becomes a social experience whereby the pointing becomes shared and, therefore, meaningful. As the child begins to understand the meaning that the adult associates with the sign, he/she begins to use the same pointing movement, intentionally. Vygotsky (1978) remarked that "only later, when the child can link his unsuccessful grasping movement to the objective situation as a whole, does he begin to understand this movement as pointing" (p. 56).

Externalization involves transforming internal activities into external activities. It occurs when mental processes require validation or correction. Mental processes can be exhibited in external behaviors, for example, when a group of people coordinate an activity (Kaptelinin & Nardi, 2006).

The second factor differentiates between the individual (intrapsychological) and the collective (interpsychological). Explaining his universal law of development, Vygotsky (1978) wrote,

> Every function in a child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological), and then inside the child (intrapsychological). This applies equally to voluntary

action, to logical memory, and to the formation of concepts. All the higher functions originate as actual relations between human individuals. (p. 57)

Vygotsky attempted to understand the early stages of skill development by identifying a gap between "the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (1978, p. 86) which he called, the zone of proximal development. Thus, in the process of higher psychological development, what begins as interpsychological mental processes transforms into an interpsychological one. In the pointing example, when the child internalizes the meaning, the activity becomes internalized from one that is intrapersonal to one that is interpersonal.

**Tool mediation.** Vygotsky's theory advanced the ideas of Marxist psychology by studying the link between the internal and external world. Vygotsky asserted that the relationship between the subject and the object of the activity (or purpose) was mediated within the limitations of artifacts such as tools, procedures, symbols, and belief systems (see Figure 4).
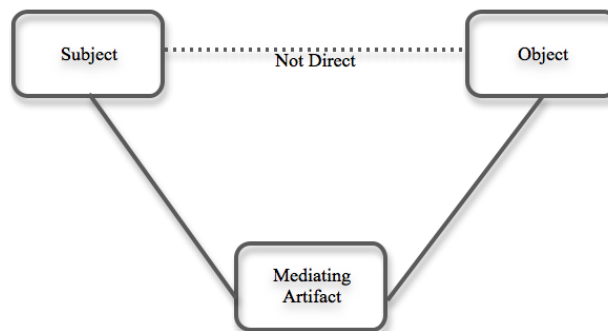


*Figure 4*. Vygotsky's relationship of subject and object.

As an example, Leontiev (1977) described language as "…the product and means of communication of people taking part in production" (para 48). A language system is

an ever transforming man-made construct that enables a society to communicate with one another. It is a representation of the material world that orients human beings, culturally and socially. At the same time, our ability to communicate is also constrained by the limitations of any given language system (Kuutti, 1996; Leontiev, 1977). Therefore, the Vygotskian notion of activity diverged from the position that human action was biologically driven by or unilaterally dependent upon the objective world, and stressed the historical and social interdependence of human activity to a particular context.

**Development.** The final principle of activity theory taken from Vygotsky (1978) and reviewed by Leontiev (1977) emphasizes the significance of cultural and historical development. Unlike other psychological theories, development, within an activity theory framework, considers "all practice as the result of certain historical developments under certain conditions" (Kaptelinin & Nardi, 2006, p. 71). It undergoes continuous changes and reforms, and as a result, it is necessary to understand these developments within this dynamic context.

**Activity Checklist and
the Present Study**

In qualitative research, Creswell (2007) suggests designing a protocol or "a predesigned form used to record information collected during an observation or interview" (p. 135). The Activity Checklist is an analytical tool used in human-computer interaction (HCI), derived from Leontiev's work on activity theory. HCI gained popularity in the early 1980s and combines research and practice in the fields of computer science and cognitive science. With the advent of personal computers, the availability of software and computer platforms for the broader public led to the recognition that there were "deficiencies of computers with respect to usability for those

who wanted to use computers as tools" (Carroll, 2013). As a result, research in HCI

began focusing on cognitive engineering (i.e., the integration science and engineering

with the field of cognitive psychology), usability, and maintainability. Of particular

importance is the examination of the relationship between technology and the user

experience.

Kaptelinin et al. (1999) emphasized tool mediation by embedding it within all of

the other principles. Thus, tool mediation permeates all of the other sections in the

Activity Checklist. The remaining four categories cover the basic principles of activity

theory:

1. Means and ends (Hierarchical Structure) – the extent to which the technology facilitates and constrains in helping users to attain goals, as well as the extent to which it impacts technology by provoking/resolving conflicts among various goals.
2. Social and physical aspects of the environment (Object-Orientedness) – integration of target technology with requirements, tools, resources, and social rules of the environment.
3. Learning, cognition, and articulation (Externalization-Internalization) – internal vs. external components of activity and support of mutual transformations with the target technology.
4. Development (Development) – developmental transformation of the above components as a whole (Kaptelinin et al., 1999, p. 33).

**Means/Ends.** The Means/Ends section of the Checklist corresponds to the basic

principle of hierarchical structure in activity theory. Kaptelinin et al. (1999) encourage

research on media use with the identification of the goals of target actions. The purpose

of identifying the goals is to understand where an action is directed, and establish how

different actions constitute the activity. The analysis of goals and subgoals should reflect

not simply what the user demonstrates at the conclusion of a sequence of actions, but also

what he/she describes as constraints and/or conflicts in the pursuit of goals and processes

that facilitate the orientation of actions toward goals.

**Environment.** The transformation of the object, or object-orientedness, is evaluated in the Environment section of the Checklist that "[identifies] the objects involved in target activities and constitutes the environment of the use of the target technology" (p. 36). The investigation of the context requires clarification of its definition and usage. As indicated earlier, educational iPad apps differ from traditional learning environments in that the physical context of use is not limited to a school classroom. Wali, Winters, and Oliver (2008) define mobile learning as "learning that occurs as a result of pursuing learning activities that are directed toward achieving some objective in multiple context (physical and social)" (p. 45). Wali et al. differentiate and emphasize the need to study both the "context that surrounds the human user of technology," and "the context that arises from the constructive interaction between people and technology" (p. 47).

With the first group, the mobility of the technology (e.g., the physical learning space, such as the school classroom, in the car, or at home) is the primary focus of attention. A limitation of such techno-centered investigations is the disregard of learning or the social elements of the environment. Furthermore, other forms of tool-mediated learning (e.g., learning without the technology, such as classroom handouts) are ignored. However, this brings up an interesting point about the capabilities of technology that may alter a learning experience. The implication is that the attribute of mobility permits certain functions that would not, otherwise, be possible.

The second group places greater emphasis on the mobility of the learner. As suggested earlier, depending on the context of its usage, the iPad can be used in a school setting or as an individualized learning tool. Collaboration (through formal instruction or

through social interaction) is assumed in the school classroom. The same considerations

cannot be expected with an individualized technology tool, such as the iPad. Thus, the

flexibility of the user is limited to physical location or space and motivations that reflect

different points in life (e.g., self improvement and leisure) and time (e.g., different times

of the day or week). Wali et al. may find discomfort in the substantial shift away from the

technologies used in the learning, however, consideration of the physical and

motivational environment is worth examining.

The second interpretation of context relates to the social context of the activity or

the "community that interacts around shared objectives" (Wali et al., pp. 44-45).

According to Leontiev (1977), the action-goal relationship in an activity was attributed to

"a society based on labour" where each participant was a contributor to a collective labor

activity. Each individual possessed individual needs but to fulfill the need required both

individual and collaborative participation of others. It was the social relations or the

relationships that arose from the participation in the labor that the motive of the activity

could be satisfied. With the present study on educational apps, this aspect of the context

involved relationships such as those between the developer and the learner as well as

those that involve the learner and possibly other people. This focus shifted from the

physical capabilities and environment surrounding the technology to the social

background and setting of the learner.

**Learning/Cognition/Articulation.** The third column of the Checklist explores

the learning process or the externalization and internalization of the learning activity that

is established through the design of the instruction. As an element of externalization, this

section explores the "support of problem articulation and help request in case of

breakdowns" or the guidance that is provided when mistakes or contradictions occur during the process of internalization or externalization (Kaptelinin et al., 1999, p. 37). In the current study, data were ascertained through the content of the apps as well as through self-reported reflections about user experiences from the customer reviews.

      **Development.** Development is the final category of the Checklist. Activity theory places a strong emphasis on the continuity of human activity within its historical development. (Wali et al., 2008). A laboratory experiment may shed light on a specific instructional method within an isolated context. However, activity theory moves away from this immediacy and examines activity through a broader, more dynamic context that is in constant transformation (Leontiev, 1977). Kaptelinin et al. (1999) state that the "analysis of the history of target activities can help to reveal the main factors influencing the development. Analysis of potential changes in the environment can help anticipate the structure of target activities." (p. 36). This section considers the user after each "life cycle" of the activity. A "life cycle" of an activity examines the mediation of the tool from the goal setting stage to the final outcome in its totality. This is an important concept in activity theory in order to assess how the "usage unfolds over time" (p. 32). In addition, the item, "Users' attitudes toward target technology (e.g., resistance) and changes over time" (p. 37) was of particular interest, as version histories and customer reviews were analyzed in tandem to see whether or not interactions occurred.

## Chapter II Summary

      Despite the promised potential of various technologies in academia, implementation of instructional media has had minimal influence on education. An examination of the life cycles of new media adopted in educational settings or for

educational purposes suggested that educational media, such as film, radio, and television have found broad but fleeting application and integration in school classrooms. Post hoc analyses indicated that in many cases, studies of instructional media have emphasized immediate gains that were attributed to the technology, with limited considerations about the interaction between instruction, the involved people (e.g., developers, instructors, students), and the learning space.

Apps on newer technologies, such as the iPad, provide noticeably visible information about the instructional design. Other sources of data, such as consumer reactions and reflections, deepen these analyses with information on the values and opinions that users have about their experiences. Used as a theoretical lens, activity theory facilitates an expanded examination about this broader conception of the educational learning space. The results of an extensive review of the apps at an expansive yet detailed level should clarify the learning environment and enhance the educational aspects of apps.

**CHAPTER III**

**METHODOLOGY**

The purpose of this study was to explore the educational iPad app learning space using an activity theory framework. The content of this chapter relays the materials, sample, research design, and data analyses procedures that revolved around these guiding research questions:

Q1     Within an Activity Theory framework, what instructional characteristics can be identified through the ethnographic content analysis of top commercial educational iPad apps (including their content, developer descriptions, and update histories)?

Q2     Within an Activity Theory framework, what attributes of the learner and the learner experience can be identified through the ethnographic content analysis of customer reviews of top commercial educational iPad apps?

**Purposeful Sampling**

The focus of the current study was to examine the highest ranking paid educational apps from the Top Charts section of Apple's App Store. An IRB approval was not necessary for this study because there were no human participants. The "Education" category was selected by the developer and reviewed and approved by Apple prior to being disseminated throughout the App Store (iOS Developer Library, n.d.). Educators typically organize and then select educational software (such as apps) by factors such as subject area, grade level, or age level. Because the purpose of the study was to understand the cultural context (i.e., how the interactions of customers and developers help shape the app experience), the sampling was determined by those apps

that dynamically appeared within the App Store environment, namely in the Top Charts (Education) section.

The Top Charts section is comprised of three categories: Paid, Free, and Top Grossing. Although there were notable differences in the types of apps in these lists (e.g., Paid apps tend to be geared more toward early childhood, and Free apps tend to be geared toward both adults and children), two considerations were made in utilizing the Paid apps list. First, in the Watlington (2011) study, 65% of the apps studied were "freemium" or "lite" versions with limited functionality until additional in-app purchase. The issue of in-app purchases was recently brought to light in a class-action suit filed against Apple for enticing children with free apps that include hidden virtual currency only accessible through real money (Federal Trade Commission, 2014). Paid apps were chosen over free in the present study because the purpose was to examine all of the available actions at the point of initial download without having to make these hidden purchase decisions. Second, customer reviews were written only by users who have made a conscious decision to pay for the app. Consequently, only customers who had downloaded the app could provide comments, suggesting more reliable experiential data. Thus, for the present study, only paid apps were selected.

The top nine, most consistently highest ranking, apps were sampled in this study because of their visibility on the iPad screen "above the scroll." The term "above the scroll" was a modern play on the term "above the fold," which traditionally suggested that the most important news stories were placed on the top half of the front page of a newspaper (Gourley, 2003; Nielsen, 2010). In the interface of the Top Charts section of

the iPad App Store, because the top nine apps were visible "above the fold" or "above the scroll," nine apps were chosen as the sample size of the study.

As a final concern, in cases where more than one app from the same company, organization, or developer appeared among the top nine apps during the timeframe allotted, only the most consistently top-rated app was considered and the next, most consistently, top-ranked app took its place. In other words, no two apps from the same developer were sampled for the study.

**Materials**

**The iPad and Educational
iPad Apps**

The current study explored iPad apps that were available for download onto Apple's iPad devices. The iPad is the hardware, in the form of a tablet computer, which runs on Apple's proprietary iOS mobile operating system. The iPad 2 that was used in the research was a 64gb second generation Wi-Fi+3G iPad (see Figure 5). This device used a 1GHz dual-core Apple A5 chip. The physical dimensions of the iPad 2 were 9.50 inches (height) by 7.31 inches (width). The display utilized a 9.7-inch (diagonal) LED-backlit widescreen Multi-Touch display with IPS technology. The screen resolution was 1024-by-768 pixels at 132 pixels per inch. The iPad 2 had a front and back camera as well as Bluetooth and AirPlay mirroring capabilities.

*Figure 5*. Second generation iPad.

Although the iPad 2 used for this study was an older model of the iPad and was

selected out of convenience and availability, iOS7.1.1, the most current operating system

at the time of data collection, was installed. The version of the hardware did not affect the

data collection or analyses processes, and there were no compatibility issues running the

apps.

The App Store was a pre-installed app on the iPad. The App Store was a digital

distribution platform or marketplace, vetted by Apple, from which apps could be

searched, purchased, and downloaded onto the iPad. Figure 6 below illustrates the

interface of the main page of the App Store and the educational Top Charts section,

which was divided into Paid, Top Grossing, and Free categories. Access to the store

required an Internet connection; purchases required an Apple ID login and a credit card.

*Figure 6*. App Store interface. Interface of the main page of the iPad App Store (left) and Top Charts section (right). The left column of the Top Charts interface lists the top paid apps.

Information about individual apps were accessed through a small pop-up menu. The Details tab included the description and version histories. The Reviews provided a list of user feedback (See Figure 7).
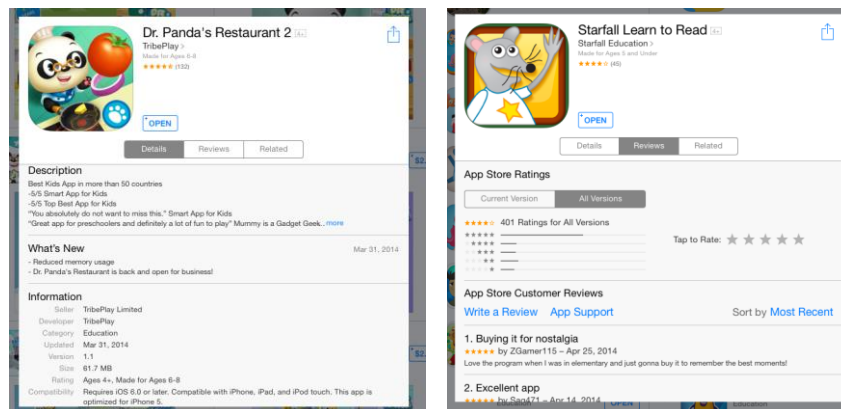


*Figure 7*. Sample interface of individual apps.

## Activity Checklist

The purpose of the Activity Checklist was to help me review the most pertinent concepts from an activity-centered framework (see Appendix A). The Activity Checklist was developed by Kaptelinin et al. (1999) and was divided into four sections that

corresponded to the basic principles of activity theory. The guide was used much in the same way that an interview protocol is typically used in qualitative research.

**Dedoose Data Analysis Software**

I used Dedoose, a web-based data analysis software to explore, excerpt, and code verbal and animated data into themes (see Figure 8). According to their website, Dedoose is "a cross-platform app for analyzing text, video, and spreadsheet data" for quantitative, qualitative, and mixed methods research methods (Dedoose, n.d.). The predecessor of Dedoose was called EthnoNotes for Filemaker Pro. Originally designed in the late 1990s by two professors at the University of California-Los Angeles, Dedoose was created to meet the growing needs of mixed-method research. This software was chosen for this study because of its capabilities to analyze and reduce themes in qualitative data and process non-text based visual data.
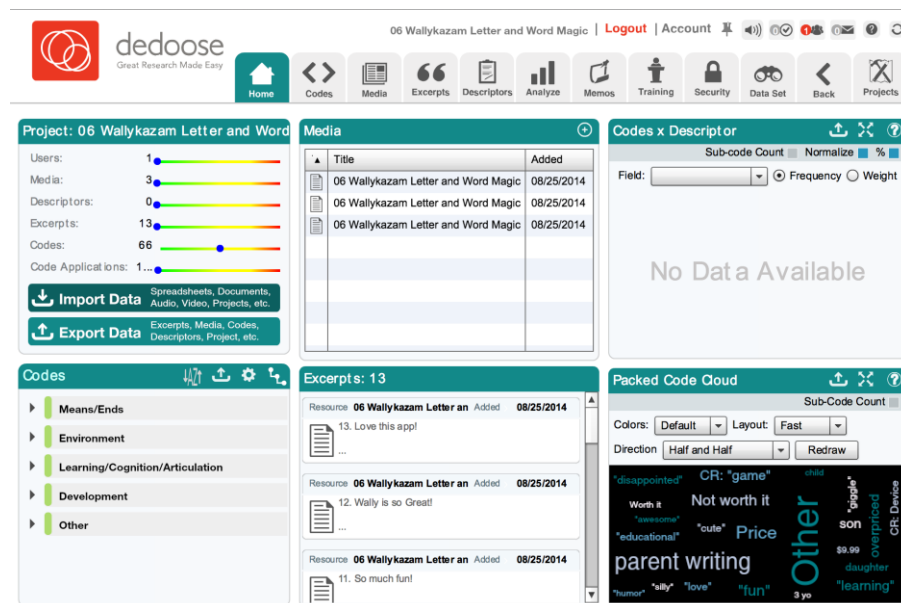


*Figure 8*. Main interface of Dedoose.

## Research Design

The research design for this study was qualitative in nature; the findings were presented in two sections. The first section explored themes related to the primary research question through an ethnographic content analysis of nine applications selected for examination. Altheide (1987) defined an ethnographic content analysis (ECA) as "the reflexive analysis of documents" (p. 65) that is used "to document and understand the communication of meaning, as well as to verify theoretical relationships" (p. 68). This research methodology blended elements of ethnographic design with content analysis by exploring the meaning of data, in context.

Methods of collecting data included a screencast video of available actions in the app and the descriptions extracted from three areas, including app descriptions, customer reviews, and version histories from the App Store. The results were illustrated through nine individual portraits of the activity. Merriam (1998) defined this type of investigation as a within-case analysis. The second portion of the study occurred after the analysis of all individual cases was completed. This latter section incorporated the characteristics of the nine portraits within a more holistic analysis of the app culture.

## Procedure

Merriam (1998) outlined three key steps in a qualitative data analysis. The first step involves data preparation and organization. The next step is to code the data and to reduce them into themes. The final step was to represent the data and answering the research questions. Using Merriam's organizational framework as a guide, the present study was divided into four principle steps that encompassed the procedure: app

selection, data preparation and organization, data coding and reduction, and data representation. The details are relayed in the following outline of the steps:

**Step 1: App Selection**

The first step was to select the nine apps using the sampling rationale described earlier. Figure 9 is an illustration of the spreadsheet used to track the top nine apps.



*Figure 9*. Spreadsheet of tracking the apps.

The sample of the top nine apps were selected based on the highest aggregate count of appearances 'above the scroll' between February 12, 2014 and June 20, 2014 (i.e., the date range of data collection).

**Step 2: Data Preparation**
**and Organization**

Data were gathered from four sources. The first was through the description of the app in the App Store. The second was through my actual use of the app in examining the intended instructional task, strategies, and sequencing of content. The third source was

user reviews from the App Store. A final source of data came from the version histories

that provided an overview of the updates made in the app. Data collection procedures for

the information related to app description (descriptive information), app content, user

reviews, and version histories of the apps are outlined below, as part of the organization

and preparation step.

**Description of the app.** The description section of every app in the App Store,

written by the developers, profiled and provided potential insight into the intended goals

and motives of the educational app (see Figure 10).
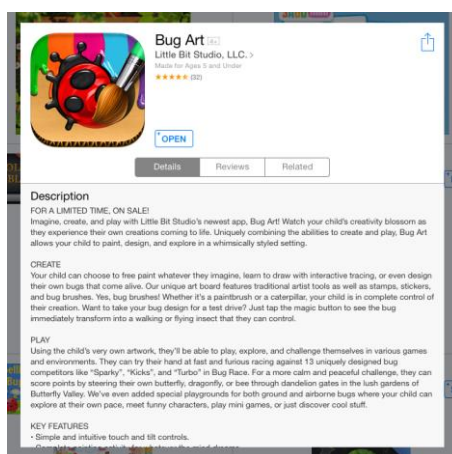


*Figure 10*. Sample description of an app.

The recording of the description of the app was conducted accordingly:

1. The app was accessed through the iPad App Store (App Store > Top Charts >
   Education > Paid Apps).

2. The description of the app was found under the "Details" menu.

3. A screenshot was taken by simultaneously holding the home button and the
   Sleep/Wake button. Multiple images were captured if the content did not fit
   within the frame. The images were automatically saved in the Photo album.

4. The Dropbox app was opened. New images were automatically imported onto the Camera Uploads folder of the Dropbox database. The images were imported into the computer hard drive.

5. All screen shot images (png files) were imported into an optical character recognition (OCR) reader.

6. The text produced from the OCR software were copied into Microsoft Word.

7. The Microsoft Word document was carefully reviewed and revised for transcription errors by comparing it with the original screenshot.

8. The Microsoft Word document was saved.

**App content.** The second source of data that was collected was the downloaded app itself. The process of data collection and organization included an instructional analysis diagram and a screencast of the app being used.

*Instructional analysis diagram.* The creation of an instructional analysis diagram occurred prior to screen capturing usage data. The purpose of the diagram was to map out the design through methodical observations of available methods, strategies, and actions that are embedded within the app.

The user interface of the app was diagrammed using Adobe Illustrator. Squares indicated the steps of the sequence. Diamonds indicated decision-making steps (i.e., opportunities to tap or swipe, etc.). In cases where the user interface looped, roman characters indicated where the selection connected. The final instructional analysis diagrams for each app can be viewed in the appendices.

*Screencast (video).* Krippendorf (2013) emphasized the importance of research, or ability to re-examine and replicate a study involving content analysis. However, in the

dynamic context of iPad apps, there was no guarantee that the same content (i.e., the

same version of the app) could be re-searched due to its dynamic nature. Thus, in order to

preserve an archive of the version of the app being studied, a video screencast of all

available options were captured and recorded in digital form. The protocol for initializing

the screen cast was as follows:

1. Turned off any software that may interfere with the recording on the computer
   (e.g., mail clients, etc.).

2. Held iPad Vertical first.

3. Opened Reflector.

4. Opened Airplay on iPad, and connect to Macbook Pro, selecting the mirror screen
   option.

5. Opened Soundflowerbed and select Built-in Output.

6. Opened System Preferences, select Sound, select Soundflower 2ch as the output.

7. Opened Quicktime, and select File > New Screen Recording. This began the
   recording.

8. In the Reflector application, selected full screen.

9. Ran the screencast, and give ample space before and after the screencast.

10. Captured the video.

11. Exited full screen in Reflector.

12. Tapped the stop button in the top menu bar.

13. In Quicktime, saved the file.

14. Trimmed beginning and ends.

15. Converted the movie from .mov to .mp4 in iMovie.

16. Imported to qualitative data analysis software.

17. Reset System Preferences sound output to internal speakers.

18. Reset menu-bar option for Soundflowerbed from Build-in Output to None.

It should be noted that during the video screencast, the instructional analysis diagram was used as a guide to ensure all possible options were captured in the recording.

**User reviews and version history.** In the current study, consumer reviews and version histories were recorded to explore the nature and development of the app (see Figure 11).
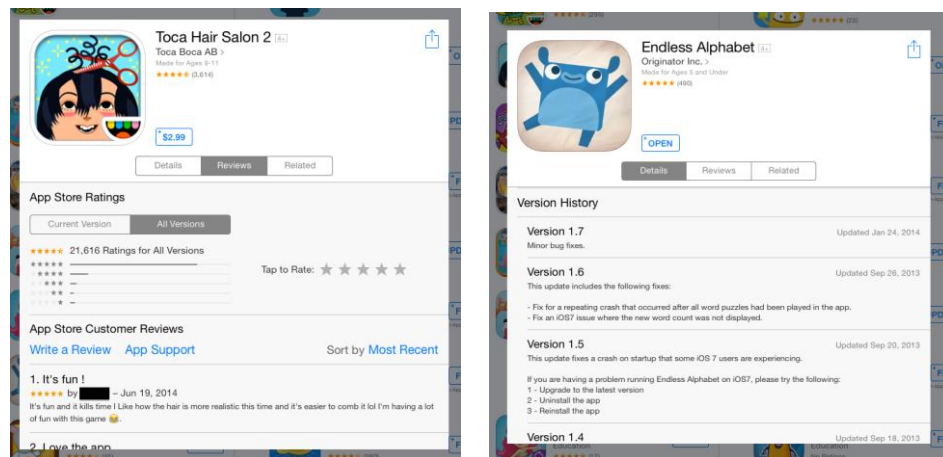


*Figure 11*. Sample reviews and histories. User reviews (left) and version histories (right).

User reviews and version histories were raw and public data available in the App Store. Verbal feedback by customers were viewed by selecting the desired app and tapping on the Reviews' section. Version histories were accessed by selecting the desired app, scrolling down, and tapping the "Show Version History" link.

*User reviews.* Recording of the customer reviews of the app was conducted using the following procedures:

1. The app was accessed through the iPad App Store (App Store > Top Charts > Education > Paid Apps).

2. The customer reviews of the app were found under the "Reviews" menu. The reviews were sorted by "Most Recent."

3. A screenshot was taken by simultaneously holding the home button and the Sleep/Wake button. Multiple images were captured if the content did not fit within the frame. The images were automatically saved in the Photo album.

4. The Dropbox app was opened. New images were automatically imported into the Camera Uploads folder of the Dropbox database. The images were imported onto the computer hard drive.

5. All screen shot images (png files) were imported into an optical character recognition (OCR) reader.

6. The text produced from the OCR software was copied into Microsoft Word.

7. Every emoji in the reviews were manually copied and pasted as a jpg into the Microsoft Word document.

8. The Microsoft Word document was carefully reviewed and revised for transcription errors.

9. The Microsoft Word document was saved.

10. The document was imported into a qualitative data analysis software. In cases where there were over 100 reviews, the Microsoft Word document was divided into 100-review chunks and uploaded into the data analysis software.

*Version history.* Recording of the version history of the app were conducted using the following procedures:

1. The app was accessed through the iPad App Store (App Store > Top Charts > Education > Paid Apps).

2. The version histories of the app were found under the "Details" menu.

3. A screenshot was taken by simultaneously holding the home button and the Sleep/Wake button. Multiple images were captured if the content did not fit within the frame. The images were automatically saved in the Photo album.

4. The Dropbox app was opened. New images were automatically imported into the Camera Uploads folder of the Dropbox database. The images were imported onto the computer hard drive.

5. All screen shot images (png files) were imported into an optical character recognition (OCR) reader.

6. The text produced from the OCR software was copied into Microsoft Word.

7. The Microsoft Word document was carefully reviewed and revised for transcription errors.

8. The Microsoft Word document was saved.

9. The document was imported into a qualitative data analysis software.

**Step 3: Data Coding and Reducing**

Krippendorf (2013) states that recording and coding "bridges the gap between texts and someone's reading them, between distinct images and what people see in them, or between separate observations and their situational interpretations" (p. 85). The purpose of the current study was to capture and record the ephemerality of a phenomenon in a way that is analyzable and replicable. An appropriate system of coding procedures was adopted to accomplish this.

Coding is a term that was used to describe a process of taking notes on relevant portions of the data. The use of computer aids, or qualitative data analysis (QDA)

software, facilitated this process, enabling the efficient comparing and contrasting of data. Functional characteristics of QDA software included the importing of text, displaying of the original text, manual and automatic coding, hierarchical and nonhierarchical categorizing, memoing, commenting, linking, and interoperability (Krippendorf, 2013). The present study adopted terminology used in QDA, but the underlying procedure for data analysis mirrored general qualitative research practices.

**Immersing into the data**. The preliminary step was to view and review the texts in their entirety to get a sense of the overall data (Creswell, 2007). Reading and rereading transcripts as well as, and in this case, using the app several times was key in becoming more familiar with the data. Each app was "played" over 100 iterations. In certain post-hoc analyses of apps with corresponding television shows, at least 10 episodes of a show were examined to ensure reliability of the show's structure. Three additional methods were used to become more familiar with the texts: converting, memoing, and diagraming.

First, verbal documents were translated into a digital format, allowing me greater ease in reviewing the documents multiple times. For example, the task of converting screenshots into legible document files required careful recording, verification/checking for error of every consumer review and all version history prior to document import into Dedoose.

Second, in qualitative studies, it is recommended that memos be taken during the entire process (Creswell, 2007). Ethnographies were typically characterized by rich, thick descriptions, recorded in an ethnographer's fieldwork journal (Merriam, 1998). Dedoose facilitated note taking and analysis by linking memos to original documents. Thus, throughout the entire process, descriptive annotations were documented within the QDA

software and my immersion into the data occurred concurrently with data preparation, organization, and collection.

Third, an instructional analysis diagram was drawn to outline the actions of the app for analyzing the educational content. The purpose of the instructional analysis diagram was become familiar as much as possible with the content and context of the apps.

**Coding and thick descriptions.** The next phase was to describe, classify, and interpret the collected data in order to be able to "describe in detail, develop themes or dimensions through some classification system, and provide an interpretation in light of their own views or views of perspectives in the literature" (Creswell, 2007, p. 151). Dedoose used the terminology "codes" to describe the process of creating themes. The Dedoose website describes codes as "the conceptual framework that you will use to organize, understand, and communicate the findings of your research" (Lieber, n.d.). Root codes were the broadest categories within which child codes could be created (see Figure 12).
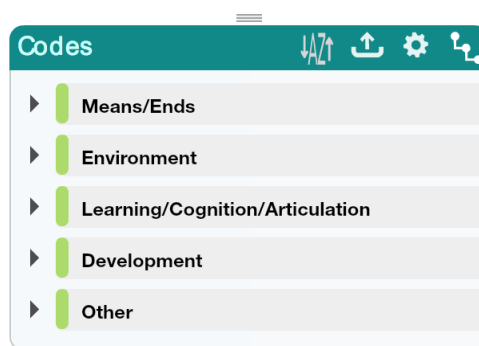


*Figure 12.* Root codes in Dedoose. Root codes include the Means/Ends, Environment, Learning/Cognition/Articulation, Development, and Other. Child codes can be created dynamically as a subset of root codes.

Prior to importing text files into Dedoose, I created four root codes in the QDA software

that reflected Activity Checklist categories. An "Other" category was created for those

codes that did not fit into any of the existing categories, but had the potential of being

important for subsequent discussions (Lieber, n.d).

After importing the text documents and video screencast into Dedoose, the first

iteration of the analysis was to assign categories to excerpts of the data. In Dedoose, the

methodology of categorizing was slightly different for visual and verbal documents.

Video categorization was called video excerpting, which was differentiated from

document excerpting in that video excerpts utilized audiovisual content as opposed to

text-based verbal content. Video clips were excerpted by marking a selection of the video

footage and clicking the excerpt button. The QDA software retained the portion of the

selected audiovisual content. In document excerpting, sections of text were highlighted,

and the excerpting button was clicked. These excerpts (video and text) were then tagged

with existing codes or new codes created dynamically (Lieber, n.d.).

Merriam (1998) describes category construction as a search for recurring patterns

or themes in the data. The creation of themes was both intuitive and systematic and was

developed through constant comparison: "The task is to compare one unit of information

with the next in looking for recurring regularities in the data" (p. 180). In the present

study, the development of child codes that were subsumed under root codes paralleled

this process.

Additionally, Merriam (1998) defined rich thick descriptions as "providing

enough description so that readers will be able to determine how closely their situations

match the research situation, and hence, whether findings can be transferred" (p. 211). In

the present study, opportunities to take in-depth notes and provide different

representations of the same concepts (e.g., diagramming) were incorporated in the design

of the study. Individual excerpts were tagged to memos and notes, which allowed field

notes to be linked to specific passages of the excerpt.

*Coding of app content.* The imported video screencasts were viewed in tandem

with the instructional analysis diagram. Relevant sections of the video were excerpted

and categorized by root code. Once the screencast was organized by root code, I reviewed

each code and used the items of the Activity Checklist as a guide. Rich thick descriptions

as well as notes pertaining to child codes created in the description, reviews, and histories

were memoed in with the excerpts. The general procedure for reviewing the app content

followed these procedures:

1. Reviewed the instructional analysis diagram for relevant sections of the video to

   be excerpted. Assigned excerpts to these video clips.

2. Created excerpts and assigned existing root codes.

3. Assigned a memo to the excerpt, provided a rich thick description based on the

   Activity Checklist guide and memoed connections with other documents.

   As a final note regarding the content, certain apps prompted the customers to rate

their experiences. This function was embedded within the app and was not consistent

among all apps. Memos were made identifying the apps that include this function.

*Coding of descriptions.* The app description provided a preliminary

representation of the app from the perspective of the developer. The text document

containing the transcribed app description was imported into Dedoose and explored,

using similar procedures utilized for coding the app content. The procedures for

reviewing the app description followed these steps:

1. Created excerpts and assign existing root codes.

2. Assigned a memo to the excerpt, provided notes and rich thick descriptions, using

   the Activity Checklist as a guide and memoed connections with other documents.

   ***Coding of reviews and histories.*** Imported text documents included a

transcription of all user reviews and version histories made by the customers that was

publicly available in the App Store. As a note, apps that included over 100 customer

reviews were broken down into smaller files because of to lag issues. This was most

likely caused as a result of the number of jpg files (of the emoji) and the length of the

customer review content. The master file was broken down into 100-review documents

and uploaded as separate files. This did not impact that coding process of the study.

The coding process followed a number of steps. The first step was to mark every

review and every new version of the app as individual excerpts (see Figure 13).
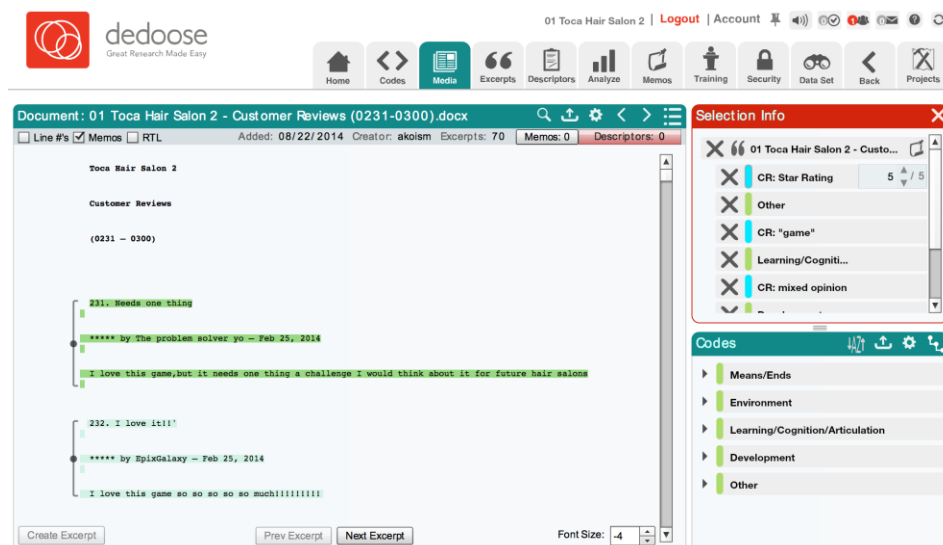


*Figure 13.* Sample user review document imported into Dedoose. Every review is excerpted and tagged with codes.

Next, these excerpts were coded based on their relevance to a root code. These root codes included means/ends, environment, learning/cognition/articulation, development, and other which correspond to the broader categories of the Activity Checklist (see the Materials section). For example, if an excerpt of a user review included specific information regarding the user (e.g., "My two-year-old loves this app!"), the parent code, Means/Ends, will be tagged to the excerpt, as it itemized information regarding the user of the technology. In most cases, excerpts contained multiple codes.

To ensure that the collected data were reflective of the research questions, each of the dynamically developed themes were bound within the Activity Checklist categories and subcategories (Merriam, 1998). Thus, subsequent iterations of coding included a manual coding of data based on the themes that emerged from the data. Using a constant comparison method, themes were created and triangulated among the description, screencast, reviews, and version histories. Triangulation referred to the process of corroborating the robustness of inferences drawn from data from multiple perspectives (Schwandt, 2007). This research was designed in a way that provided a number of opportunities to examine the same constructs through multiple perspectives, sources, and methods. These categorical constructions ended when themes were reduced to a point where the research questions could be answered. This involved a constant interpreting, or making sense of the data, as the themes were being created.

The general approach to coding followed these steps:

1. Assigned excerpts to individual units.

2. Assigned excerpts with existing root codes while taking notes.

3. Assigned excerpts with broad child codes (categories) while taking notes. The classification schemes came from the content of the data.

4. Used the constant comparison method and reduce the broader child codes until the research questions were answered.

**Step 4: Data Representation**

The data for this study were represented by the descriptive information from the portraits of individual apps and the examination of findings within a broader framework. All components of the research question were analyzed based on themes that were developed throughout the investigation and through memoing and note taking. The findings were initially presented as nine individual case studies, followed by a cross-analysis of themes that produced a more holistic view of the app experience. The outline of the procedure for conducting this study is summarized below:

1. Explored each app individually based on themes and thick descriptions pertaining to the categories of the Activity Checklist.

2. Created a portrait of each app.

3. Cross-analyzed characteristics from the nine apps and created a holistic description of the app culture.

<div align="center">**Researcher Stance**</div>

Because a primary characteristic of qualitative research was self-reflexivity, it was appropriate to consider the researcher's background and beliefs in shaping the approach chosen and interpretations made in a study (Tracy, 2013). While quantitative research methods diminish the researcher's role in a study, with qualitative approaches, it was acknowledged, articulated, and incorporated as a central element in the research eco

system. At the same time, the role of the researcher as the primary interpreter of data gives rise to opportunities for biases in the analysis. For example, themes and interpretations made from the data were limited to the knowledge, beliefs, and experiences of the researcher. The researcher's personal preference or attitude toward a certain type of instructional methodology may have impacted the partiality of identifying and assessing the characteristics of the educational apps. Thus, transparency regarding the researcher and the methodology were key in communicating the position taken.

As the primary researcher of the study, my theoretical orientation about learning changed throughout my graduate studies. At the onset, I was fascinated by the behaviorist-oriented position of designing and implementing instruction. My initial belief was that effective learning was dependent on the structured design of instruction that carefully followed the principles and strategies in instructional design textbooks. However, as I gained more experience in teaching and designing learning experiences, I began to realize that, in some cases, design that followed strategies founded upon empirical evidence did not necessarily result in the expected behavioral outcomes. In other cases, I noticed that positive student responses to learning experiences did not necessarily follow strict design principles. As a result, I shifted my interest toward constructivist theory, focusing on the active learners' meaning making processes, participatory design, and social constructions of knowledge.

However, I began to notice that much of the instructional design literature focused on a school or corporate environment. Issues related philosophical beliefs or to the use of technology were often argued based on achievement outcomes aligned to a predetermined standard or objective. Unique opportunities to learn were not always

occurring in the classroom or at a company, and the interest in my dissertation began from an identification of a gap in educational theory and application.

## Chapter III Summary

Krippendorf (2013) identified three types of units of analysis when determining the type of information to collect: sampling units, recording/coding units, and context units. Sampling units referred to the "selective inclusion" (or exclusion) of units from a larger population. Recording/coding units were typically a subset of sampling units, which are extracted for description, transcription, recording, or coding. Context units referred to units of textual matter that limit the scope of the recording units.

The current study sought to sample educational apps from the iPad App Store that were most visible during a four-month period. Four types of recording units were examined from these apps: the description of the app, the content of the apps, the reviews left by the customers, and the version history of the app. The context unit of the content of the apps were examined using the Activity Checklist, and the context unit of the reviews and versions were the individual feedback of the customers and the individual version histories, respectively.

# CHAPTER IV

# RESULTS AND ANALYSES OF NINE PORTRAITS

The purpose of this study was to identify the most frequently appearing Top Paid apps in the Education section of Apple's App Store and to gain a deeper understanding of the nature of education-related iPad apps. While there are reportedly more than 80,000 education apps designed specifically for the iPad (Apple, n.d.), the content and the mediating function of such apps within the larger App Store remain underexplored in the realm of scholarly research. Oftentimes, sampling in education-related studies for the purposes of exploring educational contexts are based on specific subject or content areas.

However, the present study recognizes that the term "educational" is loosely defined in both academic and non-academic settings. Furthermore, it cannot be assumed that the developers of apps and academics pursue the same objectives. The activity theoretical position taken in this research broadened the focus from immediate actions and goals of learning content to include the instructional, social, technological, and developmental characteristics that otherwise might have been overlooked. This study emphasized the rigorous examination of an app within the context of a social community of developers and other consumers toward creating, shaping, and contributing to the learning space. This chapter answers the following research questions:

Q1     Within an Activity Theory framework, what instructional characteristics can be identified through the ethnographic content analysis of top commercial educational iPad apps (including their content, developer descriptions, and update histories)?

Q2     Within an Activity Theory framework, what attributes of the learner and the learner experience can be identified through the ethnographic content analysis of customer reviews of top commercial educational iPad apps?

## General Overview of Collected Data

Over the course of four months (i.e., 128 days), screenshots of the top nine apps were tracked daily at approximately 12:00pm Mountain Standard Time. A final aggregate count was made on June 20, 2014, resulting in the exclusion of four apps in an effort to explore the most diverse range of developer viewpoints. The delimitation of one Disney, two Nickelodeon, and two Toca Boca apps stemmed from the duplication of developers that appeared more frequently. Table 1 lists the apps sampled for this study, the number of days in the top nine ranking system, as well as the excluded apps.

Table 1

*Sampled Apps and Exclusions*

| App Name | Days in Top 9 | Exclusions |
| --- | --- | --- |
| Toca Hair Salon 2 | 128 | |
| Stack the States | 128 | |
| Endless Alphabet | 94 | |
| Mickey Mouse Clubhouse: Wildlife Count Along | 87 | |
| Wild Kratts Creature Power World Adventure | 64 | |
| Wallykazam Letter and Word Magic | 57 | · Doc McStuffin's Paint and Play (58) |
| Starfall Learn to Read | 34 | · Bubble Puppy Play and Learn HD (49) |
| | | · Toca Pet Doctor (43) |
| Dr. Panda's Restaurant 2 | 27 | · Team Umizoomi: Math Racer HD (28) |
| Bug Art | 21 | · Toca Town (22) |

*Note.* Final list of sampled apps, days in the Top 9 list, and the exclusions.

It should be noted that no other criteria were considered in the selection process. It is coincidental that children (i.e., Pre-K to 12th grade range) were the intended audience of all of the nine apps selected.

Version histories among the selected apps indicated that the duration of app dissemination in the App Store varied and ranged from three-and-a-half years for Stack the States to two months, as was the case for Wallykazam! Letter and Word Magic (see Table 2). The date of last update also differed by app, ranging from 72 to 636. Two of the nine apps had not gone through any updates.

Table 2

*App Version and Duration in App Store*

| App Name | First Version | Last Version | Days in App Store | Days Since Last Update |
|---|---|---|---|---|
| Toca Hair Salon 2 | 11-30-2012 | 09-10-2013 | 568 | 284 |
| Stack the States | 09-13-2010 | 09-16-2013 | 1377 | 278 |
| Endless Alphabet | 01-18-2012 | 01-24-2014 | 855 | 148 |
| Mickey Mouse Clubhouse: Wildlife Count Along | 11-09-2012 | 09-15-2013 | 589 | 279 |
| Wild Kratts Creature Power World Adventure | 03-28-2014 | 04-08-2014 | 85 | 74 |
| Wallykazam! Letter and Word Magic | 04-10-2014 | N/A | 72 | 72 |
| Starfall Learn to Read | 08-27-2012 | 09-23-2012 | 663 | 636 |
| Dr. Panda's Restaurant 2 | 01-23-2014 | 03-13-2014 | 149 | 100 |
| Bug Art | 03-13-2014 | N/A | 100 | 100 |

*Note.* App version and duration and the App Store. Duration of app in the iTunes App Store and length of time since most recent app update, as of June 20, 2014.

The 17,462 customer reviews investigated in this study account for the total number of customer reviews that were posted for all of the nine apps under consideration. Table 3 displays the total number of reviews observed for the nine apps.

Table 3

*Number of Customer Reviews*

| App Name | Number of Reviews |
|---|---|
| Toca Hair Salon 2 | 7747 |
| Stack the States | 6328 |
| Endless Alphabet | 3185 |
| Mickey Mouse Clubhouse: Wildlife Count Along | 69 |
| Wild Kratts Creature Power World Adventure | 21 |
| Wallykazam! Letter and Word Magic | 13 |
| Starfall Learn to Read | 35 |
| Dr. Panda's Restaurant 2 | 50 |
| Bug Art | 14 |

*Note.* The number of customer reviews by app.

## Chapter IV Organization

This chapter presents a descriptive analysis of the nine sampled apps. The presentation of app data is broadly divided into four sections. The first section is a verbal explication of the instructional analysis diagrams, and provides a general background of the app, including information from the developer, technical specifications, version updates, as well as the aggregate count of reviews and ratings for every app. These "walkthroughs" provide exploratory accounts of app content, as the user would encounter and experience, step-by-step. The data were summarized through synthesizing information gathered from the instructional analysis diagrams (Appendices C, D, E, F, G, H, I, J, and K) and the video capture.

The second section considers the nature of the reviews, users, and context. Ultimately, the data derived from the customer reviews and other developer-supplied information are integrated toward presenting a broader portrayal of the user and out-of-app context within which the apps are utilized. A third section comprises the discussion

of the instructional and/or learning content. The fourth section offers a summary of the results. A comprehensive discussion is presented in Chapter V.

## Notes from the Data Collection Process

The following are ancillary comments about the some of the data collected, specifically app access/disposition, app appeal, order of discussion, and disparate data points. First, the reviews of customers indicated that not all reviewers used an iPad to download the apps under consideration. For example, among the 161 reviews in Stack the States that denoted a particular device, 79 were iPad users, 38 were iPhone users, and 44 were iPod users. Only WallyKazam! Letter and Word Magic prevented automatic downloading onto all devices associated with a given Apple ID account. The other eight apps permitted downloading across all devices (e.g. iPad, iPhone, etc.) associated with a registered Apple ID.

Second, a positive, negative, or mixed value was assessed for every review of customer feedback. "Generally positive" reviews indicated that nothing negative was conveyed in terms of content or recommendations. "Generally negative" reviews indicated a complete lack of positive content or constructive criticism. "Mixed" denoted a review with content that fell somewhere in between positive/negative. For example, a mixed review contained negative feedback about an app but indicated a willingness to update the assessment should the developer address his/her concern(s). Alternatively, a customer review was deemed "mixed" if the reviewer not only communicated generally positive information but also recommended changes or indicated the need for an update. It should be noted that any perceived inconsistencies between the number of opinionated reviews and the total number of reviews stem from the occurrence of reviews that were

determined to be undecipherable, in a foreign language, or indifferent (i.e. neither positive nor negative in tone or expression).

Third, the sequencing of apps in this study is based on the most frequent appearances in the top nine educational apps section of the iPad's App Store. While the apps were studied individually, there was considerable overlap in the discussion of the instructional content. Connections or relationships among apps were unintentional; direct references to other apps in the study were minimized. Parenthetical references direct readers to the section of this dissertation when a topic under discussion for one app corresponds with previously reviewed or discussed material.

Finally, there was disparate number of customer reviews among the nine apps considered. Therefore, references to consumer opinions vary in the subsequent discussions. Apps such as Toca Hair Salon 2, Stack the States, and Endless Alphabet had over 3,000 data points. Descriptive analyses for these apps incorporated many more references to the excerpts by the reviewers than apps with fewer data points. Discussion of the six other apps with fewer customer reviews focused primarily on the design of the instruction with the extrapolation of content in direct quotes, as applicable. A unique review number (rather than user name), automatically derived on the day that the data were downloaded, references specific and direct quotations from customer reviews. Although the users' code names and reviews are a matter of public information, the review number was used as an added measure to ensure anonymity and as a stylistic technique to maintain consistency in the flow of the writing.

**App I: Toca Hair Salon 2**

Toca Hair Salon 2 replicates the role of a stylist at a hair salon. The user's primary task is to select a character (i.e., a hair salon customer) and to design and accessorize a hairstyle in a fun and safe environment until the user is satisfied with his/her creation. Although users indicated an overwhelmingly positive reaction to the app, there was a significant amount of requested changes and ideas. The popular app appeared all 128 days of the data collection period, tying with Stack the States as the most frequently appearing app in the top paid educational apps section of the iPad App Store. Toca Hair Salon 2 is the second iteration of a series of hair salon related apps produced by Toca Boca AB. According to their description, Toca Boca characterizes itself as "an award winning game studio that makes digital toys for kids" (Description)

At the time of data collection, Toca Boca AB had 24 apps available for the iPad. Version 1.0 of Toca Hair Salon 2 first appeared in the App Store on November 30, 2012. It has undergone two versions, with the most recent update on September 10, 2013. The first update, which occurred on February 27, 2013, included a note of appreciation to customers, an update of two new characters, the addition of new accessories, and an option for push notifications. The second update, on September 10, 2013, concerned a minor fix with the video introduction.

Toca Hair Salon 2 required 41.4mb of storage, iOS 5.0 or later, and was compatible with the iPhone, iPad, and iPod touch. There are no in-app purchases or ads within the gameplay environment aside from the icon in the main menu, which could be turned on and off in the Settings area of the device.

**Overview of App Options**

According to the developers, "in this kid-friendly, super-creative app, you get to run your very own hair salon, with six fun characters to choose from." Figure 14 presents eight screen shots from the Toca Hair Salon 2 app experience.



*Figure 14.* Toca Hair Salon 2 user interface. Top row, left to right—opening page, character selection page, cutting area, styling area/bottom row, left to right—coloring area, washing area, accessory area, photo area. (Permission to reproduce images granted by Toca Boca AB.)

Upon opening the app, users are prompted to select one of three options. The first two links are intended for parents, and access to "For Parents" is prompted and gained with a finger swipe. Resources and information provided for parents include: (a) instructions on gameplay, (b) advice on parental collaboration, (c) settings to turn on and off the "For Parents" link and (d) "Toca News" link in the main menu area, and to turn on and off the photo saving feature. Additionally, there are various links to the Toca Boca Shop, the App Store (i.e., to write reviews and to buy other Toca Boca AB apps), the

Privacy Policy, and the Support Page. Access to the content within the second "Play it Now" (or "Toca News") is secured with a finger swipe, similar to that which is required for access to the parents' section. The icon opens a scrollable page with links to other Toca Boca apps. Tapping the name of the app takes the user to the App Store for information on and optional download of the specified app.

The third option in the app is a link (right-pointing triangle/arrow) to general gameplay. Tapping on the arrow takes the user to a page with six characters from which he/she may touch to select as the next "client" to see sitting in the cutting area. In addition to the cutting area, users have access to two accessory pages, a photo area, an area for cutting, an area for styling, an area for coloring, and an area for hair washing. These areas can be accessed by swiping right or left with a finger on the bottom of the screen.

The first accessories' section contains: 11 hats, 5 pairs of glasses, and 6 other items of adornment. The second accessories' section includes 4 different hair bows, 4 buttons, 6 chokers and pins, and variety of 6 additional adornment items. The photo booth area includes: 6 different color and texture options for wallpaper should the user wish to decorate the salon environment/background. The cutting section provides the following: a special G.R.O.W. tonic, a comb, scissors, a razor, and an electric hair trimmer. The styling section contains a curling iron, straightening iron, and crimper. The coloring section provides 11 different colors of spray cans for hair color. The washing section includes the following options: simulated rinse, shampoo, towel dry, and blow-dry.

The main interaction in the app involves the user's free experimentation in creating various hairstyles. Tapping on certain styling tools results in its selection, as confirmed by its appearance at the bottom of the screen. The user activates the item and applies the style (the actions of the selected tool) by swiping on the desired area of the client's hair with his/her finger. In addition, the user may attach adornments or decorations to the character (client) by resizing and rotating accessories using a two-finger pinch and turn gesture. Once satisfied with the creation (appearance of the client), the user may enter the app's photo booth to take a "picture" and optionally save it to the iPad's photo album (see examples in Figure 15). There are no time constraints in the game; however, there is a clock in the salon that shows the current time and changes dynamically in real time.



*Figure 15.* Toca Hair Salon 2 product examples. Examples of hairstyles saved onto the iPad using the photo booth/camera tool. (Permission to reproduce images granted by Toca Boca AB.)

**Nature of Reviews, Users,
and Context**

Toca Hair Salon received a 4.5 (out of 5) overall rating by 21,616 customers for all versions and a 4.5 rating by 3,614 customers for the most recent version at the time of data collection. In total, 7,756 customers wrote reviews for this app: 4,428 were positive, 208 were negative, and 2,862 were mixed. The reviews indicated that 2,641 customers "loved" the app, 1,623 reviewers characterized the app as being "awesome," and 1,602 consumers described the experience as "fun."

The developer-specified Made for Ages range for the app was 9-11. Among the collected data, 390 reviews noted a numerical age of users; the ages ranged from 1-29, with a median of 11 and a mode of 13. The average age was 10. Sixty-four reviewers specified that the user was male, and 243 reviewers were self-identified parents or guardians writing about their child's experiences. Most customer reviews in the other eight apps that were studied were observations of parents or adult relatives about a child's interactions and experiences with the app. Toca Hair Salon 2 was unique in that the source of most reviews was the actual user of the app.

The reviews for Toca Hair Salon 2 often used emoticons and visual representations, as the method of presenting feedback or commentary (see Figure 16). Reviewers submitted 9,666 emojis in 2,180 (28.1%) of the 7,756 reviews. Among the 8,359 icon-based emoji, 1,479 were found in the title, 732 in the customer alias, and 6,068 in the comment content. Of the 1,307 text-based emojis, 847 were included in the content or body of the review, 263 formed part of the alias of the various customers, and 196 were found in the title or subject line of the customer review.



*Figure 16*. Example of emoji in Toca Boca 2 customer review.

Analysis of the reviews was not primarily focused on assessing emoji in terms of their precise meaning and context; however, the high prevalence of these graphic representations to describe and express sentiment regarding user experience is

noteworthy and unique to the customer reviews compared to other apps that were part of this research.

**Design of the Learning Space**

There were 3,449 users who characterized Toca Hair Salon 2 as a game. But due to the lack of competition, rules, and aspects of winning and losing that are characteristic of educational games, this app may be better classified as a simulation. According to Alessi and Trollip (2001), an educational simulation is defined as "a *model* of some phenomenon or activity that users learn about through interaction with the simulation" (p. 213). As one reviewer wrote, this app is "not a game just a hair salon sim" (Review 4514).

**Simulation of a hair salon.** Fifty-four reviewers identified the app in reference to the career of a hair stylist. There were 30 comments made by users who stated that they wanted to become a hair stylist or that this app had inspired them to want to become a hair stylist in the future. As an example, one reviewer wrote, "I love this app it is so much fun and creative!!!!!! when I play this game it gives me a sense of pride and ecorages [sic] me to fulfill my dream of being a hair stylist😘" (Review 88). Twelve reviews recommended this app for anyone aspiring to become a hair stylist. Ten reviews indicated that they utilized the app as practice or for playing the role of a hair stylist. Reviewer 1867 wrote, "I like doing hair but I'm too young to have a job this give me a chance to fix some pretty hair." Similarly, Reviewer 862 wrote, "I've been wanting to become a hairstylist now I am!!!" Eight reviewers reported being an actual hair stylist, a hair instructor, or a cosmetology student.

**Goals and sequencing.** Oftentimes, simulations in academic settings incorporate a description of the objectives to inform learners about not only the processes of the lesson but more importantly, the purpose or relevance of the exercise as it relates to the overall curriculum (Alessi & Trollip, 2001). However, Toca Boca describes this app as "a digital toy that is very open-ended in its nature" (Parents section), and the content appeared to lack any predefined goals or objectives to achieve or complete beyond the actions enabled by the available tools.

In Toca Hair Salon 2, there are no in-game instructions aside from the instructions provided in the security-enabled parents' area. The interaction is non-linear in nature, and tools are used and applied on a trial and error basis. In the description, the developers write that if the user has cut off too much hair, that is, if the user was dissatisfied with the way in which the hair was cut, they were able to regrow the hair using the G.R.O.W. serum. Similarly, if they did not like an accessory, the user could remove the hat or glasses and affix another one. In other words, there are no permanent mistakes; users may rearrange, undo, redo, or fix any of the effects. Furthermore, there are no standards or objectives upon which the completed hairstyle is assessed.

**Simplification and omission.** Alessi and Trollip (2001) indicate that a key characteristic of educational simulations is in the simplification or omission of features with the purpose of "help[ing] learners build their own mental models of the phenomena or procedures and provide them opportunities to explore, practice, test, and improve those models safely, and efficiently" (p. 214).

Toca Hair Salon 2 simplified the hair styling process to cutting, styling, washing, and accessorizing hair, and ignores other key factors that are often associated with

running a real hair salon (e.g., customer preferences or orders, time constraints, personalized feedback regarding the finished product, or payment after the job is completed, etc.). This may be a matter of the recommended age range for intended users. Thus, Toca Hair Salon 2 takes advantages of some of the elements that define a simulation by offering a simulated experience of a real-world activity in the cutting/styling of hair without real-world consequences, such as financial repercussions, time constraints, safety concerns, etc.

**Realism of user actions.** Realism is also closely connected to the concept of simplification in simulations. From the description section, Toca Boca is intended to give users the ability to "cut, curl, color and style – any way you want!" (Description). Alessi and Trollip (2001) distinguish between mode and type of learner actions in a simulation. The mode of actions refers to the keyset, mouse click, or any other physical means used to manipulate the interaction and imitate the real life scenario. Type of action entails decision making points, such as making choices, manipulating objects, reacting to events, and collecting information.

The user's main interactions in Toca Hair Salon 2 involve selecting the styling area (through swiping), selecting a tool (tapping or dragging), and applying the tool (tapping, dragging, or swiping). The selection of a styling area replicates the movement through the physical areas within a real hair salon. The selection of a tool represents a stylist's physical grasping of a tool. The tapping, dragging, and swiping of the screen simulates the skill of using scissors, irons, and brushes, etc. that stylists may use in their profession. Because there are no fixed or definitive goals beyond delight in creating, the decisions in choices and actions are subjective, affective, and conscious. The interaction

is complete when the user is no longer engaged (i.e. the user is satisfied with the design).

Alterations to the style are intrinsically motivated, subjective, and essentially affective

responses on the part of the user.

Few reviewers referred to Toca Hair Salon 2 as a simulation. However, 169

commented on the realism of the app, and another 73 commented on the lack thereof and

expressed a sense of disappointment in how poorly it resembled an actual hair salon.

Both the positive and negative comments concerning realism allude to an existing mental

model of actions of hair stylists to which the users respond. In some cases, references are

to the predecessor of Toca Hair Salon 2 (i.e., the first Toca Hair Salon), while others

seem to utilize real life experiences to provide commentary on the realism of the app. In

all cases, fidelity to actual/commercial hair salons was considered a positive experience.

As stated by Reviewer 5985, "If you thought the first one was fun, you should really give

this one a try! This addition seems to give you realistic features of what a real salon

would have."

Among those who provided positive comments regarding the realism of the

functions, many compared the tools and features of Toca Hair Salon 2 to the original

Toca Hair Salon:

> Like many others have said the hair is vary [sic] realistic. The comb is a lot easier
> to use now, and I LOVE the two curling irons, they are really cool. The colors
> blend, which sometimes I don't like because I can't make all the hair red, but
> that's okay. The colors are more natural and the whole piece of hair doesn't have
> to be only one color!" (Review 7309)

Among the 318 reviews that referenced the original Toca Hair Salon, the majority of

respondents reacted positively to the changes made in the newer version. According to

one reviewer, "It's so much better than the original! it's much more realistic! And the

comb in the first, it always ruined the hair and made it crazy but this actually smooths it."

Another reviewer commented, "Much better control of the hair and much more realistic movement!" (Review 7657).

Some customers who did not feel that the app was realistic enough provided feedback supporting the need for greater fidelity to real life hair salons. For example, one commentator stated,

> This game is my favirote [sic] game but it should be a littke [sic] more realistic like have when you grow the hair out have the roots grow out the natural color and when you cut the hair not have all the colors mix and have like dead ends and be able to have the hair grow as long as you want it. (Review 1407)

Another reviewer stated, "Improve the dye.! Make It More Realistic, im [sic] real life you don't take a can of spray paint and just spray your hair.make [sic] it so you can really dye your hair" (Review 5248). Other suggestions included requests for more realistic colors (Review 6904), more tools one would expect to find in a salon (Review 7300), and more realistic movement of hair (Review 1037).

**Social Component of
Toca Hair Salon 2**

This app functions without Internet connectivity. However, the reviews from Toca Hair Salon 2 suggest that the experience is inherently social and involves sharing the experience and/or creation with family, friends, and the general public.

**Shared family experiences.** The social use of the app at the individual level is evidenced in 324 cases where the user reported played the app together with another person (e.g., Reviews 1059, 1367). For example, "I play it all the time with my sister and friends" (Review 42). Another reviewer stated, "My friends and I always have competitions to see who's [sic] person looks better" (Review 2593). Other reviews include references to other family members who enjoyed the app, but it was unclear whether they played together (e.g., Reviews 254, 1007, 1732). For example, a parent

wrote, "I love this game and so do my 4 & 7 year old girls" (Review 4321). Reviews also indicated peer play (see Reviews 92 and 5695). Another reviewer wrote, "I freakin [sic] love this game! Me and my friend r [sic] addicted lol" (Review 5718).

Somehow the elements of engagement and interactivity in Toca Hair Salon 2 connect users through observing another user play. For example, a user who described himself as a "teenage boy" wrote, "I first saw this app on my friends [sic] phone and I was like, 'Really dude? This thing looks like its for 4 year old girls' [sic] So he showed it to me, and I was immediately obsessed" (Review 1273). Another wrote, "I told my friend they said Awesome and the [sic] download It" (Review 1392). In all of these cases, the app experience was a shared experience in the physical world.

**Sharing creation with others.** Although there was no direct social networking capability, there was evidence to suggest that images created on this app were being shared with family and friends (e.g., Reviews 1763 and 1794). One user wrote, "I love this game not only for the hair I love the animations and how you can share with your friends" (Review 1098). Another user wrote, "Me and my BFF both have this game and we both send funny and cute hair styles to each other" (Review 4297). Other users described how they were using the social photo-sharing app, Instagram, to share their creations (e.g., Reviews 3786, 4758, 6208, 6890)

**Communication through reviews.** The third type of social interaction was the use of the app as a platform to share personal experiences, to seek help, or to respond to other reviews. These communications varied in terms of to whom the messages were directed and for whom they were intended.

There were 689 reviews that were comments directed toward the app developers. For example, "Thank you for the amazing game. You have outdone yourselves" (Review 7226). Some comments for the developers reported technical issues. As an example, one reviewer wrote, "IT FRECKIN [sic] KEEPS CRASHING PLZ [sic] FIX THIS PROBLEM I LOVE THE APP BUT IT WONT GO ANYFATHER [sic] THAN THE LITTLE FACE AND IT CRASHES FIX SO I CAN PLAY!!" (Review 7337). Other customers used the reviews to praise the developers and to request/suggest additional functionality or options. The following is a typical example of such a comment:

> This game is sooo [sic] fun! I play it all the time and it really makes me laugh. But toca, PLEASE make this game more challenging and interesting. More characters, and the customer could come in with an order and pay you if you style their hair correctly. With the coins, you could buy new things like styling tools and accessories! Please please please! I cant [sic] keep pretending anymore that these things are already in the game! They must be REAL life! It would be so fun! (Review 223)

In these cases, the consumers utilized the customer review section to communicate their experiences and desires to the developers of the app.

There were 563 messages that were directed toward new or potential customers. These were comments that typically described the appropriateness of the app or recommended the app to those who had not yet purchased the app. For example, "Any age would enjoy it and you should GET THIS GAME!!!!" (Review 7075). Applicability and appropriateness of the app for certain ages and children, in general, were prominent issues communicated through the customer reviews (e.g., Reviews 5895, 6125, and 6621).

The third category included 111 comments that referenced previous reviews. In most cases, the writer agreed with another customer about options they desired to be added. As an example, "I do agree with [Reviewer 6100] it should have pony tails and

braids" (Review 6094). An example of a review that dissented from previous opinions,

titled "Not just for girls," defended the app's value and appropriateness for both boys and

girls:

> My grandsons enjoy this, and the music and sounds are pleasantly low-key. But I disagree with the person who requests more girl laces and suggests omitting the males. Only the boys visit the salon at my house (unless it's me doing the styling, which does happen quite often!). (Review 5918)

With regard to comments suggesting there were unequal number of female and male

characters, one reviewer wrote, "It looks like there are three boys and girls, so I don't

know what everybody is talking about" (Review 4403).

Many reviewers also commented that this app was "kid friendly" (e.g., Review

306, 644, 2838, 6684, 7739). Other reviewers stated similar appreciative comments about

the lack of violence in Toca Boca apps (e.g., Reviews 7705 and 7714). The lack of ads

and in app purchases seemed to appeal to many self-identified parent reviewers (e.g.,

Reviews 357, 3188, 6848, 7053, and 7581). Others were less impressed by the app and

felt that elements of the app were inappropriate for children. A number of commenters

expressed concern about the sounds characters made during the salon experience (e.g.,

Reviews 2012, 7107, 7144, and 7255). For example, a parent wrote, "I really like the app,

but first time when my son was playing with this, and I was hearing the sounds, I tought

[sic] he was watching a porno movie, really!" (Review 7144). Similarly, in Review 2012,

the writer stated, "[s]ome of the characters in the game moan and groan as if they're

about to have an orgasm. I would not let a child play this."

**Instructional Issues and Concerns**

Despite the overwhelmingly positive reviews for this app, 202 comments

suggested that the app was either boring or becoming boring after extended use.

Additionally, there were comments that asked for changes to the app experience. The most frequent requests were for more characters (1,544 reviews). There were 830 requests for more options and accessories (e.g., more hair colors, more styling tools) be added to the existing inventory. In addition, there were concerns that related to the design of the app.

**Objective of the interaction.** An issue that manifested itself in various forms was the lack of goals or instructions regarding the way in which hairstyles should be created (e.g., Reviews 5650 and 6613). Reviewer 4216 succinctly wrote, "What's the point of this game? There isn't even a goal. Cut hair and take pictures? How boring. Thumbs way down." And, Reviewer 3305 expressed amazement that "they spent so much time designing a polished experience and still cant [sic] make goals, challenges and objective based gameplay a feature. Sandbox play with no sense of accomplishment is simply bad game design."

In total, there were 285 customer reviews with similar comments that indicated a strong desire for what was often referred to as a "challenge mode" or "career" mode (e.g., Reviews 4, 189, and 655). With such an option, a character or customer in the app would vocalize their desired hairstyle and the user would attempt to reproduce the style or be evaluated through an in-app monetary or token system that would enable users to unlock more functionality or tools. As one reviewer wrote, "Please add an objective, like the customer wants to look like a rockstar [sic] and you do their hair like that or they want to look old" (Review 844).

Nine customers reported liking the existing "freestyle" nature of the app, whether they enjoyed the current design or wished for such an area in tandem with a challenge

area. As a response to the other reviews, one person wrote, "I noticed that some of the comments suggest turning the game into a real salon with people waiting in line and requesting hairstyles. But, this game is aimed at younger kids (4+) and that might get a little frustrating for them" (Review 4006). Another customer stated the following:

> it's meant for the child to relax and have fun whereas other games out people under time limits and etc. Putting some of the stuff you guys are suggesting would make it easy for you, but what about a five year old? Seeing the words 'game over' would surely put him or her into a fit. So enjoy the game and express your creativity. (Review 4484)

**Simplification and realism.** There were also customers who remarked on the simplification and realism of the app: "I'm a cosmetologist and was kinda geeked out and excited when I saw this game. How disappointing! U [sic] pick one of like eight faces and do their hair and the options are NOT good. I found it frustrating too. And pointless…" (Review 3047). Another critic stated that the app is "tots fun although Im [sic] going for my cosmetologist license and it is nothing like real hair (Review 7144). In total, 73 reviews suggested that the app was not realistic enough. For example, the third most common request was the ability to rotate the head to see the back of the head (553 reviews). The fidelity of the cuts was also questioned in a number of reviews (e.g., Review 445). For others, the lack of precision in terms of the function of tools was less a matter of some deficiency in the technology used or skill of the developers, but a matter of practical disappointment, "It's kind of hard to cut the bangs and stuff without accidentally cutting another piece of hair" (Review 2668).

**Timing of feedback.** The app uses two feedback-type reactions and sounds. The first reaction is a visual and auditory responses by the characters that is automated throughout the game. These sounds are not in a particular language, instead, they are reactionary sounds or grunts. A post-hoc rudimentary analysis of reaction times, based on

30 minutes and 50 seconds of no user-interaction using a stopwatch, resulted in at least

one unprovoked (by the user) audiovisual reaction that was recorded for study (see

Appendix L). Characters (hair salon clients) automatically produced a reaction

approximately every 12.84 seconds regardless of user input. The second type of reaction

was the unique sound made by characters when certain tools (razor, the three styling

tools, spray cans, shower) were selected and utilized.

      Alessi and Trollip (2001) point to two dimensions of reactions and feedback in a

simulation: natural versus artificial and immediate versus delayed. Natural feedback

occurs similar to reactions and feedback that occur in a natural environment, whereas

artificial feedback is not natural but occur as advanced warning in learning situations.

The immediate versus delayed feedback concerns the timing of the feedback. The choice

of feedback utilized depends on the instruction and its goals, and is adjusted based on the

needs of the learner. The way in which feedback is presented in Toca Hair Salon 2 is

automated, with certain tools that provide immediate feedback. However, what is striking

is that this learning experience lacks that type of feedback that typically signals to users

that they are doing something wrong or unsatisfactory. In effect, users can never fail in

this simulation.

      **References to education.** In addition to the desire for more realistic features,

another element to consider is what was absent in the consumer reviews. What was most

striking was the scarce number of instances where the language of reviews contained

words that one would normally ascribe to education. Although this app can be classified

as a simulation or a game, the fact that only 28 reviews included words such as

"educational," "learning," or "teaching" raises the question regarding its educational implications.

Among these reviews, seven reviewers did not believe this app to be educational and they expressed confusion as to why it was categorized as such: "I have no idea how this game is educational but it is very fun" (Review 1661). One reviewer inquired, "why is this in the education category? it's nice but I don't see how my kids are learning something, and don't talk about creativity and skills, the amount of effort needed here is far from a learning point" (Review 1686). For other reviewers, the fact that they didn't understand why it appeared in the educational section of the iTunes App Store did not affect their enjoyment, "I love this game, but there is nothing educational about it" (Review 43).

A closer look at the remaining 21 reviews reveals six broad statements about the app's educational implications. For example, Reviewer 1806 wrote, "This game gives me education to lean [sic] about some things." A parent wrote, "This game has real help [sic] my kids learn and have fun at the same time!👏so that makes their brains strong!! 💪" (Review 1030). While these statements were general comments about education, three reviews specified that the app helped the user learn about hair styling or about running a hair salon, "The best thing about toca hair salon is that it is fun for kids and adults it teaches you how to cut hair and style it" (Review 4540). One self-identified early childhood teacher-reviewer commented that the app impacted students, positively, stating that the app "is a great improvement…I would highly recommend it!" (Review 7513).

Still, some reviewers were able to identify specific educational uses of the app. For example, a speech therapist stated, "I love using this app to elicit language from my

preschool students by asking them what they want to do next or to describe what they did

to someones [sic] hair" (Review 6052). Reviewer 4202 described how the app helped

children learn social customs and norms:

> a great app to help desensitize sensory sensitive kids to the sequence and sounds of getting a haircut. In this app, you can pick from 6 different customers and wash, style and/or dye their hair. I love the fact that when you reopen the app, the characters return to their original state (time to get another haircut!). This teaches us that hair regrows when we cut it and we need to do this periodically.

Another special education instructor wrote,

> Children on the autism spectrum and those with anger management difficulties relish in watching themselves be able to impact an environment. It's magical for my teaching practice to have this tool versus the other types of games (car races, bombing and the like which I won't allow, and similar) hold their interest. (Review 6076).

Comments such as the above suggest at least a small number of customers utilize or

perceive the potential for the app for educational purposes.

**The Educational Nature of**
**Toca Hair Salon 2**

Although it may be tempting to generalize academic gains based on what is being

produced or what is being evaluated through academic standards, the educational

implications of Toca Hair Salon 2 shed light on the process of learning. Among the

reviews, 426 comments were made about how the app was never boring and provided

endless engagement for users. Additionally, 318 reviews indicated that they enjoyed the

first version of the Toca Hair Salon series so much that they had downloaded the second.

Seventy-four reviews indicated eagerness in the possibility to purchase and download a

Toca Hair Salon 3. These reviews point toward the importance of the affective and

exploratory process of the exercise, as opposed to the purpose-driven, product-based,

outcome of just making a hairstyle.

**Exploration and creativity.** In the parents' section of the app, the developers of

Toca Hair Salon 2 write,

> At a certain point…it might be fun and rewarding to start working towards a goal….For inspiration and encouragement, you could draw on things from real life to try and mimic – perhaps recreating your friend's haircut? Or think of a special occasion to style the characters for, like going to a party or going to work for example. (Parents section)

This suggests that developers were encouraging users to actively connect their in-app

experience with their daily lives. The data provided evidence of how engagement and

creativity were a large part of the app experience:

> [t]hey have wonderful graphics and help stretch the creativity of children and the youth of the electronic generation It lets you style the way you want and gives you the freedom of choosing the person that you style. Thank you toca boca for helping me be more creative and want to become a hair stylist. (Review 4396)

Another reviewer wrote, "I love the role play here being a hair stylist…The different

options that the kids can choose and let their imaginations go on the different hair styles"

(Review 7737).

Other users found creative solutions to overcome some of the limitations of the

app. One reviewer wrote in response to the scarcity of certain accessories, stating that

"[e]veryone says that there is [sic] no earrings but if you are creative you can give the

character earrings" (Review 7160). One parent explained how they and their son

incorporate make-believe play into the digital play of the app by pretending that the

characters are real clients who "have appointments & want certain styles" (Review 7389).

Another reviewer shared similar experiences of extending the app play beyond the

parameters of the device, stating that a child may "even pretend that their customer is

going on vacation or to a trip, and needs their help! Or parents can give their child an

order and they will do it on their customer" (Review 4020).

**Control and freedom.** Control and freedom are other characteristics that are closely related to exploration and creativity. Reviewer 988 states, "…you get full control and get to be yourself when either destroying or creating a new dew [sic]." Users also described how they could style the hair in ways they would otherwise not be able to do in real life. For example, a parent wrote about his/her 3-year-old child: "[h]e enjoys making everyone bold [sic]!" (Review 2013). Another user wrote, "I love giving these people weird haircuts" (Review 489). Reviewer 2489 commented that the app is "so fun I can do any thing [sic]!" Still, another reviewer claimed that the app is "the best gam [sic] in the history of games because they don't tell u [sic] how to do their hair u [sic] can do it crazy or nice" (Review 702). Perhaps the ultimate expression of appreciation related freedom and individuality came from Reviewer 5114, who stated, "I love this game because I can be me:)".

Among the customers, a number of reviews responded to the desire for an objective or goal in the app. Reviewer 355 commented,

> I really like this app. I am older but this is a fun app still because I have almost full control. Some other people are saying that it should be more challenging but it you think about it, the game is really meant for kids not people who are able to do really complicated things. It's fun to have a group of people and some make these and some others judge (send them all to one device so no picking favorites even tho [sic] I don't think anyone would).

Similarly, an older sibling wrote,

> My 6 year old sister just presses a bunch of things and has fun. If she had to make hair according to someones [sic] wishes, she wouldn't like it. Challenging? Children don't want challenging. Just something with a lot of choices that is simple but complex enough so they can get what they want. (Review 361)

Despite the countless numbers of appeals for a more structured and goal-oriented format, developers have yet to satisfy these requests. Thus, the distinction among users who enjoy cutting, styling, and accessorizing characters' hairstyles is between those who

would appreciate an educational benefit even if they were unable to put it into words and those who continue to hope for a more obvious and measureable point to the app.

**Improvements and ideas**. As detailed above, there were requests for various options such as different characters and accessories. However, apart from such requests, there were 1,045 reviews that suggested new ideas for the app. Many reviews provided ways in which to improve the realism of the app. For example, a number of comments referred to the option to shampoo and wash the hair. Reviewer 584 wrote, "there should be dirt in there [sic] hair and you should wash the dirt out." Another commenter wrote, "When We Wash Their Hair Actual [sic] Show The Color && [sic] Dirt Coming Out.. What's The Point Of Washing If Nothing's Happening?" (Review 3920). Additionally, there were reviewers who shared ideas for new apps including a makeup game (e.g., Reviews 2042, 2199, 2400), a nail salon (e.g., Reviews 2194, 3091, 3678), a pet salon (e.g., Reviews 283, 5199, 5262), or a dress up app (e.g., Reviews 2280, 3140, 3223). One user messaged the developer, "Well, I love this game and I have a TON of game ideas that id [sic] LOVE to share…Im [sic] ready to share when your [sic] ready to listen :)" (Review 2001).

**Toca Hair Salon 2 Summary**

Toca Hair Salon 2 tied with Stack the States in being the most frequently appearing apps in the Educational Top Charts section of the App Store. The unique aspect of this educational app was the lack of predefined goals or expected instructional outcomes. Instead, the app's overall purpose focused on exploration, allowing children to learn through play, creation, and discovery. The number and types of reviews left by the consumers was evidence of the popularity of this app. Customers' numerous ideas and

requests also suggested that the app experience was one that indirectly promoted active

participation through the commentary—the extension of the learning environment

beyond the app became both a personal and collaborative experience.

<div align="center">**App II: Stack the States**</div>

Stack the States, like Toca Hair Salon 2, consistently appeared among the top nine

apps for all 128 days during the data collection period. As of June 20, 2014, the app had

been in the App Store for 1,377 days, making it the longest-showing app among the nine

apps. Developed by Freecloud Design, Inc. and listed in the iTunes App Store since

September 13, 2010, Stack the States has undergone 14 updates; the September 16, 2013

update was the most recent at the time of this research and is the version studied. Over

the course of the updates, 23 changes were made, including 8 bug fixes, 4 compatibility

updates, and 11 additional features.

Freecloud Design is a prolific app development company, offering 17 total apps

for the iPad when this research began in June of 2014, including six "lite" or "freemium"

versions of apps with limited functionality and ads. Stack the States requires 31.2mb, iOS

4.3 or later, and is compatible with the iPhone, iPad, and iPod touch. According to the

developer description, Stack the States is not connected with any social networks and

does not use analytics or data collection tools to mine information from users. While

there are no third-party apps or in app purchases, there are links to other apps by the same

developer in the main menu.

**Overview of App Options**

Upon opening the app, the screen becomes fixed in a vertical orientation, and the

user views two brief splash pages—one is a non-animated title screen and the other is an

abstract image of a person on the left with the words "Dan Russell-Pinson" (i.e., the name

of the designer and programmer) on the right. Animated stars, descending from the top of

the screen, serve as the transition to the next screen and main menu. The main menu (see

image a, Figure 17) consists of the title, a "Play Game" icon, a "My States" icon, a

"Select Player" icon, a "Learn" icon, a "?" icon (visible only if a player were selected),

an "i" information icon, and an "Also Try" icon. When the user initiates play, various

states with faces fall from the top of the screen. Tapping on the state shapes causes the

states to bounce. When selected, the current player name also appears on the screen.



*Figure 17.* Stack the States main menu and My States interfaces. From left to right (a, b, c): Main menu screen, main menu screen when the "Also Try" icon is tapped, and the My States menu. (Permission to reproduce images granted by Dan Russell-Pinson.)

**Also try.** The "Also Try" button displays a thumbnail icon of the other apps

produced by the developers. Tapping on this icon displays a pop-up indicating that the

actions are intended for parents only. If the user touches this icon, as instructed, for three

seconds (see image b, Figure 17), the app redirects the user to the specific app page in the

App Store. Despite redirection to an area external to the app, when reopened, the app

resumes from the main menu.

**My states.** Tapping "My States" leads the user to a menu screen that displays the

progress of the player (see image c, Figure 17). The upper portion of the screen shows a

player's earned states—the states considered won after having stacked them at some

earlier play. Tapping on an earned state on the map produces a pop-up. The pop-up

presents the name of the state, and the user sees that state enlarged and enveloping the

middle of the screen. The lower portion of the screen displays unlocked bonus games, as

well as the number of states that must be earned to unlock more bonus games. The app

has four bonus games: Map It!, Pile Up!, Puzzler, and Capital Drop, requiring the user to

earn 10, 20, 30, and 40 states, respectively. Two additional icons at the base of the page

provide the user with the option to continue playing the most recent game or to return to

the main menu.

**Select player.** Tapping on the "Select Player" icon takes the user to the "Choose

Your Profile" page, where users may record up to six players and a guest (see image a in

Figure 18) or touch a link to return to the main menu.



*Figure 18.* Stack the States profile, information, and question selection pages. From left
to right (a, b, c, d): Player selection page, new player profile creation page, information
"i" page, and question selection page. (Permission to reproduce images granted by Dan
Russell-Pinson.)

Tapping inside one of the profile slots opens a new page where users are

prompted to enter the name in a textbox and to choose a state to represent them,

graphically (see image b of Figure 18). The cancel button allows for the return to the

"Choose Your Profile" page. The user must tap "Save" after entering a player name and selecting a representative state before he/she is directed to the "My States" area.

**Information "i" icon.** Tapping the "i" icon, shows certain developer information, an icon for settings, and a link to the main menu. It is at this point that animated stars and states descend from the top of the screen. Tapping on the settings menu takes the user to the main information menu where the user may toggle on or off the music and sound. The "Back" button returns the user to the "Settings" menu. The "Edit Players" icon takes the user to another menu where user profiles may be deleted by touching on a player's name and confirming the deletion. Touching "Back" takes the user to "Settings" (see image c in Figure 18).

**Select questions.** The "?" icon becomes visible when a user is selected, and tapping on it opens a page with options to toggle specific areas that appear in the game. Options for questions include, Capitals, Abbreviations, State Shapes, Nicknames, Border States, Landmarks, Cities, and Flags. To commence play at least two quiz options must be selected. The user may cancel any changes made or save an updated list in the menu. Should the user decide to update the list, he/she will notice that the questions in subsequent games come only from the areas that were selected on the list (see image d, Figure 18).

**Play game.** The general gameplay area opens when the user taps the "Play Game" icon. The general gameplay screen shows an "X" icon on the bottom right corner that enables the user to exit and view the "My States" menu after he/she responds by tapping "Yes" to the pop-up prompt, "Do you want to exit the game?" (Tapping "No" returns the user to the current game.)

**Main state stacking game.** Instructions on how to play appear upon first use and

optionally at all starts of the game, depending upon whether the user opts to tap "OK" or

"Don't Show Again" (see image a, Figure 19). Selecting the latter bypasses the

instructions for subsequent games. Either selection initiates play—the words "Ready Set

Go" appear and a checkered line appears from above a monument or landscape feature in

the background. The checkered line is lowered and a four-item multiple-choice question

appears at the top of the screen (see image b, Figure 19). The user taps whichever state

he/she feels correctly answers the question.



*Figure 19*. Stack the States main game. From left to right (a, b, c): main game
instructions, sample question, and sample incorrect response feedback. (Permission to
reproduce images granted by Dan Russell-Pinson.)

Feedback is swift. An incorrect response is outlined and highlighted in red, and a

sound further alerts the user to the error; next, the user recognizes the correct response, as

the state with a circle of stars around it. The correct answer is further emphasized in the

form of a pop-up, displayed just below the circle of stars, that confirms the correct

response in text only (see image c, Figure 19). The next question appears, automatically.

If the correct answer is selected, positive feedback is provided as a ring of stars

around the correct state along with a positive bell sound that indicates the right answer.

The question and incorrect responses disappear, and the state resized and placed on a map

of the U.S. to illustrate its relative size. At this point, the user is able to manipulate the

state by moving and rotating the shape across the screen. Tapping the "Drop It!" button

releases the state from any new position onto the existing pedestal (see first image, Figure

20). According to the description, Stack the States is "powered by a realistic physics

engine" to simulate a bouncing-ball-physics-type of movement by the descending state

shapes. Subsequent correct responses allow the user to stack or pile the shapes onto the

platform.

The above actions are repeated until the stacked states reach the checkered line,

signaling that user has completed a level. A translucent pop-up, confirming "Level

Completed" appears with the stack height, along with the number and percentage of

correct answers (see second image, Figure 20). To earn a state, the user must answer at

least 60% of the presented questions, correctly. The pop-up indicates that the user earned

a new state, and presents the new state earned in the round.



*Figure 20.* Dropping and stacking the states. Stacking and dropping (left) and completion
page (right). (Permission to reproduce images granted by Dan Russell-Pinson.)

The newly-added state gets filled into the map in the "My States" menu. Next, the

user has the option to tap on "Play Again," returning to the instruction screen (or the

beginning of the game if they have chosen to not show the instructions again), or to tap

on "My States," opening the "My States" menu. Subsequent iterations of gameplay reveal

a slightly-elevated checkered line that corresponds to a more challenging level of game play. If/when the user earns all 50 states, "x2" is displayed atop the map in the "My States" profile area.

**Map it!** According to the instructions, the primary goal of the Map It! bonus game is to "tap the locations of as many states on the map as you can." As a secondary goal, users may continue playing to challenge their previous high scores. When this game is unlocked, the user may tap on a relevant icon to view an instruction page. Users may opt to tap "OK" or "Don't Show Again" (see image a, Figure 21). Tapping both commences the game; however selecting the latter bypasses the instruction feature for subsequent games. After the game begins, the screen displays the words "Ready Set Go."



*Figure 21*. Map It! activity in Stack the States. From left to right (a, b, c, d): Instructions page, correct answer, incorrect answer, and completion page. (Permission to reproduce images granted by Dan Russell-Pinson.)

A blank map appears in the top half of the screen, and a state shape with its name written below is displayed. The instructions direct the user to tap its relative location on the United States map above. If the correct area of the map is identified, positive feedback is provided as a ring of stars around the state along with a sound indicating that the response is correct, and the next state shape and name appear (see image b, Figure 21). If the wrong area of the map is tapped, a yellow circle identifies the correct location,

a wrong answer sound is played, and a yellow X appears at the top of the screen (see image c, Figure 21). The game ends if there are three wrong answers or if the user successfully identifies the correct positioning of each state on the map. A translucent "Map It Completed!" pop-up appears with the score. If the score is the highest attained by the player, "New High Score!" appears below the score number, star rings highlight the achievement and a sound plays. The user is prompted to "Play Again" or return to the "My States" menu (see image d, Figure 21).

**Pile up!** The instructions for Pile Up! inform the user that his/her objective is to remove the states from a pile in the shortest amount of time by tapping the state that corresponds to the name displayed at the bottom of the screen. After the instructional page is presented, the user may choose a difficulty level: Easy, Medium, or Hard (see image a, Figure 22). As the difficulty increases, the initial number of states increases (5, 8, and 12, respectively).



*Figure 22.* Pile Up! activity in Stack the States. From left to right (a, b, c, d): Difficulty selection, gameplay, warning message, and play again notice. (Permission to reproduce images granted by Dan Russell-Pinson.)

After the game begins, the screen displays the words "Ready Set Go" as state shapes drop upon an enclosed area. The user must match the state with its shape in a limited amount of time (see image b, Figure 22). A checkered line appears and represents

the demarcation of the warning area (see image c, Figure 22). Since state shapes

continuously drop and build upon one another, the user must remain aware of the

incorrect or unanswered names/shapes that rest upon one another, visually filling the

screen. The game ends if all state shapes are identified or if the user allows the pile of

unidentified states pass beyond the checkered line for over ten seconds. Feedback in both

scenarios appears in a pop-up. The user sees either a translucent "Pile Up Completed!"

with the time, score, and difficulty level, or he/she sees a bubble with the following text:

"Oh no! The states piled up too high. Play again?" The user may choose to play again by

tapping "Yes" or quit and return to the "My States" menu by tapping "No" (see image d,

Figure 22).

**Puzzler.** According to the instructions, the goal of Puzzler is to "connect all of the

states together like a jigsaw puzzle" by tapping and dragging states on the screen in the

shortest amount of time. After the instructional page is presented, users choose the

difficulty level: Easy, Medium, or Hard. As the difficulty increases, the number of states

to connect becomes increases (4, 9, and 12, respectively). The words "Ready Set Go"

descend from the top of the screen along with the states, and the game commences (see

image a, Figure 23).

Individual states will float around until the states snap together in their correct and

relative position to other states (see images b and c, Figure 23). When all states are

positioned correctly, a pop-up with the words "Puzzler Completed!" appears along with

the user's score (see image d, Figure 23). If a high score is attained, the words "New

High Score!" appears below the score number, a ring of stars highlight the achievement,

and the user hears a positive/celebratory sound. Otherwise, the user sees his/her time,

previous high score, difficulty level, and a prompt to either "Play Again" or to return to

the "My States" menu.



*Figure 23.* Puzzler activity in Stack the States. From left to right (a, b, c, d): introductory
page, medium level, hard level, completion page. (Permission to reproduce images
granted by Dan Russell-Pinson.)

**Capital drop.** The goal of Capital Drop is to "match as many states and capitals

as you can before a state falls off the screen." After the instructional page is presented,

users choose the difficulty level: Easy, Medium, or Hard. As the difficulty increases, the

number of initial states becomes greater (2 state shapes and 2 capital names, 3 state

shapes and 3 capital names, and 7 state shapes and 7 capital names, respectively). The

words "Ready Set Go" descend over a tri-leveled conveyor belt (see image a, Figure 24).



*Figure 24.* Capital Drop activity in Stack the States. From left to right (a, b, c):
Instructions page, correct answers, completion page (Permission to reproduce images
granted by Dan Russell-Pinson.)

When matching state shapes and capital names are tapped in succession, they

disappear (see image b, Figure 24). Meanwhile, more state shapes and capital names

descend onto the conveyor belt. The game concludes when one state shape falls off of the

lowest conveyor belt. Then, a translucent "Game Over" pop-up appears and the score for

the current game, the high score (if applicable), and the level of difficulty are displayed.

If the user achieves a new high score, the words "New High Score!" appear in place of

the high score. Finally, the user is prompted to "Play Again" or to return to the "My

States" menu (see image c, Figure 24).

**Flash cards.** Users may tap on the "Learn" icon from the initial start screen of the

Stack the States app. They are directed to a page with an interactive map, offering the

opportunity to learn from flash cards or to return to the main menu (see image a, Figure

25).



*Figure 25.* Flash Card area of Stack the States. From left to right (a, b, c, d): Main Flash
Card menu, interactive map menu, selected state in the interactive map, selected Flash
Card. (Permission to reproduce images granted by Dan Russell-Pinson.)

By tapping the "Flash Card" icon, the card for Alabama appears and the user must

decide whether to return to the main menu or to cycle through the state facts,

alphabetically. When the "Interactive Map" icon is tapped, the user watches a brief

animated sequence whereby the states jump into their correct location on the map (see

image b, Figure 25). Based on the states selected by the user in the profile-creation area,

the user is instructed to tap on a state to learn more about it. Upon tapping on a state, an animated graphic of the state introduces the name of the state, and the user is given the option either to tap on the state, returning it to its place in the interactive map, or to view more detailed information by tapping on the "View Flash Card" link (see images c and d, Figure 25).

**Nature of Reviews, Users,
and Context**

Stack the States has a 4.5 (out of 5) overall star rating by 11,705 users for all versions and a 4.5 star rating by 346 customers for the most recent version at the time of data collection. This app has received 6,328 written reviews. Among all reviews, 5,773 reviews were generally positive, 73 were generally negative, and 415 were mixed. The negative and mixed reviews included 285 comments about necessary or desired changes to the app. The remaining reviews were either undecipherable, written in a foreign language, or intended for a different app. In addition, 2,214 emoji were found within 554 of the 6,328 reviews. There were 1,782 icon-based emoji; 1,309 were found in the content, 209 were in the title, and 164 were in the customer aliases. Among the 432 text-based emoji, 323 were found in the body of the customer reviews, 65 in customer aliases, and 44 were found in comment titles.

According to the Made for Ages description, the intended audience for this app is children between the ages of 9 and 11. Reported numerical ages by 1,348 customers indicated a range in age from 17-month-old to 90-years-old with a mean age of 9, a median of 7, and mode of 6. Among the reported grade levels, fourth and fifth graders were the most frequent users of the app (see Figure 26). There were 36 writers who stated

that their children were homeschooled. Eleven reviewers indicated that the app

beneficiary/user was a special needs student or child.
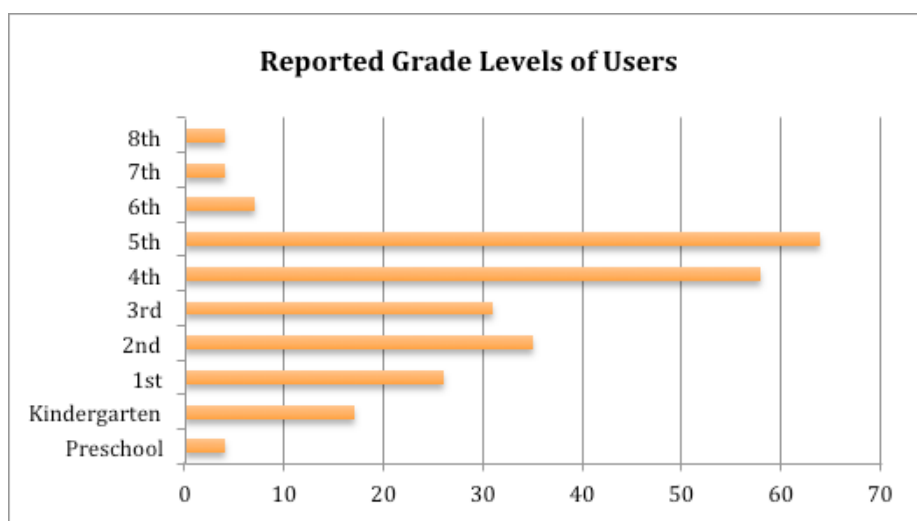


*Figure 26.* Reported grade levels of Stack the States users.

There were 1,850 reviewers who indicated that they were parents and guardians

(including grandparents or relatives), and 870 of those commentators stated that they

were also active users of the app. For example, one reviewer wrote, "[m]y son and I love

playing this game. It is so helpful in learning capitals, location of states, and state trivia.

With map skills lacking in the classroom, this is a great supplement" (Review 1234).

Among the parents and guardians, 29 stated that they were not only family of the child

user but also teachers.

The reviews for Stack the States indicated that 149 users were utilizing the app in

the school classroom, either as a student or a teacher. There were 89 students who

indicated they were using the app to practice for school, and 72 stated that the app was

used specifically to study for a test in school. Many of the reviewers were using the app

in the home rather than a school environ, and 64 reviews specifically reported on how the

app was being used outside of the home (e.g., "Great way to pass tons of time on road trips," Reviewer 2395).

**Design of the Learning Space**

The interactivity of Stack the States can be broadly expressed as a synthesis of two instructional strategies. The first involves the mastery of facts through the strategy of drill and practice, which Alessi and Trollip (2001) describe as "practice which *repeats* the material to be learned until it is mastered" (p. 11). The second incorporates elements of gaming. Although there are no systematized definitions of video games in education, Aranda and Sánchez-Navarro (2011) provide a foundational definition that may be applicable in the current context. They define video games as "the rule-based systems with goals that must be overcome with the effort and interaction of the players and their emotional bond, which are implemented through software and through computers, game consoles, and other platforms" (p. 397).

**Drill and practice.** The user faces fact-based questions in a drill and practice type of instructional strategy. According to Morrison, Ross, and Kemp (2004), a fact is "a statement of association between two things" (p. 155). Morrison et al. state that the only strategy for learning facts is through recall. In K-12 education, the Taxonomy of Educational Objectives (often referred to as Bloom's Taxonomy) is often used to classify educational goals. Divided into three parts, the most well known book focusing on the cognitive domain emphasizes objectives related to "recall or recognition of knowledge and the development of intellectual abilities and skills" (Bloom, 1956, p. 7). This domain is separated into six major classes that increase in complexity: knowledge,

comprehension, application, synthesis, and evaluation. Within the major classes, there are levels, or sub-classes, that increase from concrete to more abstract skills.

In examining solely the drill and practice portion of Stack the States, the memorization of facts in this app constitute the acquisition of skills at the simplest level, or the knowledge class that Blooms describes as:

> Knowledge of the ways of organizing, studying, judging, and criticizing ideas and phenomena. – This includes the methods of inquiry, the chronological sequences, and the standards of judgment within a field as well as the patterns of organization through which the areas of the fields themselves are determined and internally organized. (p. 68)

The main learning objective of Stack the States assesses one of the simplest and most concrete types of behaviors called the knowledge of specifics that is defined as "the recall of specific and isolable bits of information" (p. 63).

Traditionally, facts are learned through mental repetition, overt practice of writing, or through answering questions related to the fact. In terms of the instructional goal, Stack the States utilizes a rehearsal-practice strategy to help learners memorize and recall facts related to U.S. states (e.g., capital names, capital abbreviations, state shapes, state nicknames, bordering states, state landmarks, city names, and state flags) that is facilitated through the strategy of repetition.

The physical action necessary for completing a question involves simply tapping on the correct answer choice, in a manner similar to selecting one correct answer in a multiple choice question. The types of questions include:

- matching state names with state shapes.
- matching state capital names with state shapes and names.
- matching state nicknames to state shapes and names.
- matching state abbreviations with the state shapes and names.

- matching states with bordering states.

- matching landmarks to the correct state.

- matching state flags with state shapes and names.

- matching cities to the correct state.

The user is rewarded with bonus games through successive completions of levels provide further opportunities to master facts about states. The interactions include:

1. placing (tapping and dragging) state shapes in the correct location on a blank United States map.

2. placing (tapping and dragging) state shapes among neighboring states.

3. matching (tapping successively) capital names with state shapes and names.

The last interaction, described above, is a continuation in the practice of memorizing specific facts. However, because the game incorporates a time limit, the practice increases in difficulty. Regarding the first and second interactions, these exercises may constitute a more abstract objective, as the user must not only identify state shape, but also must recognize and move state shapes into their specific spatial location.

Two additional non-interactive strategies further reinforced the memorization of facts. First, the user may review simulated notecards with informational facts by visiting the "Learn" section from the main menu, a feature added in the June 23, 2011 update. Second, the background images during the main interaction provide visual images of landmarks with the associated state name displayed, textually.

**Educational games.** Based on the customer commentary, 2,595 independent reviews referred to this app as a "game." From an instructional technology perspective, many of the essential features of educational games such as rules, winning and losing,

competition, points, skill and luck, are present in the app (Alessi & Trollip, 2001). Alessi and Trollip state that an advantage of games for educational purposes is in its inherent nature to intrinsically motivate learners through competitive elements.

As evidenced above, customer reviews revealed a strong approval for the game. Most notable were references to the game as "fun" (2,316 independent reviews) or "addicting" (255 independent reviews). One teacher remarked that "this app is a great way to motivate kids to learn a subject that doesn't get enough time anymore with all the prep work needed for all the high stakes testing" (Review 4940). Most notably, there were 1,640 reviewers who used derivatives of the word "education" or "learn" along with the word "fun" at least once in their commentary. There were 78 parents who indicated that their child was having too much fun to notice the learning that was taking place.

**Instructional Sequencing
and Rewards**

Another factor worth mentioning pertains to the sequencing of the instruction. The stacking and dropping sequence of actions allows users to earn states and is contingent on selecting a correct answer from the drill and practice section. Simultaneously, unlocking bonus games is contingent on successive completion of earning states. In other words, the gaming component and bonus areas in Stack the States served as rewards for the drill and practice learning content. Deen and Schouten (2011) suggest that successful games do not typically rely on external rewards, as they force a learner to shift their attention from the learning content to a focus on attaining scores or rewards by minimizing mistakes. However, the overall perception of the customers suggested that adults and children alike were, indeed, learning (i.e., memorizing and recalling facts about states).

During the course of exploring the research, counts were tallied for the number of times derivatives of the word learning were presented in a positive manner (e.g., "My son learned…"), educational (e.g., "This app has educated me…"), and instructional (e.g., "The app instructed me on…") or teaching (e.g., "The app taught me…"). The results indicated that 1,882 independent reviews used a derivative of the word "learning," 1,271 independent reviews used derivatives of the word "educational," and derivatives of the word "instruction" or "teach" were present in 145 independent reviews.

Furthermore, many reviews indicated that users felt that the successful earning of states and bonus games were motivating rewards for persistent practice of the learning content. One review was a direct quotation by his/her 5- and 7-year-old sons who conveyed the high level of difficulty among questions, and that "it's hard to get new states. but I like it because it's fun to stack the states, especially the big ones like Alaska and Texas" (Review 1222).

**Self-Determination Theory**

Self-determination theory is characterized by three factors – competence, autonomy, and relatedness – that satisfy a particular innate need (Ryan & Deci, 2000). The following discussion utilizes these three concepts to help analyze further the engaging nature of Stack the States.

**Competence.** Competence, or self-efficacy, refers to a person's "perceived ability of (possible) successful engagement" (Deen & Schouten, 2011, p. 335). In Stack the States, the bar for completing a level is initially set low. Through iterations of completing a level, the difficulty of the game is increased in subsequent gameplay; the user must stack more state shapes to earn a new state. Deen and Schouten (2011) suggest providing

feedback so that learners are aware of their progress. In the app, feedback is provided through the visual states stack, the score menu after the game is completed, and the earned states in the interactive map. Other customer reviews expressed that the knowledge they gained from this app motivated them to try similar games by the same developer, such as Stack the Countries. As one customer wrote, "If you like it but find it a bit easy get Stack the Countries, the same concept except obviously countries" (Review 161).

  **Autonomy.** Autonomy is "the ability and the opportunity to make decisions that are of significance to the gameplay and the person's self" (Deen & Schouten, 2011, p. 337). In this app, user control is evidenced in four areas of the app experience. The first opportunity for decision-making is seen in the profile creation section. Users may independently create their own section of the game and choose a state-shaped avatar of their preference. The second opportunity occurs as users choose how to go about learning the state facts. For example, they may choose to memorize the flash cards through rehearsal and repetition. Others may opt to simply play the game and learn through trial and error. The third opportunity of decision-making is found in the settings section, where users are able to choose the subject areas that they would like to practice. For example, if a user feels less competent in certain state relationships, he/she user may choose to focus on only those particular areas. The fourth opportunity occurs during gameplay where the user must manipulate the shape and drop the state shape onto the stack. This element of user control accommodates different users and their goals because earning a state is contingent on the ability to answer at least 60% of the questions correctly, and to pile the states, vertically, without causing it to collapse.

**Relatedness.** Finally, relatedness refers to "the perceptions of social support for/against persons' performances of the behavior" (Deen & Schouten, 2011, p. 338). The concept of relatedness can be examined from the perspective of either social support in the physical environment or social support in the app-based environment.

*Physical environment.* A total of 694 comments alluded to a social component in the physical world. The relationships described include reviewers who learned about the game from a peer, reviewers who suggested that the game was a "family game," and reviewers who indicated that both the parent and the child enjoyed the game and were active users. Additionally, many of the reviews of Stack the States indicated adult, sibling, or friend interaction to varying degrees. There were 278 parents and relatives (e.g., grandparents, aunts and uncles) that stated that they played together with their child or children. For example, one reviewer wrote

> I purchased this game for my 5 yr [sic] old entering 1st grd [sic], he absolutely loves it and has my 3 yr [sic] playing with him. He has actually gotten the whole family involved, and I use the question to quiz him at the dinner table. (Review 4881)

In many cases, parents and other adults reported that they too benefited from the learning experience of the app. The grandparent of an 8-year-old user indicated that while the child enjoyed playing, the app was an educational experience for both: "I know all the states and capitals, but am still working in recognizing the shapes and especially the flags" (Review 189). A mother commented that the app "is mature for a 2yr [sic] but he understands mommy reads the question and either he knows the answer or I know the answer , [sic] and if none of us know the answer then we search the web" (Review 2631). Similarly, a grandparent described how he/she extended the learning in the app beyond the parameters of the device, making it a shared experience: "We turn it into a family

game in the car,one [sic] person reads the questions and a person gets to try to answer it, if they can't than [sic] we discuses [sic] it and answer it as a group" (Review 2622).

Other reviewers also indicated that young children were receiving partial guidance or aid. One reviewer stated that she and her husband answered the questions and had their child stack the states, adding that their 3-year-old child was "starting to guess some shapes" (Review 5469). Other reviews, such as Review 937, indicated that external tools were used in tandem with the app: "'I love playing Stack the States' says my five year old. I help him with the trivia. With a map along side him, he completes Map It on his own." Another parent of two children, ages 4 and 5, used a United States placemat map as an aid as well as providing an opportunity to extend the conversation beyond the immediate learning: "We talk about the weather in different parts of the country and where we'd like to go and why" (Review 2818).

These examples seem to indicate that, in many cases, the nature of learning is not limited to simply the knowledge-level facts that are memorized and recalled from the app. Rather, the learning is a social experience, and the app seems to serve as a platform from which learning is extended and further communication and activities are facilitated.

*App-based environment.* Although Freecloud Design clearly states that there is no social networking connectivity to the app, the customer reviews suggest two additional ways to consider the concept of relatedness. First, Stack the States has been available in the app store the longest time among the apps in this study, and a review of the version updates reveal a number of comments to and from customers and developers. Studied over time, the comments take on the tone of a conversation. Among all reviews, 243 messages were written directly to developers and 28 referred to a previous review. In

the Version 1.2 update, the developers directly thank a reviewer for a specific suggestion.

Additionally, the Version 2.0 update addressed a reviewer's concern regarding some of

the names of capital cities that were unintentionally confusing. Second, a social

component is evidenced among the types of comments left by the reviewers. There were

396 reviews that were directed toward potential customers. Of the 231 reviews

concerning the "worth" of the app, only four were discouraging; most comments

encouraged other iPad users to purchase the app (e.g., "Buy it now!").

**The Interdisciplinary Nature**
**of Stack the States**

Although the majority of reviewers indicated that the app was being used to learn

facts related to geography, social studies, or history, 62 reviews referenced uses of the

app beyond its default purpose or goal. The most prevalent offshoot in learning was

related to physics; users felt they were practicing and improving their skill in managing

the pile of states. Still other users remarked that the app provided young readers with

opportunities to improve literacy skills. In some cases, parents noted learning gains in

both physics and literacy:

> My four year returns to this far more than any other app, and has learned all the
> states by shape as well as where they go and the capitals. It has also greatly
> improved his reading and understanding of gravity and balancing. We have a blast
> playing it with him. (Review 3630)

Given the number of comments about unintentional areas of learning, it seems

appropriate to include an examination of the app instruction insofar as it relates to physics

and reading.

**Physics.** The second portion of the main game provides additional opportunities

to strengthen the user's understanding of state shapes by observing the relative sizes of

the states. The primary action involves turning the states, dragging the shape on the

screen, and tapping the drop button to release the state. Many reviewers indicated that they felt these actions provided opportunities to learn concepts of physics (e.g., Reviews 4855, 4857, and 5095). One reviewer stated that the app "not only reinforces knowledge of the United States, but also helps [the 13- and 11-year-old children] think critically about the physics of balance" (Review 4857). Another comment identified improvement in their second grade daughter's psychomotor thinking, stating that her "physics skills are getting better too by figuring out how to balance Florida, south Carolina, and West Virginia" (Review 5013).

Although customers provided positive reaction the interdisciplinary nature of Stack the States, it is unclear whether developers intended to create this app as an instruction specific to the field of physics. This is evidenced in the lack of instruction provided on the nature of velocity, acceleration, and gravity. Still, the game does seem to challenge users to look for patterns and to organize new information. St-Pierre (2011) references a study of 40 educational video games whereby nearly 80% of respondents indicated that users typically interact with a video game through trial-and-error. In other words, their strategy of learning the rules of games is facilitated through exploration of various actions and continued use.

**Literacy skills.** A number of reviewers indicated that this app was used, not only to learn about geography, but also to motivate a child to improve his/her reading skills (e.g., Reviews 2630, 3961, 4201, and 4304). Reviewer 43 stated that her 5-year-old daughter "taps on the states when I tell her the answers and she looks for states that start with the right letter." Reviewer 6198's 5-year-old daughter reportedly also felt that the app fostered literacy skills, stating,

> My 5yo [sic] has had the ability to sound out words for over a year, but hasn't felt the need to. But watching her big sisters have so much fun with this game has motivated her to really try reading. And it's now not just on this game, either, she's reading everything!

In still another comment, titled "Great for all of us," a parent states, "I'm finally learning the state capitals while the boy practice geography and reading" (Review 5387). In many ways, these examples suggest that the perceived gain in learning goes beyond the scope of the immediate and stated objectives, thanks in part to the encouragement and support of a user's social network.

**Instructional Issues**
**and Concerns**

As a final point, although the reviews of the app were overwhelmingly positive, several issues related to the instructional design of the app need to be addressed. These include: levels of difficulty, feedback, and commentary regarding younger audiences.

**Levels of difficulty.** The desire for options based on personal needs of the user was a fairly common issue. A number of comments were made in regards to the difficulty levels of the app. Reviewer 5760 writes, "there's no ability to see the difficulty level for the game. It would be good if there was an 'easy' setting for younger players." With regard to the stacking portion of the game, an 8-year-old customer stated, "The reason I rate it 4 stars is it's hard to balance the states so I think you should make it easier so we could enjoy it more" (Review 1106).

Other comments conveyed frustration with the presentation and sequencing of learning tasks. One reviewer stated that "some of the state abbreviation questions are silly because only one of the four state choices will even begin with the right letter" (Review 4486). Although matching state shapes and names with abbreviations may seem like a simpler task than identifying bordering states (which requires users to tap on individual

states to view the name on the interactive map), the likelihood of one type of question appearing over another seemed to be selected at random.

It is not clear why the bonus games are awarded in the given order. The first bonus game seems to be the most difficult and the third appears to be the easiest. As Reviewer 3961 writes,

> the first game should be the last game and the last game should be the first. When you get the last game unlocked it tells you all the demographics of that state such as landmarks, abbreviations, capital,etc. [sic] If it started with this game you would be better able to answer the trivia questions.

From an instructional design standpoint, it would have made more sense if the ordering were reversed to facilitate scaffolding of knowledge from simple to difficult or concrete to abstract (Morrison et al., 2004).

Issues concerning difficulty were also evidenced in users who had successfully mastered all 50 of the states. Although most users seemed to appreciate the game, 79 users indicated that they became bored, as they approached mastery of the instructional content. As one reviewer writes, "I think it's a good learning app but after you complete all 50 states you start with x2 states and you start all over again" (Review 16). As Reviewer 674 writes, "I bought the complete version and it's cute. I'd like it better if it had some questions about climate or environmental characteristics rather than simple landmarks." Although there is an option to toggle on and off certain types of facts, controlling the levels of difficulty to adapt to different audiences and sequencing the learning content by difficulty levels are valid issues that have been addressed by users.

**Feedback.** A number of comments indicated a desire for more in-depth explanations of the answers in the feedback, as a way to facilitate competency and especially with regard to incorrect responses (Review 675). As one reviewer stated, "For

example when it asks which is the Empire State and you guess wrong, when it shows you New York it should give the history to why it's called the Empire State" (Review 2740). Similarly, Reviewer 2554 wrote that it "[w]ould be nice if the answers to the questions offered further information, such as why the State has a certain nickname, where a specific city is located, or what a specific landmark is."

**Young learners.** The customer reviews also suggested that parents were purchasing this app for kids who were much younger than the intended age group (i.e., 9- to 11-years olds). Among all reviews for Stack the States, 73 reviewers indicated that their child or relative was not yet reading, and 70 reviewers indicated a desire for an audio option for the app to read the questions. For example, a reviewer stated "My three year old knows most of the states by shape but is unable to player [sic] independently because he cannot read the question" (Review 6308). The chief complaint was that the parents wanted their child to play the game before they would learn it in school, but the child was still too young to read and thus, could not answer the questions without adult guidance. Another reviewer wrote,

> I bought this for my 5 year old to start introducing her to the states, but was very disappointed that it does not read the questions to you. How is a young child supposed to read the instructions by themselves along with reading the questions? Will give 5 stars when this is fixed. (Review 6063)

Although it is not immediately clear whether or not the parent had read the description for the app, these cases, among many, suggested an expectation of child app use as a self-contained and self-sufficient activity that could be used alone without the assistance or presence of an adult guide.

Isolating the reviews that specified learning gains and identified the age of the learner, customers reported the greatest gains in learning among the youngest users.

There were 16 reports for children up to the age of two (including one for a 17-month-old). Some parents stated that their child was randomly guessing the answers (e.g., Reviews 4, 1094), others indicated that a child was recognizing some or all of the states (e.g., Reviews 2, 595, 2863, 5186), and still others wrote about a child having successfully learned all of the states (e.g., Reviews 1609, 5456, 6182).

Among the 29 reports of 3-year-old children, one child found enjoyment in viewing the graphics or in watching others play (e.g., Reviews 6286 3034). Thirteen parents wrote that their child had mastered all 50 states. Among these, eight knew all of the states or could place them on a map by their shape (e.g., Reviews 1137, 5623), four knew all states and capitals (e.g., Reviews 3321, 3415), and one knew all states, capitals, and flags (Reviews 1148). The remaining reports were in between (e.g., Reviews 4334, 6308).

There were 40 reported learning gains of 4-year-old children, 17 comments indicated that the child had learned all of their states (e.g., Reviews 380, 5775); one knew all states and capitals (3630); one new all state, capitals, and flags (Review 25); and one knew all states, flags, capitals, and landmarks (Review 9). Additionally, two reviews stated that their child was learning to read from the app (Reviews 2309, 2347), and one was learning motor control and spatial orientation (Review 3284).

Among the 34 reports regarding 5-year-old children, two guessed all answers (e.g., Reviews 1094, 4107), one stacked while the parent answered questions (Review 1022), and one watched a sibling play (Review 6198). Eleven knew all states (e.g., Reviews 351, 4089); one knew all capitals (Review 70); five knew all states and capitals (e.g., Reviews 758, 3415); and one knew all states, capitals, and flags (Review 2178).

Ten parents stated that their child was in the process of learning the states to varying degrees. Other learning gains included learning how to read (Review 6198) and finding examples of states in everyday life (Review 4627).

It should be noted that all of the reported comments seemed to be shared by parents, who were proud of their child's achievement and learning gains. Although there were reviews that requested an audio option for their non-reading children, as mentioned previously, there were an equal number of, if not more comments suggesting that parents were actively participating in their young child's learning experience with the app.

**Stack the States Summary**

The exploration of Stack the States revealed that a substantial number of users believed this app to be a fun learning experience. Although, from an instructional perspective, the substance of the instruction fell within the lowest tier of Bloom's taxonomy, overwhelmingly positive reviews indicated that many users were enjoying the interactions within the game, and finding the educational or learning content useful. Additionally, many parents were active participants in their children's learning—even finding creative ways to apply and incorporate the lessons in their daily lives.

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**App III: Endless Alphabet**

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According to the description in the App Store, Originator's Endless Alphabet is an "education+entertainment" app that "features an interactive puzzle game with talking letters and a short animation illustrating the definition" (Description). Endless Alphabet was ranked the third most frequently appearing app during the four-month screen-capturing period with 94 appearances on the top nine list. This app was first disseminated through the App Store on January 18, 2012, and has gone through seven version updates,

with the most recent update on January 24, 2014. Updates included bug and technical fixes, (compatibility updates), introduction of new technical and functional capabilities, troubleshooting instructions, and improvements in user experience.

At the time of writing this study, Originator, Inc., had seven apps specifically designed for the iPad, including two School Editions. From the customer reviews it was evident there were a number of changes during the course of its continuation in the App Store. First, the developer name changed from Callaway Digital Arts to Originator, Inc. Second, the reviews suggest that the app changed from a free app to a "freemium" app with ads (i.e., with the option of paying for an ad-free version), and later as a paid app ($0.99, $4.99, or $6.99).

The version of Endless Alphabet used for this study is compatible with the iPhone, iPad, and iPod touch, and requires a device with at least 42.3mb of storage and an operating system of iOS 5.0 or later. Although there is a security-protected link to access more apps by the same developer, there are no third-party ads or automatically appearing, in-app, purchases. However, the user must be connected to a Wi-Fi network in order to access more words and letters. As a note, Endless Alphabet was the only app where the "Rate this App!" message appeared during app usage.

**Overview of App Options**

The user interface of Endless Alphabet is locked in a horizontal orientation. Upon opening the app, the user briefly views a non-animated splash page with the developer's logo (see image left, Figure 27). A jingle is in unison with an animated sequence of colorful monsters, with various musical instruments, that parade from right to left of the screen. This sequence concludes with the title of the app being displayed. A "Loading…"

message appears as a transition into the main menu, which displays a large monster with an open mouth (see second image, Figure 27).



*Figure 27.* Endless Alphabet developer logo, main menu for all words. Title page (left) and main menu page (right). (Permission to reproduce images granted by Originator.)

The eyes of the large monster move depending on the how the user tilts his/her iPad. Inside the open mouth of the monster are various vocabulary word cards that display an image above a word. These word cards are listed alphabetically from left to right, and there is typically more than one word per letter. On the top lip of the monster's mouth, letters are listed alphabetically from A to Z. Tapping on the letter slides the cards to the first word of the group of same-lettered words in the monster's mouth.

In the main menu, there is a toggle in the lower right-hand corner, which can be switched between "All" and "New" (see first image, Figure 28). "All" displays the entire list of vocabulary words that are available. From time to time, Originator provides new words that can be downloaded with Wi-Fi connection. The number of unexamined words appears next to the word "New." Toggling the switch to "New" provides a list of newly downloaded words or words that have yet to be examined. The final card in the "All" section is a card with a link to another Originator app, Endless Numbers (see second image, Figure 28).

*Figure 28*. New words and links in Endless Alphabet. Main menu toggled with only new words and the final card in the "All" section that links to the Endless Numbers app page. (Permission to reproduce images granted by Originator.)

On the top left corner of the screen is an "i" icon. Tapping on this icon takes the user to a "Grown-Ups Only!" area that can only be accessed by entering three numbers displayed in text form on a number pad (see Figure 29). When the correct numbers are entered, the interface changes to an information area for parents with information about the current version, the developers, and copyright information. The area also provides six links.



*Figure 29*. Endless Alphabet's area for grown-ups. (Permission to reproduce images granted by Originator.)

The "Tell a Friend" link constructs a prefabricated embedded email message whereby the user may enter email addresses of people to whom they would like to recommend this app. "Gift Endless Alphabet" is a legacy function that, when tapped,

would have allowed the user to purchase the app for another user. However, upon tapping

on this icon, the user is notified that this feature is no longer supported. The "Like

Originator" and "Follow Originator" direct the grown-up to the Originator Facebook

page and Twitter page, respectively. The other links are for Originator's Customer

Support Center and email. The Customer Support Center link directs the user to the

customer support center page on his/her default browser. The email address for additional

support and suggestions produces a blank app-embedded email draft. Users may return to

the main menu by tapping on the "X" at the top left corner of the screen.

The main interaction of the app begins when the user scrolls left and right through

the vocabulary card list and taps on a desired word. A screen whereby the vocabulary

word is prominently displayed follows a ringing sound on lightly lined paper. On the top

left corner is a "word" icon that provides the word and definition when tapped. In the top

right corner is a home button that reverts to the main menu. As the exercise begins, the

narrator speaks the word as the written word expands and contracts. A stampede of

monsters run across the screen from right to left, knocking over the letters from their

original location but leaving a trace/outline (see images in Figure 30).
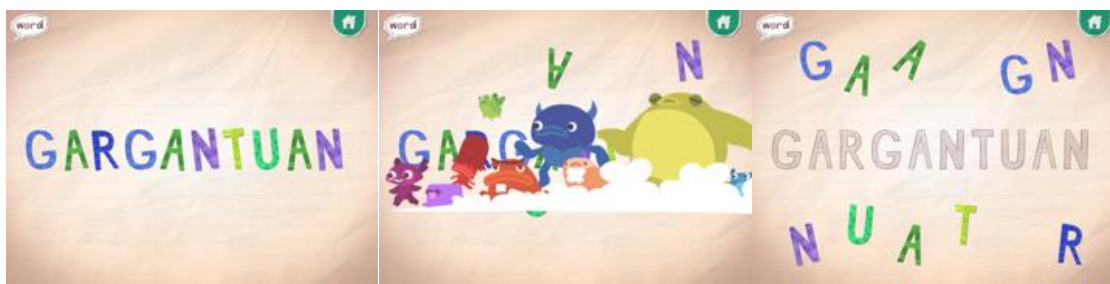


*Figure 30.* Letter matching activity in Endless Alphabet. The word is presented and
knocked over by the monsters. The user must match the letter to the correct outline.
(Permission to reproduce images granted by Originator.)

When the user taps and holds a letter, a pronunciation of the letter is repeated in

succession until the finger is released from the screen. The user must match the letter to

the correct area of the outlined word. If the letter is placed in the correct position, the

narrator pronounces the letter. If the letter is placed in an incorrect outline, an audio cue

indicates an incorrect placement, and the letter shifts slightly off of the outline. When all

letters are placed in the correct position, the letters of the words jiggle and a chorus of

people pronounce the word aloud. Next, an animated definition of the word is provided

(see images in Figure 31).



*Figure 31.* Animation in the letter matching activity of Endless Alphabet. A selected
letter animates as it is being dragged into the outline. The completed word animates, and
the definition is explained through narration and animation. (Permission to reproduce
images granted by Originator.)

When the animation concludes, the narrator defines the word, verbally. A left

arrow and right arrow appear on the bottom of the screen. The user may go to the

previous or next word in the alphabetical list. When the repeat icon that appears at the

bottom center of the screen is tapped the animation and narration sequence is repeated.

The "word" icon and home icon are both visible, allowing the user to repeat the verbal

narration or to return to the main menu.

**Nature of Reviews, Users,
and Context**

Endless Alphabet received a 5 star overall rating by 9,467 users for all versions

and a 5 star overall rating by 490 people at the time of data collection for the most recent

version. There were 3,185 people who provided written reviews for the app. Among the

3,165 reviews that reflected a preference for the app, 2,780 were positive, 47 were

negative and 338 were mixed.

Parents, grandparents, or relatives (e.g., aunts and uncles) wrote 2,097 of the

3,185 reviews, although, the majority of actual users of this app were children. Fifty

writers identified themselves as teachers, 46 wrote that they are parent teachers, and 11

were self-identified specialists or therapists (i.e., non-teachers).

This app is intended for kids, ages 0-5. The reviews reported 1,934 numerical

ages of users. These ages ranged from a 4-month-old to a 65-year-old with an average

age of 3.2, a median of 2.5, and mode of 2. Additionally, there were 22 users who were

described as toddlers, nine preschoolers, four kindergarteners, eight first graders, four

were second graders, two were third graders, one was a sixth grader and one was a

seventh grader. Fifty-nine reviews indicated the user was a child, student, or client with

special needs. Thirty-seven teachers stated that they used the app in their classroom and

five teachers indicated that they planned to use it in the upcoming school year. Four

families reported using the app while homeschooling their children.

**Design of the Learning Space**

Although 233 people characterized the app as a "game," many characteristics of

educational gaming were absent in Endless Alphabet. For example, there is no element of

winning or losing, as stated in the description of Endless Alphabet: "there are no high scores, failures, limits or stress" (Description).

**Repetition and consistency.** Two of the interrelated characteristics observed in the app were repetition and consistency. According to the universal design principle of consistency, "the usability of a system is improved when similar parts are expressed in similar ways" (Lidwell, Holden, & Butler, 2003, p. 46). Although there are no explicit verbal instructions in Endless Alphabet, the interface is simple, and the design of the learning sequence is identical for all vocabulary words. According to Lohr (2008), repetition is a systematic pattern of visual elements such as typeface, images, and shapes that promotes harmony and unity. Repetition is found in Endless Alphabet not only in the consistency of the design, but also through the repetition of letter sounds as users match their shapes with the outlines of the letters.

Repetition and consistency in design assists in the usability of the interface; repetition in the task of memorization and recall is critical in storing information in long-term memory. Among the reported progress of the user, 66 reviewers stated that a child was sounding out the letters, 52 cases indicated that children were imitating the sounds heard in the app, and 44 cases noted that the child was pronouncing or saying the word within the app environment.

Additionally, Ormrod (2003) states that the review and practice of information in periodic intervals for an extended amount of time (i.e., spanning weeks, months, and years) help to store information in long-term memory more effectively than rehearsing or repeating the same information over the course of a shorter period of time (i.e., a few seconds, minutes, hours). There were 135 reviews that indicated that children were

consistently returning to the app, and 91 parents observed in the reviews that their children were able to stay attentive while using the app.

**The Nature of Acquiring
Knowledge**

The general sequencing of the instructional content is designed from simple to more complex (Morrison et al., 2004). The main user actions of this app include (a) scanning letters and selecting a word, (b) viewing and listening to the pronunciation of the word, (c) listening to the sound of letters while dragging letters into its proper outline, (d) viewing and listening to the pronunciation of the complete word again, (d) watching an animation describing the meaning of the word, and (e) listening to a verbal definition of the word by the narrator.

The sequencing of these actions can be divided into two category types: learning as an interactive exercise and learning as a passive experience. Although the instruction, as a whole, is presented seamlessly, the content presented in the app incorporates a number of relevant instructional strategies.

**Learning as an interactive exercise.** Two components of the instruction incorporated interactive elements involving the manipulation of objects on the screen. The first occurred in the main menu, where users scanned letters that were presented in alphabetical order, and selected a word of their choosing. The concept of autonomy, described by self-determination theory may be applicable here (see Stack the States section). Many writers reported favorite letters or words that were often revisited (e.g., Reviews 365, 695, 1164, 1503, 1837). For example, Reviewer 2167 wrote, "We love this app!!! 'R" is our favorite!!!" This suggests that children were intrinsically motivated to

return and review the learning material based on their preference from earlier

interactions.

The second element of interactivity can be seen during the matching of letters to

their outlines. There were 138 reviewers that reported gains in a child's general

knowledge of letters or alphabetical knowledge, and 55 reviews indicated that their child

had learned all their letters as a result of using the app. Depending on the developmental

level of the user, reviewers reported differing gains attributed to letter learning. For

example, reviewers observed improvements in letter sounds (319 cases), spelling (138

cases), letter recognition (116 cases), letter matching (113 cases), and letter shapes (66

cases).

**Learning as a passive experience.** A second type of instruction involved the

transmission of information as the user passively observed. Visual and auditory

information was relayed through the app, and knowledge about words and their

definitions was gained primarily from observation and listening.

First, what is known as an advance organizer in the educational community was

evidenced in the portion of the instruction after the word was selected from the main

menu. According to Morrison et al. (2004), an advance organizer is "usually written at a

higher level of abstraction and serves to provide a conceptual framework to increase the

meaningfulness of the content" (p. 177). In Endless Alphabet, although extensive

information is not provided, the word is pronounced prior to the matching. Because the

final goal of the instruction is to present the full word and definition, allowing the user to

view and hear the full word before it is deconstructed into parts helps introduce the more

complex ideas about a word.

Second, although the app was intended to be used by children under the age of five, many users commented on the advanced level of the vocabulary words used in the app. As Reviewer 895 notes, "the words they use are also beyond kindergarten levels. Don't look for apple, boy, car words here." Instead, words such as gargantuan, contagious, and scrumptious are presented and defined. Parents and relatives were divided in their feelings about the advanced vocabulary.

While 10 reviews indicated that the words were too advanced or suggested less difficult and more age-appropriate words, 150 writers were content with the words or showed appreciation. One parent wrote, "I love the fact that they don't stick with basic 3 and 4 letter words, but they delve into an extensive vocabulary for kids with words like gargantuan and musician" (Review 1379). Reviewer 2176 wrote, "if you're like me and don't like dumbing down your education of your children to words like 'dog' and 'cat' you're going to love this app. It's challenging and I love to hear my 3-year-old daughter describe something as 'gargantuan' instead of 'big'…"

Finally, there has been extensive discussion in the educational literature regarding the passive learner being transmitted information. While there was no interaction on the part of the user, reviewers indicated that children were engaged throughout the word definition portion of the learning sequence. There were 558 reviewers who reacted positively to the graphics and animations, 215 reviews indicated appreciation for the narration and sounds, 169 parents reported that their child enjoyed the monsters or characters, and 47 reviewers commented on the "hilarious" nature of the animations.

**Evidence of Learning**

The animated sequence of the definition only occurred after the user had correctly matched all letters of the word, and thus, the capabilities of the app assessed whether or not the user correctly matched the letters to their appropriate outline. However, the app itself did not evaluate the user's speed or number of tries it took for them to pair the letters. Furthermore, the animation required no user actions, and as a result, it is not possible to determine whether or not the child had memorized the word and its corresponding definitions or if they can utilize the vocabulary in novel contexts. In other words, there is no explicit evaluation of the user's acquisition of knowledge.

At the same time, 149 consumers directly stated that a child was learning as a result of using this app. Among the reviewers who stated specific areas of learning gains, 179 reviewers stated that a child was showing gains in vocabulary, and 134 reviewers indicated gains in a child's general knowledge of letters. Many parents provided even more specific gains in literacy learning including areas such as vocabulary definitions (105 cases). There were also customers who reported the educative capabilities of the app. Among these, 58 customers stated that the app taught vocabulary words, and 40 reviews indicated that the app taught letters.

**Adult Assessment of
a Child's Learning**

During the course of the research, parental comments in the consumer reviews revealed an in-depth and insightful look into the ways in which parents corroborated the evidence of their child's learning. Oftentimes parental evaluations were not based on an academic or professional developmental standard, but rather, on direct observations of the child's use and engagement with the tool or by reflections of changes throughout the

course of a child's natural development. These reviews suggested that the interactive

component of the instruction produced many uses, including those that were not directly

tied to the immediate learning objective.

For example, 124 reviews referenced behavioral changes through the description

of their young child's facial expressions or physical responses. The most common

indicators of a child's engagement were through giggling or laughter. For example, a

parent wrote, "My 2yr [sic] old LOVES to play and is learning the sounds of her

alphabets. Every time she plays I hear her laughing and mimicking the sounds of each

word" (Review 2360). Other behavior observations include giving high-fives to parents

after completing a word (e.g., Review 31) and clapping (e.g., Reviews 42, 1739).

Other reviews noticed a form of kinesthetic change associated with the app. For

example, parents indicated improvements in psychomotor skills. One reviewer stated that

her, then 18-month-old daughter had acquired a high vocabulary "but her motor skills

needed work." The reviewer added that, "within a month of infrequent use, she was able

to move the letters. A month later, she was able to match the letters and say all the word"

(Review 688). Reviewer 757 stated, "Our 2 yo [sic] loves it and its helping her hand-eye

coordination and fine motor skills; using index finger, push, pull, pressure modulation, 2-

handed, using a stylus, etc." Another person stated,

> I purchased this app for my grandson when he was 17 months old, we had to help
> him for a short time and then he started getting the hang of it. In no time at all he
> could put the letters in place on his own, sometimes using both hands at the same
> time! At times, he just holds the letters to hear the sounds. (Review 91)

In total, 25 reviews noted an improvement in hand-eye coordination or fine motor skills

(e.g., Reviews 747, 1184, 1711).

The reviews also suggested that more complex learning skills were being attained, including the transfer of knowledge gained from the app to real life situations. Fifty-two reviews indicated that children were beginning to incorporate the vocabulary from Endless Alphabet in their daily speech. For example, a reviewer stated that his/her 5-year-old "admitted to 'demolishing' her cousin's building because she knocked it down on purpose" (Review 864). Another reviewer wrote, "My three year old son already knows some letter sounds and is using high level vocabulary words like hilarious to describe a happy face" (Review 1764). Additionally, there were 36 reviews that indicated that users were identifying letters on everyday items such as cereal boxes (e.g., Reviews 270, 390) or alphabet letter magnets on the kitchen fridge (e.g., Reviews 669, 1161).

**Different gains for different users.** The reported learning gains attributed to the app suggests that evidence of a child's learning was an intimate one, assessed based on a child's needs, capabilities, and potential as evaluated by an adult. What was striking about the comments was that elements of the app were being utilized for diverse purposes.

For example, one parent wrote that his/her child had initially used the app for identifying letter shapes and sounds but that the child had now moved on to learning words. This was also apparent in the 37 parents who described differing learning gains for multiple children. For example, a parent wrote, "My six year old likes that it is funny and she likes how the monsters scare each other sometimes. My two year old likes how the monster letters make sounds and move" (Review 3159).

This suggests that goals of the apps differed and changed based on the user's needs, and despite its simplicity, the app provided multiple purposes of engagement for a

wide range of users. The strategies used in this app employ motivational elements that seek not simply to maintain attention during the exercises, but more importantly, to retain interest in returning to the app.

**Instructional Issues and Concerns**

Among all reviews, 100 customers stated their desire for more apps that were similar to Endless Alphabet. For example, Reviewer 1121 wrote, "I hope they can come up with something similar for numbers/math!" Another reviewer wrote, "Can you please make it in other languages? For example Spanish" (Review 2198). At the same time, there were a number of issues brought up by reviewers that related to instructional design and technology.

**Lowercase and ordering of letters.** Among the reviews, there were 72 cases suggesting the incorporation of lowercase letters. One review noted, "I would love to see a future option to switch between upper and lower case alphabets so children could learn 'the other half' of the alphabet" (Review 2039). A kindergarten teacher also wrote, "Please, please, please add an option for LOWER CASE letters. I'm a kindergarten teacher. We teach kids to use uppercase only at the beginning of a sentence, beginning of names, holidays. Months, days of week" (Review 448).

In addition to lowercase letters, 15 reviews indicating a desire for the ability to place letters in the correct order; that is, to force the matching from left to right. A reviewer wrote, "Can you please put a parental option in where they have to spell the word the correct order? My son argues DYE is spelled E-Y-D. Would be perfect if we had to spell it in the correct order" (Review 941). At the same time, a writer commented on the other reviews, stating,

Someone mentioned that the program should only allow kids to put the letters back into the words in the correct order, but as a parent and grandparent I totally disagree. It will be too soon that my granddaughter will be indoctrinated into the world of school where everything and everyone has to follow the rules. I'm glad she's a free-thinker and she's learned more from this 'game' in the past couple of days than she has from other educational games that she's played with for much longer. (Review 2605)

In these cases, fidelity to real life usage of letters and words was the topic of discussion.

Diverse opinions about systematic rules of writing were identified.

**Phonetic accuracy.** Another issue concerned the sounds the apps made as the child dragged letters into the outlines. While 108 reviewers praised the app for teaching children phonetic sounds of letters, one of the more interesting interactions among reviews was the discussion that was initially prompted by a teacher, who wrote,

I bought this app out of curiosity. While looking up apps to use in my pre-k classroom, I came across this one that was rated highly by everyone and many with children in the 16-18 month age range. First, many of the letter sounds are given incorrectly. For example /tu/ instead of /t/, /pu/ instead of /p/. etc. Second, this is just basically a spell a word, match some letters app. It would be much more appropriate for kinder to second grade, but they'd be bored with it. When I said I bought this app out of curiosity that was only partly true. I also bought it so I could review it. I cannot stress enough how developmentally inappropriate this app is for your baby to three year old. Your child should be receiving human interaction at this stage, playing with blocks, games and toys that stimulate creativity, conversation, fine motor and gross motor development and problem solving. This does none of that. Don't waste your money. Instead get a box or something equally as fascinating to a toddler and let them be a kid. I promise, you will not have failed them if they are not reading novels by kindergarten. (Review 74)

In fact, 20 additional reviews commented on the inaccuracy of the letter sounds based on the phonetic rules. The original comment by Reviewer 74 prompted a number of reactionary responses. For example, Reviewer 37 wrote,

My son indeed spends many happy hours playing with, and in, boxes. However, there comes a point on the cross-country flight to visit his grandparents when the 10 or 12 books in the diaper bag have all been read 4 times each, the Duplos have been built and rebuilt, the toy cars have been driven, and he's starting to climb the walls. Perhaps [Reviewer 74] would recommend setting a box up in the plane

aisle, but since stewardesses usually frown on that, I am delighted at such times to have a few quality iPhone apps with which to entertain him – not cartoony schlock, but interactive apps that engage him. The assumption that the use of iPhone apps for toddlers precludes appropriate developmental play seems to me to have been made by someone who isn't actively raising a toddler or who never travels with one.

Other writers were less direct and stated that phonetic inaccuracies in Endless Alphabet were corrected with the use of other tools. Reviewer 22 stated, "I've seen some complaints about the letter sounds not being exactly right. They may not be exact but it's not that noticeable to me and this shouldn't be the only tool in your educational fun box." Although it is beyond the scope of this paper to assess the implications of teaching phonetic sounds, the comment by Reviewer 74 presents two issues related to technology learning that requires further investigation.

*The role of the technology*. The first issue relates to the role of technology learning for very young children. In the broader literature, media studies examining the role of digital technologies on children are still sparse. However, in 2003, the Kaiser Family Foundation (2003) conducted a large-scale study documenting the exposure of electronic media on infants, toddlers, and preschool children. Targeting a demographic that had not been studied extensively by media researchers, 1000 parents of children in the 6-month-old to 6-years-old range were surveyed about media use in their homes. This study indicated that that children under six typically spent approximately two hours a day in front of screen media, or three times the time spent reading or being read to by an adult.

The same study also revealed parental beliefs about the educational value of media, suggesting that 72% of parents believed that using a computer assisted in their child's learning. This indicated that parents were unaware of or were ignoring

recommendations by the American Academy of Pediatrics (2013), which suggests that children should be limited to less than one to two hours a day of screen time and children under the age of two should not be exposed to any screen time.

In the current study, 20 parents indicated that they limited the technology use with their children. A 3-year-old's parent wrote, "Granted, there are a lot more productive and efficient ways to teach children, and this app is by no means a replacement. HOWEVER, since realistically nowadays children are going to play games on tablets and phones, it might as well be something educational" (Review 43).

The same Kaiser study discovered that toddlers and preschoolers were not passively consuming media but were asking for help or proactively choosing the type of medium and the type of content they preferred. In the present study, 29 parents indicated that, while they had tried other tools, they found that their child was most engaged and showing the most literacy gains from using this app, and seven parents indicated that the child chose Endless Alphabet among others on their iDevices.

*Adult guidance*. The second element considers the social presence of parents and adults in the learning experience. Many of the issues addressed by reviewers of this app represent a conception of technology-mediated learning as one that is pursued individually and as one that provides a comprehensive ends to a certain learning objective. However, although only 14 reviewers specified that the child played with the app with another person, evidence from the previous section as well as the number of adults writing the reviews revealed that many parents were actively observing or participating, directly or indirectly, in their child's interactions.

For example, with regard to the phonetic issues, there were reviewers who indicated that, while they were aware of the inaccuracies of the letter sounds to with the phonetic rules, they were either unconcerned or worked directly with the child to help him/her understand the difference between the letter name, sounds, and pronunciation. For example, Reviewer 7 wrote,

> Now, to address the very few critics of the app, this is where engaged parenting becomes the partnership with such an amazing software app — yes, some of the sounds are a little off, and yes, our son thought the letter "T" was called "tuh tuh tuh tuh", but with some immediate coaching and reinforcement, he is quickly switching to "T" and the sound is "tuh". Yes, as he started with the app, we helped him a little to figure out what to do and let him know those were "letters". And now that he sees these symbols mean something, we are picking up letters and pointing at them to ask him what they are called. We got out the letter blocks now that he realizes that letters mean something. And we will always continue to read. The app alone won't do all this.

Although the degree of adult involvement is not explicit, the awareness of the app content in the written reviews by adults suggested that many parents were at least an indirect social influence in the app experience.

**Endless Alphabet Summary**

Endless Alphabet is a literacy-based app for the 0 to 5 age range. The instruction embedded in the app focused on gains in lower-level skills through the use of repetition and memorization, and while there were no in-app measurements on learning gains, an overwhelming number of consumers reported a positive reaction toward the app. The reviews suggested that such gains were intimate assessments observed and shared by the adults writing the reviews.

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**App IV: Mickey Mouse Clubhouse:**
**Wildlife Count Along**

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Mickey Mouse Clubhouse: Wildlife Count Along, developed by Disney, appeared 87 out of 128 days of the data tracking period, making it the fourth most frequently

appearing app in the Top Paid apps section. At the commencement of this research, there were 155 Disney apps available for the iPad. The technical requirements for this app included a minimal storage of 126mb and iOS 4.3 or later. The app was compatible with the iPhone, iPad, and iPod touch. Version 1.0 appeared on November 9, 2012. There have been four subsequent updates; the most recent update occurred on September 15, 2013. There are no in-app purchases or third-party links within the app experience, however, access to more Disney related apps were available through the secured Parent section.

**Overview of App Options**

Mickey Mouse Clubhouse: Wildlife Count Along is an app for basic math and science (wildlife identification) with a force-fixed, horizontal, orientation. Upon opening the app, the Disney Digital Books logo is displayed and a jingle plays. An introductory menu follows, and the narrator directs the user to tap on the highlighted "Start" arrow/button. Narrated instructions repeat throughout the various events or app experiences after a certain amount of user inactivity.

**Menu page.** Tapping on Mickey Mouse's iconic silhouette on the top, left, corner of the screen grants access to the menu at any time while the app is running. The top two-thirds of this menu interface include graphic icons that functions as links to seven areas of the book. There are additional links along the bottom one third of the screen to adjust the music, toggle on and off the narration, and to access the parents' section. Tapping on the "Parents" icon/link brings up a pop-up entitled "Grown-Ups Only." Security settings prompt parents to input the numerical equivalence of three, randomly generated, numbers that appear as text. The display transforms to a vertically-scrolling page upon entering the correct numerical value with instructions on the app, links to the App Store, developer

credits, and "Do-together Ideas" to help parents work with children in using the app in terms of navigation, purpose, and practical expansion of learning in day-to-day/real-life situations.

**Storyline.** The story begins with the narrator's description of the five main characters (including Mickey) and the context of their adventure. The narrator's vocalized words are also highlighted, in print, along the top of the screen. The user identifies objects and drags them into a car. Next, the user taps and drags the five characters into the car. These activities result in the audible "reward" of the revving up of a car engine but do not progress the storyline. The narrator instructs the user to move the Toon Car with his/her finger. An animated hand with an extended pointer-finger automatically demonstrates the movement. A violet and right-pointing arrow, resembling the start button/arrow, signals the user to touch it in order to continue to the next section of the digital book.

As the story proceeds, the user encounters various wildlife areas that follow a similar pattern. Mickey and his friends keep on taking wrong turns. Still, they manage to take advantage of opportunities to photograph a specified number of animals. They travel through Dusty Desert (covering the numbers one and two), Icy Arctic (numbers three and four), Breezy Forest (numbers five and six), Misty Rainforest (numbers seven and eight), and the Beach (numbers nine and ten).

In each scenario, the Toon Car moves across the screen and stops (see images in Figure 32). Mickey dictates the number of animals he wants in his photograph. There are usually two groups of animals, but only one contains the correct number. When the user taps on a group of animals, a photo viewfinder zooms into the animals. Mickey verbalizes

the name of the animal, and the narrator directs the user to "[t]ouch the animals to count them." The user can either tap the "X" box to exit out of the viewfinder or begin tapping on each animal until all animals have been counted. If the animal count is not the desired number that Mickey initially stated, the narrator tells the user that it is an incorrect response, and encourages the user to "[k]eep looking."

Upon giving a correct response, the narrator directs the user to tap on a highlighted box to "[t]ake a picture." An animated camera shutter closes along with a shutter sound, and the screen returns to the wildlife environment. At this point some of the characters provide feedback. In every scenario or environment, two numbers are identified. If only one group of animals have been counted, Mickey tells the user to find the other number of animals so that the user gets practice in counting with both numbers. Once both numbers have been correctly identified (or the user incorrectly answered the first time but got the correct answer the second time), the car moves forward. The narrator provides activities for the user as the car automatically pans from left to right when he/she completes the counting of both numerical groups. These activities include shaking the screen to cause snow, foliage, and rain; tapping on objects to make them move (e.g., the sun, tumbleweed, trees, flowers, a beach ball); and tilting the screen to make the ball move.

Additionally, Mickey encourages the user to look for more animals throughout the scene to count and capture as a photograph. At the end of every scene, the car stops and the narrator directs the user, once again, to tap on the violet right-pointing arrow. The user may move the car back and forth with his/her finger at any time and repeat any of the actions described above.

*Figure 32.* The six different habitats of the Disney app. (Permission to reproduce images granted by Disney.)

The final segment of the storyline in the app tells the end of Mickey and his friends' vacation. The user sees a photograph of Mickey and his friends on the beach and the narrator prompts the user to tap the arrow to continue to an open photo album. The images comprise the context for the four sub-sections of extension activities with Mickey requesting the aid of the user in organizing his scrapbook.

In the first story extension activity, a two-page spread of the album is presented at the top, and three images of varying groups of animals on the bottom. In one of the page spreads, an outline of a box is visible under a number. Mickey prompts the user to select the photo with a certain number of animals from the bottom three pictures and to place it into the outlined box. If the correct number is identified, positive feedback is provided and a new outline (above) and sets of images (below) appear. The user has three tries to answer the question correctly. After one or two incorrect responses, the narrator repeats the question. When there are three wrong responses, Mickey selects the correct response,

the image with the correct response is placed into the outline, and the next question appears. The user repeats this activity for six iterations (see images in Figure 33).



*Figure 33.* Story Extension Activity 1 of the Disney app. The user must choose the group that contains a certain number of animals. (Permission to reproduce images granted by Disney.)

In the second story extension activity, the album page turns and a new two-page spread with two images on each page and the corresponding number indicated above. After Mickey speaks, the user is prompted to draw a circle around the group of images with more or fewer animals (see images in Figure 34). An animated hand with an extended pointer demonstrates the movement. If the user does not draw a circle, an error sound is delivered. Dragging the extended pointer around in a circular motion on the screen causes the circle to become outlined in violet. A correct answer results in a sound and a set of new question appears. The user has three tries to answer correctly before the narrator asks the user if he/she would like to help Mickey with another question. If one or two wrong responses are given, the narrator states the number of animals in each image and prompts the user to try again. When there are three wrong responses, the wrong response will disappear and the user must circle the remaining image. This cycle repeats for three iterations.

*Figure 34.* Story Extension Activity 2 of the Disney app. The user must choose the group with more or fewer groups of animals. (Permission to reproduce images granted by Disney.)

In the third story extension activity, the album page turns, and a new two-page spread is displayed. The top section is an image of one of the habitats, within which there are a number of misplaced animals. The bottom of the screen displays three other wildlife scenes visited in the storyline. The goal is for the user to tap and drag the animals to their correct habitat (see images in Figure 35). Mickey speaks, and the user is prompted to help match specific animals to their correct habitation. When the user moves an animal to the correct habitat, the narrator indicates the name of the animal and the environment within which it lives. For example, the narrator may state that "[t]he polar bear lives in the Arctic" and instructs the user to find the correct home for another animal. If a user makes a mistake, the narrator states the name of the improperly identified habitat and explains that the animal does not live there. Repeatedly placing the same animal in the incorrect habitat results in the disappearance of the two wrong answers, leaving visible only the correct habitat.

*Figure 35.* Story Extension Activity 3 of the Disney app. The user must correctly situate displaced animals into one of three habitats. (Permission to reproduce images granted by Disney.)

In the final story extension activity, the background from the third extension activity continues to be displayed. The narrator states the name of the wildlife environment, and prompts the user to select the animal that lives in that habitat (see images in Figure 36). The user must select one animal from five choices. If the user drags the correct answer into the background, the narrator states the name of the animal and affirms that the animal lives in that particular environment (e.g., "[t]he prairie dog lives in the desert"), and asks the user what other animals live there. If the user produces three wrong answers, all incorrect responses disappear from the page and Mickey encourages the user to try to place another animal into the appropriate habitat.



*Figure 36.* Story Extension Activity 4 of the Disney app. The user must select the animal that lives in the habitat displayed in the photo album. (Permission to reproduce images granted by Disney.)

The user must drag the remaining correct answers onto the habitat background. When all corresponding animals are placed into the wildlife environment, Mickey

concludes the story with a narration. Mickey's hand closes the photo album, and the user

returns to the menu page.

**Nature of Reviews, Users,
and Context**

According to its app page in the iTunes App Store, Mickey Mouse Clubhouse:

Wildlife Count Along received a 3.5 (out of 5) star aggregate rating by 655 users for all

versions and an overall star rating of 3.5 stars by 69 people at the time of data collection

for the most recent version. However, close examination and calculation of the 69 written

reviews, resulted in an average rating of 2.5 stars and a median score of 2. It is not clear

what is accountable for this difference in calculations.

Regarding user demographics, among the 16 reported ages of users, the average

age was 3.2, with a median age of 3 and a mode of 2.5. There were 11 references to

actual users as the daughter or granddaughter of the individual giving feedback, five were

identified as sons, and three evaluators referred to the actual app user as a child in

general. Seven reviewers indicated that they purchased this app because they or their

children liked Mickey Mouse or another Mickey Mouse Clubhouse app—five users

specifically referenced the app, Mickey Mouse Clubhouse Road Rally. There were 40

generally negative, 19 generally positive, and 9 mixed reviews.

**Design of the Learning Space**

Disney's Mickey Mouse Clubhouse: Wildlife Count Along can be classified as a

combination of an interactive storybook and a tutorial. Tutorials "take the role of the

instructor by presenting information and guiding the learner in initial acquisition" (Alessi

& Trollip, 2001, p. 11). In the first half of the interaction, the narrator begins the

animated story by telling the users that Mickey Mouse is taking his friends to the beach to

take pictures of bottleneck dolphins. In the narrative, Mickey and his friends take a series

of wrong turns through four habitats until they finally reach the beach. According to the

app description, the user is exposed to learning early childhood language and literacy,

math, and science concepts. The remaining portion of the app, referred to as "story

extension activities" by the developers, extend the practice of counting animals and

identifying proper habitats through drill and practice exercises. Next, is a discussion of

the app's three main subject areas (language and literacy, mathematics, and science

learning), followed by a broader examination of the app and its educational implications.

**Language and literacy.** This app begins as a story and incorporates many

elements of a digital story. According to Ohler (2008), a good digital story contains the

three parts of a story core: the problem (tension), the transformation, and the solution

(resolution). Indeed, the Disney narrative incorporates all three of these pieces. Mickey's

plan of taking pictures of bottleneck dolphins is thwarted by the wrong turns that he and

his friends take. Instead of becoming discouraged, Mickey decides to take the opportunity

to photograph some of animals that live in each habitat he and his friends encounter.

Toward the end of the story, Mickey reaches the beach where the bottleneck dolphins

reside. Two key strategies of the storyline are used to enhance the learning experience:

bimodal literacy and interactive narrative.

*Bimodal literacy*. The text of the story is presented on-screen and corresponding

words are highlighted, as a female voice reads the sentences. There are two types of

technology that are apparent in the audio/visual narration. The first involves text-to-

speech synthesis—the simultaneous on screen reading aloud of the text as the child views

it (Rief & Heimburge, 2007). Synchronous (or synchronized) highlighting is a strategy

that visually calls attention to specific words by highlighting them as they are spoken or read aloud.

Although it is possible to toggle on and off this feature, Cavanaugh (2006) writes that text-to-speech, combined with synchronous highlighting "assists students in learning proper scanning techniques as they follow the moving highlights from the top left and then progress across and down the page, go to the next page, and start again" (p. 97). The study by Montali and Lewandowski (1996) also suggested that a bimodal (on screen, highlighted, and narrated) literary presentation was most advantageous for less-skilled readers, including those with learning disabilities.

Reviewers of the app identified at least two concerns. First, they expressed dissatisfaction with the fact that the user could not control the speed with which the text is read. Although assistive technologies exist to aid the reader, it is not clear if a child would be able to keep up with the automated speed with which this story is read aloud and visually displayed. Second, a number of reviewers indicated that the audio and visual components did not consistently function synchronously. However, it should be noted that this issue did not manifest during the course of this research. Since many customers reported inaccuracies in the technical specifications of the app, one possible explanation for the error may be an inadequate amount of memory in older devices. Such technical complications seemingly dissuaded those reviewers from articulating appreciation for potential benefits to learning.

***Interactive narrative*.** Throughout the app, the story invites the user to interact within the app environment. For example, in the beginning of the story, the user must load different objects and characters into the car by tapping on them. Green and Jenkins

(2014) explain that there is sound research to account for the beneficial, psychological, effects of such interactive narratives but point out that it has yet to gain momentum. The hypothesis put forth by these researchers on difference in psychological responses between traditional and interactive narratives is worth considering in this Disney app, since the narrative may "enhance or detract from the psychological processes that occur when individuals read or view narratives" (p. 481).

One of the aspects considered by Green and Jenkins is the concept of participatory responses, where readers "react psychologically as if they were part of the story events" (p. 489). Whereas traditional books do not allow the reader to actively participate in the events of the story or with the characters, the interactivity found in apps such as Mickey Mouse Clubhouse: Wildlife Count Along, has the potential of eliciting psychological responses that may deepen learners' sense of immersion within the storyline.

Because child engagement and persistence is a critical characteristic of literacy advancement, prompts that allow the reader to manipulate the context are, certainly, important elements in interactive stories (Justice, Pence, Beckman, Skibbe, & Wiggins, 2005). The technological capabilities available with this app may simulate, to some degree, the engaging role of a parent or teacher reading aloud to children, thereby incorporating not only the signaling cues that adults typically use to guide young readers, but also substituting the inherent stimuli from parents and teachers. The narrator and Disney characters' interactivity progress and personalize the narrative by providing instructions, comments, and feedback on user actions.

In addition to making verbal commentary about the scenery, Mickey's role involves directing the user to select certain number-groups of animals (mathematics), and introducing the names of animals when a group is selected (science). The narrator helps progress the story by reading the storybook text (literacy), providing instructions on the hidden interactions, and repeating instructions after a certain amount of time has passed without touch-based action on the part of the user. The narrator's immediate feedback on users' correct or incorrect responses helps the learner direct and manage attention on the immediate exercise. This is because immediate and corrective feedback in simulations are typically preferred over delayed feedback, particularly with novice learners (Alessi & Trollip, 2001). Furthermore, from a design perspective, the simulation of an adult reading aloud facilitates engagement and improves vocabulary and grammar skills, as well as improving children's knowledge about sequencing in stories (Fox, 2013).

**The math component.** The math component of the app focuses on practice in counting the first ten numbers. During all parts of the storyline, Mickey and the narrator instruct the user to search for a certain number of animals so that Mickey may take a picture of one or two sets of animals. In order to progress through each region of the story, the user must photograph both sets. Not only must the user identify the correct group of animals, but also, he/she must also tap on the animals, activating the narrator's counting aloud of the numbers with every successive tap. When users make a mistake, they receive feedback and additional opportunities to select the group of animals with the correct number. In the latter half of the app, users must choose the correct number of animals from one of three images, and identify which of two image choices displays either greater or fewer animals.

*Counting.* Counting, as an exercise in mathematics, is addressed and reinforced using a number of instructional strategies. The act of counting numbers is performed through a visual representation of a camera, set within the context of Mickey's desire to photograph animals and add the images to his album. Counting follows a numerical order, sequencing of numbers is reinforced toward the end of the lessons, and previously learned numbers and animal groups are recycled.

For example, in the second region when Mickey and friends visit the Icy Arctic, the primary focus is on the numbers three and four; however, after having correctly identified groups of three and four animals, the narrator and Mickey suggest the user take additional photographs of other groups of animals. Animals found in the remaining areas of the habitat are limited to groups of one, two, three, and four, facilitating the review and practice of the previously learned information. Upon successful completion of the activity the, Toon Car moves on but the user may extend his/her visit in a particular region by dragging the car back and forth to count more groups of animals.

The broad objective regarding the math component of learning is mastery of all ten numbers. The goal is facilitated through a progressive and sequential understanding of the numbers. This instructional material in the app is delivered with a scaffolding of the information that would otherwise be difficult for a child to learn if presented all together. According to Smith and Ragan (2005), scaffolding is "the cognitive processing support that the instruction provides the learners, allowing them to learn complex ideas that would be beyond their grasp if they depended solely on their own cognitive resources, selectively aiding the learners where needed" (p. 130).

***Supplemental exercises.*** In the story extension activities, the user is given more opportunities to practice numbers and counting. The first exercise prompts the user to view three images containing different numbers of animals. The narrator assigns a certain number and prompts the user to select and drag the image containing the corresponding number of animals into a frame in the album. There is only one correct answer, and the instructions are narrated as well as shown in numeric form.

The second exercise involves the identification of an image with either "more" or "less" numbers. The user must count the number of animals in each group, assess which has a greater (or fewer) number of animals, and then identify that group by drawing a circle around the correct animals with a finger. This activity requires a synthesis of cognitive and psychomotor skills. Since the age of users of this app is typically five or under, this physical-kinesthetic aspect is of significant educational consequence. Educators commonly affirm toddlers' use of the sense of touch to learn (Blagojevic, Brumer, Chevalier, O'Clair, Thomes, 2012). Kolb (1984) and Felder and Silverman (1988) are among the experts in learning styles to confirm the effectiveness of creating instruction that demands active or physical engagement on the part of the learner.

At this point in the instructional sequence, the user has had multiple opportunities to practice counting groups of wildlife. However, comparing and contrasting requires a higher level of skills. Among the six tiers of Bloom's Taxonomy (discussed previously in the Stack the States section), comprehension is the second lowest level, above knowledge, and is characterized by the type of instruction where "students are confronted with a communication, they are expected to know what is being communicated and to be

able to make some use of the material or ideas contained in it" (Bloom, 1956, p. 89).

Users are assessed in their ability to not only count, but also, interpret information.

**The nature-science component.** Along with math and early literacy

development, Mickey Mouse Clubhouse: Wildlife Count Along is marketed as an app to

assist in learning early science concepts with an emphasis in nature education. The

storyline incorporates five different habitats in addition to Mickey's home (i.e., a desert,

the arctic, a forest, a rainforest, and a beach), featured with animals in situational

occurrences that are unique to a given area. The animals and their habitats are revisited at

the conclusion of the storyline through two tutorials that prompt the user to match

animals with the appropriate home.

*Simulation of global habitats.* The design of the science instruction of Mickey

Mouse Clubhouse: Wildlife Count Along contains characteristics often found in

educational simulations. As mentioned in the discussion of an earlier app (see the section

on Toca Hair Salon 2), educational simulations provide simplification and omission as

well as realism of a phenomenon. Alessi and Trollip (2001) state that physical

simulations "are intended to inform learners *about* some object or phenomenon and its

underlying principles" (p. 217). Although the narrative follows a forced-linear path, along

the way, the interactive elements embedded in the sequence of each area help children

learn about the characteristics of each habitat by tapping various objects to cause rain,

snow, and other naturally occurring phenomena (e.g., tumbleweed rolling or a flower

blooming). The users are given numerous opportunities to learn about the types of

animals that live in a specific environment: their appearance and their names.

The global habitats featured in this app include areas that may otherwise be inaccessible for a young child. The educational potential of science simulations are described by Smetana and Bell (2006) who assert that these technologies "present dynamic theoretical or simplified models of real-world components, phenomena, or processes, allowing students to observe, explore, recreate, and receive immediate feedback about real objects, phenomena, and processes" (p. 267). However, Smetana and Bell's guidelines suggest that successful use of simulations require careful attention on the part of the instructor.

*Creating connections.* This app attempts to employ a number of strategies that strengthen the link between characteristics of different habitats, its conditions, and the animals that live in it. The first is visual. The way in which the areas of the story are divided allows the user to observe and distinguish specific animals that live in a particular habitat. Transitions from one habitat to another are connected in terms of purpose, as well as in terms of procedure. After completing the exercises in the various environs of the story, the user taps the eventually familiar violet-colored arrow to proceed. These procedural elements may point to an important visualization strategy called the method of loci, "in which the locations of objects in an imagined space…are associated with points to be remembered (Smith & Ragan, 2005, p. 160).

Other elements within the app that facilitate connections in learning include the verbal feedback that the narrator delivers, the provision of supplementary links with information about the wildlife, their names, and their natural environments. An example is the presentation of the camera interface after Mickey instructs the user to find a certain number of animals. Mickey vocalizes the animals' names after an animal group is

selected. The verbal cues, or the audible names of animals that Mickey gives, help connect the names of animals with a visual representation of their appearance within a "natural" habitat.

Piagetian constructivism permit the discernment of the instructional strategies applied in this exercise. According to Piaget (1962), learners acquire new information through the processes of assimilation, accommodation, and equilibration. Assimilation is the process of incorporating new knowledge within an existing scheme or framework, and accommodation is the process of modifying an existing scheme or creating a new framework to allow for new experiences (Driscoll, 2005). Equilibration is the complex process of finding a balance between existing schemes and new information (Ormrod, 2004).

In the current context, the user may observe and listen to the information presented in the first habitat (i.e., Dusty Desert) and recognize that animals such as the coyote, the lizard, the blazing sun, and tumbleweed are characteristics of the desert. When the user is taken to a new scene, such as the Icy Arctic, the processes of assimilation and accommodation are apparent in the presentation of the names of newly-introduced animals, like polar bears and seals, or natural occurrences, like snow. In addition, users must distinguish characteristics of this habitat from the previous habitat through equilibration. This process continues through the remaining habitats. The retention of this information is assessed in the supplemental exercises described in the next section.

***Supplemental exercises.*** The story extension activities serve three functions. A first function is the repetition in the narration, which strengthens the link between the

presentation of the animal (visual) and the name of the animal (auditory). In all four of the lesson activities in the post-storybook section, the narrator provides auditory cues for the user to make associations between the visual representation of the animal, the animal name, and/or its habitat. For example, in the more/less exercise, when the user circles the correct answer, the immediate feedback verbalizes the accuracy of the user's actions by calling to attention which groups of animals were larger or fewer in number.

As another example, the user may hear the narrator state that "[t]here are less/more [correct animal group] than [incorrect animal group]." When an incorrect answer is given, the narrator guides the user by identifying the number of animals in the group(s) and prompts the user to choose another answer, stating that "[t]here are [x number of animals] in this group, but the other group has [y number of animals]. Please try again." In this way, although the problem itself is mathematical in nature, the narrator calls attention to the name of the animal group. Understanding new vocabulary improves when learners are repeatedly exposed to new words. The technique of interactive book reading provides children with multiple chances to encounter new vocabulary and significantly strengthens the connection between a new word and its reference (Wasik & Bond, 2001).

A second function of the extension activities is to provide additional practice in the identification and placement of animals in their habitats. Two lessons related to science are presented. The user sees photos in a larger album spread, including six animals that are not in their correct habitat. On the bottom of the screen are three smaller images of empty habitats. The user must drag the out-of-place wildlife in the spread to

the suitable environment in the corresponding smaller frame. Again, the narrator provides feedback, verbalizing the name of the animal and the name of the habitat.

The section transitions into the final story extension activity of the app where Mickey realizes that there are no animals left in the spread. The latter exercise presents five animals in individual frames on the bottom of the screen. The user is prompted to help Mickey identify the one animal (out of a choice of five) that lives in the empty habitat. There are five iterations of this practice. Both of these sections contain characteristics of drill and practice, targeting mastery of lower-level knowledge (Alessi & Trollip, 2001). One of the engaging qualities of the exercises is that users may jump to this area of the app from the menu, and receive a variety of types of questions whenever he/she starts the drill. However, users cannot choose specific sections of the drill to practice. For example, users cannot simply work on the science section at the end without having to answer the mathematical questions that precede it.

Participation is the third and final function of the story extension activities, and it serves to help assess a child's broader comprehension of the content in the first half of the app. Individual questions are accompanied by immediate feedback, though the drill exercises are not scored. Since assessment is a critical component of determining mastery of a given material, the item-by-item feedback in this app (as opposed to a more cumulative approach), while atypical, is more informative than corrective information about a user's progress (Smith & Ragan, 2005). Although assessments typically provide insight into learners' performance and help plan remediation exercises toward mastery, the limitations of the app fall short of providing such features.

**Instructional Issues and Concerns**

Among the reviews that were positive, nine consumers indicated that they "loved" the app; seven stated they thought the app was "fun," "joyful," or "playful," and four described the game as "great." However, an overwhelming number of the reviews were negative. Forty-five of the 69 reviews identified unfavorable elements about the app. Many of the app experiences were characterized as "boring," "beyond dumb," "confusing," "dull," "frustrating," "not good," "not engaging," "not fun," "not entertaining," or "not interactive." Nineteen reviewers indicated that the app was not worth the cost, ten customers detailed their disappointment in purchasing the app, and nine stated that they wished for a refund. Another six dissatisfied consumers referenced other customers' negative comments and either expressed agreement or regret at not having read them prior to purchase. Five of the seven comments directed at potential customers sought to dissuade purchase of the app. Three conveyed feelings of having been cheated or mislead by the developers.

**Technical concerns.** Technical issues among 19 independent reviews referenced general concerns of malfunction. Three reviews raised concern over what they found to be the actual (666mb) versus the advertised (161mb) amount of storage space needed to run the app. Other reviews identified problems with the sound. Among these, two described issues with the text-to-speech and synchronized reading functions: "The sound does not synch with the highlighting of words being read, negating the positive of having a read along option for pre readers" (Reviewer 65).

A pattern of other technical issues became apparent with close review of the data. The first point concerns two of the story extension activities. In the first story extension

activity (i.e., dragging the correct number-group of animals into the album), when the user taps on the image placed on the left side of the album, the narrator identifies the number and the name of animal. However, because the page turns quickly after the second picture (on the right) is placed, it is nearly impossible to listen to the number and name for animals on the right side of the page.

Also, in the second story extension activity, there were numerous occasions where circling the wrong answer too quickly would result in the album portion to freeze. As another example, in the third extension activity, when the user tries three successive attempts to place the same animal in the incorrect habitat, only two wrong responses disappear. The intention in all other scenes is to eliminate the user's confusion by eliminating all wrong answers (habitats) so that he/she places the correct animal in the remaining environment. However, although the user has control over which animal to choose, placing a different animal in one of the habitats becomes impossible.

**Instructional concerns by users.** In addition to the distractions and disappointments that customers expressed regarding technical issues, there were concerns regarding the instruction itself, even from the very start. Two customers indicated disapproval in the beginning scene where the user is instructed to drag his/her finger on the screen to move the car toward the "wrong" direction. Reviewer 65 wrote that "[i]t also frustrates my daughter that 'Mickey' keeps going the wrong way, because it really means that the app is forcing HER to go the wrong way. There is no option to actually use your skills to get to beach by following the signs." It may not have been the intention of the developers to promote a "Choose Your Own Adventure" type decision-making storybook. Most likely, the purpose was simply to provide a visual-tactile progression of

a linear storyline. Nevertheless, because it was the first screen in the story and there were insufficient instructions on the purpose of Mickey's mis-direction, consumers' confusion about the flow of the narrative is understandable, as was their conclusions that the developers were teaching children to go the wrong way.

The second issue concerns two assumptions by the developers on the knowledge capabilities of the user. First, the developers assume that the user understood the meaning of the words "more" and "less" (even though the latter word is technically, grammatically incorrect since the numbers are 1-10 and countable, thereby making the word "fewer" appropriate and correct). Two customer reviews correctly identified the grammatical mistake. One acknowledged that while the 2-year-old, for whom the app was purchased, generally enjoyed the app, he/she took "major exception" to the repeated grammatical mistake of prompting the user to select the picture with "less" animals. This parent reviewer expressed a preference that Disney not confuse the child "when it comes to the difference between less and fewer" (Review 3). Because this error has not been fixed, given the emphasis on literacy and the often-employed instructional strategy of repetition, this grammatical issue may be a valid source of criticism regarding the app.

The developers also assume that users have a basic understanding of different types of shapes and possess the cognitive and psychomotor skills necessary to draw a circle around a correct answer with their finger on the screen. The necessary knowledge and skills were not only not explained or assessed, but some researchers have also indicated that it is crucial to attend to developmental skills before asking young learners to compound knowledge in practical application. Sequencing schemes emphasize the importance of ordering content in a specific way in order to teach content most

effectively (Posner and Strike, 1976). Thus, prerequisite skills and less difficult skills must be mastered prior to more complex tasks.

**Other issues.** Other instructional concerns observed during the data collection related to the nature-science content, where the assimilation and accommodation of facts about a habitat occurred by chance. For example, when the signpost at the beginning of each area is tapped, the narrator provides additional information on the nature of the habitat. Although this is critical information related to science and nature, there are no verbal cues or visual indicators to suggest that tapping on the sign may provide the user with additional information. Therefore, whether by accident or inquisitiveness, the user may serendipitously reveal the content.

It is a particularly surprising aspect of the instruction in the app since users are alerted to other "hidden interactions" by specific visual cues (e.g., shaking, tapping, and tilting the screen). Even such interactions that lead to the revelation of factual information pertaining to various habitats are not cued in the supplemental exercises. Visual cues may facilitate user access to the learning environment, and given the lack of practice with wildlife names, visual supports could help users understand and assimilate new knowledge. Blagojevic, Logue, Bennett-Armistead, Taylor, and Neal (2011) report that it is critical to consider

> visual cues that match children's development and learning needs. They may not understand what is being said if the speech is too fast, is unclear, or uses unfamiliar words. Children may become confused or feel anxious and overwhelmed. These feelings can affect a child's ability to learn, interact with others, and feel comfortable as a member of the classroom community. (Visual supports help children understand… section, para 2)

While this context is not a virtual environment, it seems reasonable to assume that learning in the app-based community should rely to an even greater extent on visual cues.

The range of abilities and needs among learners in the iPad app environ is necessarily broad and "[v]isual strategies are considerate of diverse learners" (Blagojevic et al., 2011, para 2). Blagojevic et al. further recognize the value in considering visual strategies and visual supports since they are often critical to users' comprehension of verbal (spoken and written) communications, stating that young learners "may need additional time to process what is being said and come up with a response" (para 2).

Another issue concerns the maintenance of information throughout the course of the digital storybook. Because the user is not required to tap on any animals with the exception of the first two that appear on every page (for the purposes of counting), the alignment of the exercise and the assessment in the last two extension activities seem awry. To add to the difficulty of the assessment toward the end of the app experience, the user must retain the knowledge of animals belonging to a specific habitat from earlier areas.

Two particular matters that rouse some apprehension relate to storage capabilities of human memory and the organization of activities. According to Miller (1956), the human memory can store seven bits of information, plus or minus two bits, at a time. This app presents five distinct habitats with five different animals in every environment for a total of 25 different animals. The information is chunked by area but the user is not offered the opportunity to practice identifying animal names within the various environments until the assessment at the end.

This leads into the second issue that concerns the proximity of the learning content and the assessment. Given the complexity in the content of the app among such disparate disciplines, the number of unique habitats and variety of wildlife,

environmental/climate phenomena, and the literacy component, the placement of the extension activity is puzzling. Because of the way in which the story is presented, it is understandable that these exercises would occur after Mickey's vacation has ended. However, from an instructional design perspective, memorizing the detailed information from the content appears to be too demanding of a task for even an adult, much less a child under the age of five.

**Educational Considerations**

Mickey Mouse Clubhouse: Wildlife Count Along provides an interdisciplinary approach to early reading, mathematics, and science for children during their first five years. The previous sections examined the goals, processes, and interactions related to the subject matters, as well as the issues and concerns about the design of the app experience. In this section, holistic considerations are made regarding the educational implications of the app as a singular unit of learning.

**Interdisciplinary learning.** Mickey Mouse Clubhouse: Wildlife Count Along attempts to synthesize three disciplines within a single app. Flevares and Schiff (2014) outline the importance of integrating early childhood mathematics with picture books. They state that this interdisciplinary approach helps to (a) promote vocabulary development and interactions with other children or adults (communication), (b) formulate connections with words and images (representation), (c) bridge formal and non-formal learning environments and experiences (connections), (d) engage children's problem solving skills (problem solving), and (e) support children's processes of generating reasoning and proof (reasoning and proof). In addition, the importance of fostering connections between disciplines is not limited solely to literacy and

mathematics. The National Science Education Standards (1996) also promoted the integrated teaching of mathematics and science in their benchmarks.

At the preschool and elementary levels, children begin to learn and understand the world around them. Fleege and Thompson (2000) write that, the life science skills of "observing, comparing, measuring, and classifying" can be bridged with the mathematical concepts being learned such as "counting, sorting, classifying, looking for patterns, and graphing" to facilitate connections with real world situations (p. 74). Furthermore, Hadzigeorgiou (2001) states that the key to developing the foundation of conceptual knowledge in the sciences is through the establishment of a long-term relationship between the world of science and the child at a young age. Hadzigeorgiou suggests that a child's initiation into this world begins with the formulation and appreciation of their perceptions of wonder, mystery, and curiosity. Hadzigeorgiou goes on to advocate the use of stories and storytelling, written in a logical or conceptual sequence, to draw the learner's interest in a way that is easily remembered.

**Interactivity.** An attractive feature of digital storybooks is the interactive nature of the narrative. However, the reviews by customers indicated frustration and confusion about certain functions in the story. Green and Jenkins (2014) highlight the inconsistencies in the literature in defining the term interactivity among different types of media, yet, they state that "in interactive narratives, interactivity is both a component of the story and the way in which the reader engages with the narrative" (p. 481). In other words, with the Disney app, the extent to which the interactivity drives the story was not clearly defined.

As an example, in certain cases within the Disney story, users may tap on objects to cause movement (e.g., shaking the iPad to cause snow to fall in the arctic habitat). This action teaches the user about various environmental conditions in different habitats; however, these actions are optional decision points, and the story moves forward whether or not the user performs these actions. At the same time, the counting component at the beginning of every scenario of Mickey's adventures the story requires user action to cause the story to proceed. This variability in the user interface is problematic, particularly because parental instructions become accessible only after the story begins, causing disruption in the user experience, and also because the instructions for using the app in the parents section do not clarify the linear nature of the story.

**Appropriateness and Guidance.** The final point that must be addressed is the appropriateness of the app for the targeted age range. It is beyond the scope of this study to determine if the content of the app was appropriate for the developmental capabilities of a user five or younger. Yet, from an instructional design perspective, the analyses in the previous sections clearly demonstrate the complexity of the app. On one hand, the literature suggests the attractiveness and merits of an interdisciplinary approach. On the other hand, considerations must be made regarding the complexity of this app as an individualized learning tool.

An exploration of cognitive load in the context of this app for the purposes learning merits discussion. Cognitive load is a term that refers to the mental processing required by working memory to learn a new task (Paivio, 1990). When a learner encounters a novel task, he/she must retain the information. But, there is a limitation in the extent to which information can be stored. In the case of Mickey Mouse Clubhouse:

Wildlife Count Along, the information-rich learning tasks are likely demanding given the

processing capability of the user age range.

*Guidance in mathematics.* While the importance of language and literacy are

considered in other sections of this dissertation, the literature suggests that adult guidance

in the math and science disciplines are equally important. According to van Oers (2010),

there is a growing trend in initiating mathematical and arithmetic operations training at an

early age. Aunola, Leskinen, Lerkkanen, and Nurmi (2004) state that learning of math

begins before a child enters school for the first time, and their performance in higher-

level skill development is contingent on their ability to initially automate basic concepts

and skills. In examining the developmental dynamics of math performance of young

children, their study indicated that individual differences in mathematical performance of

preschool-level children increased over time and that the level of counting ability,

metacognitive knowledge, listening comprehension, and visual attention were

determining factors in math performance in successive grades. Aunola et al. proposed (a)

introducing mathematics, with an emphasis on counting skills, at an earlier age; (b)

synthesizing both drill and practice as well as constructivist approaches to instruction;

and (c) supporting the cultivation of metacognitive, listening, and visual attention skills.

While the research by Aunola et al. (2004) centers around a formal educational

context, van Oers (2010) uses a cultural-historical perspective to argue that global

changes in a knowledge-based and information-driven society have resulted in economic

need, which is founded on not only the efficient distribution and exchange of

commodities, but also on a population that posses the quality of understanding required to

fulfill such needs. In response, educational policy has begun to increasingly emphasize

the cultivation of individuals who possess operational knowledge, creativity, and critical thinking skills.

In the context of emergent mathematics education, van Oers advocates a developmental approach with an emphasis on play, facilitating meaningful learning through participation in cultural practices. Playful learning occurs through a guided process, where symbolic representations in mathematical thinking are embedded within a child's everyday activities. In such cases, the role of and intervention by a facilitator (in a school context) or parent/guardian becomes critical in a child's practice and development of schematic representations.

***Guidance in science.*** According to the National Science Education Standards (1996), student understanding of living things and their environments occur at the elementary level. There exists an abundance of literature concerning the importance of learning about animals, nature, and various habitats from a young age. For example, Bone (2013) puts forth the view that learning about animals, particularly those that are outside the usual experiences of a young child, helps create the foundation for learning about the biological sciences, as well as cultivate empathy toward other living beings and the environment. Davis (2009) argues that although early investment in a child's educational achievement promotes significant returns to individuals and their community, insufficient attention has been paid in the field of environmental education emphasizing sustainability. The science-based component of the app may serve as a primer or supplement to such scholastic goals

Because science concerns the real world and helps develop reasoning skills, it is critical for children to gain exposure to science at an early age (Eshach & Fried, 2005).

Instructor and parental involvement is vital in helping a child make meaning of the science content (Stylianides & Stylianides, 2010). However, Falk and Dierking (2010) contend that, although the scientific community assumes that the most acceptable way for students learn about science is through formal schooling, "...average Americans spend less than 5 percent of their life in classrooms" (p. 486), and most scientific understanding is acquired outside of the school setting.

Falk and Dierking (2010) also highlight parents' important role and suggest that children with parents who actively support their learning do better than children without parental support and participation, regardless of socioeconomic factors such as race, ethnicity, or quality of school. Falk and Dierking cite the potential benefits of out-of-school play-oriented science learning, particularly with young children who are afforded "free-choice" opportunities and experiences to interact with others and to develop scientific inquiry skills. However, there is a growing disconnect between children and the natural world. Although Louv (2008) provides a critical view on the role of technology in impacting children's disengagement with their immediate natural environment, if technology tools are utilized, not to replace, but to supplement or even underscore outdoor learning, it may be too reasonable to accept and discover its capabilities and applications.

**Mickey Mouse Clubhouse: Wildlife**
**Count Along Summary**

The previous discussion on Mickey Mouse Clubhouse: Wildlife Count Along began with an investigation of the instructional elements, by subject matter, and analyzing the goals, strategies, and processes involved with the reviews left by customers. The developers of this app incorporated numerous strategies to enhance the

learning experience. However, in the end, it is unclear if the content from each of the three subject areas were thoroughly explored or appropriate for the target audience.

## App V: Wild Kratts Creature Power World Adventure

Wild Kratts Creature Power World Adventure is developed by PBS Kids and is based on the Wild Kratts television series, produced by the Kratt Brothers Company and 9Story Entertainment. Wild Kratts Creature Power World Adventure appeared on the top nine list 64 times during the four-month tracking period. At the time of writing this study, there were 31 PBS Kids-developed apps available for the iPad. The update on April 8, 2014 (a compatibility update) was the only change made to the app since its release on March 28, 2014. The app requires 60.4mb, iOS 6.0 or later, and is compatible with the iPhone, iPad, and iPod touch.

### Overview of App Options

Wild Kratts Creature Power World Adventure begins with the presentation of the PBS KIDS logo, followed by the Kratt Brothers and 9Story Entertainment logo pages. The introduction of the interface includes a jingle, and a male narrator verbalizing "Wild Kratts Creature Power World Adventure" as the words are printed on the screen (see first image, Figure 37). The main menu interface shows a monitor, which takes up the majority of the screen, and four icons on the bottom. The narrator directs the user to "select a creature" and repeats this request twice if there is no user action. Continent and ocean names are verbalized and presented on the screen when the user taps on certain areas of the map. On the top portion of the screen, there is a "Parents" icon on the left and a "More Apps" icon on the right (see second image, Figure 37).

*Figure 37.* Opening screen and main page of the PBS KIDS app. Title sequence (left) and main menu (right). (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

Tapping on the "Parents" button displays an "About the App!" page (see images in Figure 38). There are no security measures to access these pages. On the bottom right of this section, there is a "How To" button, which provides the instructions for the three game activities. Both pages display "About" and "How To" buttons that toggle between the pages. Users can exit the parents' area by tapping any area of the screen.

The "More Apps" button presents the user with a security question for parental access. Four numbers are written in text form, and the parent or user must tap the corresponding number on the number pad below. When the correct number is inputted, the user is taken to the PBS Kids app page in the iTunes App Store.



*Figure 38.* Parents page of the PBS KIDS app. (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

This game presents three animals: the pileated woodpecker, the bottlenose dolphin, and the orangutan. An illustration of each of these animals is displayed in round icons on the left side of the main menu. When an animal is selected, the globe icon on the bottom highlights, a red "x" appears to indicate the location of the animal, and a play game button appears on center of the map. In addition to the globe, there is camera button, a book, and a light bulb with a question mark, lining the bottom of the screen.

**Globe.** The globe icon is the game interaction of the app. There is a different game associated with each creature (see images in Figure 39).



*Figure 39.* Three game areas of the PBS KIDS app. (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

The three games include the Woodpecker Drill Down, the Dolphin Trash Dash, and the Orangutan Swing. Winning successive games unlocks stickers and Wow! Facts that can be viewed in other sections.

*Woodpecker drill down.* The Woodpecker Drill Down game can be accessed by tapping the "Play Game" button after the user selects the pileated woodpecker. As the game begins, Chris (one of the characters), wearing a woodpecker suit, stands to the left and the woodpecker (or "headbanger") stands to the right of a tree. The narrator verbalizes the instructions for the game, and explains that the goal is to help Chris find the woodboring beetles before the woodpecker catches them. Each level has three rounds.

The character that wins the most games out of three is the ultimate winner for the level.

This is the only section of the app that requires users to flip their device to portrait mode.

To begin the game, a yellow circle with an illustration of the woodboring beetle

appears, and the round number is written above a Go button and a right pointed triangle.

The user taps this icon, and the game commences. When the user taps on an area of the

bark, the inside of a section of the bark is revealed (see image a, Figure 40).



*Figure 40*. Main interaction of Woodpecker Drill Down. From left to right (a, b, c, d): Finding the beetle, tapping on the screen, identifying the winner, and tally illustrating the winner among three games. (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

If the area is empty, there is no bug. If an outline of a bug appears, the narrator

states, "You found a beetle. Touch it to move on top of it" or "Sounds like a beetle" and

instructs the user to tap on the area near the beetle. Once the area is tapped, the narrator

states, "You're on it. Tap tap tap to peck a hole." (see image b, Figure 40). The user must

continuously tap on the tree bark until the Chris has successfully caught the beetle. If the

user is able to catch the bug before the opponent, the narrator provides feedback stating

that the user has won that round (see image c, Figure 40). There are three rounds total for

each level, and the tally is presented at the top after each round (see image d, Figure 40).

If the headbanger collects the beetle before the user, the narrator states that the

headbanger bird has won. Throughout the game, there are power items that can be gained

(in the same procedure as obtaining the beetle), which provide advantages such as

freezing the opponent temporarily (see images in Figure 41).



*Figure 41.* Power items in Woodpecker Drill Down. This power item, found in the tree, freezes the woodpecker's power for a few seconds. (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

When the game ends, the narrator states, "Let's fly headbanger. All rounds

complete." Next, the screen displays the number of points earned from collecting beetles,

the number of points deducted as a result of losing to the headbanger bird, and the final

score (see first image, Figure 42). Based on the score, a star rating is given on a three-

point scale. On the bottom of the screen, a horizontal bar indicates the progression toward

the next reward. If the user has amassed enough points to win a reward, the narrator

prompts the user to tap on the trophy to view the prize. This directs the user to the Sticker

Art or Wow! Facts areas. The available options are to return to the map menu, to replay

the game, or to go to the next level. For subsequent iterations, the first screen the user

sees (upon tapping the globe in the main menu) is a levels menu where the user can view

completed and locked levels, as well as the highest stars earned for each level (see second

image, Figure 42).

*Figure 42*. Evaluation screens for Woodpecker Drill Down. (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

***Dolphin trash dash.*** When the user taps the "Play Game" button, the narrator

states "Bottlenose Dolphin. Diving into the Atlantic Ocean" and introduces the game as

"Dolphin Trash Dash." The calibration page is displayed. The narrator provides verbal

instructions on calibrating the device, and an image of two hands holding an iPad

illustrates this procedure (see first image, Figure 43).



*Figure 43*. Device calibration in Dolphin Trash Dash. Calibration (right), and pause menu (left). (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

When the user taps the "Calibrate" button, the user is taken to the main game play

area. On the top left corner of the screen is an icon of a recycling bin displaying the

number 00. On the top right corner is a horizontal progress bar. Throughout the game,

there is a pause button on the bottom left, which, when tapped, gives the user the options of quitting, continuing, or re-calibrating the device (see second image, Figure 43).

In this game, the user takes on the role of Chris, who wears a dolphin suit and is submerged in the ocean. A large ship traverses above the sea and dumps various trash items that are scattered around the sea (see image a, Figure 44). The narrator encourages the user to help Chris pick up the trash that has been dumped by Zach, who is on the ship. The user must tilt the iPad left, right, forwards, and backwards to move Chris forward, backward, or emerge and submerge into the ocean. The gameplay follows a side-scrolling format where the screen scrolls forward at a consistent rate. One point is added to the tally for each item of trash that is collected by Chris.



*Figure 44.* Main interaction of Dolphin Trash Dash. From left to right (a, b, c): Zack throwing trash into the sea, Chris hitting an obstacle, and Chris near a power item. (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

During the game, there are obstacles, such as corals, whales, and blowfish that must be avoided. When Chris comes in contact with any of these objects, points are deducted from the tally, the obstacle turns red, and stars appear near Chris' head, indicating dizziness (see image b, Figure 44). In addition to picking up trash, power up items, such as the Dolphin Wingman Power Up, Sonar Power Up, and Shark Defense Power Up, are scattered across the ocean (see image c, Figure 44).

The game concludes when Chris reaches his dolphin friends, Click and Whistle. "You Did It" is displayed on the scene, and the dolphins produce a whistling sound (see first image, Figure 45). The screen displays the number of points earned from collecting the trash, the number of points deducted as a result of hitting barriers and animals, and the final score. Based on the score, a star rating is given on a three-star scale (see second image, Figure 45). On the bottom, a horizontal bar illustrates the progress toward the next reward. The available options are to return to the map menu, to replay the game, or to go to the next level. For subsequent iterations, the first screen the user sees is a levels menu where the user can view completed and locked levels, as well as the highest stars earned for each level.
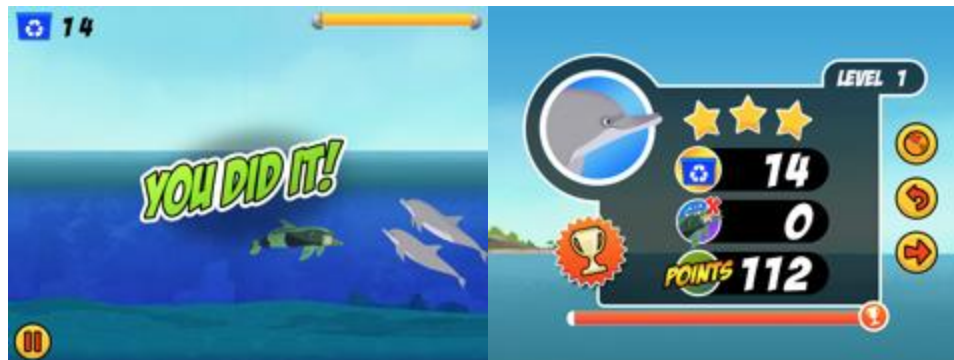


*Figure 45.* Evaluation screens of Dolphin Trash Dash. The game ends when Chris reaches Click and Whistle. Points are awarded based on the number of trash collected. (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

***Orangutan swing.*** The orangutan game is accessed by selecting the orangutan from the main menu, tapping on the "Globe" icon, and tapping "Play Game." The narrator states, "To the Indonesian Rainforest," and the "Orangutan Swing" menu is displayed. The goal of this game is to "help Martin move through the rainforest to collect fruit."

The game begins with another character (Martin), in a blue orangutan suit,

holding onto a thin tree. On the top right is a horizontal bar recording the progress of the

activity. On the bottom right is a round yellow icon with a red open hand in the center.

The word "Go!" displays in the middle of the screen, and the game begins. The narrator

describes the instructions while an image of a tablet with left and right turned arrows

direct the user to tilt the screen to swing to and from the tree (see first image, Figure 46).

Grabbing a tree requires the user to press the hand button when the orangutan's hand

hovers over the tree and becomes outlined in white (see second image, Figure 46). If the

user taps on the hand button when the tree is not highlighted, the character falls off the

tree. The narrator provides feedback, and reminds the user to only grab the glowing trees.

Certain trees contain fruit, which are collected to gain points.



*Figure 46.* Visual instructions in Orangutan Swing. Visual instructions are presented to guide the user. The red hand button is tapped to grab the highlighted tree branch. (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

When too much time has lapsed between tree grabs, there are negative

consequences. The two images in Figure 47 depict a large orangutan, named Huge-O,

who has reached down to toss Martin off of the tree. The game is completed when Martin

reaches the two orangutans (an adult and a child). The narrator asks, "Fruit, anyone?" and

the collected fruit are piled onto a tree branch.

Similar to the previous games, next, the screen displays the number of points

earned from collecting the fruit, the number of points deducted as a result of falls, and the

final score. Based on the score, a star rating is given on a three-star scale. On the bottom

is a horizontal bar that indicates the progression toward the next reward. The available

options are to return to the map menu, to replay the game, or to go to the next level. For

subsequent iterations of beginning the game, the user is taken to a levels menu where the

user can view completed and locked levels, as well as the highest stars earned for each

level.



*Figure 47.* Consequences in Orangutan Swing. There are negative consequences if too
much time has been spent on a tree. (The PBS KIDS Logo is a registered trademark of
the Public Broadcasting Service and used with permission.)

**Camera.** For all three creatures, tapping on the camera icon reveals the "Creature

Power Selfies" page for the selected creature (see images in Figure 48). The photo access

button initially prompts the user for access to the iPad's camera roll. When "OK" is

selected, any pictures taken within this app are stored in the photo album. On the main

page, the narrator prompts the user to "tap the camera button to put your face in the

power suit." Tapping the camera opens the photo page where an image of the selected

animal is displayed with an opening for the facial area. The instructions direct the user to

frame his/her face in the creature's face and to tap the camera button. When the user taps

the shutter button, the narrator provides feedback, and the user's face is superimposed

onto the creature's face.



*Figure 48.* Creature Power Selfies. (The PBS KIDS Logo is a registered trademark of the
Public Broadcasting Service and used with permission.)

**Book.** Tapping on the book opens the "Sticker Art" section (see image a, Figure

49). Although each selected creature provides different types of stickers and

backgrounds, the format is consistent among all creatures. In the main menu, tapping on

the book cover presents a page displaying all earned or collected stickers as well as

locked stickers (see image b, Figure 49). A curved left-pointing arrow returns the user to

the previous page.



*Figure 49.* Sticker Art in the PBS KIDS app. From left to right (a, b, c): Sticker Art main
page with locked/unlocked stickers, Sticker book page, Sticker interaction. (The PBS
KIDS Logo is a registered trademark of the Public Broadcasting Service and used with
permission.)

Tapping on one of the sticker pages enlarges the page as a full screen background

(see image c, Figure 49). If the user has taken a selfie in the camera section, his/her face

appears in the body suit of the creature. Users may tap on the yellow icon on the bottom

right to reveal all collected stickers. By selecting and dragging a sticker into the background, the user can decorate the environment with various stickers. If a user wishes to delete the sticker, the user can drag the sticker into a trash bin with his/her finger. On the top right, there is a camera and folder icon. Tapping on this icon takes a screenshot of the image and to saves it into the iPad camera roll. A curved left-pointing arrow returns the user to the previous page.

**Light bulb.** The light bulb icon directs the user to the "Wow! Facts" section (see first image, Figure 50). When the light bulb icon is tapped, the monitor displays locked and unlocked items from the game. Tapping on an unlocked item displays a "Wow! Fact" page (see second image, Figure 50).



*Figure 50.* Wow! Facts in the PBS KIDS app. Wow! Facts sticker picture (left), and Wow! Fact (right). (The PBS KIDS Logo is a registered trademark of the Public Broadcasting Service and used with permission.)

On each page of the Wow! Fact, there is an image of the creature next to the collected reward and a fact about the creature. The audio icon at the bottom right of the page reads aloud the written text. A curved left-pointing arrow on the bottom left returns the user to the previous page. There are no assessments associated with these facts.

**Nature of Reviews, Users,
and Context**

The developer specified Made for Ages range for Wild Kratts Creature Power

World Adventure was 6-8, although the description indicates that the range is more

appropriate for children between the ages of 4-8. This app has a 3 (out of 5) star overall

rating by 52 customers and a 3.5 rating by 22 customers for the current version at the

time of data collection. Among the 21 written reviews for the PBS KIDS app, the average

star rating was a 2.09 and a median of 1. In examining the customer reviews, 11 reviews

were generally negative, 2 reviews were generally positive, and 1 was mixed. The only

user whose review was mixed indicated that, although he/she had enjoyed the game on

the computer, the app version would not open. Technical issues such as loading and

opening issues were the largest complaint regarding this app (11 cases) as well as the lack

of content (2 cases). Overall, customers did not enjoy this app, with six reviewers

requesting refunds and four reviewers indicating that the app was "disappointing."

**Design of the Learning Space**

Wild Kratts Creature Power World Adventure is a science-related app marketed

as an extension of the PBS KIDS series Wild Kratts, the educational nature television

show that provides facts about creatures, their characteristics, and their habitats. The app

dedicates a section for three creatures: the pileated woodpecker, the bottlenose dolphin,

and the orangutan. Each of these sections includes four areas: a game area, a photo area, a

sticker area, and a fact area. Although users do not have to have seen the television

program, possessing a certain amount of knowledge about the show aids in understanding

some the features of the app. At the time of writing, there were 92 episodes made for the

television program; however, only three of the featured creatures (i.e., the woodpecker, the orangutan, and the dolphin) from the show provide content for this app.

**App game vs television series.** Although the current study focuses on the Wild Kratts app, because of some of the unclear elements stemming from the exploration of the app content (which will be discussed later), some context is needed to better understand the relationship between the app (Wild Kratts Creature Power World Adventure) and the television series (Wild Kratts).

Each television episode introduces a creature in the world. The shows begin and end with live action scenes of the Kratt Brothers describing the featured creature which serve as bookends for the animated sequence in between. The animation provides further in-depth information about the creature, its habitat, and its characteristics seamlessly through a rich storyline. Typically, the animated sequence involves an adventure or mission related to the creature, partaken by the Kratt Brothers, Martin (who wears a blue sweater) and Chris (who wears a green sweater). The story incorporates a problem or a dangerous situation that the characters (or the specific creature) encounter. In some cases, a villain (e.g., Zach), who attempts to sabotage a mission, appears. The Kratt Brothers resolve the issue, enlisting the help of their friends, Aviva and Koki, two female engineers; Jimmy Z, the pilot of their ship (the Tortuga); and other characters, such as the "Wild Kratt Kids."

The content of the episodes clarify some of the contextual cues missing in the app. For example, the "Wow! Facts" that are rewarded in the app are informative facts that are mentioned in the featured episode. Also, the unique jargon for objects (e.g., "creature power suit," "creature power disks," the paw print logo, etc.) and actions (e.g.,

"creature power"), used throughout the app game, are explained in the television series as transformative tools and functions that facilitate simulated skills and powers of creatures. Audiences who are familiar with the show also recognize that the large monitor serving as the background for the app is the same monitor used in the episodes to obtain knowledge and to communicate with people around the world.

In addition, the animated sequence in the show present a "What If?" scenario, visually differentiating the real world (i.e., the corporeal Kratt Brothers) with the simulated environment (i.e., the animated Kratt Brothers in a hypothetical or imaginary world). However, those who only use the app may not fully be aware of this distinction. The next sections introduce the corresponding episodes for the three creatures featured in the app and provide an in-depth discussion on the relationship between the TV episode and the corresponding game.

*Woodpecker.* Season 2 Episode 20, entitled "Attack of the Tree Eating Aliens" focuses on the pileated woodpecker or what the Kratt Brothers refer to as the "headbanger." The animation begins with a couple of Wild Kratt Kids introducing the episode problem: Their clubhouse and all the surrounding trees are dying. Aidan, a Wild Kratt Kid, has spotted holes in the trees. The brothers' friends suspect that the pileated woodpecker is the culprit, drilling holes into the trees. However, they assess that hole shapes are different from the holes spotted by another one of the Wild Kratt Kids. In their investigation, the Kratt Brothers realize that it is not the woodpecker, but an unidentified beetle that is hurting the trees. A message from a Wild Kratt Kid from China on the large monitor identifies the beetle as the Asian longhorn beetle. Aviva, the engineer, develops a woodpecker suit prototype that equips Chris with "woodpecker powers" to compete

against the headbanger to save a miniaturized Martin, entrapped inside a tree during his investigation. The episode concludes as the Wild Kratts deduce that the headbanger and wasps would need to learn to catch the beetles to restore the ecosystem before the beetles destroy the environment.

Although the beetles are the source of the problem that poses as a threat to the environment in the show, the game content appears to minimize or disregard their negative impact. Also, the app game does not clarify the relationship between Chris, in his woodpecker power suit, and the "headbanger." At the same time, background knowledge of this episode helps contextualize the app experience. It can be deduced that Chris is competing against the "headbanger" with a larger purpose of creating a sustainable ecosystem, although this instructional context from the show is omitted in the game.

*Dolphin.* In Season 2 Episode 13, entitled "Speaking Dolphinese," the live action sequence introduces spotted dolphins, found in the Caribbean Sea. The animated portion of the show begins with Aviva introducing her new creature language invention, a "dolphin decoder," which allows the brothers to talk to animals. The problem or mission is to capture and code the sounds and words of the dolphin language. The brothers, equipped with a hydrophone recorder, with the intent to capture the sounds, "dolphin dive" into the ocean and swim with the assistance of a motorized machine. Throughout the course of their exploration Chris and Martin, along with their two dolphin friends (Click and Whistle) provide the viewership with various dolphin facts. Aviva creates a "dolphin disk" which facilitates the communication between human and dolphin. The problem of the story arises when Whistle becomes separated from his pod, and Martin

attempts to find him. The two eventually find each other but are threatened by a great white shark. "Dolphin power" and "shark defense" are used to avert the danger.

Unlike the television episode, the app version uses bottlenose dolphins from the Atlantic Ocean as opposed to spotted dolphins of the Caribbean. However, familiar characters, items, and concepts that appeared in the show are integrated in the game. For example, those who have seen the show will recognize the "dolphin power" transformation and understand why the character, Chris, is wearing a dolphin suit. The two dolphin protagonists, Click and Whistle, also make an appearance at the end of the game.

Much like the woodpecker game, the episode and the game are loosely connected. While the television episode provides in-depth facts and knowledge pertaining to the lives of the dolphins, the game seems to focus on water pollution. It appears that the motive of the app game is to educate the user about pollution as a result of human neglect and about the importance of ridding the ocean of human trash. Again, there is no direct instruction or narration to support this learning objective.

*Orangutan.* Orangutans are the featured creature of the Season 1 Episode 28 show, "A Huge Orange Problem." The animated series begins with the Kratt Brothers, who go out in search of the orangutan. On their way, the brothers realize that they have forgotten their first aid kit, and return to retrieve it from Aviva before setting off again. They reach an area of the forest where they spot a mother and child orangutan. Back at the ship, Koki, Aviva, and Jimmy Z enjoy a day of swinging on vines and eating wild figs. Too much swinging causes the friends to have sore and stiff muscles. They call the Kratt Brothers for the muscle relaxing cream that is stored in the first aid kit. However,

the brothers are captured by Huge-O, an orangutan, who swings from branch to branch, throwing the brothers back to the orangutan mother and baby three times.

Sensing that Huge-O's actions are not a coincidence, the Kratt Brothers witness the orangutan mother chewing leaves into a paste and spreading it on her baby's sore arms, taking the "ouch away." Realizing that 98% of the DNA between orangutans and human beings are identical, the Kratt brothers deduce that what works on an orangutan will most like help their sore friends. They return to their ship carrying large amounts of the medicinal leaves.

Meanwhile, the antagonist, Zach, realizes he is in need of a side table made out of black wood. He orders his "Zachbots" to indiscriminately cut down trees in the forest until the Zachbots find ones with black wood inside. The Kratt Brothers use the "orangutan power disks," developed by Aviva, to transform into orangutans and crush the Zachbots as they swing from vine to vine.

In the television episode, Huge-O serves as a central character in helping Martin and Chris discover natural medicinal remedies for muscle soreness. However, in the app, the orangutan is seen as a bully, knocking Martin off the trees when the Kratt Brother is not swinging fast enough between the trees. A customer review indicated that connections between the app game and corresponding television episode were not reinforced. Reviewer 5 erroneously wrote, "My kids learned that an orangutan is a monkey" even though the Kratt Brothers specifically differentiate between monkeys and apes (which include orangutans) in the show version.

**Gaming and play.** The focal point of the app centers on the three main games. Although each game is nature-related, there are no direct explanations on the learning

point or purpose. Instead, the goal is inferred. Rules and instructions are presented either

verbally, visually, or both, depending on the content. The narrator provides preliminary

instructions on the user-prompted actions when the game begins. On occasions, where the

user gains a power item, the narrator explains its function. The action is controlled in so

far as options are concerned, and the user's role is to simply follow the rules of the game,

using the available actions (i.e., tapping, moving the device, etc.), and to complete the

required task. Levels of the game increase in difficulty, as adversaries increase in number

and speed. Users may replay the same levels to accumulate more stars or to improve their

high score.

There are also three additional sub-areas for each creature that serve as

supplemental interactions that familiarize the user with the featured creature. The creature

selfies allow users to superimpose their portrait into the face of the creature. The image is

saved in the iPad photo album and can be shared externally if permissions are given.

Although instructions on taking the picture are provided, there is no instructional content

associated with this activity. This suggests that the creature selfies are for personal

enjoyment and play, allowing the user to visually take on the role of the creature. The

creature selfies can be taken and retaken. The last image saved is incorporated in the

sticker section.

The remaining two incorporate rewards that are earned through repeated play and

successful completion of the games: Sticker Art and Wow! Facts. The Sticker Art section

is an area where users may review earned stickers and engage in play. The only

instructions given are to "drag stickers onto the picture." Thus, by selecting, moving

around, placing, or deleting the collected stickers on various pre-developed backgrounds,

it is possible for the user to create a personal artwork. Again the completed sticker art can be saved onto the photo album and shared.

Wow! Facts are the second type of rewards that are redeemed through successive gameplay. As described earlier, Wow! Facts are informational facts pertaining to the featured creature that were presented in the corresponding episode. The user may view the fact or have the words read to them. Users are not assessed for their comprehension of these facts, and as they are considered earned rewards, no other actions are associated with this activity.

**Instructional Issues and Concerns**

Taken out of context of the television episode, the reason for why the app content of Wild Kratts Creature Power World Adventure is characterized as an educational game, as opposed to a regular game, is not apparent. Furthermore, it is not clear why only three of the featured creatures were selected or why additional creatures were not added in subsequent version updates.

**Content knowledge.** A discussion on the importance of nature science was explored in an earlier section (see Mickey Mouse Clubhouse: Wildlife Count Along section). However, there seems to be a gap between the instructional purpose of the television show and the app. The knowledge of the episodes provides the context for a larger environmental goal that is beyond the app game. The topic of two of the games (i.e., the woodpecker and dolphin games) does seem to reflect real life issues in environmental science; however, it is not consistent with the third. What is evident is that, while the television episodes utilizes instructional strategies and cues to interweave science-oriented facts and content in its programming, the supplemental content found in

the apps provide little relevance or parallels to support the educational goals of the television series.

One could suggest that the games are an experiential educational simulation with an educational goal that is motivated through a gaming platform. The television show differentiates between the real world and an imaginary world (i.e., the "What If?" world) by switching between live action video and animated sequences. Thus, it can be assumed that user's opportunity to transform into an animated creature is an indication of his/her own simulated metamorphosis within a "What if?" scenario. Nonetheless, there is no explicit instructional information provided about the purpose of the transformation, nor are there opportunities to connect the learning goals to the actions.

Perhaps the goal of the game is to provoke an affective appreciation for the environment. For example, the background of the bottlenose dolphin game concerns Zach (one of the antagonists from the show) dumping trash from his ship into the ocean. Once again, it can be assumed that the user comes to the realization that polluting the water is harmful for the environment. However, none of the television show episodes seem to focus on the topic of human directed pollution of the ocean, and as indicated earlier, the featured television show does not cover this topic. Thus, if there is to be a link between the creature and the topic of pollution, the user would have to have learned about these concepts elsewhere and would have had to have made the connection irrespective of the game or show.

**Play and motivation.** The previous discussion suggests that the context within which this app is used is important. In the case of Wild Kratts Creature Power World Adventure, the more related tools and knowledge a user has about the show, the more

educationally relevant the learning becomes. The consumer comments indicated that the demographic purchasing this app were parents of children who enjoyed the television program. Those who had knowledge of the show could make connections with the Wild Kratts characters, emblems and symbols, jargon, and transformations. In addition, those who had knowledge of the featured episode could relate to secondary characters such as the Headbanger, Click and Whistle, and Huge-O, although their roles were inconsistent.

In Wild Kratts Creature Power World Adventure, users were able to earn Stickers and Wow! Fact rewards that repeated some of the factual content from the show. However, because the broader educational goal of the games were not clearly expressed, the purpose may not have been to acquire content-oriented knowledge, but instead, to further appeal to the interest of children and attract their curiosity in learning from the television show. In other words, the games and interactions may have been developed, simply, to heighten user engagement through play.

Educational theory regarding the implications of play and learning were discussed in an early section and so it will not be repeated here (see Toca Hair Salon section). However, the motive of the app is, perhaps, more closely tied to a child's interest in the Wild Kratts television show. Although the educational label of the app is suggestive of an in-app learning experience, it is possible that the focus of nature science knowledge acquisition is found elsewhere. According to a New York Times article, research on children's educational television programming has suggested that 79% of children with access to apps first utilize the television medium for content (Jensen, 2012).

For the developer of the show and for Nickelodeon, this may mean that the primary focus of disseminating educational content is through the show, and the app is a

secondary a tool that mediates the relationship between the child and the goal of increasing television viewership. Creating connections between the children via the app familiarizes the child and the characters of the show, helping creating rapport and resulting in more children utilizing the television show to learn about the topic of nature science. The app also serves as middle ground between parents' motives of educating their children through quality educational programming and children's motives of engaging in a fun and challenging activity.

**Wild Kratts Creature Power**
**World Adventure Summary**

The app content of Wild Kratts Creature Power World Adventure incorporated elements of gaming through the synthesis of characters, animals, and symbols of the television program. Although the television shows utilize various instructional strategies to teach facts about animals, their behaviors, and their habitats, the educational objective or intention of the app was not clarified. In addition to analyzing the content, an activity theoretical justification was presented, postulating the motives of the developers.

## App VI: Wallykazam! Letter and Word Magic

Wallykazam! Letter and Word Magic! is marketed as "the first preschool literacy app" and is based on the Nick Jr. television show, Wallykazam! According to the description, the purpose of this app is to "help kids develop phonemic awareness, letter knowledge, letter-sound associations and promote excitement about words and learning to read" (Description). This app appeared on the top nine list 57 times, ranking as the sixth most frequently appearing app. Although Doc McStuffins Paint and Play appeared an aggregate total of 58 times, they was excluded from the final list because of duplicating developers. The Wallykazam! Letter and Word Magic app, developed by

Nickelodeon and sold by Viacom International, has not been updated since its initial

release on April 10, 2014. At the time of writing this study, there were 32 Nickelodeon-

developed apps for the iPad. This app requires 121mb of space, iOS 6 or later, and is

compatible only on the iPad.

**Overview of App Options**

Wallykazam! Letter and Word Magic begins with a static Nickelodeon logo. In

the introductory menu, there is an illustration of Wally and Norville (i.e., Wally's pet

dragon) on the left and the title on the right. A "More nick jr." button, a "Parents" button,

a "Privacy" button, and a "Play" button appear on the bottom of the screen (see image a,

Figure 51). Upon entering this page, the narrator prompts the user to tap the "Play"

button to get started, and repeats these instructions until a selection is made.
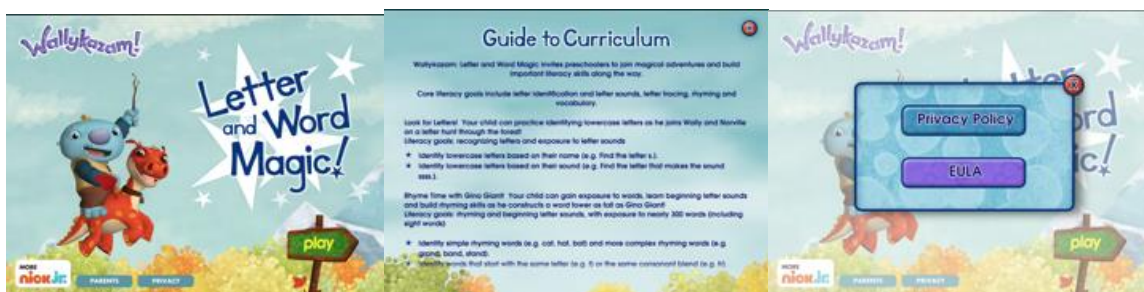


*Figure 51* The opening menu for Wallykazam! Letter and Word Magic. From left to right
(a, b, c): Introductory menu, parent's page, and privacy/EULA pages. (Permission to
reproduce images granted by Nickelodeon.)

When the "More nick jr." icon is tapped, access to the page requires a security

code. The parent (or user) must type in the corresponding numerical values for the three

numbers printed on the screen. If the wrong response is entered, "Incorrect, please try

again" is displayed. The security-protected area includes links to other games by

Nickelodeon. Tapping on any of the other apps leads the user to the specific app page in

the App Store.

The "Parents" page (which is not security-protected) includes an informational guide to the curriculum (see image b, Figure 51). The text-based page includes a summary of the instructional content as well as the literacy goals for each area of the app learning experience. Tapping on the "Privacy" button opens a pop-up with two buttons: the "Privacy Policy" details and the "EULA," or the end user license agreement (see image c, Figure 51).

When the user taps the Play button, white and blue stars fill the page, transitioning the interface to the "Pick a Player" page. The background is a static image of Wally and Norville in a field. Up to four profiles can be created in this area (see image a, Figure 52). On the bottom, there are two buttons, one for credits and the other for privacy. The credits page lists the participants who have contributed to this app (see image b, Figure 52). The Privacy area is identical to the one found in the introductory page (i.e., with the Privacy Policy and EULA buttons).



*Figure 52.* Player selection page of Wallykazam! Letter and Word Magic. From left to right (a, b, c): Profile creation page, credits page, and profile area. (Permission to reproduce images granted by Nickelodeon.)

The user can tap an existing user or create a new profile. When a blank profile is selected, a textbox appears and the narrator prompts the user to type in his/her name (image c, Figure 52). Once the profile is created, it can be deleted by tapping on the name and tapping on the "delete" button that appears on the screen. Otherwise, the user must

select a player's name and tap "Play." This directs the user to the main interface of the app. As a note, it is not possible to return to this area once the user has entered the main interface without restarting the app.

When a user creates a new profile, blue and white stars transition the user to an introduction by Wally, who displays his "magic stick" and explains that it can make any word come to life. He provides an example with the word "begin" by waving the stick. Blue and white stars transition into the main interface of the app (see first image, Figure 53). This animated sequence only occurs immediately after the profile is created, and when the user returns to the app in subsequent occasions, this animation is bypassed.



*Figure 53.* Transition to learning area in Wallykazam! Letter and Word Magic. The "begin" animation (left) and main menu (right). (Permission to reproduce images granted by Nickelodeon.)

Once the user is in the main interface, Wally introduces himself and Norville before an environment with four learning areas (see second image, Figure 53). The user may swipe left and right in the landscape to alter the perspective of the environment. Wally briefly explains the four activity areas, which include, Look for Letters, Letter Trace with Libby Light Sprite, Rhyme Time with Gina Giant, and Word Magic. After three iterations of any activity, tapping the "Next Game" button takes the user to the

succeeding game ordered above. Throughout each game, a Home icon allows the user to

return to the main menu at any time.

After three iterations of a game are completed, a transitional area is displayed.

Wally stands to the left holding his magic stick. On the right, a wooden post with a sign

pointing left, which reads "play again," and a sign pointing right, which reads "next"

becomes visible. There is also an icon on the top right, which links to the Word Magic

activity. Wally provides positive feedback for the prior exercise, and asks the user if

he/she wants to play again or go to the next game. On certain occasions, Wally introduces

a new earned word that is added to the Word Magic activity (see first image, Figure 54).



*Figure 54.* Introduction of new words in Wallykazam! Letter and Word Magic. From left to right (a, b, c): Transition page, Wally presenting magic word, and animated interaction of a new magic word. (Permission to reproduce images granted by Nickelodeon.)

For other words, a bi-directional arrow swirls around the sign post, and an

interactive segment introduces a new word and their meaning. In some cases, Wally

simply presents the new word. For example, the second image in Figure 54 illustrates an

example of the earned "magic word." In this case, the word is "fluorescent." In other

cases, there are interactive animation sequences. The third image in Figure 54 illustrates

an example of the interaction for the magic word "music," whereby Bobgoblin's teeth are

tapped to play a song.

**Look for letters.** According to the parent's section, Look for Letters is a game where the user "can practice identifying lowercase letters" based on their letter name. When the exercise begins, the user enters a forest-type environment. The screen displays a link at the top left to return to the main menu, a tree branch with three square frames in the top-center area, and one round frame at the top right.

Bobgoblin, one of the characters, carries three letters above his head and runs to the center of the screen, states that he enjoys letters because of his ability to hide them, and runs off the screen to the right. Wally comes into frame and invites the user to help him find the hidden letters. He prompts the user to find a specific letter, and upon waving his stick, the letter appears in the middle of the screen (see image a, Figure 55). The user is told to search in the forest and tap on the letter when he/she finds it. The letter is placed in the round wooden frame on the top right as a guide during the search. The user must pan left and right in a forest where letters are scattered throughout the ground (see image b, Figure 55).



*Figure 55.* Look for Letters activity. From left to right (a, b, c): Wally displaying the letter to find, finding the letters, and completing the letter searching exercise. (Permission to reproduce images granted by Nickelodeon.)

During the search, the user can (a) swipe the landscape; (b) tap a letter, which Wally pronounces; (c) toggle the arrow to move into the foreground or back out into the background; or (d) tap a character to make it react. Once a letter is tapped, if the response

is incorrect, the user hears an error sound and Wally points out the mistake before encouraging him/her to keep looking. If the answer is correct, Wally pronounces the letter and provides positive feedback, and Norville places the letter in one of the three square frames (see image c, Figure 55).

However, if a certain amount of time passes and users do not respond, Wally reminds them of the letter they should be looking for and provides the instructions or pronunciation of the letter. If more time passes, the environment scrolls horizontally to reveal the location of the letter. In such cases, Wally states, "Here's the letter we're looking for. Tap on it" and prompts the user to tap on the correct answer. In order to end the interaction, the user must tap on the found letter.

After three iterations, Wally provides positive feedback and re-states the three letters that were found in the exercise. The user is taken to Wally's transitional page (described in an earlier section). Tapping on "Next" begins the Letter Trace with Libby Light Sprite exercise.

**Letter trace.** The parent's section indicates that Letter Trace is an activity for a user to "practice tracing the alphabet as [he/she] lights up the night sky with Libby." The essential literacy goal is letter tracing, to strengthen motor skills, and to learn sequencing of letter strokes. Letter trace begins with Wally introducing Libby Light Sprite, who is lighting up the night sky (see first image, Figure 56). He indicates that the user can help by tracing letters. This transitions to a night sky filled with lighted-out lower-case letters (see second image, Figure 56). Libby becomes animated as she twirls her body, and she encourages the user to choose a letter to light up.
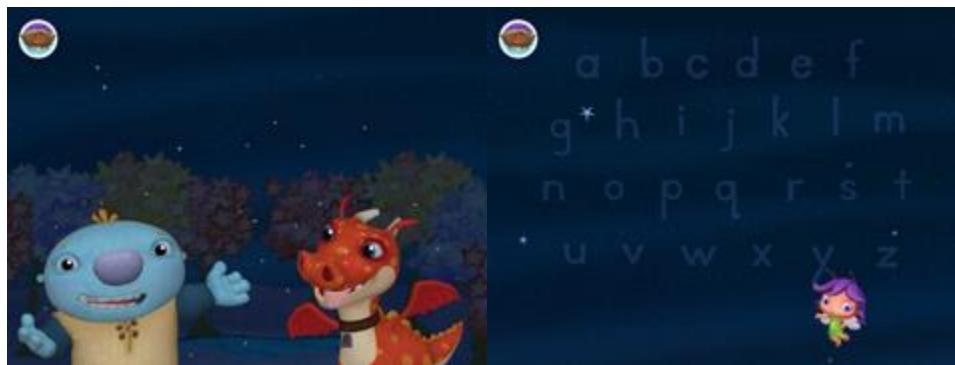
*Figure 56.* Introduction to Letter Trace with Libby Light Sprite. Letter trace introduction (left) and dimmed letters in the night sky (right). (Permission to reproduce images granted by Nickelodeon.)

Users may freely select a letter of their choosing. Libby provides feedback before simulating the trace (see image a, Figure 57). Next, step-by-step visual instructions on the trace are displayed (i.e., dragging on the screen with the finger). If the user does not trace the letter correctly, the app produces an error sound, and corrective feedback is provided. If the user traces the letter correctly, Libby provides positive feedback, identifies the letter that was traced, and provides the pronunciation of letter sound (see images b and c, Figure 57).



*Figure 57.* Libby Light Sprite modeling letter traces. From left to right (a, b, c): Libby modeling the trace, user traces the letter using the arrow as guides, user completes the letter. (Permission to reproduce images granted by Nickelodeon.)

Libby encourages the user to trace the letter for a second time "to make it brighter" or to tap on the back arrow to choose another letter. The second tracing is optional. Every three times a letter is traced, Libby provides positive feedback, thanks the

user for the help, and reminds the users of the three letters traced in the activity. The user is taken to Wally's transitional page (described in an earlier section). Tapping on "Next" begins the Rhyme Time with Gina Giant exercise.

**Rhyme time.** The developers state that the purpose of Rhyme Time with Gina Giant is to help a child "gain exposure to words, learn beginning letter sounds, and build rhyming skills as he constructs a word tower as tall as Gina Giant." The user learns to identify rhyming words and words that start with the same letter. When the game begins, the right side of the screen displays Norville, flying next to Wally in a tower. To the left is a very tall girl with yellow hair, violet skin, and a red dress, who is identified as Gina Giant (see first image, Figure 58).



Figure 58. Opening sequence for the Rhyme Time activity. Opening scene (left) and visual and verbal instructions (right). (Permission to reproduce images granted by Nickelodeon.)

Wally suggests making the tower as tall as Gina so they can all greet each other. There are two types of exercises covered in this activity, although the procedure is the same; one is to find rhyme words and the other is to find letters that start with the same letter or letter sound. Wally displays the key word displayed on a flag below him. On the bottom right corner is an illustration of a tower indicating that there are three segments of the activity, and the progress is indicated through changes in the color of the tower.

On the left, Gina's right hand is visible, and on top of the hand are six word blocks. Each word can be tapped to hear the pronunciation. The instructions are provided visually and verbally for the first iteration of the exercise (see second image, Figure 58). The user must swipe the blocks that rhyme or start with the same letter (see image a, Figure 59).
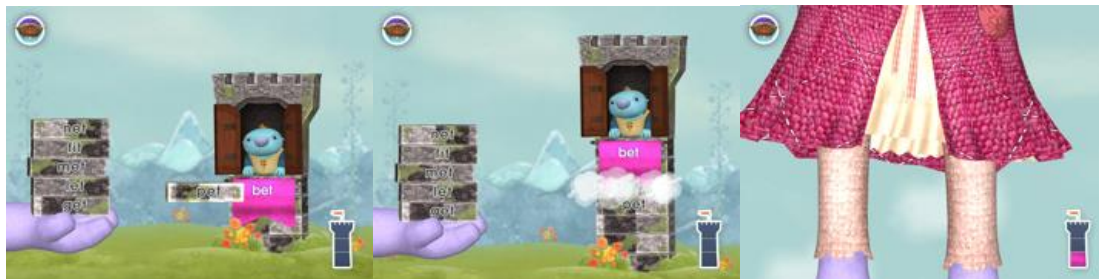


*Figure 59.* Main interaction of Rhyme Time with Gina Giant. From left to right (a, b, c): Swiping the letter to the tower, increasing the height of the tower, and seeing the progress in proportion to Gina's height. (Permission to reproduce images granted by Nickelodeon.)

The tower is divided into three sections or stages. If the selected letter is incorrect, the word breaks the tower, the tower shrinks, and new words are added. If the word is correct, the word block is added to the tower, and the tower grows (see image b, Figure 59). Each stage requires an aggregate total of five correct answers.

During the second third of the game, the orientation changes from landscape to portrait mode. In each section break, Wally and Gina provide positive feedback, and they indicate the progress of the user by identifying how tall the tower has grown, relative to Gina's height (e.g., Gina's knee, elbow; see image c, Figure 59). Once all three sections of the tower have been built, Wally shouts, "We made it!" and introduces Gina by greeting her (see Figure 60).

*Figure 60.* Conclusion of Rhyme Time activity. Wally and Norville greet Gina. (Permission to reproduce images granted by Nickelodeon.)

**Word magic.** The Parents section indicate that, in Word Magic, users "can explore the power of words" as they "magically transform Borgelorp." Upon entering the Word Magic area, Wally stands before two houses (see first image, Figure 61). Wally provides the instructions for the interactions in the activities. The screen zooms into Borgelorp, and to his left are three words printed on a piece of paper. On the top right, a camera icon is visible (see second image, Figure 61).



*Figure 61.* Opening sequence of Word Magic. Wally introduces Borgelorp's house (left), and Borgelorpe stands next to a list of words. (Permission to reproduce images granted by Nickelodeon.)

Scrolling up and down on this paper displays other groups of words. Certain words are lighted out, indicating that the words are locked. If the word is locked and the user taps on the word, Wally prompts the user to play more games to unlock more words.

If the word is unlocked, the user can swipe the word toward Borgelorp. Instructions are

provided verbally and visually (see image a, Figure 62). Swiping a word toward

Borgelorp causes the word to be pronounced, and once it hits Borgelorp, his actions

become reflected in the meaning of the word.



*Figure 62.* Main interaction of Word Magic. From left to right (a, b, c): Presenting visual and verbal instructions, swiping the word toward Borgelorp, and watching Borgelorp transform. (Permission to reproduce images granted by Nickelodeon.)

For example, if the word "blue" is swiped toward Borgelorp, his body turns blue

in color (see images b and c, Figure 62). Once in a while, Wally provides positive

feedback. Tapping the words on the list causes the word to be pronounced. Tapping on

the camera produces a shutter sound, a flash, and the word "cheese" is spoken. Wally

states that the picture has been saved, and this image becomes visible in the iPad photo

album. The Magic Word section does not have a definitive end; if the user wishes to

return to the main menu, he/she must tap on the home icon. There is no transition page

after experimenting with words in this area.

**Nature of Reviews, Users,
and Context**

As indicated in the introduction of this chapter, Wallykazam! Letter and Word

Magic had only been in the App Store for 72 days at the time of data collection and had

not gone through any version updates. Similar to the previous two apps, the number of

reviews for Wallykazam! Letter and Word Magic were far fewer than the first three apps.

Thus, it is difficult to provide an in depth analysis of the nature of the customers or the context. Nonetheless, the following results were derived based on the available data.

The Made for Ages range for Wallykazam! Letter and Word Magic was children 0-5. Though the demographic information was scarce in the customer reviews, three reviewers indicated having a son, and two reviewers indicated having a daughter. At the time of data collection, Wallykazam! Letter and Word Magic had a 4 (out of 5) star rating by 53 customers and had 13 written reviews. The median star rating was 3.61 and a median of 5. Among all reviewers, seven were generally positive, three were generally negative, two were mixed, and one other. Favorable reviews suggested that the adults writing the reviews observed and noted (a) a particular exercises that the child found enjoyable (e.g., the tower game, the letter trace game, etc.), (b) the specific reactions displayed by the child (e.g., giggling, repeating words learned in the game, etc.), and (c) the motivation and duration that the child spent playing with the app (e.g., "hours and hours of educational game play," Review 7). Four of the reviewers indicated that the app was "fun." The term "learning" was used in three reviews, and the word "educational" was used in two reviews. Among the negative feedback, customers indicated that they were "disappointed" or felt the app was "ridiculous." Four customers specified that the app was not worth the price, and two noted their disappointment in having to pay for the app for multiple devices.

**Design of the Learning Space**

According to the developers, Wallykazam! Letter and Word Magic is an early childhood language and literacy game based on the animated television series, Wallykazam! The description states that the app "help[s] kids develop phonemic

awareness, letter knowledge, letter-sound associations and promote excitement about words and learning to read." The app can be divided into two sections, a pre-instructional parent and settings area and the main learning space.

The first section of the app experience provides details regarding the app, links to other Nick Jr apps, and profile customization. Information that primarily serves the interests of parents, such as privacy policies and the End User License Agreement (EULA), are also presented. As a note, once users reach the main learning area, they cannot go back to the previous introductory section without resetting or restarting the app. This suggests that the introductory section not only serves to help parents learn about the app and manage profiles, but it also appears to separate and dedicate the latter section as a unique learning space, devoid of unrelated links and other distracting materials.

The main learning space of Wallykazam! Letter and Word Magic is divided into four independent stations or areas which follow a semi-sequential format. Although the user has the control to choose among the various areas, there is a specific sequence of actions that automatically progresses from section to section when three iterations of an area are completed. The instructional content of the first two concerns the nature of letters. Bobgoblin's area focuses on identifying letters, and Libby Light Sprite's area focuses on letter tracing. The latter two areas concern the nature of words. Rhyme Time with Gina Giant helps in practicing rhyming words and identifying similar characteristics of words. Successive practice leads to earned words in the Word Magic area, where the user can change the appearance of the character, Borgelorp, based on the rewarded

words. The following sections highlight key characteristics related to the instructional content discovered in the study.

**Educational Gaming**

Although the developers characterize the learning space as a "game," only three reviewers used this term to describe the learning space. Key characteristics of educational gaming were described in an earlier app (see Stack the States section), but will be explicated further in the current context.

**Fantasy game and motivation.** The scenario of the game, Wallykazam! Letter and Word Magic, takes place in a fantasy environment. Anthropomorphic characters such as Wally, Norville, Bobgoblin, Libby Light Sprite, Gina Giant, and Borgelorp interact with the user through the use of oversized or traceable letters and words that can be tapped on or swiped to cause change in in the fictional environment.

According to Malone's (1981) theoretical framework for motivation, fantasy elements are intrinsically motivating and may enhance the interest in the instructional content. In Malone's paper, extrinsic fantasies, "where the fantasy depends on the use of the skill but not vice versa," are contrasted with intrinsic fantasies, where "not only does the fantasy depend on the skill, but the skill also depends on the fantasy" (pp. 360-361). The fantasy of the game, Wallykazam! Letter and Word Magic, underscores the idea of extrinsic fantasy. The progression of actions depends solely on the skill of the user; that is, the learner must correctly answer literacy-based questions to complete the exercise. There are no adaptive elements that influence the fantastic nature of the environment based on the user's responses, as there is a definitive correct and incorrect response. Malone states that intrinsic fantasies are generally more interesting and more

instructional than extrinsic fantasies because skills gained through the practice have the opportunity to transfers to a real world goal. However, Malone concludes that individual preferences impact the emotional desirability of certain fantasies over others.

**Winning, losing, and rewards.** As a second element of gaming, the concept of winning and losing are apparent, although not in the traditional sense. For example, in Look for Letters, the exercise is not timed, and users either select the correct response or the wrong response. If a user continues to select the wrong answer choice (or if a certain amount of time passes), the scene scrolls horizontally to reveal the location of the word. Thus, in essence, it is not possible to fail the exercise. The game is set up in a way that the user must choose the correct response in order to advance.

Alessi and Trollip (2001) state that rewards for winning vary from game to game, however the reward of the game should not be the ultimate and most influential portion of the game. Instead, the focus of the objective should be tied to the learning goal. In Wallykazam! Letter and Word Magic, there are no point values or ultimate decisions on a winner or loser. Rather, the evaluative component is primarily formative, and extrinsic rewards in the form of "magic words" are earned for completing the exercises in the first three areas. The Word Magic section, which differs from other sections, serves as an area where redeemed rewards are used for experimentation. Because the nature of winning in the game is, for the most part, intrinsic, it does not seem as though the educational goal is overshadowed by the motivation to earn any extrinsic rewards.

**Gaming goal vs instructional goal.** According to Alessi and Trollip (2001), every game has a goal. However, they underscore the importance of distinguishing the gaming goal with the instructional intent. The gaming goal of Wallykazam! Letter and

Word Magic may be characterized as what Alessi and Trollip refer to as "the repetitive practice variety" or the "drills in game clothing" (p. 270). For some users, the goal of each learning area may be to complete three iterations of an exercise and to proceed to the next section. For others, the goal may be to continue practice in the area until a new "magic word" is earned. In each case, the purpose is to complete a life cycle of the interaction.

In regards to the instructional goals, Nickelodeon clearly specifies literacy-based goals for each learning area in the parents' section. For example, in Look for Letters, the literacy goal is stated as, "recognizing letters and exposure to letter sounds" by identifying lower case letters based on their name and their sound. As the name suggests, the stated goal of Letter Trace is to "strengthen fine motor skills by tracing twenty-six lowercase letters" and to "learn the sequence of letter strokes." The goal of Rhyme Time with Gina Giant is described as "rhyming and beginning letter sounds, with exposure to nearly 300 words (including sight words)." The actions associated with this exercise include identifying simple rhyming words and identifying words that start with the same letter or same consonant blend. Finally, the literacy goal of Word Magic with Borgelorp is to master new vocabulary words by "gain[ing] exposure to over thirty vocabulary words, including words featured on the television show" and "experiment[ing] with words to create different outcomes" (Parents section). Although the gaming goal and the instructional goal serve two distinct objectives, it is the synthesis of these two that provides the functionality of the app.

**Instructional Strategies**

In addition to the game design, strategies employed in the instruction facilitate practice in literacy learning while maintaining focus on the instructional content. The first element of the analysis concerns the literacy objectives and the strategies used to facilitate the learning of the instructional content.

**Kinesthetic exercises.** One strategy that is used in the learning spaces is the incorporation of different types of psychomotor tasks to facilitate learning. For example, in Look for Letters, users must search for letters, compare and contrast them, and assess whether the found letter matches the one displayed and tap on the screen. This involves a kinesthetic task of swiping on the screen with a finger to move through the environment horizontally and tapping on a signpost to switch the scene from the foreground to the background. In Letter Trace, further practice in memorizing and understanding the nature of letter writing requires users to use their finger or a stylus to learn the correct sequence and directions of tracing roman letters. In Rhyme Time, users must not only make an assessment about the characteristics of words and swipe on the screen, but they must also rotate the device mid-game. This is similar, in terms of required task in the last area, Word Magic, where swiping allows users to control which words help transform Borgelorp to show the meaning of the word.

**Guidance and feedback.** The design of the instruction features a number of ways in which guidance and feedback are provided for the user. For example, in the main area, Wally presents verbal cues, briefly explaining the content of each learning section. Instructional explanations are also addressed in the beginning of an exercise. For example, at the beginning of a Rhyme Time activity, Wally explains that the tower will

only grow taller if words rhyme with the key word (e.g., words that rhyme with the word "bet"). He also provides an explanation of a rhyme and examples by stating, "Words that rhyme end in the same sound, like bat and hat."

Because it is assumed that the user has not yet fully developed his/her reading skills, instructions for all areas are narrated and sound effects provide cues to direct the user. In Look for Letters, positive feedback is given immediately after the correct response is selected (e.g., "Great job, you found it!"). If the user has difficulty identifying the correct letter or if there is no user action within a given amount of time, Wally encourages the user to continue searching (e.g., "Swipe to look in other places" or "Remember, we are looking for the letter, R").

Visual elements such as arrows are also used to guide the user. Both in Rhyme Time and Word Magic, arrows serve as visual indicators illustrating the direction the user must swipe. In Letter Trace, arrows and verbal feedback are strategies used to guide the user. Prior to user practice, Libby models the correct tracing sequence by showing the user, first, how to write the letter. When the user mimics the Libby's actions, although there are no penalties for making mistakes, it is possible to trace in the wrong direction, out of sequence, or out of bounds. In such cases, a sound effect signals the user of the error and he/she must try again.

Guidance and feedback are also evidenced in Rhyme Time through the use of visual and verbal indicators representing the progress of the user. The castle tower icon on the bottom right serves as a visual to self-evaluating the extent to which the user has reached the goal. Gina Giant's comment about how far the user has reached, relative to

her height, provides further feedback on the progress (e.g., "You started down low, but now you're up to my elbow! Nice rhyme, huh?").

**Repetition.** Closely related to the guidance and feedback is the use of repetition. Repetition is used in the delivery of instructions and in providing feedback. In Look for Letters, letter names are repeated after tapping on a letter, regardless of whether or not the user has made the correct selection. Repetition is also illustrated in the learning experience. Each learning area requires a number of iterations of practice before the user is able to proceed. In Letter Trace, the user traces three different letters, and each letter may be traced a second time to make the letter shine brighter.

**Exploration.** The ideas of play and exploration have been discussed in the analysis of other apps (see Toca Hair Salon 2 and Wild Kratts Creature Power World Adventure). Wallykazam! Letter and Word Magic also incorporates an element of play. The last area, Word Magic, consists of a list of "magic words" that are unlocked through successive completion of the prior three interactions. There are ten groups of three verbs and adjectives, and words in each group begin with the same letter (e.g., big, blue, and burp). As an open-ended activity, the user explores the meaning of words by sliding the word toward Borgelorp, changing and animating him. Unlike the other three learning areas, there are no right or wrong answers, and the user may freely choose when to end the exercise.

## Instructional Issues and Concerns

Wallykazam! Letter and Word Magic is based on the animated television show, Wallykazam! which began airing in February of 2014. The television show caters to a wide range of children of varying literacy developmental levels. Each episode is

comprised of a comprehensive instructional lesson that incorporates letters, letter sounds and relevant words. The Nick Jr. (n.d.) webpage for the television show suggests that, in addition to supporting phonological awareness, letter knowledge and letter sound correspondence, the show introduces high frequency vocabulary words (i.e., "sight words"). In many ways, an app-based medium and a television-based medium differ in elements such as goals, interactions, and capabilities. The instructional issues stemming from the app can be better expressed by comparing the design of the television episodes with the app design.

     **Similarities with show.** A number of notable instructional elements utilized in the television series are also apparent in the app content. First, Wallykazam!, the television series, presents the protagonist, a blue troll named Wally Trollman, who is in possession of a "magic stick" that produces "magic words." Within each episode, viewers are introduced to Norville (Wally's pet dragon) and many of Wally's friends. In the app version, the magic stick is also used to create letters (in Look for Letters) and words (in the inter-game exercises). Additionally, familiar environments such as the forest as well as characters such as Bobgoblin, Libby Light Sprite, Gina Giant, and Borgelorp make their appearances in the app.

     There is also an overlap in instructional content. For example, in "How to Bathe Your Dragon" (Season 1 Episode 4), the magic letter "b" and the corresponding phonological [b] sound are the focus of the episode. During the course of the show, Bobgoblin steals and hides the letter b among other letters to try to confuse Wally. The letter b is presented with similar looking letters such as p, q, and d. In Look for Letters

exercise not only do users learn a specific letter or letter sound, but they must also learn how to discriminate between different (or similar looking) letters.

Second, each episode begins with the introduction of a letter (or letters) and its corresponding phonological sound. Wally uses relevant words that begin with the featured letter(s) to produce magic words that are used throughout the show to advance the storyline. In "Naptime for Borgelorp" (Season 1 Episode 1), Wally babysits his friend Ogre Doug's pet Borgelorp and is forewarned not to feed the pet any purple flowers. All magic words in this episode begin with the phoneme [s] and also begin with the letter "s." This element from the show is reviewed in the Gina Giant area of the app where users must find words with similar characteristics. What differs between the television show and the app is in the assessment.

In each episode of the television series, Wally is confronted with a contextual problem that is oftentimes caused by his troublemaker friend Bobgoblin. For example, in "Castle Caper" (Season 1 Episode 2), the phoneme [c] and the letter "c" is reviewed. Wally makes Norville the king of a castle with "couches" and "carpets." However, Bobgoblin steals the "crown" from the dragon and usurps the role of king. Throughout the episode, various magic words beginning with the letter "c" and the phoneme [c] (e.g., catapult) are used to try to regain control over the castle. The familiar castle is revisited in Rhyme Time with Gina Giant.

In a similar way, each area of Wallykazam! Letter and Word Magic presents a contextual component. For example, in Look for Letters, the exercise begins with the introduction of the context and problem: Bobgoblin enjoys letters and has hidden letters in the forest. Wally requests help from the users and prompts them to identify a letter,

among many, scattered throughout the forest. In Letter Trace, Libby Light Sprite requires help in making the night sky brighter. Finally, in Rhyme Time, Wally requests the help of the user to help him build the castle in order to greet Gina Giant.

Additionally, Wally often addresses the audience directly by looking toward the viewers, prompting questions, and providing a moment of pause users to provide an answer. In "Day in the Dark" (Season 1 Episode 8), Libby Light Sprite helps light up the sky in search of Norville's favorite squeaky toy after Bobgoblin turns the sky dark using Wally's magic word. Wally asks the user whether "drum" or "horn" begins with the phoneme [d]. Later, he also asks the audience, "what sound does daylight start with?" In both cases, the letter sound for "d" is reinforced in context throughout the episode. The parallels between this episode and Letter trace are negligible; however, awareness of the television content provides a more grounded understanding of the app interactions (see Wallykazam! Letter and Word Magic section).

**Differences with show.** While many of the instructional elements of the television series were carried over to the app, there were a number of notable differences. In the television format, it is not possible to assess whether or not a user has mastered the literacy-based problems presented in the programming. The television episode assumes that the user has listened to the narrative and has actively participated in responding to Wally's prompts, which are followed by the use of long pauses and positive feedback. However, it is possible that the child vocalizes an incorrect answer, to which Wally provides positive feedback erroneously. In contrast, the interactive capabilities of the app version provide users with formative and immediate feedback, which is directly influenced by the response provided by the user.

At the same time, the television episode allows for a seamless and in depth flow of a specific learning objective. One of the issues apparent in the analysis of the app content was the sequencing of learning areas. For example, it is not immediately clear from simply using the app why there is such a gap in difficulty levels between Letter Trace and Rhyme Time. The flow of the instruction between Look for Letters and Letter Trace is logical in the sense that users, who may be unfamiliar with alphabetical knowledge, may practice identifying letters through their shapes and also to trace them. However, after the tracing exercise, the child is asked to identify more complex patterns of words. Although practice in identifying words that start with the same first letter may be a continuation of letter identification, there is no direct explanation of how words are developed (i.e., through the combination of letters) and only a few examples of rhyming words are provided in the instructions. The assumption is that children have seen the show or have learned these skills elsewhere.

Unlike the app, the television show incorporates all of these skills in context. For example, in "Dragon Hiccups" (Season 1 Episode 5), a "problem" is presented to the learner: Wally must help find a cure for Norville's dragon hiccups. Prior to the Wallykazam! jingle, an advance organizer-type exercise sets the stage for that particular show introduction (see Endless Alphabet section). Wally begins the episode by introducing the nature of the magic words of the day (i.e., "words that rhyme with 'sash' or 'bash'). Wally brainstorms aloud for another rhyming word, and comes up with the word "flash." Wally and Norville present a visual explanation for the meaning of "flash" by dancing under a number of flashing spotlights.

Throughout the show, Wally presents other examples of rhyming words in context (e.g., crash, mash, dash). Additionally, users are supplied with non-examples, or incorrect examples, throughout the storyline. For instance, in order to help alleviate Norville's hiccups, Wally considers giving Norville "water," but because the word did not rhyme with the word of the day, he is unable to use his magic stick to produce water. Instead, he comes up with the word "splash" as an alternative. In addition, other instructional strategies such as songs, which repeat the learned rhyming words, are presented.

**Wallykazam! Letter and**
**Word Magic Summary**

Wallykazam! Letter and Word Magic is a literacy app for emergent learners based on the television series, Wallykazam! Many of the instructional strategies carried over from the television episodes were apparent in the app, although notable differences highlighted the capabilities and limitations of both types of media. In the end, the exercises of the app seemed to provide supplemental practice for the content of the television show.

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**App VII: Starfall Learn to Read**

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Starfall Learn to Read is a product of Starfall Education. It appeared on the top nine list 34 times. It is the seventh most frequently appearing app after Bubble Puppy Play and Learn HD and Toca Pet Doctor were excluded. Starfall Learn to Read first appeared in the App Store on August 27, 2012, and two versions have been made, with the most recent being on September 23, 2012. At the time of writing this study, Starfall Education had 11 apps available for the iPad. Starfall Learn to Read requires 29.7mb, iOS 4.3 or later, and is compatible with the iPhone, iPad, and iPod touch.

**Overview of App Options**

Starfall Learn to Read begins with the presentation of the Starfall Education logo, followed by the main menu. In the main menu, there are three options: a toggle locked/unlocked button (though its function is unclear); an "i" button, which presents informational text; and 15 blocks, or learning areas (see images a and b, Figure 63). Tapping on the block opens a sub-menu, which includes a book, a back button, and up to three activities (see image c, Figure 63). Though not all options are available for each block, the following sections describe various types of activities that are present throughout the app. As a note, the option to exit the lesson is available throughout the entire lesson by tapping on the "x" on the top right area of the screen.



*Figure 63.* Main, parental, and sub menus of Starfall Learn to Read. From left to right (a, b, c): Main menu of Starfall Learn to Read, parental menu, and sample block sub-menu. (Permission to reproduce images granted by Starfall Education.)

**Book.** The element of the app that is consistent among all blocks is the book, which is presented on the top two thirds of the sub-menu. A title is displayed above a book with an illustration on the cover. Tapping on the book begins an animated song whereby a dancing word, representing a phonetic category, appears on the screen (see image a, Figure 64).

The narrator sounds out highlighted area of the word being pronounced. The hand prompts the user to tap the "x" to exit out of the pop-up menu. If there is no response by

the user, the pop-up menu disappears after a certain amount of time has passed. Next, the

hand appears again and prompts the user to tap on the right arrow. When the right arrow

is tapped, the story begins.



*Figure 64.* Sample book opening introduction of Starfall Learn to Read. "Zac the Rat" (Block 1) interaction from right to left (a, b, c): Opening animation, superimposed letter, and pop-up and visual instructions. (Permission to reproduce images granted by Starfall Education.)

In each page of the story, there is an "x" button to exit out of the sequence, a back

button, a forward button, an illustration or animation at the top, a short sentence on the

bottom, and an icon of an ear (see first image, Figure 65). Tapping on the ear highlights

the sentence, and a narrator reads the sentence. Tapping on the image causes it to

animate.
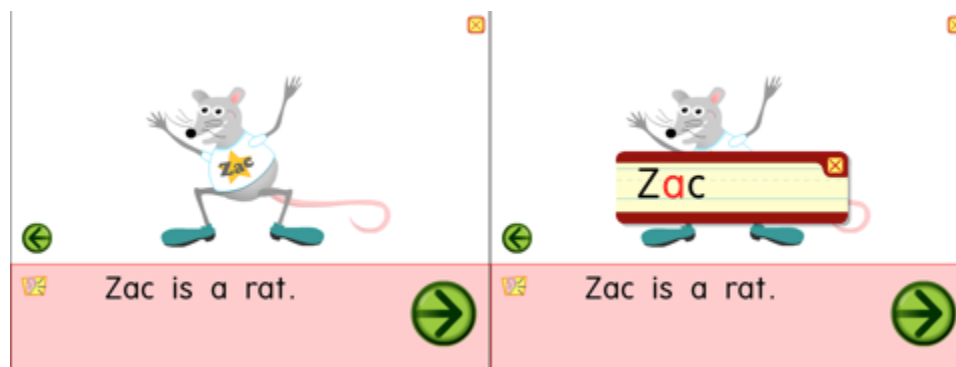


*Figure 65.* Sample book pages. A page from "Zac the Rat" (left) and sample pop-up to help pronunciation skills (right). (Permission to reproduce images granted by Starfall Education.)

Furthermore, when a specific word is tapped, the lined paper pop-up appears, and the user is able to listen to the narrator sound out and say the word (see second image, Figure 65). This pop-up can be closed by tapping on the "x" or by waiting for a period of time. The right arrow on the final page reverts back to the sub-menu main page.

**Card game.** The card game is the most frequently occurring activity totaling 22 games. Card game begins with a short animation of the letters (or letters) that are the focus of the block (see image a, Figure 66). The card game presents an illustration and the corresponding word underneath, with one or more missing letters (see image b, Figure 66). When letters in the list are tapped, the narrator sounds out its phonetic sound. When the illustration is tapped, the word is read aloud. The goal of the game is to choose and drag the appropriate letter (or letters) from a list into the missing gap in the word. If the selected letter is incorrect, the narrator says "Oops," and the letter is returned to the list. If the answer is correct, the card slides into the hole, the letter turns red, the narrator sounds out the phonetic letter, and the word card turns green (see image c, Figure 66). If there is a next word, the same process continues.



*Figure 66.* Sample card game from Block 1. From right to left (a, b, c): Opening animation, main interface, selecting the correct answer. (Permission to reproduce images granted by Starfall Education.)

When the last word is completed, the screen clears and the completion menu is displayed (see Figure 67). On the right of the screen is the phonetic sound emphasized in

the lesson. A star jumps onto a blue ribbon on the left side of the screen, as the narrator

provides feedback (e.g., "Groovy!"). Next, the completed list of words and their

corresponding images are sounded out. When the user taps on the word, the word turns

red and the narrator sounds out the word. Tapping on the right arrow returns the user

back to the sub-menu main page.



*Figure 67.* Reward for completing the Card Game activity. (Permission to reproduce images granted by Starfall Education.)

**Picture hunt.** When the icon for Picture Hunt is selected, the title page displays a

black and white image on the top and a title card on the bottom (see image a, Figure 68).

The title card falls, eventually revealing text-based instructions on what item to find in

the illustration (see image b, Figure 68). One word is highlighted in blue. When the user

taps a word in the sentence, the narrator pronounces the word. If one of the words was

covered in one of the activities, the phonetic sounds are sounded out before the full word

is pronounced.

The purpose of the exercise is to read the sentence and correctly select the object

in the illustration. If the correct object is selected, the relevant area is colorized, and the

word appears next to the image in a blue box (see image c, Figure 68). This box moves to

the sentence, and once again, the phonetic word is sounded out before the word is

pronounced. The user presses the right arrow for the next word. If any words are skipped,

they become cycled through again.



*Figure 68.* Picture Hunt activity. From right to left (a, b, c): Opening graphic, instructions under the image, selecting the correct answer. (Permission to reproduce images granted by Starfall Education.)

When all words are identified, positive feedback is provided, the whole image is

colorized, and an animation plays (see images in Figure 69). The app contains three

Picture Hunt activities. As a note, the user is prompted to "click" on objects in the

picture, even though there is no way of clicking on an iPad.



Figure 69. Completion of the Picture Hunt activity. Positive feedback (left) and colorized animation (right). (Permission to reproduce images granted by Starfall Education.)

**Make a match.** Make a Match begins with the presentation of an opening

animation (see image a, Figure 70). Twelve cards appear, face down, and the goal of the

game is to successively tap and match two cards (a word and an image), similar to the

card game, Concentration (see image b, Figure 70). When the user taps the first card, the

card turns over, revealing an image or a word. Next, the user selects a second card, which turns over to reveal an image or a word. If the two cards are identical, the cards combine (see image c, Figure 70). The narrator pronounces the word as the word turns red, and the card is entered into the progress bar on the bottom portion of the screen. If the words do not match, the cards return to their original position.
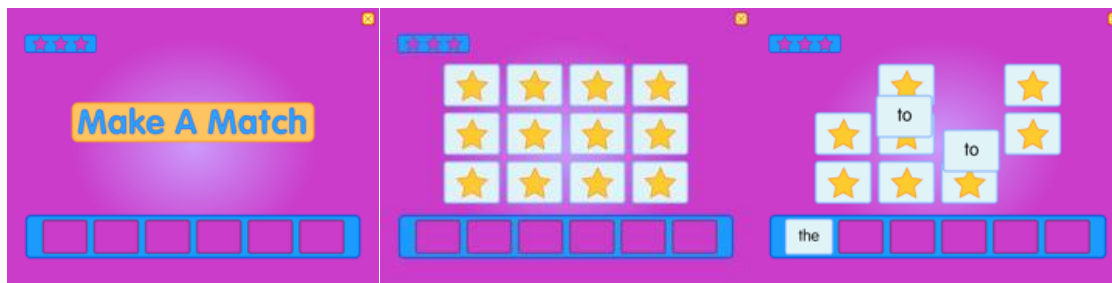


*Figure 70.* Make a Match activity. From left to right (a, b, c): Opening animation, main interface, matching two words correctly. (Permission to reproduce images granted by Starfall Education.)

There are a total of six combinations for each of the three levels. After completing levels one and two, a clip art of a star jumps, and the user is directed to the next level (see first image, Figure 71). After the final level is completed (i.e., level 3), the star becomes animated, a jingle plays, and the narrator provides positive feedback. The user can tap on the right arrow to return to the sub-menu main page (see second image, Figure 71).
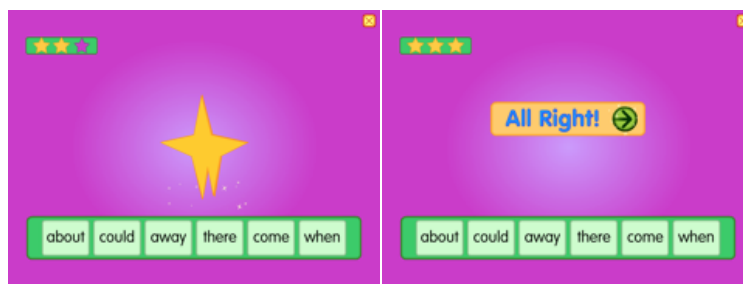


*Figure 71.* Completion of the Make a Match activity. Animation sequence after completing levels (left) and positive feedback and main menu link (right). (Permission to reproduce images granted by Starfall Education.)

**Word sort.** There are two word sorting interactions in the app. When the game

begins, an airplane flies across the screen trailed by a banner, which reads "Word

Sorting" (see image a, Figure 72). On the bottom, there are three groups of words, each

containing two examples. Phonemic sounds are highlighted and introduced (see image b,

Figure 72). The sound is narrated, and a cloud with a word appears. The first time the

user plays the game, an overlay of a hand prompts the user to move the word from the

cloud to the correct phonemic sound area. Subsequent iterations omit this instruction.



*Figure 72.* Word Sort activity. From left to right (a, b, c): Opening animation,
presentation of word in the cloud, and correctly matching the word to the sound.
(Permission to reproduce images granted by Starfall Education.)

The user drags the word from the sky to one of three areas. If the response is

incorrect, the word returns to the cloud. If the word corresponds to the correct phonemic

sound, the word fits into place, and it is boxed (image c, Figure 72). The phonemic letters

turn red and is sounded out phonetically by the narrator. Next, the whole word turns red,

and the word is pronounced. A jingle plays as the word object is placed near the pile area.

This activity requires the completion of six words. When all six words are

completed, an animation plays, positive feedback is vocalized and displayed across the

screen (see images in Figure 73). The user may tap on the right arrow to return to the sub-

menu main page.

*Figure 73.* Completion of the Word Sort activity. (Permission to reproduce images granted by Starfall Education.)

**Movie and video.** The Movies and Videos of Starfall Learn to Read are instructional animations. There are four Movies and three Videos in Starfall Learn to Read that teach users specific skills associated with reading (see images in Figure 74).



*Figure 74.* Sample Videos and Movies. (Permission to reproduce images granted by Starfall Education.)

Most movies and videos begin to play when the icon is tapped on the sub-menu main page, and returns to the main menu upon completion. However, a number of them include interactions at the end. The images in Figure 75 illustrate a sample interaction.
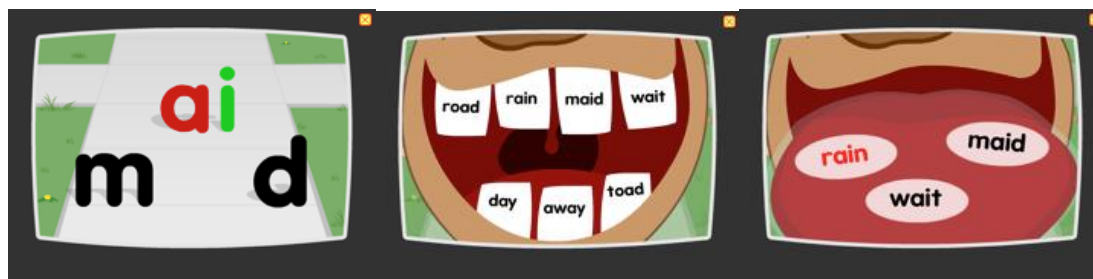


*Figure 75.* Sample interaction in Videos and Movies. After viewing the animation (left), the user must select words that contain the "ai" sound (two images on the right). (Permission to reproduce images granted by Starfall Education.)

**Pronunciation.** The first half of the Pronunciation section begins with the

narrator introducing rules for one of four letter couplings (e.g., "sh," "wh," "th," or "ch")

and explaining how the combination of these two letters produce a specific sound. To the

right, is a photograph of a person's mouth, displaying the shape of the mouth when the

sound is made (see images in Figure 76). The sparkling arrow cues the user to tap on the

right arrow to proceed. The letter coupling appears on the left, and an animation plays on

the right side of the screen.
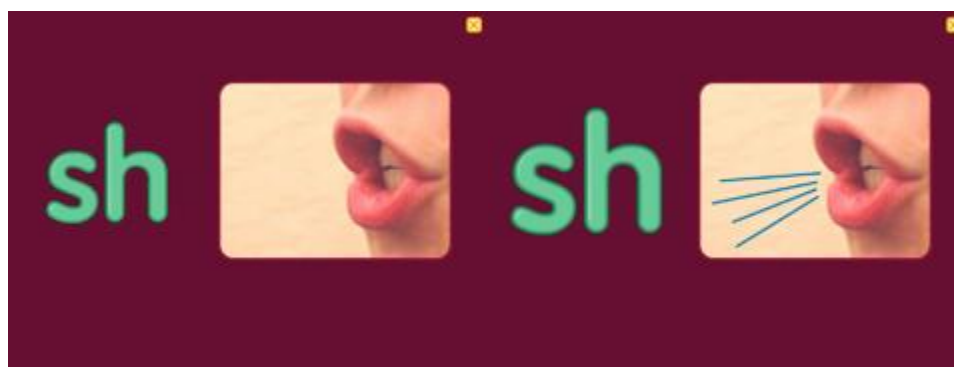


*Figure 76.* Visual representation of phonemes. The pronunciation activity begins with the
visualization of the letter couplings. (Permission to reproduce images granted by Starfall
Education.)

Next, the narrator repeats the rule followed by an animation that explains the rule,

visually and verbally. The sentence is displayed at the bottom of the screen; the words

turn red as the narrator verbalizes each word (see images in Figure 77). This process can

be repeated by tapping on the letter coupling. The user is prompted to proceed by tapping

a sparkling arrow that cues him/her to the next page.
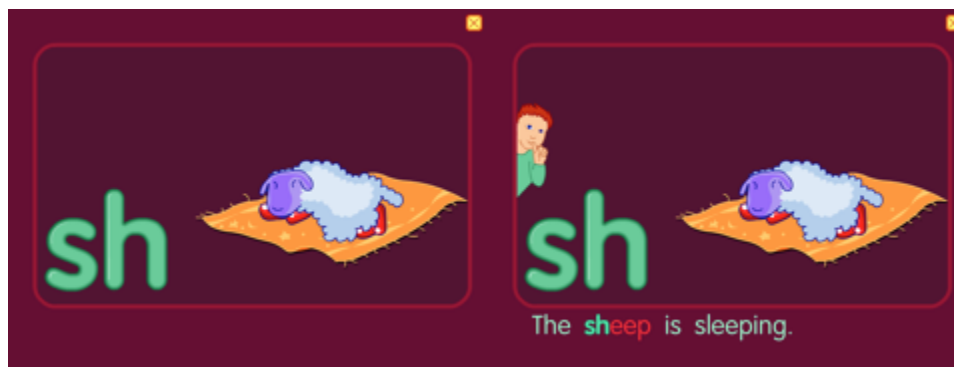
*Figure 77.* Sample instruction of Pronunciation activity. Narrated portions of the text turn red. (Permission to reproduce images granted by Starfall Education.)

When the user taps the arrow, the second half of the exercise begins, and a word

appears on a lined piece of paper. The user is prompted to look at the word and tap on the

letters that make a particular phonemic sound (see images in Figure 78).



*Figure 78.* Final assessment in the Pronunciation activity. The user taps on the portion of the word containing the letter sound. (Permission to reproduce images granted by Starfall Education.)

A progress bar is displayed on the bottom. If the correct letter (or letters) is

selected, the narrator pronounces the phonemic sound, and the letter (or letters) that

correspond to the phonemic sound, jumps. The narrator pronounces the word again, and

the word turns red. This process is continued until the letters are identified in all five

words. At the end, an animation of the phrase is displayed. For certain combinations, the

narration adds emphasis on the phonemic sound. The user is prompted to play again or

tap on the sparkling arrow to return to the sub-menu main page.

**Nature of Reviews, Users,**
**and Context**

Starfall Learn to Read is an app version of a website-based activity (see

http://www.starfall.com/n/level-a/learn-to-read/load.htm). Nine reviewers referenced the

Adobe Flash version on the Starfall website. Four reviewers indicated that, having used

the web version, they appreciated the offline app version. One reviewer quoted his/her

son's remark, "This is a lot easier to use on an iPad" (Review 29).

The description indicates that this app is intended for children 0-5. Fifteen people

specified the ages of the actual users, ranging from 2- to 7-year olds, with a mean of 4.2,

a median of 4, and a mode of 5. (One reviewer indicated that his/her twin children were

under the age of three but did not specify an age.) Among the 13 comments written by

parents that specified genders, nine were parents with sons, and four were parents with

daughters. An additional four reviewers identified themselves as a teacher or a tutor. Four

reviewers indicated that their child was a special needs child or required extra attention

for his/her behaviors. According to four customer reviews, this app may be appropriate

for students, younger children, children with special needs, and non-English speakers.

Starfall Learn to Read has received a 4 (out of 5) star rating by 401 customers for

all versions and a 4 star rating by 45 customers for the most current version. Among the

35 customers who have written reviews for this app, the star rating mean was a 4.37 with

a median of 5. In examining the feedback provided by customers, 25 reviews were tagged

as "generally positive" and four were tagged as "generally negative." The most

frequently used words to describe the app included "love" (11 reviewers), "great" (9

reviewers), "fun" (4 reviewers), "learning" (3 reviewers), "excellent" (3 reviewers), "amazing" (3 reviewers), and "best" (3 reviewers). One parent wrote,

> My 5 year old loves this application. She loves music and the app presents lots of good phonics information in songs. It is a good mix of entertainment and learning. It feels less like "work" than sounding out the words in a book because there are cartoons with each sentence. (Review 26)

The negative reviews were attributed to technical issues and doubt in the learning capabilities of the app: "$2.99 for 20 minutes. Frozen! Not happy" (Review 35). Five reviewers provided mixed feedback regarding the app, noting differences between the web version, confusion regarding the user interface of the main screen, as well as the need for more options (e.g., a reward system, a writing component, etc.).

**Design of the Learning Space**

The app, Starfall Learn to Read, can be best described as a learning platform. Unlike other apps that were developed with tablet and smartphone devices from the onset, Starfall Learn to Read was initially distributed through an html and flash-based web-environment and was, then, directly replicated and transferred into an app format. According to the developer's website, Starfall.com was created in 2002 "as a free public service to teach children to read with phonics" (Starfall Education, n.d.). A quick query in Google, Yahoo!, and Bing search engines for the word "phonics" produces the Starfall website within one of the first five search results.

**Web-based instruction.** Beginning with "Starfall ABCs," the website states that Starfall Learn to Read is the second part of a series of apps "to help and encourage your child as he learns to read," modeling the recommendations from the National Institute of Child Health and Human Development. There are additional resources (e.g., print outs and materials) for educators and parents available to use in tandem with the instructional

content. The Starfall Education website makes the sequencing of their phonics curriculum clear (e.g., ABCs, Learn to Read, It's Fun to Read, and finally, I'm Reading). However, because the corresponding apps are sold individually in the App Store, the overall curricular organization and the sequencing is not fully explained in the app version. Only one reviewer noted that this app should be paired with other Starfall applications such as Starfall ABCs (Review 25).

While more recent instructional Starfall programs provide in-depth information regarding the alignment to national and state standards and benchmarks, because Starfall Learn to Read was developed prior to the establishment of the Common Core Standards, the website does not provide a clear alignment of app goals with educational standards. However, the California Learning Resource Network (2014) does provide applicable standards, though the reference seems to review the web version and incorporate elements from other programs of the series.

**Phonics instruction.** The app uses the phonics method to teach reading skills to young children. According to Justice et al. (2005), phonology is defined as "the set of rules governing the sound systems of language, or the specific sounds used by a given language to generate syllables and words" (p. 4). Both the web version and the app version of Starfall Learn to Read are divided into 15 "blocks" that include three types of interactions: play, book, and skill (although some blocks do not contain a skill). Each block covers a specific phonic rule (e.g., short-a) or phonetic combinations (e.g., double vowels and the silent-e).

The intended age group of Starfall Learn to Read, which falls in the preschool and kindergarten levels in schools, coincides with the developmental period referred to as

emergent literacy (Connor, Goldman, & Fishman, 2014). It is at this time that alphabetical awareness, or "knowledge of letter names and sounds" and phonological awareness, or "the ability to detect, manipulate, or analyze spoken words independent of meaning, including syllable and phoneme-level tasks" become critical in preparing children for reading instruction in subsequent grades (Spencer, Spencer, Goldstein, & Schneider, 2013, p. 46).

It is theorized that, by the time a child begins school, the gap between those with strong and weak literacy skills become unmistakably clear, and the gains during this period have a tremendous impact on a child's development. Children showing weak phonological awareness at this age are seen to encounter literacy issues in future grades, affecting success in school and beyond (Justice et al., 2005; Spencer et al. 2013, Connor et al., 2014). Knowledge of the importance of teaching literacy skills to children by parents may explain why many parents found the app useful in their child's learning. As one parent wrote, "I really like this app as a mom. It is great reinforcement and extra practice for what my 5 yr old is learning in kindergarten" (Review 18).

**Explicit Instruction and Practice**

Starfall Learn to Read utilizes direct instruction to support its methodology in orthographic instruction. Traditional interpretations of direct instruction emphasize the importance of regulating the amount and manner of providing guidance to learners to acquire a set of skills delegated by the instructor. Clark (2009) defines instructional guidance as

> providing students with accurate and complete procedural information (and related declarative knowledge) that they have not yet learned in a demonstration about how to perform necessary sequence of actions and make necessary decisions to accomplish a learning task and/or solve a problem. (p. 161)

Clark suggests three interpretations of guidance and support in an instructional environment: explicit communication of goals, forced by varied practice, and frequent and immediate corrective feedback.

      **Explicit communication of goals.** The first is the explicit communication of what is to achieved, how to achieve it, and when to do so. The Starfall app is divided into 15 blocks, each of which contains an instructional goal based on a phonemic rule. The storybook, video, movies, and the pronunciation activities provide users with explicit instructions on these rules. Each of these books incorporate elements of dialogic reading, word elaborations, and print referencing, which are three recommended strategies used to guide young children with their verbal literacy skills (Pentimonti, Justice, and Piasta, 2013). Explicit communication of the phoneme rule is introduced and repeated throughout the exercise, both in visual and auditory form. For example, each book begins with an animated sequence introducing the phoneme rule. Accompanying the animation is a song or jingle that models the sound or the rule (e.g., "Short-a makes this kind of sound, ah ah ah ah ah" in the tune of Pop Goes the Weasel). Additionally, when the ear is tapped, the narrator reads the sentence to the user. Tapping on each word of the sentence produces a pop-up interaction, providing additional guidance on sounding out individual words (e.g., Figure 65, image on right). Furthermore, when the user taps on the green arrow to go to the next page, the arrow changes to the letter and the narrator pronounces the sound. All of these strategies are used to reinforce the association between the phonemic sound and letters as well as their applications in words and sentences.

      A Washington Times review of Starfall Learn to Read identified four distinct steps that were used to develop reading skills (Tsubata, 2007). The first step focused on

the hearing and discerning of component sounds in a word, such as "sat." Next, children learned the representation of those sounds in written letters (S, A, and T). The app also taught the child to vocalize those letter-sounds and to recognize those sounds in words. Finally, interesting stories that use recognizable words are employed to create comprehension and to develop vocabulary.

In addition, the storybooks offer practice in learning concepts of reading. For example, children may learn about general characteristics of books (e.g., sequencing of books from the first page to the next, sequencing of the story from beginning to end, incorporation of words and images, etc.) and characteristics of reading (e.g., reading sentences from left to right). Furthermore, the capabilities of the digital medium add a level of interactivity not found in physical books, engaging the user with animations and assistive prompts to direct the user's learning.

**Varied practice.** Clark also emphasizes the need to provide forced but varied practice in order to effectively transfer knowledge and skills in novel situations. The instructional materials presented in Starfall Learn to Read utilize an array of strategies utilizing the capabilities of the medium. Alessi and Trollip (2001) suggest that effective and efficient learning incorporate the following four phases of instruction:

- Information is presented or skills are modeled.
- The learner is guided through initial use of the information or skills.
- The learner practices for retention and fluency.
- Learning is assessed.

In Starfall Learn to Read, a number of lessons support these phases of instruction. For example, the Book, the Videos/Movies, and the Pronunciation exercises aid in the

mastery of the first two points. These exercises are transmittal in nature, and present a multitude of visual and auditory examples to reinforce the phonemic rule. For example, Pronunciation requires users to identify letters that are associated with a rule.

Card Game, Make a Match, Picture Hunt, Word Sort, and the final sections of Pronunciation and (some) Videos/Movies provide practice in retention and fluency through the use of a game. In each case, the user must successfully complete all parts of the game in order to complete the lesson. For example, in Picture Hunt, if a user skips a word, the word is placed at the end, and the user must correctly identify all answers (including skipped questions) in order to watch the final animation. In Make a Match, three iterations of six card matches must all be completed in order to watch the star animation.

**Feedback and guidance.** Clark's last point suggests a need to provide frequent and immediate corrective feedback following the practice to prevent student error. Starfall provides a number ways in which feedback and guidance are given to the user. One type of feedback and guidance is the in-app corrective feedback that is automated in the interactions. For example, feedback is presented in the book, where tapping on certain elements causes the illustration to animate, providing examples of a certain rule. Also, each game provides immediate feedback on correct and incorrect response. For example, in the games of Make a Match, Card Game, and Word Sort, when a user selects the wrong letter, an auditory response informs the user that the answer is wrong, and returns the letter or word to the original position. At the end of all games and drills, the user is presented with positive feedback, such as "Great Job" or "All Right!" In the reviews, a

parent stated that the rewards helped his/her son stay engaged and maintain his interest in

reading:

> My 4 year old has had absolutely no interest in reading or spelling... until we tried this app. It is interactive and rewards him when he spells correctly. If you have a hyperactive boy that is hard to get to sit still or get interested in reading and spelling, this app will help! (Review 19)

At the same time, the literature on emergent literacy indicates that it is the shared

reading experience, particularly through scaffolding, that is vital to a child's achievement

gains at a level higher than he/she can learn alone (Pentimoni et al., 2013). It is, perhaps,

important to point out a number of differences between learning phonics in a school

environment and an app-based environment. In a school environment, specific phonetic

rules may be the focus of a lesson, and the app may be a tool used in conjunction with

other instructional materials. Learners have the ability to utilize and vocalize the learning

content, and receive corrective feedback from the teacher and other students. However,

because of the number of students (with differing levels of development) in a given class,

efficiency may be a major concern to meet curricular goals and standards, and as a result,

personalized attention to specific needs may not be met.

 In a non-academic environment, parents who are invested in their child's literacy

development may seek out apps such as Starfall Learn to Read to personalize the learning

experience for their child. However, those contextual provisions that typically strengthen

a learner's acquisition of knowledge in schools (skilled teachers and other students) are

only assumed.

As an example, while pronunciation is emphasized throughout the app, the user's

participation is inferred and not directly assessed. A teacher reviewer addressed this

issue, citing the lack of options allowing his/her children to practice vocalizing the

learned material:

> I don't mind using this app, but I wished they had a settings feature to turn off giving the word. For example the student can tap on a word they don't know and the app will sound it out, but the app does not give the student a chance to say it. Instead it gives it to them. It'd be nice to be able to control some of these features within the app. (Review 13)

Although a parent reacted to Reviewer 13 by stating, "Mute the volume if you do not

want to give off the word" (Review 11), the teacher's review may be a valid request. In

the current design of the instruction, children are quizzed on their knowledge of the

phonemic rules but are not assessed on their practical usage of the material.

Transfer of corrective uses of the learned material must be reinforced through

communication, support, and guidance in the home environment (Justice et al., 2005).

While, in many ways, the instructional strategies utilized in this app may mimic the role

of a teacher in a classroom, Starfall Education addresses this issue on its website, and

encourages parents and schools (including home schools) to be involved in the child's

learning by providing supplemental practice and exercises.

Clues from the reviews seemed to suggest that parents were, indeed, involved in

their child's interactions with the Starfall app. One review described a parent's shared

experience with his/her son: "[M]y son and I are almost finished with this module. he was

getting bored with the phonics book we started with but this keeps him interested and

curious. excellent progress" (Review 31). Another parent stated demonstrated knowledge

of the content: "The songs are catchy and its easy to navigate through. Love love love

this!" (Review 20). Reviewer 34 directly attributed learning gains to the app by stating,

"One of my 5 kids has Down syndrome and he is reading well today thanks, in part, to

Starfall!" This indicates that the parent had observed the child before and after using the interaction and had noticed improvements in the son's reading skills as a result of utilizing the app. Similar to the findings of another app in this study (see Endless Alphabet section), evidence seemed to suggest that parents were demonstrating involvement in their child's literacy development, whether directly or indirectly.

**Instructional Issues and Concerns**

The education experts at Starfall Learn to Read developed the app's learning content on a number of evidence-based practices and strategies. Yet, the sound instructional value of the lessons and activities (integrated via storybooks, tutorials, and visualizations) lacks a cohesive design structure, defeating to some degree the patterns or relationships the developers sought to promote. For example, a tutor who taught students with dyslexia described how he/she generally enjoyed the contents of the app but was confused by the interface:

> This app covers CVC words. VCV long e words, vowel teams VV, and the sounds or, er, ir, ur, ar. Included are a lesson, exercises, a well thought out animation with catchy songs, and some fun activities. My only complaint is the main screen where it is difficult to know which picture to select, you just don't know what it is. (Review 17)

In addition, the present study revealed inconsistencies in the design of the instruction, which warrant further exploration.

**Sequencing of blocks.** The first issue concerns the sequencing of the lessons, which is an important consideration in the effective and efficient design of instruction (Morrison et al., 2004). In Starfall Learn to Read, because of the manner in which the interactive exercises are presented, the purpose of the individual exercises and their relation to the overall goal within a given block are not explained. As a result, the proper

sequencing of exercises is unclear. For example, in each block, the storybook takes up the top two thirds of the screen (see third image in Figure 63). Visually, one may assume that the storybook is the most important exercise among the activities, and consequently, that the other activities are less significant or supplemental to the book.

The sequencing of instruction becomes an issue in cases such as Block 5 of the app ("Gus the Duck"), where the book introduces the short-u sound. Following the aforementioned logic, the user would first read the book and interact with the accompanying exercises (Word Sort, Make a Match, and Movie). However, among the three lessons, the objective of learning the short-u sound is only covered in the Word Sort exercise. The Make a Match lesson covers short vowels, and the third exercise, the Movie introduces the silent-e skill (which is not practiced until Block 6).

The progression of exercises is more directly aligned in the website version, where blocks are arranged horizontally with their related lessons (see http://www.starfall.com/n/level-a/learn-to-read/load.htm). For example, in the website version, the ordering of exercises suggest that the user should progress from the play exercises (e.g., Card Sort, Word Sorting, Make a Match, Picture Hunt), continue with the book, followed by the skill exercises (e.g., Movies, Videos, Pronunciation).

This sequencing scheme would make the presentation of the silent-e movie in Block 5 more logical. After the user plays Word Sort and Make a Match, he/she continues with the reading exercise in "Gus the Duck." Prior to the play exercises of Block 6, by introducing the silent-e in the form of a movie, the exercise does not assume prior knowledge or interaction of the content and creates a logical flow, segueing into the

next lesson objective. In essence, it is presented as prologue to Block 6 where a new Word Sort game introduces and incorporates silent-e words.

The website instructions for parents state, "Although we recommend your child progress sequentially, there is no harm in allowing him to follow his own interests and create a unique path. Starfall supports your child's exploration." While it may be true that users can go in numerical order or choose to skip around, the instruction on the website seems to follows a more systematic path than the app version, effectively sequencing the material in a way that progresses in difficulty and familiarity (Posner & Strike, 1976).

**Ambiguous instructions.** In the books of Starfall Learn to Read, there are two ways to trigger the animation. The first is to tap on the ear icon and to listen to the sentence. The second way is to tap on the illustration at the top. Unfortunately, the directions for doing so are not immediately clear. Because the user may erroneously tap on the large right arrow that is displayed at the bottom right corner of the screen, causing the story to continue on the next page, users may overlook certain interactions and words in the storyline.

As an example, Zac the Rat (Block 1) begins with an animation. The third image in Figure 64 illustrates the use of the hand to provide signaling cues to the user. In this animation sequence, the hand, first, demonstrates how the user can close the pop-up, and second, it informs the user to tap on the green arrow. When the reading portion of the book begins, there are no overt instructions indicating that the user must tap on the ear icon or the illustration above the sentence to see an animation. Having viewed the instructions on the previous page, a user may tap on the green arrow without watching the animation.

Continuity issues in the storyline are one of the consequences resulting from the ambiguity in the instructions. In Zac the Rat, there are a number of animated sequences that are directly related to the story but require the user to watch the animation for the narrative to make sense. For example, on page two, the text reads "Zac sat on a can," and on page three, the text reads, "The ants ran to the jam." On page two, if users are aware of the fact that either the ear icon or illustration must be tapped, they watch an animated sequence of Zac falling off of the can, the can toppling over, and the can spilling its contents. However, if they erroneously skip over these visualizations, the association between the contents of the sealed can and the spilled jam must be assumed. More specifically, the learner must assume that something has happened in between the two pages that has caused the can to open and the contents of the can to spill.

Furthermore, two cultural assumptions are made about the learner. The first concerns fidelity of the visual representations to reality. While many children may have encountered jam in their daily lives, typically, jam is not stored in a can but in a jar. On page two, children who may have seen the jam, cans, and jars in real life must create a unique association between the jam and can. Additionally, on page three, the user must be developmentally aware that ants are attracted to the sugary contents of the can of jam, illustrated through a purple-colored puddle next to the can. Although such details of the story may be insignificant to the overall practice of the short-a phoneme, a simple clarification in the instructions may help minimize some of the confusion that may emerge from the user interaction.

**Hidden instructional pop-ups.** Additionally, the books contain certain pop-ups that are placed in certain areas of the animation, however, their timing and location of

their occurrences as well as their purposes are not always clear. The pop-up feature

provides visual and phonetic cues to help the user understand the procedure in sounding

out words. For each word, the narrator reads the phonetic pronunciation in order, while

the section of the word is highlighted, and at the end, the narrator also repeats the whole

word. In the book, however, the phonological cues and the visual cues are often hidden,

difficult to engage, and inconsistent. Furthermore, scaffolding does not seem to be the

explanation for the variability in the instructional strategies; pop-ups are not available for

all words in the illustration, even among new words related to the lesson objective.

As an example, on page three of "Zac the Rat," after the user taps on the ear icon,

the narrator reads, "The ants ran to the jam" and the animation sequence begins. The

words related to the short-a sound in the text include "ants," "ran," and "jam." In the

illustration, relevant words include images of "Zac," "rat," "can," "ants," and "jam."

While tapping on each word of the text produces a pop-up, there is no indication that the

user must tap on the jam to reveal the pop-up for the word "jam." Furthermore, "jam" is

the only word in the illustration that contains a pop-up. Even though the word "ant" is

introduced for the first time in the story, tapping the ants in the animation do not produce

a pop-up; in fact, this causes the ants to mysteriously disappear one by one.

Similarly, on the following page, although the new sentence, "Zac had a pan"

introduces the word pan in a sentence and also through a visual representation, tapping on

the pan does not produce a pop-up, but instead restarts the animated sequence.  In the

animation, the pan falls over, revealing another short-a-word, "bam." While tapping on

the illustration "bam" reveals a pop-up, tapping on any other short-a related illustrations

produce no visual or auditory outcomes.

It is not clear why certain words animate after tapping on them (e.g., bam), but others do not (e.g., pan, ant), especially when words such as "pan" and "ant" are more integral to the narrative, compared to words such as "bam" that are seemingly superfluous. These actions suggest that certain objects in the animation produce a pop-up, however, the user must guess which of the objects produce this outcome, as there is no indication about which objects contain further instruction and interaction. There is no intuitive pattern among the pages, and no visual cues provided for pertinent elements of the visualization.

It is certainly possible to argue that the learning occurs through continued interactions with the app or through the discovery of "hidden gems" that provide new experiences in each iteration of app use. However, the effective use of animation in helping learners understand complex concepts and processes has been studied extensively in the broader literature (Falvo, 2008). Deviations from recognized multimedia principles may impede rather than efficiently facilitate user acquisition of intended goals and outcomes.

**Ambiguous objectives.** The last point concerned the role of the animations as it related to the instructional goal. The first issue concerns the purpose integrating interactive elements in the instruction. In the storybooks, certain pages contain animations and others do not. Some of the animations clarify the story, but others do not. Some require one tap, and others require two taps (e.g., Jill has a mitt in "The Big Hit"). An example of this problem is found in "Peg the Hen" (Block 2), where words such as "Peg," "hen," "red," "get," "jet," and "wet" are introduced in the story to teach the short-e sound. On the last page of "Peg the Hen" (Block 2), a red book with the title "JETS"

appears next to a green jet. Although it would make logical sense for animations to occur for objects that reinforce the short-e sound, tapping on the green jet does not make the object animate. However, tapping on an object that does not reinforce the short-e sound causes objects to animate (e.g., tapping on the book causes it to become animated and fly around the room). This suggests that, perhaps, the animation and interactions in the story may be unrelated to the objective of the lesson and serve simply as interesting visuals.

Certain animations also seem to detract the learner from the main objective. For example, the sentence on the first page reads, "Peg is a red hen" with the word "red" displayed in a red color. The accompanying illustration above the sentence features a red hen and three objects: a pair of blue and black sunglasses, a brown hat, and a yellow scarf. The three objects can be tapped and dragged onto the hen as accessories, but again, these actions do not produce pop-ups (including the word "yellow" which uses the short-e sound) nor are the words of the items displayed or pronounced.

The problem arises when the user interacts with the illustration of the hen. Upon tapping on the hen, the color of the hen changes, and the color name and color of the word also change in the sentence. For example, tapping on the red hen causes Peg to turn blue and the sentence to change from "Peg is a red hen" to "Peg is a blue hen," and the word blue becomes displayed in blue. Successive taps of Peg cycles through the colors of green, pink, and purple. What is problematic about the option to change Peg's color requires a reevaluation of the instructional goal of this lesson (i.e., learning the short-e sound).

Because the option to change the color of Peg occurs on the first page of the book, altering the colors to words that do not contain the short-e sound seem to distract focus of

the overall objective of learning examples of short-e to words to other rules associated with the different colors (e.g., long-e for the word "green"). Changing the color of the hen on the first page of the book alters the visual representation of the hen for the remainder of the story. For example, if the user decides to choose the color blue, the story of Peg the Hen depicts a blue Peg, as opposed to a red Peg, weakening the associations of the short-e sounds with relevant vocabulary. There is further confusion when words with similar letters but with different rules, which have not yet been taught, are introduced. For example, the lesson for the short-e (Block 2) sound appears before the long-e sound in Block 7 (e.g., green). It is not clear why this option to change color is available at this stage in the program.

One justification may be that the there is an alternate goal of teaching learners new vocabulary words (i.e., the different colors) through the use of visual and auditory associations. Evidence of this is supported on the third page of "Peg the Hen," where the default sentence reads, "Peg gets into a green jet" with the word green displayed in a green color. Similar to the previous color change, tapping on the plane causes the color to cycle through its variations, and the text becomes altered accordingly. From a design perspective, the default placement and highlighting of the word green (written in green) in the text places emphasis or importance on the word green (and the instruction of learning different colors), or the differentiation of colors in general. Although learning colors may be an important element of child literacy learning, the differentiation of colors also detracts from the overall focus on the short-e words. The inclusion of a new learning element adds a level of complexity. The exercise appears out of place, sequentially, and seems to obstruct the natural flow of the learning experience.

**Starfall Learn to Read Summary**

The Starfall Learn to Read app provides a unique, offline, opportunity for young learners to develop and improve their reading and pronunciation skills through direct instruction and tutorials. Reviewers of the app, who were primarily parents, indicated strong and positive outcomes as a result of utilizing this app. However, inconsistencies in multimedia principles in terms of goals and sequencing of lessons warrant two brief comments regarding the educational implications of the presentation and the design of the instruction.

<p align="center">**App VIII: Dr. Panda's Restaurant 2**</p>

Dr. Panda's Restaurant 2 is the second iteration of a series of restaurant apps developed by TribePlay in the education section for paid apps in the Apple's iTunes App Store. This app may be characterized as a simulation in that it simulates the real world situation for activities that are related to restaurant behavior, such as the process of taking orders, selecting ingredients, cooking, and serving a meal.

Dr. Panda's Restaurant 2, ranked eighth after Nickelodeon's Team Umizoomi: Math Racer HD was excluded from the list, based on the sampling procedures that were outlined in Chapter III, limiting the selection to one app per developer. The app first appeared in the App Store on January 23, 2014, and has undergone two subsequent revisions. The most recent update and the version used in this study was March 31, 2014. The two updates for the app involved technical fixes, including the reduction of memory storage and the facilitation of a smoother user experience on certain tablet devices.

TribePlay had 22 apps available for the iPad at the start of this research. Dr. Panda's Restaurant 2 requires at least 61.7mb of storage, iOS 6.0 or later, and is

compatible with the iPhone 4s or newer, the iPad 2 or newer, and iPod touch 5th

generation or newer. The app included a resume feature, did not require access to Wi-Fi

or a cellular network to operate, and offered parental settings (e.g., vegetarian mode),

saved for subsequent use upon reopening the app. There were no in-app purchases or

third-party ads; although, there was a link to other TribePlay apps in the area secured for

parental settings to toggle on and off.

**Overview of App Options**

Fixed on a horizontal orientation, Dr. Panda's Restaurant 2 opens with a logo

page that leads an introductory menu, animated with two mice eating pizza while a jingle

plays in the background (see image a, Figure 79). Two links, "For Parents," in the upper

left corner of the screen, and a green, right-pointing, arrow appear. Tapping the former

leads to a security question pop-up. Tapping the lock a certain number of times, as

prescribed (see image b, Figure 79), grants access to the area for parents (see image c,

Figure 79). Adults may review the app in the App Store, subscribe to a newsletter, "Like"

the app/developer on Facebook, and toggle on and off various features (i.e., promotional

links, vegetarian option, sound, music).



*Figure 79.* Introductory menu and settings in Dr. Panda's Restaurant 2. From left to right
(a, b, c): Introductory menu, secure entry screen to area for parents, and options in
parents' section. (Permission to reproduce images granted by TribePlay.)

The second link is a triangle pointed toward the right, leading to the main

interaction of the app. Tapping on this icon pans out the visual interface from mice and

the roof of the building to the restaurant, located behind a dock with a picnic table

covered by a checkered tablecloth. To the right of the table is the panda chef. A small

boat arrives with a raccoon, the boat's captain, and two of his four potential customers

(see first image, Figure 80). Customer options include a bear, an elephant, a

hippopotamus, and a monkey. Tapping on the chef or the captain generates a reactionary

response. Tapping on a customer causes the animal to exit the boat, step onto the dock,

and walk toward the table (see second image, Figure 80).



*Figure 80.* Dock area of Dr. Panda's Restaurant 2. Customers disembarking (left) and customers placing orders (right). (Permission to reproduce images granted by TribePlay.)

The interface zooms into the table area where the two customers, selected by the

user, stand and present their order to the chef, as seen through text that is displayed in a

thought bubble. The selection of food options includes wok, soup, salad, pasta, and pizza.

Each of these dishes varies in its procedure, although the preparation of additional

ingredients remains the same. The user is taken to the food preparation area. Once the

user has entered this kitchen area, there is no way to return to the table area until the food

is prepared.

After the food is served the customer examines the food. If the food is not acceptable (i.e., the customer does not like any of the ingredients), the customer will shake his/her head and refuse the food. If the user swipes the screen to move the food to the customer, thought bubbles will appear indicating which ingredients the customer did not like. The user must swipe the screen again to move the food to the tray. Next, the same customer re-orders another meal.

If the dish is acceptable, tapping the customer causes the animal to smile and nod, though this step is optional. The user, then, swipes the food toward the customer, and the customer's reaction is produced through up to three thought bubbles (see image a, Figure 81). In cases where certain condiments were too strong, the customer reacts accordingly (e.g., burping fire with too much spice, sneezing with too much ground pepper, etc.). The same process is repeated for the second customer. When the two customers have successfully eaten their dish, a dirty pail cart becomes visible and the user must swipe the plates into the pail (see image b, Figure 81). As a note, the dish may be placed into the pail after the first customer finishes his/her meal, but both pails must be placed in the pail for the interaction to proceed.



*Figure 81.* Customer reactions, cleaning up, and payment. From left to right (a, b, c): Customer reacting positively to served food, returning dirty dishes to the pail, and accepting payment (right). (Permission to reproduce images granted by TribePlay.)

The chef responds by nodding and giving a thumbs up or by nodding and laughing. Coins appear in front of the customers (see image c, Figure 81). The user must swipe the coins to the chef. The chef laughs, and as someone says "Bye," the customers get on the boat and leave. At this point the environment switches between day and night, and another boat arrives with two new customers. This cycle has no time limits, and there is no tallied scores or rewards based on the quality of the dish.

One of the repeating features of Panda's Restaurant 2 is the tools and procedures of preparing food. The user is presented with a food rack area where the customer stands behind the window on the left, with a tray in the foreground, and a shelf of food with three different types of food items on the right (see first two images in Figure 82). The food shelf includes a round red lever with a paw print, which, upon being tapped, cycles around to reveal more options. If the user taps the customer, the customer responds by nodding.

When an item on a shelf is tapped, the customer has three predefined responses that suggest that the customer (a) likes the item very much, (b) is ambivalent with the choice, or (c) dislikes the item. Images a and b in Figure 82 provide two examples of customer reactions. The preferences of customers are consistent through each iteration of the game. The choice in ingredients affects the overall assessment of the dish by the customers at the conclusion of the activity. Knowledge of these preferences (as well as the reactions) are not immediately revealed; this is an element of the simulation that the user must learn through continued usage of the app. Next, the user selects up to three ingredients from the shelf. By dragging over a selected item on the tray and returning it to

the shelf, the user may freely include and remove items before tapping on the check mark

placard.



*Figure 82.* Food rack area in Dr. Panda's Restaurant 2. From left to right (a, b, c):
Customer reacting positively, customer reacting negatively, and chef in the kitchen
(Permission to reproduce images granted by TribePlay.)

Once the check mark is tapped, the chef takes the tray to the kitchen area where

there are three plates (see image c, Figure 82). Once the chef gets into position, the item

on the middle plate pulsates, encouraging the user to do something with the product.

There are five different options from which the user can choose to prepare the food:

sautéing, baking, cutting, blending, and boiling which are outlined below.

**Sautéing.** Sautéing a food item requires the use of the frying pan (see images in

Figure 83). Once the item is selected, dragging and hovering over the frying pan is an

indicator that that tool is selected.



*Figure 83.* Sautéing area in Dr. Panda's Restaurant 2. (Permission to reproduce images
granted by TribePlay.)

Upon releasing the finger, the view changes perspective to a close up of the frying pan. The user can mix the food in the pan, move the pan itself to stir fry the item, or toggle on/off the heat. Although the food does not burn, puffs of smoke appear as an indicator that the item has been cooked. Furthermore, the on/off toggle begins to blink. The user taps on the on/off switch, and a check mark placard appears. Tapping the placard returns the food item to the plate. As this is the main element of stir frying, this option is not available in normal area for the wok dish.

**Baking.** Dragging a food item over the oven causes the food to be placed onto a pan in front of the oven (see images in Figure 84). The in-and-out movement of the pan encourages the user to swipe up to place the item into the oven. The blinking on switch is pressed, and the five-second time begins to count down. The oven turns red, and when the item is ready, the item is removed from the oven, and stars sparkle. The food, then, gets placed back onto the plate.



*Figure 84.* Baking area in Dr. Panda's Restaurant 2. (Permission to reproduce images granted by TribePlay.)

**Cutting and grating area.** The cutting area, which is located to the right of the sautéing area, is selected by dragging the food item from the plate to the wooden board behind the chef. The movement of the cutting board, the knife, and the grater indicate that the specific area is selected. This leads to a closer perspective of the cutting area (see image a, Figure 85). The user chooses between the knife and the grater. If the knife is

selected, the perspective changes to a top-down view. A hand provides an example of

how the item should be cut (see image b, Figure 85). The user drags his/her finger across

the item to make the cut. If the grater is selected, the food item is placed before the tool,

and the user must swipe to produce strips of the item (see image c, Figure 85). Users are

allotted five knife strokes and three grate strokes before sparkling stars indicate that the

limit has been reached.



*Figure 85.* Cutting and grating area in Dr. Panda's Restaurant 2. From left to right (a, b, c): Food item in the cutting area, top-down view of the knife function, and grating strips of food. (Permission to reproduce images granted by TribePlay.)

It should be noted that a blended item can be cut, but cannot be grated. Also, an

already-cut item, which has reached the limited number of cuts cannot be cut or grated

again. In such cases, an "x" sign appears when the item is hovered over the cutting area.

**Blending.** Dragging an item from the plate to the blender, which is located on the

right of the chef, causes the equipment to jump. The interface switches to a close up of

the blender (see images in Figure 86). An animation causes the food item to be inserted

into the blender. The on/off switch begins to blink, prompting the user to tap and/or hold

the button. A blending sound plays as the ingredient mixes.

*Figure 86.* Blending area in Dr. Panda's Restaurant 2. (Permission to reproduce images granted by TribePlay.)

Tapping successively on the switch produces a visualization of the food item being gradually pureeing in the machine. After a while, a check mark placard appears. Tapping on this button returns the interface to the kitchen area, and the mixed food emerges on the plate. After mixing an item, it is possible to continue using other equipment tools with the exception of the grater.

**Boiling.** The boiling area is located to the left of the frying pan. When an item is dragged and hovered over the large pan, the kitchen tool moves to indicate that the tool is selected (see images in Figure 87).



*Figure 87.* Boiling area in Dr. Panda's Restaurant 2. The food item rises to the top and the color of the water changes to add realism to the cooking process. (Permission to reproduce images granted by TribePlay.)

The interface shifts to a top-down perspective, and the food item dropped into the pan. After a while, the food item begins to float. Users may stir the contents by swiping on the contents of the pan. An on/off switch blinks, and when it is tapped, a check mark placard becomes visible. Tapping on the check mark returns the perspective to the kitchen and the food item is dropped onto the plate.

**Wok**. The wok begins in the preparation area. Once the items are prepped, the user drags each ingredient into the wok pan (see image a, Figure 88). The interface is identical to that of the sautéing actions described above. The exception is that, the user is given five condiments on the right hand side of the screen (see image b, Figure 88). This area shakes to encourage the user to use these items. A checkmark placard is visible (see image c, Figure 88), and when tapped, the Panda loading image appears, and the interface reverts to the picnic table where the customers await their food.



*Figure 88.* Wok dish in Dr. Panda's Restaurant 2. From left to right (a, b, c): Chef with the wok in the kitchen, visualization of the wok pan, and presentation of condiments (Permission to reproduce images granted by TribePlay.)

**Pasta**. The pasta segment begins with the chef holding a basket and standing next to a shelf with three types of pasta (see images in Figure 89). The user taps and drags the desired pasta bag toward the chef. The chef replies "Ah" and takes the basket (now filled with the pasta) to the right. Next, in the boiling area, the pasta is dropped into a pot of water. Swiping across the screen mixes the noodles. After a few seconds, the pasta begins

to float, and a check mark placard appears. At this point the user taps on the on/off switch

to proceed to the adjacent straining area, where the user must slide his/her finger

downwards over the floating pan in order to drain the pasta of water. Next, the colander

moves to the plating area where it hovers over the plate until the user slides down over

the colander, placing the pasta onto the plate. At this point, the user is taken to the

preparation area. Once all of the prep work is completed, the user must drag and drop the

prepared food above the plate. Next, the user can place condiments such as tomato sauce,

lemon juice, and salt, among others, atop the food. If too much of a condiment is placed

onto the pasta dish, a voice provides the feedback, "Uh-uh." The user can proceed by

tapping on the check mark placard. When this is completed, the Panda loading image

appears, and the interface reverts to the picnic table where the customers await their food.



*Figure 89.* Pasta dish in Dr. Panda's Restaurant 2. (Permission to reproduce images granted by TribePlay.)

**Salad.** The process of creating salad begins with a head of lettuce hovering over a

wooden bowl (see images Figure 90). The user may tap on the lettuce up to four times to

slide the lettuce into the bowl. Stars sparkle and the user is taken to the preparation area.

Once all of the prep work is completed, the condiments (e.g., vinegar, olive oil, red chili

pepper, etc.) are presented, and the user selects, holds, and drags (up and down) the

condiment into the salad bowl. If too much of a condiment is placed on the salad, a voice

provides the feedback, "Uh-uh." The user can proceed by tapping on the check mark

placard. When this is completed, the Panda loading image appears, and the interface

reverts to the picnic table where the customers await their food.



*Figure 90.* Salad dish in Dr. Panda's Restaurant 2. (Permission to reproduce images granted by TribePlay.)

**Soup.** The soup segment begins with a pan of boiling water, an on/off switch, and

three types of broth (see images in Figure 91). Toggling the on/off power switch

recommences or halts the boiling process. The user may choose as many broth cubes

he/she wishes, although at least one must be selected. The broth disintegrates into the

water.



*Figure 91.* Soup dish in Dr. Panda's Restaurant 2. (Permission to reproduce images granted by TribePlay.)

Next, the user is taken to the preparation area. Once all of the prep work is

completed, the user drags and drops each food item into the pan. In the stove and

condiments area, the soup continues to boil unless the power is toggled off. The user can

stir the soup by swiping across the screen or select, hold, and drag (up and down) various

condiments. If milk, one of the condiments, is added, the broth turns translucent white in

color. If too much of a condiment is placed onto the soup dish, a voice provides the

feedback, "Uh-uh." The user can proceed by tapping on the check mark placard.

**Pizza.** The images in Figure 92 illustrate the process of creating a pizza dish. The

pizza interface is different from the other food options in that, first, the process of

cooking follows a linear procedure, and second, the reactions by the customers are

always positive. To begin, a clump of dough appears on a wooden cooking board. The

user must tap it to flatten it out. Next, the perspective of the dough tilts, and a tomato can

appear. The user taps the can to open it, and holds and drags (up and down) the can until

the limit has been reached or the user taps on the check mark placard. Stars sparkle and a

bag of shredded cheese appears. Again, the user must hold and drag (up and down) on the

screen. Once the limit has been reached or the user taps on the check mark placard, the

bag of cheese is removed from the screen.



*Figure 92*. Pizza dish preparation: adding the ingredients. (Permission to reproduce
images granted by TribePlay.)

A conveyor belt delivers small bowls of toppings. The user can slide the belt left

and right for more ingredients, drag the topping onto the pizza, or move the toppings

around. Once the limit has been reached (14 toppings) or the user taps on the check mark

placard, stars sparkle, and the user is presented with the condiments area where he/she

can select, hold, and drag the condiment up and down on the screen. If too much of a

condiment is placed on the pizza, a voice provides the feedback, "Uh-uh." The user can

proceed by tapping on the check mark placard.

Next, in the oven area, the user is prompted to slide the pizza into the oven (see

images in Figure 93). The user slides up on the screen, and is, then, prompted to turn on

the oven. The user taps on a flashing button, and the timer begins to count down from

five seconds. The oven chimes to indicate that the baking process has ended and the pizza

slides out of the oven.



*Figure 93.* Pizza dish preparation: baking and cutting. (Permission to reproduce images
granted by TribePlay.)

Next, in the cutting area, the user is given a visualization of how to cut the pizza.

The user may drag his/her finger across the areas (for up to three cuts) to indicate where

he/she would like to make the cut. Once the limit has been reached or the user taps on the

check mark placard, sparks sparkle, the panda loading image appears, and the interface

reverts to the picnic table where the customers await their food.

**Nature of Reviews, Users,
and Context**

This app has received a 4.5 (out of 5) overall star rating by 275 customers for all

versions. The most recent version has earned a 4.5 star rating by all 132 raters, but among

the 50 customers who reviewed the app, the average star rating was a 3.8 with a median

of 5. The developer-stated age range of this app is between 6- and 8-years-olds. Among

the seven reported ages of the actual users, the mean age was 6.43, and both the median and the mode were 5.

Twelve customers directly addressed their messages to the developers of the app (e.g., "Please fix the game so it doesn't crash every time my kids try to cook something," Review 31). There were 20 "generally positive" reviews, 12 "generally negative" reviews and 17 mixed reviews. The most common words used to describe the app were "fun" (15 reviewers), "love" (10 reviewers), "awesome" (7 reviewers), "great" (6 reviewers), and "good" (5 reviewers"). Among the more frequent type of comments, 15 customers indicated a desire for more options (e.g., more menu, food options, etc.). Four commenters provided positive feedback for other Dr. Panda apps.

Additionally, 14 reported crashes, glitches, or other technical issues. It should be noted that during the course of the research, similar technical issues were also encountered, rendering the app impossible to reload on the iPad 2, although there were no observable issues on the iPhone 5. However, all of the app content data were collected prior to the loading issues on the iPad, and the problem was subsequently fixed.

**Design of the Learning Space**

Among the 50 reviews, although 31 customers described Dr. Panda's Restaurant 2 as a game, many characteristics of the interaction suggest that the app is more consistent with a simulation. Educational games typically consist of characteristics such as winning or losing, competition, and a reward; features which are not present in the Dr. Panda's Restaurant 2 app.

As the title of the app suggests, the interaction provides a simulation of a restaurant, where a panda chef takes orders from and prepares meals for anthropomorphic customers. The description of the app lists three educational skills that are emphasized:

1. Learning the basic steps of making all sorts of different foods.

2. Getting familiar with how different recipes and kitchen tools work.

3. Picking up on facial cues and choose what things customers want to eat.

While many features of simulations have been introduced in an earlier app (see Toca Hair Salon 2), the following discussion identifies the attributes of simulations found in Dr. Panda's Restaurant 2 and examines how the design of the interaction underscores the educational skills listed in the discussion.

**Simulation types.** The app content of Dr. Panda's Restaurant 2 incorporates characteristics found in, what Alessi and Trollip (2001) categorize as, iterative, procedural, and situational simulations. First, iterative simulations teach content, which is continually manipulated by the user within a static time frame. In Dr. Panda's Restaurant 2, because there are no overt instructions provided, users must discover for themselves about functional elements such as using various kitchen tools, and situational elements such as taking into account the reactions of the customers. As there are no limit on the time for users to select food items and to prepare the meals, users are given sufficient time in their decision-making. Although, in a real restaurant, orders that are late may negatively impact a customer's dining experience, the focus appears to be on the process, as opposed to the consequences of the product. This suggests that learning point of the app is facilitated through the iterative practice of trial-and-error, and through successive

uses of the app, the capabilities and limitations of tools and characters become apparent to the user.

Second, procedural simulations teach a sequence of steps toward a specific goal. In Dr. Panda's Restaurant 2, the first educational skill from the description is to recognize that each recipe follows a predetermined order of steps, and that there is an overlap in steps from recipe to recipe (e.g., selecting items from the food rack, utilizing certain tools). Incorporating the iterative nature of the simulation, successive interactions with a dish helps users learn the sequence of its recipe. For example, the process of making a pizza requires kneading of the dough prior to placing toppings or that the steps of making a wok begins with the selection and prep-work before stir frying the ingredients. In addition to specific ordering of steps, the app provides visual and auditory cues to help the user understand when an ingredient has completed its cooking process. As an example, when cooking the pasta, the user can only move onto the next step when, visually, the noodles float to the top of the boiling water.

Third, situational simulations teach behaviors and attitudes of people. Alessi and Trollip (2001) state that probabilistic (or random) actions in situational simulations help learners investigate alternate approaches to problem solving. In Dr. Panda's Restaurant 2, instructions are presented in non-verbal form, and customer orders and reactions are presented through facial expressions and thought bubbles. Thus, one of the ways in which the app teaches the causal effect of behaviors and attitudes is through the characters' reactions. The app takes, what initially appears to be, random outcomes to provide practice in the third educational skill listed above.

All dishes (with the exception of the pizza) must go through the food rack sequence, where the user selects three items from the rack or pantry and places it on the prep tray for the customer. Users are not directly informed about characters' preferences for certain food items. As a result, the user may, initially, select three items randomly or based on his/her own preferences. However, each customer is pre-programed with preferences for certain food items based on a three-point desirability scale. Table 4 presents the number of characters who disliked an ingredient, felt ambivalence toward an ingredient, or indicated a strong liking to a certain food item.

Table 4.

*Customer Preferences*

|  | Dislike | Ambivalent | Like |
|---|---|---|---|
| **Tomato** | 2 | 1 | 1 |
| **Egg** | 2 | 1 | 1 |
| **Onion** | 1 | 1 | 2 |
| **Pineapple** | 1 | 1 | 2 |
| **Pepper** | 2 | 2 | 0 |
| **Lemon** | 2 | 1 | 1 |
| **Carrot** | 1 | 1 | 2 |
| **Fish** | 2 | 1 | 1 |
| **Sausage** | 0 | 2 | 2 |
| **Mushroom** | 2 | 0 | 2 |
| **Eggplant** | 2 | 1 | 1 |
| **Pumpkin** | 2 | 0 | 2 |

*Note.* Number of characters with certain preferences for each type of food item in the food rack area.

Because the reactions are consistent for each iteration of gameplay, with repetition and practice, users may begin to recognize that that characters' changes in facial reactions provide clues about their predispositions. Based on the item a user chooses, reactions for a completed dish is altered.

**Safety and simplification.** Safety is one characteristic of simulations that is apparent in Dr. Panda's Restaurant 2. In this case, the app medium provides a secure environment where young children may enjoy the process of cooking and serving without concern for dangerous activity or consequences that may occur in a real restaurant. Examples include accidents or physical injuries that may result from the use of tools such as knives, graters, or stove tops, and consequences to the served food include overcooked or burned food, overuse of condiments.

In addition, simplification or omission of certain features allows developers to not only seems to facilitate instruction of complex problems in age appropriate ways, but they also seem to help add focus to the ultimate purpose of the activity, without compromising loads on cognition. Dr. Panda's Restaurant 2 simplifies the functions of a restaurant in a number of ways. In the interaction, the process of making a meal is simplified, with certain procedures being omitted. Specific details in managing a restaurant are excluded. For example, users do not need purchase or restock the inventory in the restaurant, wash the dishes for future customers (although it is implied), or pay rent on the property.

More complicated procedures such as peeling a pineapple or deboning and de-scaling a fish are also omitted. Instead, the pineapple and fish are automatically cut into rings or fillets once the item is removed from the preparation plates. Additionally, while the functionality of cooking apparatuses such as the stove and oven are simplified, and the concept of time is also distorted. For example, the user does not have to wait for the water to boil to insert the pasta, and baking a fillet does not require preheating the oven

and cooking times for baking an ingredient are reduced. Also, the number of cuts, grates, and mixes of certain utensils are limited.

Furthermore, there are limitations on the number of choices available. For example, there are only four customers, five menu items to choose from, and 12 food rack items (in regular mode) in the inventory, of which, only three can be selected for use in the meal preparation. Restricting the number of characters provides users more opportunities to interact and understand the personalities of characters (underscoring educational skill #3 above). Limiting the number of menu items to the wok, pasta, salad, soup, and pizza provides not only practice in the basic steps of making particular dishes (skill #1), but also illustrates how there are similarities and overlap in the process of making different meals (skill #1, skill #2).

## Exploration and Play Through a Visual Experience

In this simulation, one of the key features in motivating users to incite intrinsic motivation is through the emphasis in exploration and play. Alessi and Trollip (2001) underscore the importance of user control through the interaction and participation within a simulated environment. Two points are addressed with regards to Dr. Panda's Restaurant 2.

**Play and exploration.** The first point concerns the experimentation of various kitchen utensils to better understand what objects exist, how they work, and what outcomes each produces. These tools are objects that users may encounter in their own kitchen, including tools that help prepare the food (e.g., a knife and grater) as well as tools that help prepare the food (e.g., oven, frying pan, etc.). Although certain steps are omitted or simplified, the subtle but realistic attributes of many of these tools provide an

element of authenticity in the app experience. For example, when the pasta is cooked, stirring the ingredients cause the noodles to move around in the pot, and when the user swipes on the wok quickly, the contents flip in the pan. Frying items causes ingredients change color (e.g., browning), indicating that the item is cooked.

In addition, this app allows, and encourages, users to test multiple cooking processes in all iterations of gameplay, even if the actions seem unrealistic. For example, a user may initially only fry the fish filet because this may be what he/she is accustomed to seeing in real life. However, in subsequent attempts, the user may boil or even place the filet into the mixer. It is also possible to place an uncooked fish in a salad or place a whole uncut tomato in the wok. The exploration with different uses of food items and uses of tools reinforce the iterative nature of the learning experience and help provide opportunities for users to test the extent of their imagination.

Second, TribePlay states in their description, "A pasta dish to rave about or a soup so spicy your customers will breathe fire! Sweet or salty? Spicy or bitter? It's up to you!" As Alessi and Trollip (2001) write, one of the advantages of simulations is in its ability "to explore questionable alternatives safely" (p. 224). In this app, users are given the opportunity to "test out" or explore various ingredient combinations. It is also possible to intentionally create a meal that the customers will dislike, but the user is not penalized for doing so.

For example, in the food item selection area, the feedback provided by the hippopotamus indicates aversion toward tomatoes, peppers, and mushrooms. Selecting these three items for a meal results in the hippopotamus rejecting the dish and reordering. However, if only two of the items are disliked and one is liked, the feedback is indicated

through thought bubbles. Although these preferences are pre-programmed, once the user becomes aware of the preferences of each animal and the resulting outcomes, the users may choose to elicit a certain response (positive or negative) for the purposes of play. This is also true for the various condiments that can be overused, causing the characters to produce humorous responses.

After completing a dish and receiving feedback, the panda chef is presented with coins by the customers under two conditions: the customer has indicated approval of the dish, and the user returns the plate to the dish rack. Although coins are collected, this simulation differs from a game in that there is no cumulative tally, score, or reward that is recorded. The nature of the simulation suggests that the overall goal is not simply to replicate the real world precisely and accurately or to focus on creating an ideal product (i.e., to serve the requested meal to the customer's satisfaction). In contrast, the design suggests that the learning occurs through the exploration of ingredients, recipes, cooking, as well as human behavior through the continued and repetitive use of the app.

**Educational implications.** The guiding educational philosophy of Dr. Panda's Restaurant 2 seems to be that of experiential learning or learning by doing. John Dewey, a philosopher and psychologist during the Progressive Era, explained the importance of direct personal experience in education. At the time, Dewey wrote in response to the industrialization of society and the negative impact it had in the education of children about responsibility obligation to act; cultural values that were once experienced in the household and community life (Dewey, 1915). He argued that, with modernization, traditional schooling was becoming devoid of real or authentic experiences that reflected social life. Furthermore, he critiqued the mechanistic methods of drill-and-practice in

schools, in particular the instruction of abstract knowledge devoid of context. For Dewey, abstract knowledge was only meaningful through concrete experiences.

In his lectures, Dewey (1915) provided an example from observing a cooking class, which focused on egg preparation. Rather than providing a cookbook or a recipe, the teacher encouraged the children to experiment with the food items: "So undoubtedly the little child who thinks he would like to cook has little idea of what it means or costs, or what it requires. It is simply a desire to 'mess around,' perhaps to imitate the activities of older people" (p. 39). In the class, the students compared and contrasted the characteristics of vegetables (e.g., woody fiber, cellulose, etc.) and meat (e.g., connective tissue) that held each together. As a transition from learning about vegetables to learning about cooking meats, the class experimented with eggs in various temperatures of hot water to see the how the qualities of egg whites changed. Dewey stated,

> For the child simply to desire to cook an egg, and accordingly drop it in water for three minutes, and take it out when he is told, is not educative. But for the child to realize his own impulse by recognizing the facts, materials, and conditions involved, and then to regulate his impulse through that recognition is educative This is the difference, upon which I wish to insist, between exciting or indulging an interest and realizing it through its direction. (p. 41)

Dewey's ideas on children's experiential knowledge creation may be relevant despite the transformation of the learning environment from school classroom to app environment. In both cases, the experience begins with the curiosity of the child; however, the educational goal is guided through a teacher or certain capabilities of the educational app. Dewey writes,

> All children like to express themselves through the medium of form and color. If you simply indulge this interest by letting the child go on indefinitely, there is no growth that is more than accidental. But let the child first express his impulse, and then through criticism, question, and suggestion bring him to consciousness of what he has done, and what he needs to do, and the result is quite different. (p. 41)

Similarly, in Dr. Panda's Restaurant 2, the learning experience allows children to experiment with various food items, utensils, and tools. On one hand, because of the lack of rewards or overt instructions for what a "good dish" should look like, it may be assumed that there is no intended learning goal or purpose beyond exploration and play. Gengry (1990) echoes Dewey's sentiment regarding experiential learning that is devoid of a motive: "What the student takes away from a particular experience is often idiosyncratic to his/her perceptions of the experience, and is somewhat outside the control of the instructor" (p. 9).

On the other hand, the capabilities (that allow certain functions), and the limitations (that restrict certain actions) point to a non-direct, but purposeful, instructional strategy that underscores Dewey's emphasis on learner-initiated experimentation and app-enabled guidance and feedback. For example the reactions of the panda chef cues users on what is acceptable and what is now. The required usage of certain ingredients (e.g., the soup base) and of certain sequences (e.g., using the strainer before putting the pasta on the dish) target specific outcomes which, without guidance or restrictions, may revert to the indefinite indulgence depicted by Dewey above. The general approach to the instruction of Dr. Panda's Restaurant 2 can be described as a gradual, yet recursive, learning process supported by the instruction of both procedures in the meal creation process and social customs through the interpretation of interpersonal skills.

**Instructional Issues and Concerns**

Despite the educational potential of the app, Dr. Panda's Restaurant 2 received numerous unfavorable reviews. The two most frequently appearing requests were to fix

the technical crashes and to incorporate a larger variety of options (e.g., diversity in the food item choices or dishes).

With regard to the technical issues, it is important to see whether the reports were ongoing problems or an isolated event in the development of the app. The 50 consumer reviews were written between February 13, 2014 and June 17, 2014 (i.e., date of data collection). There were two version updates during this time. The first reported a smoother user experience on the iPad 2 and iPad mini. The second update indicated a reduction in memory storage. Among the 14 customer reviews that indicated technical issues, 11 occurred between February 14, 2014 (or four days after the first version update) and March 31, 2014, for a duration of 45 days. There were no reported issues prior to the first update (or for a duration of 18 days). Among the 11 customer reviews, five occurred before the iOS 6.1.6 update, and six occurred after. March 31, 2014 was the same day that Tribeplay made their second version update (1.1) available for the app For the next two months and 7 days (68 days), there were no reports of crashes or glitches. From June 7, 2014 until the date of data collection there were three reported crashing issues.

This suggests that crashing issues were most prevalent after the first version update up until the second version update. Although it is not possible to determine whether or not the customer reviews had any influence on the changes made by the developers, the second version update seemed to have mitigated many of the reported technical issues encountered prior to the update. Thus, although, in reading the reviews, the technical issues seemed to be a consistent issue that was reported in the commentary,

in considering the timeline of reports, many of these issues occurred prior to the second version update.

The second critique involved requests for more options: "Great game but cooking the same stuff can be boring. Adding more things will give it more diversity" (Review 7). Reviewer 41 stated,

> Could have had a menu so you could select the meal, could have had breakfast, lunch and dinner meals, so kids could make more stuff...pancakes, omelets, sandwiches, etc. Dessert items would have been lots of fun too, And who eats without a drink of some kind.

Reviewer 36 wrote, "Like other reviewers, I wish there were more options in the cooking portion of the game…" Another comment referred to the process of the simulation. Reviewer 30 stated, "You should also be able to put MORE than 3 ingredients per plate." In a real restaurant kitchen, it is likely that a dish may use more than three ingredients.

On one hand, the additions of options would reduce the attrition rate and enhance the retention in the entertainment of the simulation. From an instructional perspective, more options would mean that users would be given more opportunity to expand their knowledge of different types of food and recipes. On the other hand, limiting the number of options, in terms of dish types may also have its advantages. For example, minimizing the variance in procedures ads focus to the redundancy and overlap of basic cooking skills. Additionally, with regard to the number of usable items per dish, using only three items expedites one iteration, or life cycle, of the interaction (i.e., from the customers arriving until their departure), allowing more opportunities to explore and discover different combinations of customers and recipes.

**Dr. Panda's Restaurant 2**
**Summary**

TribePlay's Dr. Panda's Restaurant 2 provides a fun and safe experience for young users. The app takes advantage of the simplified but experiential iterations of exploration and play to teach procedural and situational skills associated with cooking. The procedural elements incorporate practical knowledge about different food items and kitchen tools. The situational features provide a context for understanding the consequences of complying with or rejecting certain preferences of the animal customers.

## App IX: Bug Art

According to the Little Bit Studio (n.d.) website, Bug Art is described as "an amazing creative platform that enables kids of all ages to produce works of art and design their very own life-like bugs." Among the 14 customer reviews, 9 referred to this app as a game. Although Toca Boca AB's Toca Town appeared 22 times on the top nine list, it was excluded from the final selection because Toca Boca AB app (i.e., Toca Hair Salon 2) was already selected in the final list, and as a result, Bug Art, by Little Bit Studio LLC., became the final app explored in this study.

Bug Art first appeared on March 13, 2014 and has appeared on the Top Nine app list 21 times but has not been updated since the first version. At the time of data collection, Little Bit Studio, LLC. had seven apps available for the iPad in the iTunes App Store. Bug Art requires 169mb of storage, iOS 4.3 or later, and is compatible with the iPhone, iPad, and iPod touch. In addition, this app is localized for 14 languages. In the description, the developers noted their child privacy policy, and stated that there are no third party advertising, no in-app purchases, and no collection of personal information.

**Overview of App Options**

Bug Art begins with a logo splash page followed by one of three randomized opening sequence animations (see first image, Figure 94).



*Figure 94.* Opening animation and main menu of Bug Art. One of the opening sequence animations (left) and main menu area (right). (Permission to reproduce images granted by Cupcake Digital, Inc.)

In the main menu area, there are seven items that can be selected: a dandelion, Settings, Free Paint, Bug Race, Bug Designer, Butterfly Valley, and Playground (see second image, Figure 94). Tapping on the dandelion results in a short animation of the flower blooming.

The Settings icon leads to a "Kids Lock gated area" where the user (or parent) must answer a simple multiplication problem or return to the main menu by tapping "Cancel" (see image a, Figure 95). Two main areas of the Settings section can be toggled and selected: Settings and About Us (see images b and c, Figure 95). In the default Settings panel, there are options available for language, play, and profiles that can be toggled on and off. Enabling profiles allow multiple users to view individual achievements and creations. The About Us section introduces the coder and artists of the development company as well as links to other apps, copyright information, and a support email.

*Figure 95.* Settings section of Bug Art. From left to right (a, b, c): "Kids Lock gated area," settings area, and about us area. (Permission to reproduce images granted by Cupcake Digital, Inc.)

The remaining icons comprise the four main interactive areas of Bug Art. The five section of the Bug Art learning space include three exploratory sections and two games. All of these areas include a "II" pause button on the top right corner, allowing users to pause, return to the area, or return to the main page.

**Free paint.** The main menu of Free Paint includes a top section, where the user selects from 1 "new" document, 11 backgrounds or 7 "Learn" areas (from left to right). Tapping on any document presents the painting area. This painting area consists of an art board, an expandable color palette, and a link to the Library (see images in Figure 96).



*Figure 96.* Free Paint activity. Main menu (left) and one of the backgrounds (right) of Free Paint. (Permission to reproduce images granted by Cupcake Digital, Inc.)

The main paint area is the art board, where the user swipes across the screen to color, draw, paint, and design using the selected tool (see images in Figure 97). Tools can be selected by tapping on the large round paint swirl, located at the top right corner of the screen. This displays a two-tiered drawer, which includes 43 stickers, 7 drawing and paint

tools, 7 bugs, and 7 stamps and 1 camera icon. The color palette, located below the large

paint swirl includes 11 different paints including a rainbow swirl, which slides open a

hidden drawer with 30 additional colors. This is the common interface for both Free Paint

and Bug Designer areas.
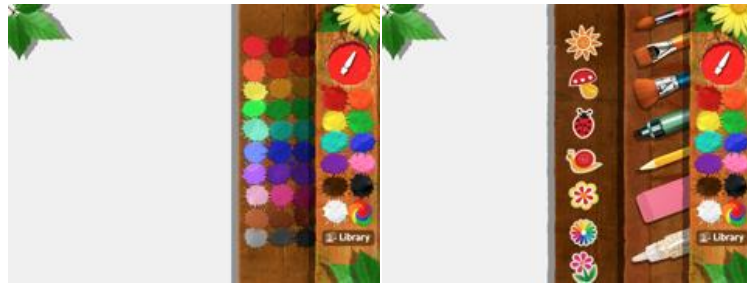


*Figure 97.* Tool Palette in Bug Art. (Permission to reproduce images granted by Cupcake Digital, Inc.)

In the Free Paint main menu, when the "new" white document is tapped, a blank

sheet appears in the paint area. Eleven backgrounds allow users to paint over a pre-drawn

pastel illustration. The "Learn" area opens a blank document with a partially drawn

outline of a bug (see image a, Figure 98). Users select a desired color and trace the

outline using instructional arrows as a guide (see images b and c, Figure 98). Upon

finishing the instructional outline, users may use the paint tools to color in the foreground

and background.
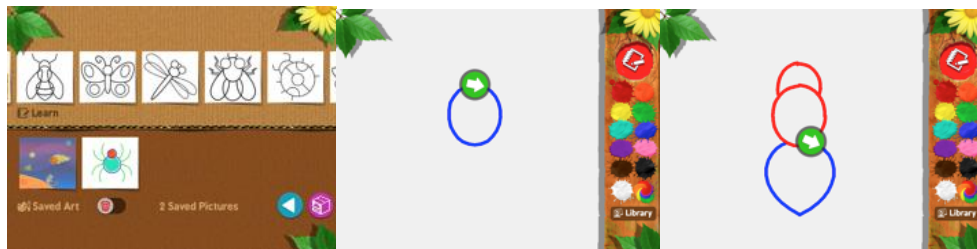


*Figure 98.* The Learn area of Free Paint in Bug Art. From left to right (a, b, c): Free Paint Learn templates, guides in Learn area, and drawing with guides in learn area (Permission to reproduce images granted by Cupcake Digital, Inc.)

The bottom area of the Free Paint main menu display any saved art that can be opened by tapping on it or discarded by tapping the trash icon. In addition to these options, there are two icons, a leftward pointed triangle and a cube with a ladybug. Tapping the triangle reverts to the last opened document (regardless of it being saved or not). The cube returns the user to the main menu.

**Bug designer.** The main menu of Bug Designer is similar to the interface of Free Paint. The user taps the desired template and he/she is taken into a painting area. There are two notable differences. First, the top horizontally scrolling area includes nine "Stencils" and nine "Realistic" images (see image a, Figure 99). These images can be designed and customized for use in "Bug Race" and "Butterfly Valley." Second, in addition to the leftward pointed triangle and the cube, if the user has entered the bug designing area from either "Bug Race" or "Butterfly Valley," there is an icon that directly links back to the previous area.

When a template is selected, the user is taken to the same paint area as Free Paint, with the addition of an advanced bug designer activity (see image b, Figure 99). In the lower left corner, a bug icon leads users to an area where they may drag their finger across the screen to preview their creations (see image c, Figure 99).



*Figure 99.* Bug Designer activity. From left to right (a, b, c): Stencils in Bug Designer, sample stencil, and animated preview of designed bug (Permission to reproduce images granted by Cupcake Digital, Inc.)

**Bug race.** Bug Race simulates a drag race among bugs. The Bug Race main menu

is divided into the top title banner and the bottom interface (see image a, Figure 100). In

between, the word "Be Awesome. Select your racer…" instructs the user to select a bug

for the racing game. There are three options: select a bug designed in Bug Designer,

create a new bug in Bug Designer, or select one of six pre-designed bugs. Tapping on a

bug leads to the game area where the user's bug and two other bugs crawl out of a

cardboard hole. The level number is presented at the top of the screen as well as the

accumulated points.



*Figure 100.* Bug Race main menu and interface. From left to right (a, b, c): Bug Race
main menu, visual instructions, and reaching the goal. (Permission to reproduce images
granted by Cupcake Digital, Inc.)

Instructions are provided by a hand with the index finger extended (see image b,

Figure 100). Bug Race begins with an engine sound and smoke coming out of the rear or

the bug. A praying mantis, which is visible in the top half of the screen, lowers two flags,

raises both, and lowers the green flag. The user must tap alternating buttons to accelerate

the bug toward the goal. The race is a straight line, and the bugs run through various

terrains, such as grass, wood, and coarse dirt. The goal of the game is to reach the end of

the drag strip (see image c, Figure 100).

Every third game is a 'boss' round, where the user competes with one other bug

(see images a and b, Figure 101). If the user finishes in first or second place, the user

advances to the next level. Points are awarded based on the placement in the ranking. As the level increases, the competition becomes more difficult. The game concludes when the user-selected bug is last place in the race. The tallied score is presented along with positive feedback (see image c, Figure 101).



*Figure 101*. The boss round in Bug Race. From left to right (a, b, c): Boss round against Diamond, boss round against Stinky, and final point presented after getting third place. (Permission to reproduce images granted by Cupcake Digital, Inc.)

**Butterfly valley.** The Butterfly Valley interface is similar to Bug Race, although with different words and images. It is divided into the top title banner and the bottom interface. In between, the word "Be Graceful. Select your racer…" instructs the user to select a butterfly (or flying insect) for the game (see first image, Figure 102). There are three options: select a butterfly designed in Bug Designer, create a new butterfly in Bug Designer, or select one of three default butterflies or flying insects.



*Figure 102*. Main menu and interface of Butterfly Valley. Butterfly Valley main menu (left) and visual instructions (right). (Permission to reproduce images granted by Cupcake Digital, Inc.)

Selecting a butterfly leads the user to the game area, where a top-down perspective displays a grassy area. The point tally is visible on the top left corner of the screen. The selected butterfly emerges, and an animation instructs the user on how to hold and turn the device for the game (see second image, Figure 102). The words "Steady, 3, 2, 1" are displayed on the screen.

A lighter colored area of the grass provides the path upon which the butterfly must follow (see image a, Figure 103). Points are accumulated and energy is restored as the butterfly crosses a green horizontal bar that is set between two dandelions (see images b and c, Figure 103). The game is concluded when the energy level is depleted.



*Figure 103.* Gameplay of Butterfly Valley. From left to right (a, b, c): Beginning of Butterfly Valley game, crossing a gate, and passing a gate. (Permission to reproduce images granted by Cupcake Digital, Inc.)

**Playground.** The Playground area uses the same interface as the previous areas. The writing in the middle of the screen displays "Explore and Play. Select your bug…" (see image a, Figure 104). The bottom horizontal navigation displays the designed bugs, the bug designer link button, and the predesigned bugs. Tapping on the bugs leads the user to one of two environments: one for flying insects and one for crawling bugs (see images b and c, Figure 104). Both of these contexts are viewed from a top-down perspective. The user drags his/her finger across the screen, leading the bug or flying insect around to interact with various objects and other bugs in the environment.

*Figure 104.* Playground activity. From left to right (a, b, c): Playground main menu, bug exploration area, and butterfly exploration area. (Permission to reproduce images granted by Cupcake Digital, Inc.)

In the Playground activity, small pearls can be searched and collected throughout the environment and is tallied on the top left corner of the screen (see images in Figure 105). The aggregate count of these pearls is displayed in the main menu.



*Figure 105.* Collecting pearl bubbles in the Playground. (Permission to reproduce images granted by Cupcake Digital, Inc.)

**Nature of Reviews, Users,
and Context**

This app has received a 4.5 (out of 5) overall star rating by 32 people and was reviewed by 14 customers, who have all posted a star rating of 5 stars. Overall, the 12 generally positive comments indicated that reviewers had a favorable opinion of the app. Four of the reviews commented positively about the usability of the interface (i.e., no in-app purchases, no accidental clicks, no ads or pop-ups, and the intuitiveness). Three specified that the app was worth the purchase. Two reviewers, whose feedback was

categorized as mixed, provided a generally positive evaluation, aside from specific features they requested from the developers. These included the ability for ladybugs to fly in Butterfly Valley and the ability for a user to name his/her own bugs.

The Made for Ages rating for Bug Art was ages 0-5. Among the 14 reviews left by customers, eight reviewers specified the age of the actual users. Because the app was intended for young children, it is not surprising that adults were writing the reviews for the children. Twelve indicted that they were the parents or grandparents of the users of the app. Among the nine parents who indicated a gender of their child, five were female and four were male users. These users ranged from ages 2-7, with a mean, median, and mode of 4. The three reviewers indicated a recommended age group for the app, two stated that this app was applicable for kids, and one indicated that it was appropriate for younger children.

In addition, four reviewers indicated that their child enjoyed the creating process of the bugs, and five indicated their enjoyment of the visual aesthetics of the app (e.g., the graphics, the textures, the beauty, and the animated bugs). The most commonly used words to describe this app were "love" (which was mentioned seven times), "fun" (three times), and "great" (three times). Other words used to describe this app were amazing," "awesome," "engaging," "excellent," and "fantastic," among others. At the same time, only two reviews indicated that the app was educational or that the app was helping a child learn.

**Design of the Learning Space**

Bug Art provides an exercise in art exploration and visual art skill development. Because all areas of the app require users to move their finger across the screen or move

the iPad device, it can be argued that the app provide exercises in digital-tactile development. This app also provides a simulated nature-science context within which children utilize their creations to explore different types of terrains and environments. The learning space incorporates five interactive areas with no defined linear sequence, although, creations in the Bug Designer area can be applied to other areas of the app. The following themes were discovered through the research of the app.

**Philosophical rationale.** Bug Art incorporates many ideas of constructivist approaches. Constructivists embrace the idea that the understanding of reality is through the process of subjectively interpreting and making sense of what we perceive (Alessi & Trollip, 2001). With respect to learning, constructivist instruction focuses less on design of the instruction toward a specified outcome. Instead, constructivist practices assume a) students actively construct, rather than passively receive knowledge; b) students are naturally motivated; c) meaning is created through connecting new information with prior knowledge; d) knowledge can be personally or socially constructed; and e) knowledge is best constructed in authentic learning contexts where ill-structured problems parallel real life issues and problems.

One of the most vocal critiques concerning constructivist instruction is the perception that there is no guidance given to learners: "rather than being presented with essential information, must discover or construct essential information for themselves" (Kirschner et al., 2006, p. 75). Sweller (2009) asserts that in constructivist practices, the instructor purposely "withhold[s] easily presented information from learners" (p. 127) when guidance is needed by the learners to proceed. Such advocates of explicit instruction use a narrow definition of constructivism (Kirschner et al. 2006; Klahr, 2009),

which is not supported by all constructivists (e.g., Spiro & DeSchryver, 2009). Ernest (1995) strongly cautioned against this reductionist view of constructivism as "an overly child-centered, romantic progressivism" (p. 464) and the notion of instruction as an endorsement of every child's expression of internal creativity.

In reality, Duschl and Duncan (2009) state that constructivist agree with that guidance is necessary, however, they state that "where we part company is how that guidance is provided and to what ends" (p. 316). Gresalfi and Lester (2009) contend that guidance can be provided in many forms, and in constructivist learning environments, teachers are rarely transmitting information in the front of the room, however their role is far from the image of a detached, unresponsive figure in the classroom: "…he or she is moving around between groups, or listening to conversations, intervening to redirect, reframe…and remind students about connections between different ideas" (p. 274).

**Constructivist applications.** Despite previous critiques on constructivist learning, Bug Art provides an example of constructivist learning whereby art skills are presented recursively through the design of the learning environment. Although the developmental goals of art skills are not overtly (or linearly) specified by learning area, the underlying objective of each learning exercise suggests that the app facilitates the exploration of art for children of varying developmental levels and skill sets. Four broad levels related to visual arts learning are identified in the two art-specific learning areas of the app.

The first is to facilitate a safe, constructive environment within which users can freely draw and explore. In the customer reviews, many parents made note of the lack of in-app purchases and ads (e.g., Reviews 2, 5, 10) that are usually considered distracting

for children. Goals are self-directed, and processes are discovered through the selection

and testing of various tools. According to Wachowiak and Clements (2006), one of the

benefits of utilizing digital technology to produce art is the emphasis on the creation

process as opposed to the product. Digital art allows for a non-destructive means by

which users utilize tools to test colors or morph and manipulate objects through trial and

error.

For example, although there are no options for layers, opacity, filters, undoing, or

blending of colors, the simplification of tools available in Bug Art allow the youngest of

users to not only explore the use of colors, shapes, textures, and sizes of painting and

drawing tools, but also utilize patterns and shapes of stamps and stickers to understand

the additive ordering of the creative process (e.g., placing a sticker over a drawing will

cover the drawing). Although the end product may seem like scribbles to an adult,

Danko-McGhee and Slutsky (2007) state that the act of moving his/her finger or a stylus

across the screen is a practice in kinesthetic exercise that is vital to cognitive functioning,

particularly with young children.

Additionally, the blank page of Free Paint allows young children to develop their

individuality and identity through the doodles. According to Southworth (2009),

> art should ensure opportunities for the child to be himself whilst learning about
> others and other things. If the child is not being himself then what he is doing may
> not be art, since the essence of the artist is his uniqueness and no two children are
> alike. (pp. 25-26)

The process of scribbling and doodling are the beginnings of a child's natural process of

self-expression: "When children scribble, their physical and mental gestures become

visible. The marks of their bodies and minds taken on permanence" (Danko-McGhee &

Slutsky, 2007, p. 5). Even simple lines become a graphical mode of communication for

children who may not be verbal. Thus, the first level of the art instruction in Bug Art facilitates an experiential context of personal expression and discovery.

The second level highlights an important concept in development of visual arts skills where children's drawings begin to become associated with a meaning. Both Free Paint and Bug Designer enable the exploration and improvement of drawing and painting skills through the creative selection and use of various tools; however, both offer an added layer of complexity in goals beyond free exploration. For example, the 11 different background templates in Free Paint provide a situational objective, offering a springboard from which children's ideas and imagination may develop. These scenes differ in terms of familiarity and realism. Some users may be more familiar with classroom, farm, desert, or outer space scenes. Nonetheless, users have the ability to create a visual story without judgment or criticism based their knowledge (or lack thereof) of the environment as well as their interests.

For example, although there are outer space-related stickers (e.g., astronaut, space ship, rocket, etc.) that may be relative to the two space-related backgrounds, the user may choose to place a soccer player, flowers, or a turtle. The drawings and objects placed into the illustration may seem exaggerated (e.g., oversized people) and colors may not be reflective of reality (e.g., purple dogs). While the user is not constrained in terms of realism in the scene, the incorporation of background templates introduces to the young artist not only the concept of foreground and background or the placement of objects within a setting, but also a new layer of sophistication, illustrating the more complex ways of representation and communication of a meaning.

The third level concerns the introduction of realism in the development of art skills. As children begin to understand that the lines and shapes they draw communicate socially shared meanings, the refinement in the details in the drawings as well as in the realism of the colors begin to develop (Danko-McGhee & Slutsky, 2007). Improved control and organization in drawing skills add realism to the intended objective. Whereas, in previous exercises, the main object of the drawing and painting processes were arbitrary, the bug templates of the Free Paint area provide a precursor to what may be considered as still life drawings. The "Learn" area of Free Paint picks up where the Background lesson left off, and the guidance of interactive contour lines teaches users how to draw objects (in this case, bugs) in a way that is a closer representation of the real bug.

As a final level in the development of art skills, the Bug Designer area further advances the development of artistic skills. In both Free Paint and Bug Designer, the functions of the tool palette are almost identical: users select an image from the menu, tap on a tool, and swipe on the screen to apply the colors, stickers, or stamps. However, where the two learning areas differ is in the terminal goal. Unlike Free Paint, Bug Designer incorporates additional features. First, the fidelity of the stencil outlines are more realistic to the actual bug. Shapes of bugs are no longer represented by simple lines, circles, and curves. Instead, the illustrations demonstrate more precision in the contours of the bugs through the variability in sizes of the lines (e.g. webbing of the wings of a dragonfly or a bee).

Second, two versions of each bug are presented: the outline version and the photo-like depiction. While the realistic version can be manipulated and further decorated, it

also serves as a model, providing a worked-out example of what the bug would look like in real life. Third, users not only can preview the super-imposed design on a stereographic image of the bug, but can also to move the bug around in the drawing board. In Bug Designer, the goal extends beyond an expression of personal meaning. The app facilitates a visualization of the product, in motion, in a world external to his/her imagination. Furthermore, by contextualizing the user's creation in a preview, the affective goal may be to deepen the user's appreciation for the discovery and exploration of natural organisms and environments. Reviewer 10, a parent, wrote, "My daughter simply loves creating new bugs, and she ADORES watching her creations come to life!"

**Gaming vs instructional goals.** Among the 14 reviews, nine referred to this app as a game, as opposed to an art app or coloring app. In Bug Art, the areas Bug Race and Butterfly Valley, and to a certain extent, Playground, incorporate certain features of gaming (Alessi & Trollip, 2001)**.** For example, each game has a goal or mission to complete, and the levels become increasingly more difficult. Bug Race is a competition to see who can tap on the screen fast enough to reach a certain distance first. Various terrains alters the speed of the bug, and increasing levels of the game requires a higher aptitude of the competitor. The goal of Butterfly Valley is to see how long the user can balance and maneuver the device through a chain of dandelion gates. As time passes, the speed and proximity of the dandelion gates increase.

Furthermore, while is possible to lose in Bug Race and Butterfly Valley, because of the additive nature of the point system, there are no deduction of points once the points are accrued. In both games, the competition is between the user and the computer. Although profiles can be created for multiple people, the gaming aspect is not a

competition among players. In other words, top scores are personal and individualized. The gaming goal, then, is simply to accumulate as many points as possible. Users are not given any further rewards beyond the point system. Thus, retention in continuing to top the last highest score must be achieved through other intrinsically motivating factors.

Aside from the gaming goals, there is a need to examine the role of the games in the broader context of the instructional goal. As indicated in the previous section, the capabilities of Bug Designer allow the user to synthesize individual construction of meaning with the world beyond the immediate self. A unique feature of the app is the ability for the child to use his/her own creation in the gaming and exploration portions of Bug Race, Butterfly Valley, and Playground. While the primary functions of the games may be to have fun through play, the overall flow of the instruction suggests a higher-level goal of intersecting the individual and the social and natural world. By incorporating the functionality of the drawing experience with the games, the app teaches children that not only does a piece of artwork convey a personal meaning, but that it also serves a purpose. In this way, the app establishes a motive beyond the immediate exercise (e.g., drawing, painting).

Furthermore, Danko-McGhee and Slutsky (2007) underscore the importance of displaying, revisiting, and reflecting on a child's artwork. They suggest displaying children's artwork in a visible area and to change it regularly. In Bug Art, by merging the designed bugs into the interactive areas of the app, the visibility of a user's creation becomes infused in the already motivating nature of games. Furthermore, children become engaged in not only reviewing and reflecting on the art they have created, but

also are inspired to create new renditions of their art, allowing further practice of their visual art skills.

**Interdisciplinary Art and
Science Education**

The importance of art in education has been extensively debated in the literature. In academia, although the current Common Core Standards do not include the subject area of Fine Arts, the Partnership For 21st Century Skills (n.d.) highlights the importance of art education and the skills related to creativity and innovation in facilitating "21st century readiness." Furthermore, in 2014, the National Visual Arts Standards (NVAS) was created through the organizations of the National Coalition for Core Arts Standards (NCCAS) with the intent of developing a national visual arts standard for art education for Pre-K through grade 12 students. Among many reasons for incorporating art in education, Wachowiack and Clements (2006) list cultural understanding; national needs; celebrating ordinary experiences; personal communication and expression; creativity; vocations; aesthetic awareness; and visual literacy and integrated learning as some of the benefits.

Furthermore, as indicated before, Bug Art incorporates elements of visual arts and nature science. Wachowiak and Clements (2006) state that art and science share a number of common goals such as the developing of curiosity; the building of a knowledge base; the visualizing of mental images; and the investigating, fantasizing, and combining objects and ideas in new ways. As a classroom-based example, Cowie and Otrel-Cass (2014) describe a case study, where a teacher used scaffolding of children's thinking through the combination of experiential learning (e.g., reading of storybooks, visiting a reptile habitation) and art to sustain children's interest and curiosity on the topic of the

tuatara (a reptile endemic to their country of New Zealand). One of the strategies she incorporated in the lesson was to prompt students to draw pictures of their understanding of the reptile. The teacher observed that the drawings became progressively detailed and complex based on the children's exploration and discovery of new knowledge about the tuatara. The act of drawing is seen to enhance engagement with different learners, to help learners generate representations in science, to help visualize reason in science, and to communicate (Ainsworth, Prain, & Tytler, 2011).

**Instructional Issues and Concerns**

The discussion of Bug Art illustrated the use of guidance through the design and the capabilities of the technology to facilitate a systematic progression of visual art skills. For the user, the app may be a fun experiential and exploratory activity in drawing and playing with bugs. At the same time, individual exercises in the various areas of the app seemed to provide guidance for different levels of drawing skill. Thus, in many ways, the design of the instruction facilitates a social interaction between the user and the app, whereby strategies of increasing complexity in the exercises provide the scaffolding strategies used in a classroom.

However, there is one essential component that is continually underscored in an academic visual arts literature is seemingly limited (or perhaps assumed) in the app experience. Much of the discussion on art education and effective transfer of art skills in other disciplines specify the importance of allowing children to talk about their art projects with others (e.g., parents and peers) as they complete them (Althouse, Johnson, & Mitchell, 2003; Danko-McGhee & Slutsky, 2007; Wachowiak & Clements, 2006). According to Althouse et al. (2003), art talk "includes references to the child's interest in

media and tools; the expressive quality of his marks, ideas, feelings, efforts, and inventiveness; and an understanding of the basic elements and principles of design" (p. 130). For example, in the Cowie and Otrel-Cass (2014) case study, the creative process was only one element in the overall goal of learning about the tuatara. In addition to the drawing exercise, the teacher incorporated several other activities (including discussion of the drawings) that complemented the overall instructional goal.

Although it is not possible to fully understand how the app is being utilized by children and their social circle from only examining 14 reviews, evidence in the customer reviews suggest that those parents and guardians that have commented, at the minimum, are observing the child's interactions with the app or are knowledgeable about the app content. One parent stated, "I am glad I bought this app....My son loves creating bugs and making them come to life! He also enjoys bug racing, the bosses are awesome!" (Review 14). Reviewer 7 wrote, "Graphics are out of this world and games are so engaging and intuitive. My three year old loves it as much as my seven year old. The section where you color bugs has set the bar so high that every other drawing app pales in comparison." The review by another parent suggested that the app experience was shared: "This is a beautiful, engaging app that entertains my boys for quite awhile. We're still exploring all the various games, but so far this is a winner!" (Review 4).

While the communication between parents and children about the child's artwork can only be assumed, it is clear that the developers of the app made a conscious decision to design the app where (a) artwork is separated by profiles, (b) games are not competitive among players, and (c) artwork is stored locally in the app with no in-app

option to save them on the device. As a result, opportunities to share and talk about the drawings and bug designs become limited.

**Bug Art Summary**

Bug Art is a multi-disciplinary, child-friendly platform within which art and natural science skills, as well as fine motor skills, are introduced to and developed by young children. Two prominent actions in the app include drawing and painting artwork in addition to applying user-created bugs and butterflies in simulated environments. The present study introduced constructivist perspectives of learning and detailed how guidance is provided through the capabilities of the app. On one hand, there are no limitations on a child's creative engagement and discovery of his/her own artistic innovations. On the other hand, missing in this app are efforts to directly facilitate collaboration and competition among peers. Furthermore, the attainment of key visual literacy practices are limited by the amount of social, out-of-app interaction a child has with his/her surrounding support group.

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**Chapter IV Summary**

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This chapter presented a descriptive analysis of the nine most frequently appearing apps sampled over a four-month period. The instructional analysis diagrams served as a model to provide a detailed account of the available functions and actions of each app experience in the overview. The aggregate results from the customer review data (e.g., demographic and attitudinal information) were reported in the nature of the reviews, users, and context section. Subsequent sections explored the nature of the instruction, highlighting the capabilities, limitations, and design of each app. The resulting data demonstrated a variation in instructional sequencing, strategies, and

purpose, within and among the apps. In Chapter V, the ideas presented in this chapter will

be framed within a broader context of the educational app culture. Mediating elements

that contribute to the overall app experience will be explored.

# CHAPTER V

# DISCUSSION OF EDUCATIONAL APP CULTURE

Anthropologists, instructional technologists, and historians have not had time to debate much less define the phenomenon of an "app culture." Since there is no definitive definition of the term, borrowing from the earliest definition of culture may provide an ironic authenticity toward establishing a foundation upon which the discussion in this chapter proceeds. The English anthropologist, Edward B. Tylor wrote in 1871, "culture, or civilization, taken in its wide ethnographic sense, is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society" (Tylor, 1871, p. 1). This definition suggests that culture is an amalgamation of the history, events, experiences, etc. that individual members of a community mutually compose and continually adjust. Culture is not a static notion that may be explained by simply investigating its fragmented parts, however. The discrete pieces are mere reflections of that culture. Tylor goes on to write,

> Our modern investigators in the sciences of inorganic nature are foremost to recognise, both within and without their special fields of work, the unity of nature, the fixity of its laws, the definite sequence of cause and effect through which every fact depends on what has gone before it, and acts upon what is to come after it. (pp. 1-2)

Culture includes the interactions among its parts as well as the existence within its dynamic and historical development. Thus, change is an essential and inevitable quality in any culture.

While the conceptualization of an "app culture" in the present study may seem inanimate and lacking in community membership, many parallels can be drawn from the anthropological understanding of culture through an activity theory framework. Up to this point, the research has explored the nature of the constituent parts (i.e., the gamut of the information available for the nine apps) with very little representation of the broader whole. However, the cultural aspects of the apps require an understanding of the context within which they reside, individually and among the members of the community. Although versions of updates may have remained static for certain apps, they are nested within a culture that is in constant fluctuation. Thus, the purpose of this chapter is to identify characteristics that represent and contribute to the inherently dynamic app culture.

**Chapter V Organization**

The literature on children's education-related media is often limited to technology use in the classroom. The instructional design literature typically addresses the appropriate tools based on the educational objective and the most efficient and effective means to facilitate learning for a diverse yet concentrated audience (Morrison et al., 2004; Smith & Ragan, 2005). As described in the second chapter, Vygotsky (1978) coined the term zone of proximal development to call to attention the difference between an individual's actual developmental level and the ability to accomplish a task with the help or guidance of a more experienced adult or peer. By highlighting this range of possible development, Vygotsky reconsiders the conception of a child's development, shifting the focus away from a retrospective assessment to an emphasis on the prospective mental development and "allowing not only for what already has been

achieved developmentally but also for what is in the course of maturing" (p. 87). In this way, the assessment of a child's development centers not on what they can already do, but begins with the considerations concerning the potential he/she can achieve with assistance.

Oftentimes, in a school setting, the administrators and teachers impact the direction and content of instruction because they are responsible for many of the decisions about the mission of the school and corresponding learning objectives. Available resources and time constraints also contribute to education-related decisions. Tools or resources, such as books or technology, may help students gain knowledge, skills, and attitudes in specific subjects that have the potential to be useful in subsequent grades or in future endeavors. The scarcity of certain resources may also impact continued success in school or eventual employment. In either scenario, it is clear that the function of modern schools is not limited to the traditional subject-based coursework. Furthermore, a school may provide an environment that facilitates socialization through opportunities for interactions with peers and teachers. These are only some of the components of a school that interact, dynamically, to create a model of what the term, "educational," means in contemporary society.

Similarly, elements outside of the immediate interactions that affect a user's engagement within an app influence, to a greater extent, the app experience, and consequently, form part of the app culture. Understanding how these mediating factors help shape an individual's activity and experience is vital to any discussion on the educational nature of the app culture. The following discussion highlights a few key

characteristics that contribute to this app culture. The examples, extracted from the data, synthesize the individual portraits of the apps that were analyzed in Chapter IV.

Ultimately, this discourse forms a broader illustration of the dynamic and complex core of "culture" in the nine educational apps. This core is based on the four main attributes that played a role in constructing the app culture for the apps studied in this research: (a) the mediating role of the technology, (b) the mediating role of the instruction, (c) the mediating role of the adult guide, and (d) the mediating role of the App Store.

The mediating role of the technology refers specifically to the iPad, as a device with which users access the apps within the app culture. This perspective deviates from traditional educational research in that it also includes the more informal data from the customer reviews insofar as how the device mediates their experiences. The second section focuses on the app content and examines the role of the instruction in the app culture. Educational theories ground the discussion about the instructional content and how it affects and is affected by the capabilities and limitations of the apps. The role of the adult or guide forms the main point of discussion in the third section. Vygotsky's ideas concerning the zone of proximal development are relevant and discussed in the context of educational apps. The fourth section concerns the inherent social component of the app experience via the exploration of the App Store and its role in connecting people (customers, potential customers, users, developers) and ideas.

## The Mediating Role of the Technology

From an activity theory perspective, the iPad is a tool that permits the mediation of a user's orientation toward his/her object of attention. Certain capabilities of tools,

such as the iPad and apps, enable unique learning experiences. This section introduces

the general role of the technology as it relates to the educational app culture,

incorporating and extrapolating observations from the descriptions, and examinations of

the nine apps in the previous chapter.

**Role of the iPad Device**

Ubiquitous learning (or u-learning) is a contemporary term used to describe

learning, supported by technology that is not restricted by time, physical location, or

availability of content. The attractiveness of u-learning is characterized by factors such as

urgency of learning need (i.e., on-demand learning), initiative of knowledge acquisition,

interactivity of learning process, situated instructional activity, context-controlled

environment, personalization of services, self-regulated learning, seamless learning,

adaptable content, and connected learning community (Watson & Plymale, 2011).

Consumers reported using their iPads or smartphones in informal learning settings

not limited to the home. For example, customers reported using Endless Alphabet in

restaurants (e.g., Reviews 2, 45), Stack the States during car rides (e.g., Reviews 2622,

2790), and Toca Hair Salon 2 to pass the time in a variety of places (e.g., Reviews 910,

940). Other contextual evidence suggests that engagement among family members with

iDevices and apps was based at least in part on portability and access. Users and

observers attributed, to the device, a number of emotional effects that were permissible

due to the flexibility in use, as described by Reviewer 1911 of Toca Hair Salon 2: "My

little cousin is [sic] stops talking and jumping and for a while shes [sic] quiet." The

parent of an Endless Alphabet user explained that the kids in the home, who were 3- and

5-year-olds, "played it for quite some time quietly and shared their accomplishments with

us" (Review 2613). These remarks indicate educative effects that are not constrained by institutional or developmental limitations or expectations. Thus, given the flexible nature of the technology, it is not surprising that users synthesized app interactions and experiences, especially with literacy apps such as Endless Alphabet and Starfall Learn to Read, within everyday contexts.

**Role of the Apps**

As previously indicated, the number of education-related apps continues to expand, and there are a growing number of factors that consumers must take into consideration when selecting a piece of technology for learners (Craig, 2000). Activity theory suggests that tools and artifacts are designed and developed to satisfy a need, and the mediating role of the technology is not limited to the capabilities of the device itself. The iPad may satisfy general spatio-temporal needs, but the apps may go beyond satisfying specific needs, helping users overcome other physical and cognitive limitations (Murphy & Rodríguez-Manzanares, 2014). The apps studied for this research differed in design, purpose, and intended demographic. Users' true motivations may not be discoverable; however, a number of observational comments can be made about the customers' general objectives in purchasing or using the apps within the activity theory framework.

**Communication with family.** In the present study, the customer reviews provided insight into the social environment within which the app was utilized. The comments for apps such as Endless Alphabet, Starfall Learn to Read, Mickey Mouse Clubhouse: Wildlife Count Along, Wallykazam! Letter and Word Magic, and Bug Art were primarily written by adults who had observed children using the app. Reviewers

differed in age and role—some were also the primary users, as was common for apps like Toca Hair Salon 2 and Stack the States. In many cases, there were subtle indications that, while all of the apps could be played individually, the activities were, most often, shared with others. In some cases, the shared experience was the actual process (e.g., individuals playing together); in other cases, users shared the product they created or the results they achieved in working through the app with family and friends.

Educators and scholars indicate a growing interest in the role and context of children's apps. For example, a multinational study conducted in 2013 by Nickelodeon Kids and Family GPS, surveying parents with children ages 4-12, examined how apps have affected families (Garcia, 2014). They determined that 80% of the millennial parents who were questioned use apps with their children and considered the time to be a family activity. Additionally, 73% of parents purchased apps for the whole family's enjoyment: "For many parents, apps create a platform that helps them interact with kids" (para 3). This suggests that the mediating role of educational apps serve not only to produce gains from the instruction, but also to create rapport and facilitate communication among family members.

**Communication with the tool.** While it may seem obvious, a commonality found in all of the studied apps was the interaction and communication between the user and the device. This interaction was characterized through the user's input (e.g., tapping, swiping, shaking, or turning the device) and the app's output (e.g., visual, verbal, or auditory response). The experiential component of an app is dependent on not only the specific actions of the users, but also on the response and feedback provided by the technology. In essence, the interactivity is inherent in the nature apps.

The current study revealed that, depending on the capabilities and limitations of the app, the interactive communication differed. For example, because none of the apps required Wi-Fi connectivity, on one hand, users could not directly communicate with other users, but on the other hand, the app allowed for full ubiquitous usage on devices such as iPads, iPods, and iPhones (which were often hand-me-downs) that did not have cellular connectivity. Thus, it was possible to utilize the app and interact with it in more places than apps that may have required an Internet connection.

At the same time, the broader literature suggested that, in some cases, the use of certain media may also impede in learning, depending on the guidance and feedback given to the user. While researchers often agree that the use of feedback is important in computer-based instruction, there is no "best" way of providing feedback that is appropriate for all situations (Mason & Bruning, n.d.).

As an example, in Mickey Mouse Clubhouse: Wildlife Count Along, the narrator guided the user in reading through the use of text-to-speech and synchronized highlighting. However, a study indicated that with electronic storybooks, a reader's attention to the print may aid in letter reading but does not necessarily improve a child's understanding of the conventions of print, a skillset necessary in future literacy competency (Gong & Levy, 2009). With regard to reading, the study differentiated between informal literacy experiences, which focused on the message of the story, and formal literacy experiences, which emphasized the conventions of print. Gong and Levy indicated that the type of guidance was critical to an emergent learner's ability to discriminate between acceptable and unacceptable print. In other words, examples as well as non-examples would be instrumental in producing learning gains regarding print rules

and traditions. Although there were options to toggle on and off the assistive technology, the degree to which the narrator in the Disney app could personalize and cater to the learning needs of an individual may have been constrained due to the capabilities and functionalities of the app.

Additionally, none of the apps contained ads or in-app purchases during the interaction. While this may be a characteristic of paid apps (i.e., direct fee as opposed to ad-based, freemium, or in-app purchase model), some of the apps recording a longer history of consumer reviews revealed that the monetization model was not constant, and prices of apps were continually being reconsidered and altered. The Nickelodeon study reported above indicated that 48% of parents reported paying for apps while 46% would not spend money on them (Carlos, 2014). The customer reviews suggested that parents were aware of the differences in the monetization strategies, and many parents indicated that they were pleased that the direct fee model prevented children from being detracted from the interactions within the content by distracting prompts from ads and in-app purchases.

It should be noted that the interactive communication between user and tool differed in capacity from app to app. Further observations on the capabilities and limitations on the instruction is presented in the next section.

## The Mediating Role of the Instruction

As evidenced in the previous chapter, each of the nine apps incorporated some sort of interactive content, whether it was in the form of a game, a simulation, tutorial, drill and practice, or a combination of strategies. The diversity of subject matter also differed. Language arts, mathematics, science, social studies, visual arts, and vocational

content were subject areas that were the focal point in one or more of the apps. It can be

argued that all nine educational apps were developed to teach *something* or to help a user

learn *something*. However, differences were found in the methods, strategies, and design

of the instructional delivery.

In the instructional design literature, the method and delivery of an instruction

should be triangulated with the goal and assessment measures in order to facilitate

effective and efficient learning (Cennamo, 2009). Although analyses of instructional

content of individual apps were examined in Chapter IV, the following discussion uses

instructional theory to explore types of designs used in the apps, with a focus in the

following areas:

- The goals and mission, through a discussion on the inherent nature of knowing.

- The assessment, through the exploration of evaluation strategies.

The purpose of this section is to offer a descriptive exploration on the ways in which

these two elements are presented in the content of the app learning space.

**The Inherent Nature of Knowing:**
**A Philosophical Examination**

In understanding the goals of an instruction, one of the first considerations is the

inherent nature of learning or how one comes to know that *something*. Although the

developers did not directly state their views on learning, the design elements of the app

shed light into the philosophical perspective they hold about the nature of knowledge.

The perspectives can be broadly divided into two categories: a) knowledge transmission

and b) play and exploration. Many apps incorporated one or both of these elements in the

design, albeit in different capacities.

**Knowledge transmission.** Stack the States, Endless Alphabet, Mickey Mouse Clubhouse: Wildlife Count Along, Wild Kratts Creature Power World Adventure, Wallykazam! Letter and Word Magic, Starfall Learn to Read, and Bug Art all incorporated an element of transmitting rules or lower-level subject area-specific knowledge to users, although the strategies employed differed. The instructional content in Stack the States served to transmit concrete facts about states. In the Mickey Mouse Clubhouse: Wildlife Count Along, the user matched animals and their correct habitats. In the Wallykazam! Letter and Word Magic, there was a correct procedure for matching letter shapes and letter sounds as well as tracing letters. In Starfall Learn to Read, phonetic rules were transmitted visually to users through videos. Arguably, Bug Art also included an area with a fixed template where the app helped users correctly draw the bugs. All of these cases suggest that the purpose is to transmit scientifically or culturally accepted facts, rules, and procedures related to a specific subject area and to help users attain them. In addition to understanding *what* is being transmitted, *how* the information is transmitted and assessed is equally important in the consideration of a learning environment. Significance is placed on the learning that is an outcome as over the process by which knowledge is attained.

In the educational psychology literature, the objectivist tradition holds that a meaningful reality exists outside of the individual consciousness (Crotty, 1998; Driscoll, 2005; Schuh & Barab, 2008), and there is an external reality that is waiting to be discovered by human beings (Crotty, 1998). To know something suggests that individuals create representations of the external world that acts like a "mirror" of the objective world (Schuh & Barab, 2008). There is an absolute or generalizable truth that can be

verified objectively, and the purpose of learning is to transmit this knowledge to the learner (Driscoll, 2005).

Among the academic community, behaviorist instructional theory extends such objectivist perspectives. The famous Pavlov's dog experiments underscored the notion that learning is best understood, objectively, through the conditioning of stimuli and responses (Ormrod, 2004). Behaviorists contend that it is impossible to measure internal processes, thereby emphasizing the importance of behavioral performance as an indication of change. To a certain extent, behaviorist theory assumes the existence of an individual capable of assessing whether or not learning has occurred. For example, with the dog experiments, Pavlov or another researcher had to be present in order to observe, record, and assess changes in the canine's behavior.

Similarly for the learning with apps, excluding the human factor, a computer algorithm assessed responses and provided feedback. Two different strategies were evidenced in the design that suggested parallels to this mode of instruction. The first type of instructional content was presented visually to a passive user. The second type included an evaluative component through certain interactions by the user.

*Types of instructional content.* The first type of instructional content was evidenced in the video and animated sequences in Endless Alphabet, Starfall Learn to Read, and the Wow! Facts of Wild Kratts Creature Power World Adventure, highlighting the transmission of content through simple presentation. In these cases, the user passively viewed moving (or static) content on a screen. There were no interactions on the part of the user to practice the information, and no evaluation measures assessed the performance of the user.

The second type of instruction was also visually presented, but required users to demonstrate their knowledge and understanding of the content. For example, in all aforementioned apps (with the exception of Wild Kratts Creature Power World Adventure), users were presented with a stimulus (e.g., a question or a procedure) and were required to respond (e.g., identifying the correct answer, tracing the correct pattern) in order to proceed. More correct answers or fewer errors (i.e., changes in the behavior) were indicators that the user had learned the content effectively and accurately and was positively reinforced with sounds, points, or other rewards.

**Play and exploration.** Whereas the first perspective primarily emphasized the gains of a concrete goal, the second evidenced a focus in the design of the apps on the process of user engagement through play and exploration. All apps incorporated an element of play and/or exploration, however, the role of the experience differed in terms of their educational function and goals. The previously mentioned Nickelodeon study indicated that 49% of parents considered apps to be good learning tools and find the educational properties beneficial: "They want to make sure kids don't just play games, but learn in a fun and entertaining way" (Carlos, 2014, para 4). This sentiment was echoed in a New York Times article concerning the relationship between apps and television shows. The writer of the article interviewed Scott Chambers, Sesame Workshop's senior vice president for digital worldwide distribution, who stated, "Parents want to feel good about what they are purchasing and downloading for their kids," indicating that the educational aspect of a purchase was a significant decision making consideration for parents (Jensen, 2012, para 9). At least two types of experiences were evidenced: play as a function of games and free exploration.

***Play as a function of games.*** The first type of play was evidenced as an action within a game or simulation. It should be noted that among the 17,462 reviews, 36% of customers (6,334 reviews) generally referred to any one of the apps as a game. However, in the present study, apps were considered a game if an element of the interaction incorporated some of the defining characteristics of educational games such as characters, rules, winning or losing, and rewards, among others (Alessi & Trollip, 2001). Among the studied apps, key characteristics of educational games were featured in apps such as Stack the States, Wild Kratts Creature Power World Adventure, Wallykazam! Letter and Word Magic, Starfall Learn to Read, and Bug Art. In these interactions, the instructional goal differed from the gaming goal, and in many cases, the gaming component served as a platform upon which the instruction was delivered. For example, in Stack the States, the instructional goal was to memorize and recall facts about states. Playing the game portion of the interaction served as a way to earn states and unlock other areas. In Wallykazam! Letter and Word Magic, the literacy goals of learning letters, words, and nature of words were facilitated through play.

Aranda and Sánchez-Navarro (2011) argued that most of the informal learning occurred at the home and that games were the context within which users most commonly enjoyed educational apps. In the past, video games were criticized for their excessive violence or sexual content (Aranda & Sánchez-Navarro, 2011; Brown, 2008). This stigma resulted in the characterization of video games in general as inappropriate and the minimization of its educational impact.

Nevertheless, the customer reviews examined for this study suggested that, despite past criticisms, parents and users were cautious, yet generally accepting of

education-related games. For example, concerning the gaming aspect of Stack the States, a 5-year-old's parent wrote, "It's one of the few games that makes 'too much screen time' ok" (Stack the States, Review 57). A 62-year-old reviewer wrote, "No violence, no blood, no guts, just reinforced learning with a clever interface" (Stack the States, Review 4242).

In recent years, educators have begun to reconsider an educational game's effectiveness, suggesting that they serve as tools for fostering various skills in an environment that is intrinsically motivating, particularly with younger audiences (Deen & Schouten, 2011). Additionally, numerous scholars (Bavelier, Green, Pouget, & Schrater, 2012; Green & Bavelier, 2003; Green, Pouget, & Bavelier, 2010; Blumberg & Fisch, 2013) reported compelling evidence on neuroplasticity and other cognitive improvements due to frequent digital videogame play.

***Free exploration.*** Although many of the apps included a gaming component, some apps included an element of exploratory open-ended component devoid of rewards and scores. Toca Hair Salon 2, Bug Art, Wild Kratts Creature Power World Adventure, Dr. Panda's Restaurant 2, and Wallykazam! Letter and Word Magic all incorporated some sort of experiential, as opposed to goal-directed, tasks. In these apps, intrinsic motivation was a key tool in shifting the focus from identifying correct answers to an emphasis on the affective process toward emotional and social development. For example, in Toca Hair Salon 2, Wild Kratts Creature Power World Adventure (Sticker Art section), and Bug Art, one of the key features of the apps was the focus on the process of creating or constructing as opposed to fulfilling an intended goal or objective.

One may consider Dr. Panda's Restaurant 2 as an exception. In the app, customers provide a mission or objective, and money is rewarded after the meal is served. However,

on closer inspection, the users are not required to adhere to the request by customers and may intentionally create an unfavorable dish in order to elicit amusing responses from the customers. Also, the payment does not seem to influence the condition or likeability of a dish. Thus, depending on the personal motive for play, the type and degree of exploration may differ.

     ***Play in the educational literature.*** The broader literature supports the notion that imaginative play is a vital element of a child's cognitive, social, and creative existence (Soderman, Gregory, & McCarty, 2004). Theoretical models connecting learning and play are often attributed to Jean Piaget and Lev Vygotsky as two major influences in the cognitive psychology research regarding play and child development (Nicolopoulou, 1993). Piaget, one of the leading figures who studied the relationship between play and cognitive development, shifted the understanding of play from an emphasis on a particular behavior to an orientation toward a behavior. Many critics found that the theoretical framework proposed through Vygotsky's sociocultural theory of mental development completed the social and cultural elements missing in Piaget's work (Nicolopoulou, 1993).

     Whereas Piaget's explanation focused on the individual, Vygotsky's sociocultural theory of mental development considered the social characteristic of play. Vygotsky (1933) presented three ideas about the nature of play: (a) play allows for self-gratification of personal desires, (b) tools provide a means by which children can play, and (c) play facilitates practice in self-regulation. A child watching his/her parent utilizing iPads may want to imitate the parent's actions. Through play, he/she may act out the desire to search for information through a toy tablet or a similarly shaped object. In this way, the toy or

object becomes a tool that socializes the children in understanding norms and practices of a contemporary app culture.

Obviously, digital devices such as the iPad did not exist during Vygotsky's time, and the context of social play described in Vygotsky's writing assumed the physical presence of parents, other adults, or other children. Nevertheless, it is clear that children continue to find playful gratification in social learning. In addition, Vygotsky (1933) pointed to the importance of unstructured play and the creation of rules that accompany imaginary situations. Children around the age of three begin to distinguish the meaning of a word with its object/reference; the imagination of a child emerges and develops through imitation and the extension of cultural practices. However, the process of play does not simply underscore existing cultural rules. Through play, children's actions transcend the understanding of their immediate perception of objects or immediate situation and begin to become affected by and acts according to the meaning associated with the situation. Vygotsky (1933) stated that play for preschool-aged children is distinct from objects, and action arises from ideas rather than from things.

To provide an example from Bug Art, the animated user-creation of a butterfly represents a real butterfly, and the ways in which a user moves the bug to interact with environmental elements in the Playground exercise are determined by the rules and ideas the child has about that bug. Play helps children progress beyond their independent performance and allows them to develop personal rules based on their own ideas about objects, as opposed to being based on the objects themselves. Vygotsky designated the transformation of tools mirroring reality as a transitional stage of development, altering a

child's actions within his/her material reality, so as to transform a world of independent objects into a world of sense and meaning.

**Goals and Assessment in Apps**

Assessment, or the way in which a user became aware of his/her progress and mastery of a knowledge, skill, or attitude, was another critical piece in the effective and efficient design of an instruction. Assessment is closely tied to the mediating role of the interactivity between the user and the apps, discussed in an earlier section. One of the more interesting observations throughout the course of study was the variety of ways that users could make mistakes or errors and the various responses from the apps.

**Errors and feedback.** There were a number of apps that made it possible for users to make errors or mistakes. Among these interactions, the ways in which feedback and guidance were provided to the users differed in terms of purpose. In one group, there were apps such as Stack the States (main game, drill portion), Endless Alphabet, Mickey Mouse Clubhouse: Wildlife Count Along, Wallykazam! Letter and Word Magic (Look for Letters, Letter Trace, and Rhyme Time), Starfall Learn to Read, and to a certain extent even, Dr. Panda's Restaurant 2. In these interactions, feedback was immediately given to questions or actions with correct or incorrect responses, either in the form of a visual or auditory response.

For example, in Mickey Mouse Clubhouse: Wildlife Count Along, if the user selected the wrong number of animals, the narrator provided verbal feedback, encouraging the user to try again. In Endless Alphabet, if the letter shape were placed into the wrong outline, the movement of the letter and the ensuing sound indicated to

users of the error. Starfall Learn to Read also incorporated games and tutorials, which provided feedback immediate following the selection of a response.

There were also apps such as Stack the States (main game, stacking portion), Wild Kratts Creature Power World Adventure (main games), Wallykazam! Letter and Word Magic (Look for Letters, Letter Trace, and Rhyme Time), and Bug Art (Bug Race, Butterfly Valley, and Playground), where the instructional materials were presented in the form of a game, the interaction provided summative feedback. In all cases, a reward or point system was used to provide summative assessment of a user's progress through one life cycle, or iteration, of an exercise. For example, in Stack the States, after one cycle of questions, the user played the stacking game, to earn states. In Wild Kratts Creature Power World Adventure, the user collected a certain number of items in a habitat to earn stars and unlock new levels. In Wallykazam! Letter and Word Magic, although no visible points were given, successive completion of exercises unlocked new words. In Bug Art, points were accrued through playing Bug Race or Butterfly Valley and by collecting bubbles in Playground. In all of these apps, there was some sort of reward for achievement in successive practice.

The stacking portion of Stack the States (main game), the magic words of Wallykazam! Letter and Word Magic (Word Magic section) and the stickers in Wild Kratts Creature Power World Adventure (Sticker Art section) are three examples of how rewards from one area of the app experience provide further practice in the goals of another area of the learning experience. In all cases, rewards were earned as a result of successive play of an instructional piece in the app experience. However, the nature of these exercises differed, depending on the philosophical perspective.

For example, in Stack the States, the stacking portion (which determined if the user would earn a new state) was contingent on the user correctly answering a number of fact-based questions. Earning new states, in turn, unlocked more gaming areas, providing further practice of the instructional objective of mastering state knowledge. The instructional goals of Look for Letters, Letter Trace, and Rhyme Time provided opportunities for users to demonstrate mastery of literacy concepts using drill and practice. In Wild Kratts Creature Power World Adventure, there was a gaming goal accumulating points in order to complete a level. Completing multiple iterations of the game helped in fulfilling the more affective instructional goal: Users were given further opportunity to not only familiarize themselves with various creatures in nature, but also to show appreciation for different habitats. In such a way, the alignment of goals and the assessment measures of these apps underscored the philosophy behind that particular learning experience.

What was also observed about the formative and summative evaluatory measures was that, in all of these apps, although it was possible to make mistakes, there were no lasting negative consequences resulting from the mistakes. Among those interactions that provided immediate feedback, users were not penalized for their errors, and among the apps that awarded the user, the rewards were always additive, and points and rewards were never removed or subtracted as a result of making mistakes.

For example, in Stack the States, when users were unable to complete a game, previously earned states were not taken away or removed. In Bug Race, it was possible to lose to the competitor, however, this did not negatively impact the points already accrued. Similarly, in the three Wild Kratts Creature Power World Adventure games, it was

possible to lose a game, but this did not cause users to lose any existing points. Thus, rather than punishing the user for mistakes (e.g., by deducting points), the strategy used to motivate a user return and repeat an exercise was through, what behaviorist psychologists refer to as, positive reinforcement.

The one notable exception may be Dr. Panda's Restaurant 2. In this app, the animal customers provided immediate feedback based on their preferences, and the panda chef shook its head when the user had placed too much of a particular condiment in a dish. Although the characters did approve or disapprove of a food item, the user was not required to select a more favorable item. Furthermore, although the customer paid the panda chef at the end, because the money was not additive and was not used as a reward to unlock other features, it can be assumed that the emphasis of the simulation is in the creative process, and the feedback from the characters are added interactions to diversify the experience.

There were also apps such as Toca Hair Salon 2, where guidance and feedback was not given directly for mistakes. This may be understandable, as the purpose of the interaction was more exploratory in nature, and the overall objective was not simply to copy a model or imitate an ideal hairstyle. Similar findings were found in the drawing portion of Bug Art and Wild Kratts Creature Power World Adventure (Creature Selfies section), where the user created and constructed an illustration or a photo using various templates. Again, there was no "wrong way" to complete these activities because there were no pre-designated instructions or standards for what would be considered an acceptable outcome. Any errors or mistakes made by the user were subjective and could be altered or fixed until the user was satisfied with the results. At the same time, all of

these exercises provided a way in which the product could be shared. Some of the capabilities of apps allowed users to disseminate their creations externally, using the camera function (e.g., Toca Hair Salon 2, Wild Kratts Creature Power World Adventure). Other apps, such as Bug Art, utilized the in-app, social interaction between the user and the technology to apply and use the creations in other areas of the app environment. Thus, in these cases, what would be considered mistakes were individually identified and rectified through self-evaluation (or through the assessment by others).

Overall, the study of the app content revealed differences in the philosophical perspective of developers in their delivery of the instructional content. The differences in the philosophy, subject areas, and design, made the commonalities in corrective feedback one of the more interesting findings. Users were not penalized in any of the apps during assessment of competency. Because nothing was taken away from users, while it was possible to make mistakes in certain apps, it was impossible for users to fail.

**The Mediating Role of the Adult Guide**

The previous section presented an exploration of the role of instructional content in the app experience. Although all of these apps were stand-alone apps that could be used individually and without access to a Wi-Fi connection, many of the reviews intimated a more social component to the experience. Vygotsky's (1933) writings suggested that children's connections and meaning were facilitated by means of engagement with adults and more advanced children. Thus, it can be argued that while the goals of a given app satisfy certain needs (e.g., memorizing facts about states from Stack the States), actual learning took place when the user implemented the information

into the appropriate context of his/her corporeal social and cultural context (e.g., recognizing borders of certain states during a family road trip).

Although it could not be assumed that all parents held similar beliefs about their children's interactions with apps, the prevalence of apps geared toward children 11 and under, as well as the overwhelming consumer reviews written by adults, indicate a need for further examination on the role of adults in app culture. It seems that parental involvement with iPad use in informal contexts is a critical component in bridging the gap between the instructional content in the apps and the application of the knowledge learned in the real world. Subsequent sections explore the role of the adult as a mediator for facilitating this development.

**The Modern Child and the Zone
of Proximal Development**

The zone of proximal development has, in the literature, been analyzed in a number of ways. First, Vygotsky (1978) championed the idea that a child's development begins socially when a child imitates the actions of his/her parents. Within the discourse of technology education, the skillset required to perform the actions of each app was not limited to the acquisition of the learning content embedded within the app. For example, learning the shapes of letters and nature of words in Wallykazam! Letter and Word Magic! required an understanding of the navigation as well as operational skills, such as using the touch interface. Broadly speaking, these skills are often learned through the observation of parents' use of tablets and smartphones.

Concurrently, if the mediating role of apps were considered, the object would be for a younger child to learn literacy skills before or in preparation of formal schooling. In this case, the apps such as Endless Alphabet could be used to help the user focus on the

recognition, identification, and matching of letters and letter sounds. Another child could require more practice in the composition of words. He/she may use the same app not only to review letter and letter sounds but also to understand how to generate words by combining letters. An older child in the family may use the same app to expand his/her vocabulary and memorize definitions, visually. Such a perspective emphasizes the role of app content as the anthropomorphic assistant that aids in the engagement of a learner's zone of proximal development.

Another application specific to this study advocated the importance of play in relation to a young child's development (Vygotsky, 1933). As stated earlier, apps incorporated an element of play, whether in the more structured form of a game or through unstructured exploration. This component of the app activity considered the ability for a child to self-regulate beyond his/her mental capacity with the iPad apps aiding in satisfying personal desires. Generally speaking, the observed gap between non-play and play situations claimed higher levels of self-regulation among children of the latter group (Bodrova, Germeroth, & Leong, 2013). Optimal engagement in the zone of proximal development is an assumed effect resulting from a child's participation through play with the apps. In other words, the capabilities and the limitations of an app environment also impact the user's capacity to attain certain developmental accomplishments.

These ideas have been widely recognized and used as grounds for interactive and engaging instructional strategies with the use of modern technologies such as iPad apps. Meanwhile, questions arose regarding the degree to which potential benefits could be gained in a child's development. Many Vygotskian scholars agree that a certain level of

play must occur before any gains can be achieved (Bodrova et al., 2013). Academics and researchers identified levels of make-believe play, suggesting that not all play equally optimized a child's continuous evolution of his/her zones of proximal development. They asserted that not only were certain types of play more effective than others, but that the quantity and quality of modern children's play practices also failed to develop skills like those at the time of Vygotsky's writing. In fact, the study by Bodrova et al. (2013) indicated a regression in the level of play practices in comparison with those of children studied in the 1940s.

Bodrova et al. (2013) indicated stark differences between current play practices among toddlers and those of their predecessors. Modern children's play is characterized by disconnected and repetitive actions, the solidarity of play practice, and a lack of attempts to communicate their actions with others. The researchers also indicated that the children they studied had a more difficult time following the directions of adults. In other words, current play practices did not incorporate self-regulation practices that are critical in a child's development. Though Bodrova et al.'s research does not go as far as to champion the vital role of an adult's involvement in the mental and social skill development of children, the concerns expressed by the researchers highlight the need to review this modern cultural phenomenon and to reconsider how mediating tools may effectively meet the needs of a techno-and individual-centric society. The following sections consider the role of adults in guiding and evaluating a child's development.

**History of Parental Involvement**

Jeynes (2011) described how the conception of parental involvement in the United States began with the Puritans and Pilgrims, who believed academic success was

dependent on a strong trilateral bond between the home, church, and the family. The paramount influence of parental commitment in fostering the moral development of children was underscored by leading educationists such as Benjamin Rush, Noah Webster, DeWitt Clinton, and Joseph Lancaster. Despite criticism, by the 1830s, the national common school movement began to take hold. Proponents such as Horace Mann and Johann Pestalozzi reassured skeptical parents at the time by asserting the importance of "the maternal role of the schools" and the adoption of motherly duties by schools when children were away from the home.

However, parental involvement in learning began to decline as the common school movement became widely standardized. Parents' roles in a child's education, which were once considered the foundation of a child's social, moral, and professional development, began to change. Jeynes attributed urbanization and the beginning of industrialization as one of the causes in the diminishing significance of parental participation in the education of children. Notwithstanding the changes in U.S. society, parental responsibility of supporting their children's learning maintained a contentious, yet collaborative, partnership. Jeynes believed that parental involvement encountered a steep decline in the 1960s with the changing nature of American families, particularly with the rise in divorce rates and the dissolution of the traditional family structure.

While efforts to reconsider the relationship between parents and their role in children's education have gained prominence in recent years, the historical changes in parental involvement is reflective of the needs of a society and is one that is in constant transformation. In essence, what may have been an assumed role of parents during the colonial years cannot, and perhaps should not, be the same as the roles of parents in the

present. At the same time, because of the novelty of the technology, the literature on

children's app learning is still sparse. Nonetheless, it is possible to investigate previous

studies on the relationship between parents and children with older technologies as a

foundation for creating dialogue about parental roles in educational app environments.

**Importance of Adult Guidance**
**for Academic Success**

The role of the adult guide is documented extensively in the early childhood

development literature. Experts have insisted that language skills are learned primarily

through informal interactions at home and that sociocultural influences impact readiness

for school (Connor et al., 2014; Justice et al., 2005). Factors such as financial stability

and safety have been noted as factors that contribute to the success of young students;

but, more importantly, Soderman, Gregory, and McCarty (2005) identified the ability to

read, as the key indicator of students' future, and that literacy is dependent on whether or

not they have " access to books...and have opportunities to talk with adults and other

children" (p. 8). The importance of adult guidance is not limited to early literacy skills.

Neumann and Meumann (2010) also acknowledged the importance of scaffolding

strategies in joint writing activities between parents and children.

Research by Stylianides and Stylianides (2010) examined kindergarten

achievement by examining the type of parental involvement and related it to the

proficiency in mathematics, reading, science, and social studies achievement. The

researchers sampled more than 10,000 children from an urban setting and measured how

often the parents (a) read to their child, (b) told their child stories, (c) helped their child

do art, (d) built things with their child, (e) taught their child about nature, (f) played

games with their child, or (g) did sports with their child. The findings suggested that

children in environments with more parent-child interaction demonstrated higher academic achievement. Furthermore, the study by Hofer, Farran, and Cummings (2013) suggested that mathematical performance on preschool children was determined through the careful evaluation of the interaction between the learning content, the strategies employed, and the child's engagement. Encouraging a child to talk aloud helped parents and teachers to understand better the state of the child's development and to make critically effective choices when addressing immediate needs.

Connor et al.'s (2014) examination of preschool literacy studies suggested that the level of achievement depended upon where the attention was focused in the learning process. This was irrespective of where the guidance originated (i.e., whether the guidance were given by an adult or through technology). For example, with reading, the most gains were seen when the child was instructed to focus on the printed words because, oftentimes, children tended to center their attention on accompanying images and illustrations instead of the words (Justice et al., 2005). The literature pointed out the importance of sharing the reading experience, and in many ways, apps such as Endless Alphabet and Starfall Learn to Read incorporated some of the assistive strategies of shared reading. The most significant element in gaining literacy skills is through the interaction and engagement between the adult and the child. The instructional guidance and cues provided by the adult and the reciprocated inquiry by the child is seen to help the child form intelligent speech and thought through the shared reading process (Shanahan & Lonigan, 2013; Woude, van Kleeck, & Veen, 2009).

**Parents, Children, and Technology**

One of the issues that emanated from the reviews was the discussion on regulating technology use, particularly for small children. Although many parents described their child's prolonged device use as a positive affirmation of motivation and engagement, some parents indicated that the iPad was used only as a reward for good behavior. Other parents indicated that they placed restrictions on the extent to which their child could use the iPad.

The term, "digital natives," coined by Marc Prensky described children, who were born immersed in a technology-rich society. Prensky (2001) asserted that, "as a result of this ubiquitous environment and the sheer volume of their interaction with it, today's students think and process information fundamentally differently from their predecessors" (para 4). In his seminal work, Prensky distinguished digital natives from "digital immigrants." The digital immigrants adapted or socialized into a technology-rich world, rather than having been born into it.

A two-year study by Plowman, McPake, and Stephen (2008) on children's use of and parents' beliefs about technology and learning provided some insight into the disconnect between digital immigrants' views of technology's role in children's learning. Plowman et al. (2008) focused on the social practices surrounding technology in informal settings and concluded that many parents underestimate their role in supporting their child's use of technology in learning and often erroneously conclude that their children were self-taught. Even though the majority of the top ranked education-oriented apps have been developed for children, indicating a large group of digital native learners, the

research has yet to focus on how young children experience play through technology prior to formal schooling (Plowman, 2014).

Rosin's (2013) discussion on the "touch-screen generation" gave some much-needed insight on the implications of iPad use with young children. Rosin introduced her research by reflecting on a gathering that included developers of children's apps and interested parents and their toddlers. To Rosin's surprise, the parents were carefully monitoring their children's interaction with iPads, regulating screen time and context of technology use. Rosin stated that, historically, a period of criticism (e.g., violence caused as a result of video game use) has always followed the introduction of new technology. As a result, the reported negative effects have often impacted parental perceptions.

However, Rosin's perspective suggested a concessionary, yet promising attitude toward the natural technological and social transformations, currently occurring. While acknowledging recent warnings and recommendations by researchers and educators, Rosin questioned the practicality of absolute thinking: "Are books always, in every situation, inherently better than screens?" (p. 65). Despite the countless number of apps, intended for kids under the "Education" moniker, Rosin stated that whether or not the apps were considered educational would be dependent on the perspectives of the parents. Their values, involvement, and regulation of iPad use is one of the most significant factors in users' app experience.

There is a plethora of studies indicating what the child can do with the help of an adult, provided the growing, yet not fully understood, interest in children's relationship with the technology. A next step may be to try to understand how adults identify and act on behalf of their child's zone of proximal development, and how their actions impact the

dynamic nature of the overall app culture. The next section explores the social communication and participatory nature that exists in the App Store community and contributes to an interactive and mutually supportive educational experience outside the confines of the instructional space.

## The Mediating Role of the App Store

The fourth and final point concerns the role of the App Store as a mediating tool, connecting the app learning space, socially and technologically, to the consumer, user, potential consumers/users, developers, etc. This symbiotic relationship is demonstrated in the user's orientation toward his/her object and the corresponding impact on the tool that is mediating this orientation. To enhance the understanding of the social practices surrounding app use, this study analyzed customer characteristics and user interaction within apps based on the descriptive information provided by the developers and through the reviews that the paying customers wrote.

Because the number of customer reviews varied among apps, ranging from 7,756 (Toca Hair Salon 2) to 13 (Wallykazam! Letter and Word Magic), and because the app-specific content was reviewed in Chapter IV, the proceeding discussion is more of a commentary on the somewhat surprisingly transformative and communicative space of the App Store, as evidenced in the connections, beliefs, and innovative uses that people made with regards to the app they purchased.

### Discoverability: The Visibility of Apps in the App Store

A primary purpose of this study was to explore nine education apps; yet, at some point over the course of the study, it became apparent that the data did not clarify why the nine apps under consideration had been ranked consistently high among the top paid

apps. It had been noted, previously, that there were inconsistencies between the published star rating and the actual star rating. There was also a disparity in the length of time apps were among the top ranks. Some apps had been available for over two years; others had been available for only a few months. Furthermore, even apps with relatively low star ratings appeared in the "Top Charts" section of the App Store. Although it is beyond the scope of this study to go into details related to search engine optimization and marketing, it is incumbent upon me to highlight the mechanisms imposed by Apple, not controlled by the developers that have significant implications within the educational app culture.

  **Importance of discoverability.** For a typical customer, the App Store ranking may simply be a means by which consumers can effectively or efficiently identify popular apps that, most likely, meet their needs. Additionally, the search engine tool filters information based on topic or subject matter. However, for a developer, how a search engine within the App Store locates and ranks apps is of vital importance (Edwards, 2014). The benefit/cost ratio is not consistent among developers. All developers of iOS apps pay an annual membership fee of $99. However, the return on their investment is not so clear or consistent.

  Regarding app revenue, based on a survey of 10,000+ of the estimated 2.9 million mobile app developers in the world, Vision Mobile's (2014) Developer Economics report suggested that 50% of iOS developers are below the 'app poverty line' of $500 per app, per month, 24% of developers earn nothing, and 23% make less than $100 per app per month. Thus, even developers of education-oriented apps must focus on app search processes, as well as instructional and technical matters in order to reach customers. Marketing and branding are critical elements of their development efforts.

**Limitations in discoverability.** The ability for developers to showcase their apps depends partly on Apple's enigmatic system of rules, regulations, and capabilities. Fiksu (2013), a mobile analytics company, noted that, with Apple's acquisition of the app search and discovery platform Chomp, in addition to download volume and velocity of downloads, App Store rating and reviews may impact placement of an app in the Top Charts section. Edwards (2014), stated that, while Apple keeps its search rankings a secret, app developers suspect that ranking may be based on the following algorithm:

> Ranking = (# of installs weighted for the past few hours) + (# of installs weighted for the past few days) + Reviews (star rating + number of reviews) + Engagement (# of times app opened, etc.) + Sales ($)

One thing developers have learned is that Apple's discoverability formula is not static. TechCrunch writer Perez (2013) reported improvements in search engines to correct spelling errors as a result of users' "fat finger" touch-typing errors. Only recently, Apple began allowing developers to bundle a selection of their software for purchase by customers at a discounted rate (Etherington, 2014). Furthermore, Apple receives 30% of the revenue from apps sold in the App Store. Thus, search infrastructure and changes to it may not necessarily occur to benefit the developer or the customer.

**Implications for educational apps.** The algorithms used to determine the promotion of apps (i.e. app discoverability) will, likely, continue to change. Because purchasing choices of parents are indirectly dependent on the relationship between Apple and their developers, it was important in the context of this study to identify the nature and impact of the App Store search engine, especially in terms of how that searchability meets the needs and motives of all involved.

The App Store itself functions as a mediating device within an activity theory context, providing revenue for the hosting company (Apple) and potentially for the

developer, in the dissemination of tools and products that the consumer needs/wants. The App Store also functions as a mediating tool between Apple and the developers. The social relationship among Apple, the developers, and the consumers affects the consumer's perception of the world around them. The importance of end-user feedback is exemplified by the inclusion of customer reviews in the search algorithm that may elevate or lower visibility and searchability.

An example of this aspect of the app culture may be seen in the actions of a parent who buys an educational iPad app, based on a need that must be fulfilled. He/she may want to find an app for his/her child to use in the car that is fun, educational, and interactive. The child may be struggling in math, and the parent may want the child to play a game to help him/her practice for the next exam. The parent may go to the App Store, use the general search or limit their search to educational apps based on a specific app name or subject matter, and review the top ranking apps. Apple's search algorithm is responsible for what is displayed. The degree to which the keywords, entered by the developers in their titles and description, and other users' ratings affect the results is unknown. However, it is clear that if an app does not appear among the queried results, its existence may remain undiscovered and its value/usefulness, thereby, negligible.

The ideas and values espoused by users regarding the educational nature of a visible/discovered app are assessed in the form of stars and commentary from customer reviews that are transformed into bits of data, entered into an algorithm that ultimately impact an app's position/ranking and discoverability. The discoverability and rankings of an app form part of the information that consumers or a parent of a child struggling in math, in this example, may use to identify apps that fit into the conceptions of an

educational iPad app. Apps of a lower rank and weaker discoverability affect revenue and are limiting for Apple and the developers. Low searchability conceivably gets caught in a sort of vicious cycle that deprives developers of the feedback they need to improve the app to meet consumer/user needs/expectations until the algorithm consigns the app to oblivion, thereby excluding it from the app culture.

**Social Experiences and Communications**

Another consideration is the user's physical social environment. Because many of these apps were intended for children, in many cases, parents or guardians (including grandparents, teachers, and relatives) formed part of the context external to the app but was still a contributing factor to the overall app culture. A secondary social community is built by the reviews of customers and the updates (or lack thereof) by the developers. Among the 17,462 customer reviews analyzed in this study, 1,386 (8%) directly addressed developers, 1,027 (6%) comments directly addressed future customers, and 196 (1%) directly addressed other reviews.

As a virtual store, the primary role of the App Store is to facilitate the purchasing and downloading of apps onto the iPad (or other device). A secondary role of the App Store is to facilitate communication between customers and developers as well as among customers. Undoubtedly, the descriptions and reviews can serve to help potential customers determine their general purchasing decisions (Chevalier & Mayzlin, 2006). Developer descriptions and customer comments may provide insight to a prospective customer as to whether or not a particular app would be useful. However, the type of information provided by customers and how they are relayed may also be important in impacting the educational understanding of an app culture.

**Sharing of personal experiences.** In examining the reviews, many consumers shared information related to the affective experiences of users and/or parents. For example, in Endless Alphabet, 1,984 reviews indicated the grade level or age of the primary user of the app, and in Toca Hair Salon 2, 272 reviews shared personal stories about user/guide experiences with the app. Experiences with the app were also seen in the reviews that illustrated diversity among users' personal goals in terms of individual purpose behind app use. This information could not have been gathered through quantitative data. What follows are samples of customer/user comments that relate personal experiences with Stack the States:

- Reviewer 998: Great app for those who want to study the states, immigrants like me:) I'm a Crimean Tatar living in New York, and I now the world history and geo [sic] very good [sic], but I know little about the place where I live know- [sic] USA The app gives me an opportunity to study and know the American geopolitical location from within. Thank you, creators of the app, a lot! A+, In a short term promise to know the states as good as my fellow American college mates))

- Reviewer 1279: I truly cannot express how amazing this app is. I am an adult that has always been extremely embarrassed at my lack of knowledge of geography. This app is honestly the best buck I have spent in my life.

- Reviewer 1113: This helps me study for the national geographic bee love it

- Reviewer 1313: I love this app, I am 60 years old but I've forgotten a lot about our wonderful states in a wonderful country.

- Reviewer 1533: I have had a stroke & it is a fun way to challenge my brain connections/rewirings daily! It is really helping me therapeutically & I am having so much fun!!

- Reviewer 3056: To the developer of these games: I cannot than [sic] you enough!!! My son J has autism. He is high functioning. And he just turned 5. Not yet in Kindergarten, he has taken a huge liking to this game.

It may not be possible to deduce why so many consumers shared personal experiences; but, it may be possible to infer their reasoning by examining research in other areas that has analyzed similar data. A 2006 study by Lee, Cheung, Lim, and Sia explored university students' motivation in sharing their experiences in a web-based discussion board. An overwhelming number of respondents (87.5%) reported intrinsic enjoyment in helping others for a variety of reasons. Yet, only 35% of participants reported a willingness to share their experiences by commenting in an online forum.

Another study by Min and Park (2012) discovered a correlation between customer reviews that mention personal experiences with using a product over a long period of time and the quality of a review. A study related to the hospitality industry from Black and Kelley (2009) proposed that a customer's ability to write online reviews served as a foundation for sharing stories of their experiences to prospective customers. They found that a persuasive review often included key elements of storytelling such as trust, character development, story details, tone of superiority, inspiration, and good writing. It is possible that the customers who chose to leave reviews for others did so because they believed their in-depth experiential commentary would prove beneficial.

**Shared problem solving.** There is a temporal element that must also be considered. While customers may comment on the apps based on their convenience, changes in pricing or alterations in the version updates do not necessarily guarantee that the comments from two users reflect the same conditions under which they formed their experiences. The chronological listing of the reviews facilitated clearer communication, gave opportunities to developers and consumers to share troubleshooting issues, and provided a space for reactionary commentary to concerns and opinions.

As an example, when iOS 7 was released on September 18, 2013, it was necessary for developers to update the compatibility of their apps. The comments from Endless Alphabet indicated a surge of crashing and app-loading related issues. Although, on the same day (and again two days later), the developer, Originator, provided a version update addressing instructions for troubleshooting this issue, there was a surge in the comments related to this problem, suggesting frustration and disappointment by the customers:

- One parent wrote on September 18, "Just updated to iOS 7 and now the app will not load" (Review 581).
- On September 19, another parent wrote, "My kids LOVE this app but since the update yesterday it keeps crashing on the 'loading' page. My autistic son was very unhappy today trying to play this and he couldn't even get past the opening screen. Fix this PLEASE!!!!!!" (Review 558).

There were also people who provided other users with instructions for the fix:

- On September 21, Reviewer 516 wrote, "Updated the iPad to iOS 7 today, which rendered Endless Alphabet useless. Tried the update - no luck. Deleted the app

completely and redownloaded it - worked like a charm. Give it a try, hope this

helps some of you having problems!"

Other reviews provided information on the reinstall fix. Within a week of the update, the

number of comments related to the compatibility issues had decreased. The following

review is exemplary of this phenomenon:

- "I had trouble after the iOS7 launch. But I simply deleted it and reinstalled the

   latest version to resolve the issue. (A big thank you to the reviewers that posted

   this helpful tidbit.)" (Review 504).

   Shared problem solving was also evidenced in the app, Stack the States, where the

developer utilized comments from the reviews to modify or update the content of the

apps. For example, in April of 2012, a reviewer indicated an error in the question,

"Augusta is a city in which state?" Two of the four answer choices were correct (i.e.,

Georgia and Maine), however only one was programmed as the correct answer. The

developers promptly corrected this error in the June version update.

**Chapter V Summary**

The present study explored the top nine educational iPad apps through an activity

theory framework, and identified key characteristics of the educational app culture. While

the previous chapter presented individual portraits of apps from different data sources,

Chapter V presented a descriptive analysis of the overall culture from a holistic

perspective, supported by the broader literature. The chapter began with a re-examination

of the role of the iPad and apps as tools that mediate a user's orientation toward a motive.

Evidence from the reviews supported the notion that certain actions in apps facilitated the

spatio-temporal needs of customers. In regards to the instructional content, although

philosophical differences were apparent in the goals of each app, the data revealed that a common characteristic among all nine apps was the development of an interactive environment and that the development and mastery of skills were underscored by positive reinforcement and active creation as opposed to punishment.

Additionally, the data revealed both individual and social interactions. While learners could use the apps without others, the data suggested that they did experience the apps with other people, thereby broadening the app culture and making it a socially dynamic environment. For example, parents shared personal stories with strangers, including observations on their child's learning and level of engagement/enjoyment. Children also shared their experiences with others, and many reviewers directly referenced the comments of other reviewers/users. The commentary provided developers with valuable information regarding technical issues, as well as recommendations on improving the user experience.

## Future Research

This study was a starting point for a conversation about the convergence of iPad app research and instructional design. Tremendous effort was placed into providing a better understanding of the individual apps toward a more complete picture of the broader app culture. However, the methodology and the resulting portraits need further examination and other scholars and researchers' input will improve the processes.

Future research shall investigate the bridge-building capabilities of educational apps in terms of lessening the digital divide and gaps in academic, personal, and commercial short-term and long-term learning objectives. As evidenced in this study, the goals of the various members of/contributors to the app culture, including the developers,

consumers, users, educators/academics, and researchers, may differ based on individual needs. However, when coalesced, they form a community that is socially constructed and sensitive to the needs and expectations of the app culture that they created. Finding a connection among these individual needs facilitates a shared understanding of contemporary needs and broader goals of modern society, as well as an open communication about the ways in which specific apps may be individualized for personal skill development.

The second consideration involves a holistic look at tablet-based instructional content and strategies. Research in the area of literacy (both verbal and visual) should consider the role of apps and parental involvement, particularly with emergent learners. It may also be important to evaluate the design of digital storybooks, particularly those with an interdisciplinary approach since newer digital media purports to facilitate learning across the curriculum.

A final consideration for future research concerns the developmental appropriateness of apps for young children. The concept of the zone of proximal development has not been fully explored beyond the area outside of the zone. There is an assumption that the capabilities of adults or more knowledgeable peers limit gains in learning and development; should a learner wander beyond this zone, he/she may experience detrimental consequences. It was, therefore, surprising that many customer reviews from parents indicated high satisfaction with gains in achievement of children beyond their cognitive developmental level. Whether or not one feels a 1-year-old needs to learn the word "gargantuan," or if a child who has yet to master basic literacy skills needs to memorize state facts, shapes, and the relative geographic location of state

boundaries, research on learning in the app culture and the concepts of Vygotsky's zone of proximal development is needed. It will be a benefit to examine the extent of reach of the zone of proximal development, as well as the personal and social motives that may conflict with the intended goals of the developers.

## Limitations of the Study

As with all research, the present study was subject to a number of limitations. Limitations included weaknesses in the study or elements that were beyond my control. Disclosing limitations in a research study helps readers determine whether or not the study can be generalized to specific people and situations (Creswell, 2008).

1. The present research studied the top nine, paid apps, in the education section of the App. Similarities and differences among the apps were noted but the purpose of the research related more to in-depth, individual, portraits, rather than understanding the apps as a unit. The data analysis and discussion could not be generalized beyond the scope of the targeted apps.

2. Because of the differing nature of every educational app, the purpose of this research was not to assess or compare apps for their educational quality or integrity. Although the present study did examine the instructional capabilities and limitations of the apps, using existing literature, questions of their appropriateness or suitability for specific audiences was purposely disregarded.

3. The data analysis was limited to my personal experiences and the availability of time, tools, and resources. Although considerable effort was made to explore primary and secondary sources related to the culture of each app, the research process was a continual journey of discovery that was by no means exhaustive.

**Final Thoughts**

Before I conclude this study, I would like to provide an anecdotal reflection about my experiences during the course of this research. One of the limits, or perhaps the meritorious qualities of qualitative research is my role as the primary investigator in this study. My predispositions, prior experiences, awareness of technology tools, as well as my understanding of theories and practices all impacted and were influenced by my role as a participant in the analysis of data and the representation of findings.

Initially, when I began the pilot study for my research the underlying question I sought to explore was, *what is it about these apps that makes them top among educational apps?* Soon after I began collecting data, I became overwhelmed by the daunting task of finding and justifying commonalities among the seemingly disparate apps. Classification of apps based on instructional and learning principles and strategies suggested that, aside from the intended audience (i.e., children), the nine apps differed in terms of learning goals, strategies used, expectations and recommendation of users and parents, as well as their "educational" nature.

On one hand, there were apps such as Starfall Learn to Read, which were seemingly very "educational" from an academic standpoint; although, the number of reviews was relatively low. On the other hand, there were apps such as Toca Hair Salon 2 and Dr. Panda's Restaurant 2. They had beautiful modern graphics and goofy sounds that didn't seem to have any educational purpose. Apps, such as Mickey Mouse Clubhouse: Wildlife Count Along incorporated many of the theories and strategies that I had learned in my graduate courses. The instructional design was meticulous, but many customer reviews indicated great disappointment. My own perceptions of learning, education, and

theory that I had carefully studied, categorized, and stored in my mental toolbox for the purposes of this capstone project began a mental rebellion.

As I delved deeper into the content of the data, I realized that the interactions within a particular app were not the start of the app experience, and learning with the app did not begin with the opening of the iPad app in front of the child. The experience was a social one, often initiated by the parents who had made personally motivated decisions about their child's learning and safety. This sharing element was coupled with the timing of the developer's actions (or inactions) in disseminating the app onto the App Store. The developer descriptions supplied an initial presentation of the apps, but the ratings and reviews by previous customers provided a more intimate and detailed assessment of the learning spaces. Furthermore, previous reviews were written by people with personal and direct experiences to share and distinct motives for purchasing and using the apps. All of that was going on before, during, and after my four months of recording, collecting, and analyzing the data.

I had intended to examine the apps separately. However, the process of researching data that was so complex and cumbersome in volume became increasingly disorderly to the point of verging on chaos. The recursive but painstaking task of coding and recoding over 17,000 written reviews was further exacerbated when I began to notice characteristics of apps that were overtly emphasized in one app but only hinted at in others. For example, Stack the States seemed to focus on the academic content, whereas Bug Art focused on the educational experience. Endless Alphabet, Wallykazam! Letter and Word Magic, and Starfall Learn to Read were all literacy apps with very different strategies for emergent learners. Nonetheless, the academic content in Bug Art seemed

just as important as the educational experience. And, the varying philosophical perspectives regarding the message design in the literacy apps provided much insight into the visions and missions of the developers.

I once had a professor, who taught me that design was a messy process. She likened it to rocket science but qualified the comparison, pointing out that instructional design can be far more complicated. The comparison never seemed so appropriate as it did when I was considering the complexities of making an educational iPad app function in a straightforward manner for millions of users with vastly different characteristics, expectations, abilities, and objectives. Based on this research, I also found myself wondering if it were necessary to expand the traditional instructional design processes from ADDIE (analysis, design, development, implementation, evaluation) to include the community of learners, parents/adult guides, consumers/reviewers, etc.

My research of the nine apps taught me that the creation and the making available for "consumption" of apps are by no means the only or even the most important elements of the educative climate. Developers created the apps, but the apps were shaped by the millions who heard about them, bought them, or chose to ignore them. Every customer who rated, reviewed, or ignored an app had a need to fulfill, fully or partially, and the educational beliefs and choices of one individual impacted others, directly or indirectly. All of these experiences (and probably more that have yet to be explored) formed the muddled mess that culminated into the superficially simple dynamic of the app culture.

The focus of my original question shifted from finding static or dominant educational characteristics of apps to capturing the unfettered ethos of app culture that fluctuates due to the inherent mobility and flexibility of the device. The clincher and final

obstacle in my research involved persuading perpetually-moving thoughts and ideas to coalesce, verbally, in a dissertational format that only allowed for a finite and linear progression of thought. Ten years from now, the concept of apps and app culture may be strikingly different. The iPads we possess now may be relics, thrown into the deep corners of our closet, waiting to be turned on again to remind us of the technology we used during more simple times. Nevertheless, my hope and intent in conducting this research was to offer a modest appendage to the historically evanescent yet ever-transforming essence of current technologies, theories, and practices.

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**APPENDIX A**

**KAPTELININ, NARDI, AND MACAULAY (1999)
ACTIVITY CHECKLIST**

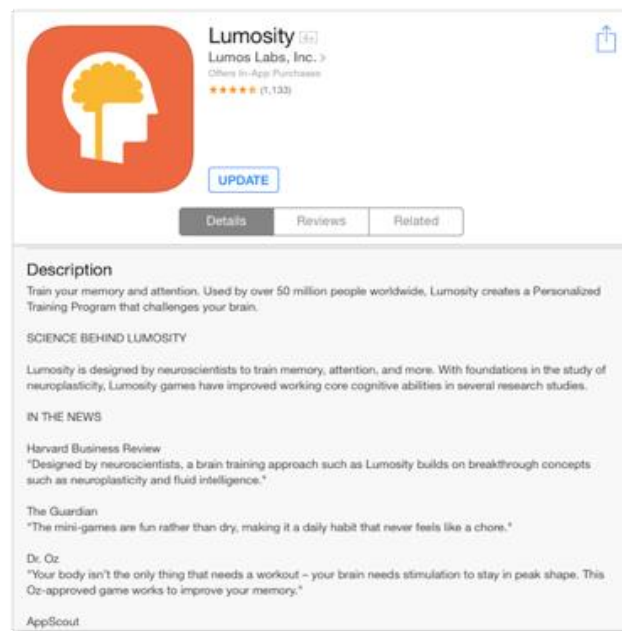| Means/ends | Environment | Learning/Cognition/ Articulation | Development |
|---|---|---|---|
| · People who use the target technology<br>· Goals and subgoals of the target actions (target goals)<br>· Criteria for success or failure of achieving target goals<br>· Decomposition of target goals into subgoals<br>· Setting of target goals and subgoals<br>· Potential conflicts between target goals<br>· Potential conflicts between target goals and goals associated with other technologies and activities<br>· Resolution of conflicts between various goals<br>· Integration of individual target actions and other actions into higher-level actions<br>· Constraints imposed by higher-level goals on the choice and use of target technology<br>· Alternative ways to attain target goals through lower-level goals<br>· Troubleshooting strategies and techniques<br>· Support of mutual transformations between actions and operations | · Role of target technology in producing the outcomes of target actions<br>· Tools, other than target technology, available to users<br>· Integration of target technology with other tools<br>· Access to tools and materials necessary to perform target actions<br>· Tools and materials shared between several users<br>· Spatial layout and temporal organization of the working environment<br>· Division of labor, including synchronous and asynchronous distribution of work between different locations<br>· Rules, norms, and procedures regulating social interactions and coordination related to the use of target technology | · Components of target actions that are to be internalized<br>· Knowledge about target technology that resides in the environment and the way this knowledge is distributed and accessed.<br>· Time and effort necessary to master new operations<br>· Self-monitoring and reflection through externalization<br>· Use of target technology for simulating target actions before their actual implementation<br>· Support of problem articulation and help request in case of breakdowns<br>· Strategies and procedures of providing help to other users of target technology<br>· Coordination of individual and group activities<br>· Use of shared representations of support collaborative work<br>· Individual contributions to shared resources of group or organization | · Use of target technology at various stages of target action "life cycles" – from goal setting to outcomes<br>· Effect of implementation of target technology on the structure of target actions<br>· New higher level goals that became attainable after the technology had been implemented<br>· Users' attitudes toward target technology (e.g., resistance) and changes over time<br>· Dynamics of potential conflicts between target actions and higher-level goals<br>· Anticipated changes in the environment and the level of activity they directly influence (operations, actions, or activities) |

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**APPENDIX B**

**PRELIMINARY RESEARCH**

The purpose of conducting this analysis is to elucidate data analyses procedures and to provide insight into the types of themes that may appear in the customer review data source. The free app, Lumosity, was used for this preliminary study. Data were downloaded on February 3, 2014.

**Methodology**

**Data Collection.** Verbal data were collected from the app description, version histories, and customer reviews of Lumosity's section in the App Store. Additionally, a video screencast was created using the instructional analysis guide. General sampling and data collection procedures parallel the format intended for the full study and have been summarized in the following video: https://www.youtube.com/watch?v=vTTI0sME7Z4
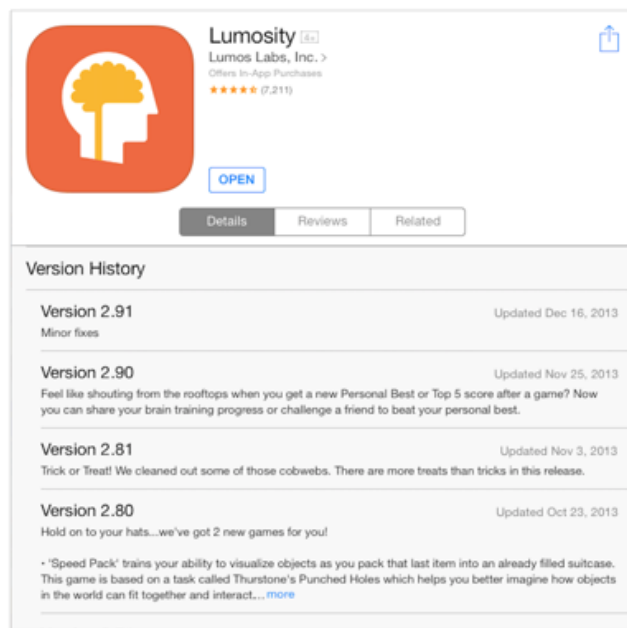


Sample App Description

Sample Customer Reviews



Sample Version History

Instructional Analysis Diagram for Lumosity



Sample Screencast of App Content

**Data Excerpting and Analysis.** Collected data were imported into the qualitative data analysis software, Dedoose. General data excerpting and data analyses procedures parallel the format intended for the full study have been summarized in the following video:

http://youtu.be/Zl7gLEOrAGo



Dedoose Interface

 **Dynamically Developed Child Codes**

The four data sources were individually analyzed for themes. Given the rudimentary nature of this preliminary exploration, initial child codes were not reduced and the data were not synthesized with other data sources.

Packed Code Cloud (Dedoose)

**App Description.** Data from the app description were excerpted and coded. The following child

codes were dynamically developed in the preliminary analysis:

Means/Ends
- Desc: demographic info
- Desc: purpose/goal

Other
- Desc: links (website, social media)
- Desc: testimonials
- Desc: expert opinion/information

**App Content.** The following child codes were dynamically developed in the preliminary

analysis:

Environment
- AC: reference to other devices/OS version
- AC: social elements
- AC: subscription page
- AC: user feedback/request to developers

Learning/Cognition/Articulation
- AC: "spatial speed match"
- AC: "speed match"
- AC: "guidance and support"
- AC: personalized learning
- AC: "lost in migration"

Other
- ● AC: opening title
- ● AC: reset password
- ● AC: login screen (three options)

**Version Histories.** Six revisions posted on the app page were excerpted and coded. The

following child codes were dynamically developed from these version histories.

Means/Ends
- ● VH: purpose/goal update

Environment
- ● VH: reference to previous post

Development
- ● VH: other changes
- ● VH: specific technical fix
- ● VH: bug/minor fixes
- ● VH: new function

**Customer Reviews.** In the first iteration of the customer reviews, 502 of 1716 reviews were

excerpted and coded. The following child codes were dynamically developed from the sampled

customer reviews:

Means/Ends (Instructional Goal)
- ● User: demographic info (age, sex, occupation, etc.)
- ● User: for whom this app is recommended)
- ● User: report of progress (e.g., first time user, used a month, etc.)
- ● User: conflict/troubleshooting – technical issues
- ● User: perceived purpose/goal (general)

Environment (Social & Tech)
- ● User: direct message to developers
- ● User: direct message to potential customers
- ● User: specifies device used
- ● User: opinion about design of app
- ● User: reference to other version/apps/tools
- ● User: user's social relationship
- ● User: when/where app is being used

Learning/Cognition/Articulation (Learning Process)
- ● User: context/duration of use (e.g., how long each day)
- ● User: description/instructions about app UI/process
- ● User: ease of use (positive)
- ● User: self-reflection of learning process

Development (Change)

- User: generally positive opinion (e.g., fun, Awesome, great)
- User: generally negative opinion (e.g., worthless)
- User: mixed opinion (e.g., Great but missing…)
- User: anticipation for app to help/work
- User: desire for more functions (e.g., landscape mode)
- User: pricing issues

Other

- User: where they learned about app/ref to commercial
- User: remarks regarding star ranking
- User: reference to expert opinion/information
- Undecipherable words/images (e.g., foreign, emoticons, jibberish)
- Something else (to be examined later)

**Preliminary Memoing**

Memos taken during this test phase (for consideration in subsequent iterations of the coding)

include the following:

- #258 This is tagged as 259 but only because I couldn't tag the image. This is actually #258 which was all emoticons
- Duplicate excerpt: This excerpt is a duplicate of a previous review and is excerpted but not re-coded.
- Easy and Hard: This did not make it into the ease of use category because the user is talking about the difficulty/ease of the learning content and not the ease of use overall (or in the general sense)
- Environment: enjoys how they don't have to use the computer version (or another version). This is regarding convenience of one medium/device/tool over another.
- It's helpful/It works/useful: Customer states it's helping or that it works, but doesn't explain how or why.
- Looking forward to: Looking forward to more "lessons" can mean looking forward to doing more of what they are doing now or looking forward to the developers providing more lessons/options.
- Not sure if it'll "work": Something about not being sure if it'll work keeps popping up
- Personalizing: In lieu of having an instructor, the app prompts the user for their preference
- Positive and mixed: Positive and mixed are selected because it is evident that he user generally enjoyed the app. They only had one aspect (technical) that they did not like (e.g., portrait/landscape mode), but they went back and explained how they liked it despite the shortcoming.
- Reminders: When personalizing the app, reminders can be made for different days of the week.

Memos in Dedoose

Given the diverse nature of each app, there is no guarantee that the same child codes will be developed for those nine paid educational apps sampled for the study. The implications stemming from these codes and memos can only be understood when all reviews are examined and when they are analyzed in the broader context of the study, which includes synthesizing the data among data sources.

**APPENDIX C**

**TOCA HAIR SALON 2**
**INSTRUCTIONAL ANALYSIS DIAGRAM**

Toca Hair Salon 2
(Toca Boca AB)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka

Full Image available for download:
https://drive.google.com/file/d/0BzRa9pMh4jXZQXRUeXdCUUlrT1k/view?usp=sharing

**APPENDIX D**

**STACK THE STATES**
**INSTRUCTIONAL ANALYSIS DIAGRAM**

Stack the States
(Freecloud Design, Inc.)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka

Full Image available for download:
https://drive.google.com/file/d/0BzRa9pMh4jXZemRaQi1ISEw3MUU/view?usp=sharing

**APPENDIX E**

**ENDLESS ALPHABET
INSTRUCTIONAL ANALYSIS DIAGRAM**

Endless Alphabet
(Originator Inc.)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka

**Endless Alphabet Logo, Intro Animation, Jingle, Logo ♪**

Loading...

Main Menu: Cards in Monster's Mouth ♪ (A)

Tap Letter

Word Dial Swipes Horizontally To First Word of Letter Sequence

Tap Word Card

Word Appears, Word Pronounced as Word Expands & Contracts (E)

Animation: Monsters Run Over Letters Word Pronounced

Outline of word letters Letters are are scattered (C)

Home — (A)

Word Pronounced
Word Defined

Drag Letter to Outline

Tap & Hold Letter

Letter Sound Repeated

Letter Sound Repeated

Correct Placement

Incorrect Placement

Letter Sound Pronounced

Wrong ♪ Feedback "Wah-wah" or "Uh-uh"

All Letters Placed

If Unplaced Letters Remain

Letter Shifts Out of Outlined Word

Positive Feedback ♪ Letters Move (Dance) Word Pronounced (by group)

Explanation of Word (D) - Animated - Verbal

Home — (A)

Tap Screen App♪

Word Pronounced
Word Defined

Colorful Relevant Letters of Words Sprinkle Out Sound Effects ♪

Tap Screen App♪

Word Pronounced
Word Defined

Colorful Relevant Letters of Words Sprinkle Out Sound Effects ♪

Bottom Right Menu

ALL — Displays All Words in (A)

MORE — Displays New Words in (A)

Home — (A)

↑ — Next A-Z Word (E)

Q — (D)

↓ — Previous A-Z Word (E)

Home — (A)

Security Instructions

Type Numbers

X — (A)

If correct

If incorrect

Menu shakes (incorrect)

Info for Parents (B)
- Version Number
- Logo
- Purpose
- Design/Developed by
- Copyright

Link: Support Email — Continue? — OK — Embedded Email Message — Cancel — (B)

Link: Support Center — Continue? — OK — Internet Browser — Cancel — (B)

Follow on Twitter — Continue? — OK — Twitter (Internet Browser) — Cancel — (B)

Like on FB — Continue? — OK — Facebook — Cancel — (B)

Gift This App — Gift This App? — OK — App Store: Feature Not Supported — Cancel — (B)

Tell a Friend — Embedded Email Message

X — (A)

Type Recipient Email

Send — (B)

Delete Draft — (B)

Save Draft — (B)

Cancel

Full image available for download:
https://drive.google.com/file/d/0BzRa9pMh4jXZOUp4VUFrekk5Zzg/view?usp=sharing

**APPENDIX F**

**MICKEY MOUSE CLUBHOUSE: WILDLIFE COUNT ALONG
INSTRUCTIONAL ANALYSIS DIAGRAM**

Mickey Mouse Clubhouse: Wildlife Count Along
(Disney)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka

Full image available for download:
https://drive.google.com/file/d/0BzRa9pMh4jXZd1BBbWRZTlJrNUU/view?usp=sharing

**APPENDIX G**

**WILD KRATTS CREATURE POWER WORLD ADVENTURE**
**INSTRUCTIONAL ANALYSIS DIAGRAM**

Wild Kratts Creature Power World Adventure
(PBS KIDS)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka

Full image available for download:
https://drive.google.com/file/d/0BzRa9pMh4jXZSGh1Z0dOUGFZMGs/view?usp=sharing

**APPENDIX H**

**WALLYKAZAM! LETTER AND WORD MAGIC**
**INSTRUCTIONAL ANALYSIS DIAGRAM**

Wallykazam! Letter and Word Magic!
(Nickelodeon)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka

Full image available for download:
https://drive.google.com/file/d/0BzRa9pMh4jXZa2NNV3VudlBCdjQ/view?usp=sharing
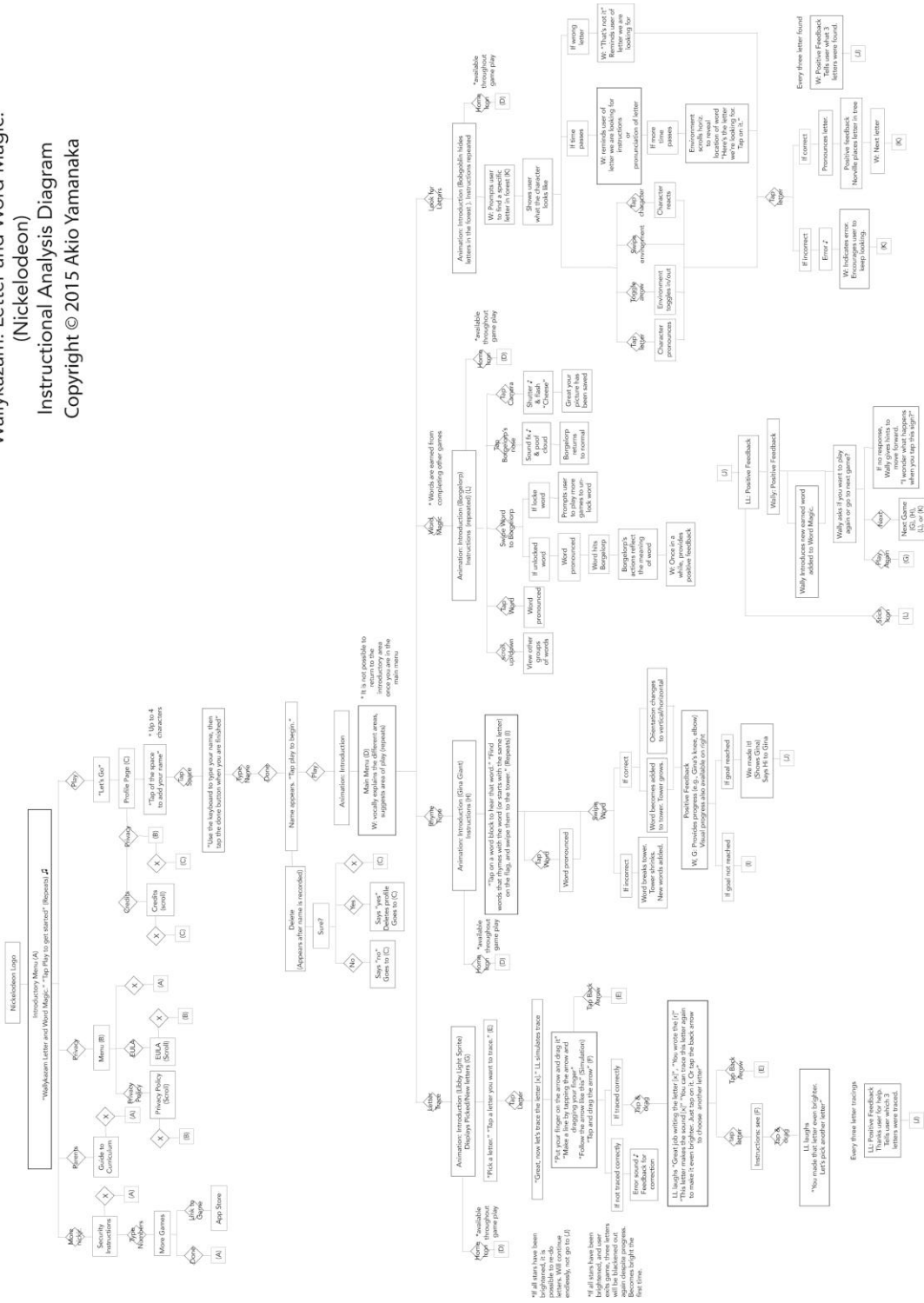
**APPENDIX I**

**STARFALL LEARN TO READ**
**INSTRUCTIONAL ANALYSIS DIAGRAM**

Starfall Learn to Read
(Starfall Education)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka

Starfall Education Logo

Main Menu (A)

Toggle on/off Lock

Information Text

15 Blocks

Sub-Menu (B)   * Not all options available for each sub-menu block

**Tap Block**

Movie/Video — Plays instructional video in the form of a story.

Picture Hunt — "Picture Hunt" Image on top. Title on bottom (H). Instructions appear on bottom (H).

Pronunciation Card — Written phonetic letters "[phonetic letters] sounds like [phonetic sound]." Image of mouth. (For some, lines appear when spoken.) User prompted to proceed by sparkling arrow.

Make a Match — "Make a match" 12 cards appear. User taps two cards with same words. Six combinations. Three levels. Level progress on top. No instructions. (I)

Word Sorting — Airplane flies "Word Sorting" (For Block #11. Jingle ♪ Phonetic rule is sung). Phonetic sounds highlighted and introduced. Sound narrated. Cloud with word appears (K).

Tap Card Game — "Make a word with [sounds out phonetic letters] [sounds out phonetic sequence]." or "Make" a word to match the picture

* Option to exit available through out entire gameplay.

Full image available for download:
https://drive.google.com/file/d/0BzRa9pMh4jXZT2d5dkRrVWg3d3M/view?usp=sharing

**APPENDIX J**

**DR. PANDA'S RESTAURANT 2**
**INSTRUCTIONAL ANALYSIS DIAGRAM**

Dr. Panda's Restaurant 2
(TribePlay)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka

Full image available for download
https://drive.google.com/file/d/0BzRa9pMh4jXZV3dkZGhpUVZpZk0/view?usp=sharing
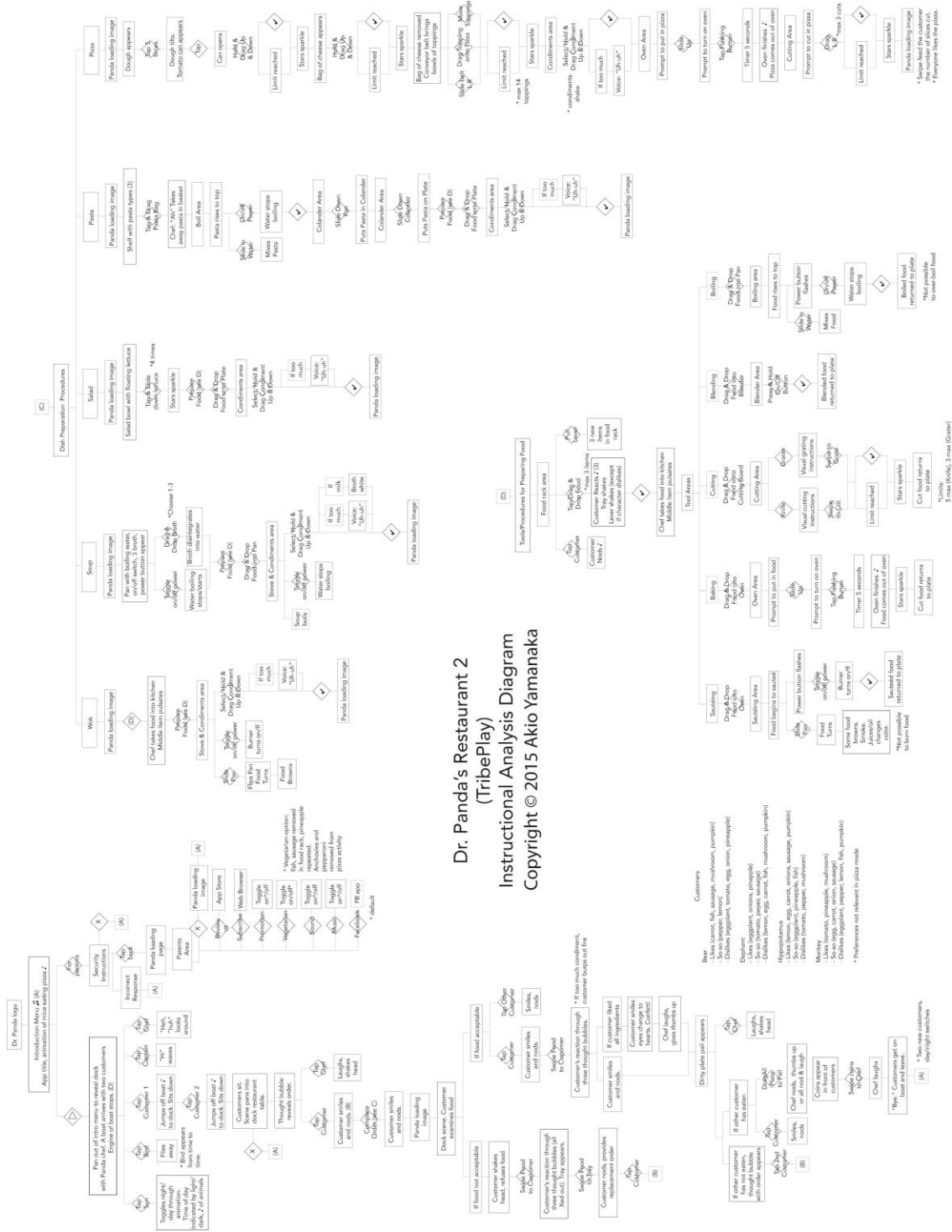
**APPENDIX K**

**BUG ART**
**INSTRUCTIONAL ANALYSIS DIAGRAM**

Bug Art
(Little Bit Studio, LLC.)
Instructional Analysis Diagram
Copyright © 2015 Akio Yamanaka



Full image available for download:
https://drive.google.com/file/d/0BzRa9pMh4jXZM0ZJU2VjemV0UUk/view?usp=sharing

**APPENDIX L**

**TOCA HAIR SALON 2
REACTION TIMES**

| | | | | | |
|---|---|---|---|---|---|
| 1 | 12.96 | 51 | 13.06 | 101 | 12.86 |
| 2 | 12.75 | 52 | 12.58 | 102 | 12.79 |
| 3 | 12.73 | 53 | 12.85 | 103 | 12.83 |
| 4 | 12.88 | 54 | 12.98 | 104 | 12.83 |
| 5 | 12.83 | 55 | 12.81 | 105 | 13.05 |
| 6 | 12.94 | 56 | 12.73 | 106 | 12.66 |
| 7 | 12.83 | 57 | 12.91 | 107 | 12.89 |
| 8 | 12.71 | 58 | 12.79 | 108 | 12.80 |
| 9 | 12.94 | 59 | 12.86 | 109 | 12.91 |
| 10 | 12.95 | 60 | 12.76 | 110 | 12.73 |
| 11 | 12.71 | 61 | 12.85 | 111 | 13.01 |
| 12 | 12.81 | 62 | 12.88 | 112 | 12.65 |
| 13 | 12.91 | 63 | 12.78 | 113 | 12.83 |
| 14 | 12.79 | 64 | 12.81 | 114 | 12.96 |
| 15 | 12.98 | 65 | 12.88 | 115 | 12.75 |
| 16 | 12.76 | 66 | 12.85 | 116 | 12.88 |
| 17 | 12.73 | 67 | 12.76 | 117 | 12.86 |
| 18 | 12.81 | 68 | 12.96 | 118 | 12.83 |
| 19 | 12.86 | 69 | 12.76 | 119 | 12.86 |
| 20 | 12.96 | 70 | 12.83 | 120 | 12.78 |
| 21 | 12.78 | 71 | 12.93 | 121 | 12.83 |
| 22 | 12.73 | 72 | 12.73 | 122 | 12.85 |
| 23 | 12.86 | 73 | 12.86 | 123 | 12.76 |
| 24 | 12.86 | 74 | 12.93 | 124 | 12.89 |
| 25 | 12.86 | 75 | 12.80 | 125 | 12.88 |
| 26 | 12.80 | 76 | 12.85 | 126 | 12.78 |
| 27 | 12.91 | 77 | 12.83 | 127 | 12.88 |
| 28 | 12.85 | 78 | 12.89 | 128 | 12.88 |
| 29 | 12.83 | 79 | 12.69 | 129 | 12.74 |
| 30 | 12.79 | 80 | 12.86 | 130 | 12.86 |
| 31 | 12.84 | 81 | 12.86 | 131 | 12.84 |
| 32 | 12.85 | 82 | 12.73 | 132 | 12.83 |
| 33 | 12.88 | 83 | 12.86 | 133 | 12.85 |
| 34 | 12.83 | 84 | 12.93 | 134 | 12.86 |
| 35 | 12.89 | 85 | 12.76 | 135 | 12.88 |
| 36 | 12.73 | 86 | 12.99 | 136 | 12.70 |
| 37 | 12.93 | 87 | 12.71 | 137 | 12.99 |
| 38 | 12.76 | 88 | 12.95 | 138 | 12.79 |
| 39 | 12.96 | 89 | 12.76 | 139 | 12.84 |
| 40 | 12.66 | 90 | 12.88 | 140 | 12.80 |
| 41 | 12.86 | 91 | 12.74 | 141 | 12.88 |
| 42 | 12.90 | 92 | 12.81 | 142 | 12.76 |
| 43 | 12.85 | 93 | 12.91 | | |
| 44 | 12.74 | 94 | 12.81 | **TOTAL** | **12.8365493** |
| 45 | 12.93 | 95 | 12.95 | | **30min 23.50 sec** |
| 46 | 12.81 | 96 | 12.71 | | |
| 47 | 12.93 | 97 | 12.91 | | |
| 48 | 12.73 | 98 | 12.76 | | |
| 49 | 12.86 | 99 | 12.86 | | |
| 50 | 12.81 | 100 | 12.85 | | |