DISCOVERING THE MEANING BEHIND THE STORY: CREATING A SYSTEM FOR DOCUMENTING AND SUPPORTING CHILDREN'S NARRATIVE DEVELOPMENT

by

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Abstract

Narrative is a powerful core component of human development. Our ability to tell stories has been credited as one of the major influences for the success of the human species. We communicate, think, encode memories, dream, and learn about the world around us through stories. As story-beings, we need to recognize and harness the power of narrative as an educational tool.

Despite the importance of narratives, there are significant gaps in the literature for understanding children's narrative development and designing interventions to support growth. Unlike literacy, there are no state-reported statistics of the rates of narrative development for children, nor are there established consistent methods with comprehensive metrics to systematically document narrative progress or evaluate interventions. These gaps are perpetuated by the complex space of narrative, specifically in the form of the content and the social, cultural, and individual context.

In response to these gaps, we developed Learning Loops, a novel digitally-mediated family learning system for documenting and supporting children's narratives. Embedded in the Learning Loops system is StoryBlocks, an open-ended storytelling app for children ages six to ten. While children play in StoryBlocks, their fine-grained interaction data is captured and streamed to a human coach, who uses a custom-built tool to analyze play and identify narrative trends. Coaches use this analysis to scaffold children's narrative process through direct feedback and promote caregiver co-engagement through text message updates and activities. This system is unique in that it: 1) documents children's stories as a basis for a comprehensive narrative analysis system, and 2) incorporates the important social role in children's learning by using digital tools to augment and support human social engagement in the narrative process.

Through presenting Learning Loops, this work explores the roles that both technology and humans play within these digitally-mediated systems to support narrative development within the child's social context. This dissertation proposes the Two-Lens Approach, a holistic theoretical framework for studying the form, content, and context of children's narratives. This approach is applied to critique the current design and guide future iterations to improve the program's ability to document, analyze, and support children's narrative capacity.

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Table of Contents

1.0 Introduction

We have all felt the power of storytelling. Both the power of having a captivated audience hang on your every word as you recount a thrilling tale, and the power of feeling emotion overtake your body as you listen to the oscillating arc of a gripping narrative. Storytelling is not just important for entertainment; it is how we communicate, form memories, and translate information to one another. In order to understand how we operate as story-beings, we must examine not just the complete stories that follow traditional narrative arcs, but the incomplete stories, scripts, and conversations that hold meaning and convey information [1; 2]. Some researchers, linguists, and educators may not consider these to be "stories" or "narratives", and, especially when it comes to children's stories, do not see the value in examining them. However, only by capturing and examining children's seemingly incoherent stories can we begin to understand not only how and why we develop narratives [1], but we can also begin to uncover the meaning children are communicating about their world [2]. In this dissertation, we take a broad definition of "narrative" to include the incomplete, messy, and complex scripts, proto-narratives, and stories of children in order to understand how they develop narrative, how we can document their narrative progress, and how we can build systems to support children's creative expression.

Storytelling has been shown as a motivating and effective way to support children's language, literacy, social-emotional, and communication skills, and has been linked to later academic success [3; 4; 5; 6; 7]. Research has shown that narrative proficiency at age five is one of the strongest predictors of later reading comprehension [8; 9; 10; 11]. Despite the importance of supporting expressive narrative opportunities for children, as children enter elementary school, they tend to write less for the purpose of communication and, instead, often only write when prompted by an adult (e.g., teacher). Additionally, school-aged children's writing is less expressive, focusing more on writing conventions and less on content and function [12]. One potential reason for this is that children are often only encouraged to use writing to tell one type of story in schools [6], because there are very few research-based practices that are known to support narrative development. Since the definition of "good writing" is subjective and relatively ambiguous, there are no clearly defined metrics, making the tracking of narrative growth hard to identify and evidence-based writing interventions difficult to research and implement within and outside of the school setting. The complexity of defining narrative is compounded by the gaps in the literature on children's narrative development. Unlike other components of literacy, such as reading fluency and comprehension, there are no reported statistics or rates of narrative skills for children. Meteas and Sengers (2003) explain that the research agenda tends to rule out the ability to study human narratives because its complexity defies the possibility of complete, testable models [13]. Therefore, due to the seemingly paradoxical nature of narrative research, very few comprehensive standards or metrics exist to evaluate children's narrative abilities.

Technology has three potential benefits that can be harnessed to help start to close the research gap surrounding children's narrative development: interactivity, data capture, and connectivity. The interactivity of digital tools can provide a stimulating, personalized platform for children's creative expression and storytelling [14; 13]. However many literacy-based apps are neither open-ended to allow for children to create their own stories, nor targeted towards school-aged children, where the need for creative expression is particularly acute [15; 16; 17]. Another unique affordance of technology is its ability to capture data in a new way to document

children's stories. While this ability exists, the majority of children's learning app companies only use children's interaction data to measure app usage. Unfortunately, the bulk of the rich learning data is either not stored or not synthesized in any meaningful way to support the child's learning process [18; 19; 20; 21; 22].

Despite the advantages of technology, few platforms harness these affordances to support children's creative expression through storytelling for early and middle childhood, and even fewer include a social community to support narrative growth. Narrative development does not happen in a vacuum, but exists in the child's social context [7; 6; 23; 24; 25]. Technology has the potential to connect people in a faster and more immediate way than ever before. However, despite the importance of the social component of children's storytelling and the ability for technology to connect one another, few platforms for children's storytelling are designed to include the child's social context and community [15; 14]. Instead, some platforms are designed to actually replace the child's social support with a digital agent [26; 27; 28; 29; 13; 30; 31]. This makes technology more alienating, and has the potential to actually distance the child's social community from the learning experience, rather than include it [21; 17].

Given the breadth of problems surrounding children's narrative development, we see an opportunity to create Learning Loops, a platform for children ages six to ten years old (1st-5th grade) that not only provides a space for creative expression through writing stories, but also uses play analytics and builds a supportive learning community to promote the growth of children's narrative skills (i.e., writing, creativity, collaboration, iteration, imagination). Through Learning Loops, our goal is to address this multifaceted problem by combining data-driven analysis with human analytics skills to capture and identify a child's meaningful learning patterns beyond what either could produce alone. This allows us to systematically document, synthesize, and interpret elements of children's narrative skills in order to continually track narrative progress.

The purpose of this dissertation is to develop a theoretical framework for children's narrative development, and apply this framework to inform the design of Learning Loops, specifically in the program's ability to document and support children's narrative capacity. In this dissertation, I use Leaning Loops as a case study to conduct research towards understanding and designing systems for children's narrative development by addressing the following research questions:

1. Based on our theory of narrative development, how do we design the best platform for children's narrative expression?
2. Using our theoretical framework to inform our analytics, how do we document and track children's narrative progress from their stories?
3. How can we best use children's story data to support children's narrative capacity?

The benefits of this work are three-fold. First, narrative is one powerful aspect of what makes us human and studying children's narratives is a crucial step in understanding narrative development. Second, children express themselves and their beliefs about the world through their narratives, and creating platforms with frameworks to systematically study these narratives can help us better understand the child's cognitive and emotional development. Third, children's narrative expression plays a big part in their overall learning and development, and we need to design more evidence-based interventions and platforms to facilitate this. This work will

continue to inform the design and approach of the Learning Loops program, and aims to serve as an internal constitution for how the program defines, documents, and supports narrative development. In this way, this work will help build on the program's foundations as Learning Loops transitions to the nonprofit space.

This dissertation is summative in its examination of the existing literature and the current Learning Loops program, yet formative in its design of new iterations and analysis tools that align with my proposed theoretical framework. This dissertation is organized into five sections. First, I present the current Learning Loops system and approach, complete with literature reviews that informed the program's design and development. Next, I examine the current system's ability to document and support children's narrative development by analyzing findings from the Learning Loops Spring 2019 pilot. Then, in response to our findings, I conduct a literature review of children's narrative development and synthesize it into my own theoretical framework, the Two-Lens Approach, which uses a formalist and interpretive lens to analyze the form, content, and context of children's narratives. Finally, I apply the Two-Lens Approach to the Learning Loops system retrospectively and prospectively in order to surface considerations and suggest designs to improve the program's ability to document and support children's narrative capacity. This dissertation culminates in a design document that will inform the next iterations of our platform for children's expression and narrative analysis tools.

2.0 Learning Loops Approach and Current System Design

2.1 The Learning Loops Approach

2.1.1 Background Literature for Developing the Learning Loops Approach

Narrative is inherently social, both in its communicative purpose and in its acquisition. The act of storytelling often involves at least two people; an author/teller and a listener/reader [7; 31]. For younger children, the development of storytelling and narrative most often occurs from relationships with caregivers or other adults, usually in the context of conversation, reminiscing, or play [12]. Children can engage in storytelling and develop narrative skills from and with peers, caregivers, adults, teachers, and others in their community [6; 3; 4; 23; 32; 33; 34]. Storytelling and story acting is a heavily researched practice that demonstrates the benefits and influences of the child's social learning community on the development of children's narratives [5; 3; 35; 6]. Children construct narratives that represent the influence of the themes or topics that their peers have shared [3; 5; 6], the language used in common fairy tales they are exposed to [4; 36], the cultures and contexts that occur at home or in school [3; 7], and the scaffolding of the adult scribe and director [3; 6]. For play-based narrative approaches (i.e. storytelling and story acting) the adult is constantly trying to strike a balance between excessive and insufficient support by assessing the child's zone of proximal development [37] in order to adjust the level of scaffolds available to the child to optimize their learning [5; 38; 39; 40].

Research has shown that this scaffolding role is often better played by adults, rather than same-aged peers, as it requires a level of sophistication and background knowledge about the child [41; 3]. As adults model, facilitate, scaffold, and co-engage, they help activate the learning for the child by contextualizing the material [42; 3]. Multiple research studies have found that storytelling and play activities that are scaffolded by encouraging adults and other more experienced partners increased children's emotional regulation and expression [43; 44; 45] and showed greater narrative skill gains than those without scaffolding [46; 47; 33]. Furthermore, parent-child activities are directly linked to better literacy skills, including narrative [48; 49].

Despite the well documented impact that social support, especially from adults and caregivers, has on children's narrative development and greater literacy learning, educational technology is not commonly designed to include opportunities for adult and peer social engagement [15; 33]. This is an unfortunate oversight, as research in children's educational media highlights that well-designed technology alone is not enough to support children's learning [50; 51; 52]. Instead, Guernsey and Levine (2015) suggest a "tech-assisted, human powered" learning approach, in which technology in combination with adults who can guide children will produce the best learning outcomes [50]. Unfortunately, rather than inviting caregivers to be guides, technology has a tendency to both distance caregivers from actively engaging with their children and perpetuates parental insecurity around supporting children's learning [51; 52]. Research shows that when literacy apps include more automated scaffolds, parents are less likely to co-engage and more likely to feel incompetent at supporting their child and misinterpret their role as unnecessary [21; 22; 50]. Designing apps to include caregivers in the activity can increase parent's sense of self-efficacy and motivation, especially when encouraged by others (e.g., teachers) who invite parents into the process and actively encourage their involvement [53; 18]. Researchers have suggested offering ongoing coaching to parents on

how to support specific literacy skills as a way to both improve children's literacy acquisition and bolster parents' confidence and involvement [49; 54].

However, rather than using children's interaction data to augment social supports that include caregivers, researchers and developers are using AI tools to build digital social agents that aim to replace humans as social learning partners [55; 56; 57; 58; 31; 27; 28; 29]. There are several limitations to the ability of the current technology platforms and digital tools in replicating the richness and benefits of human social interactions for learning. One is that digital social partners such as interactive media characters or instructional tutors, run on pre-scripted material, which inherently assumes that there is one way to solve a problem or have an interaction [55; 59; 26; 58; 31; 27; 28]. This pre-scripted material cannot work for more open-ended and complex disciplines like narrative, and research shows that creating lengthier and varied scripts for these characters/agents can actually be detrimental to children's learning by over-structuring or stripping away the child's agency and initiative in the interaction [57; 60].

Another limitation is that agents who are programmed on trigger-words can often provide irrelevant scaffolding that distracts rather than aids children's learning. One study on digital agents for scaffolding between peer learners found that the interjections from the agent tended to be distracting and annoying, interfering with the students' ability to learn [57]. This is consistent with the research in children's digital e-readers, which found that the animations and manipulative features (such as automated scaffolds) actually distracted children, hindering their letter recognition and story comprehension [32; 17]. The scaffolds provided by a human adult are less distracting because they are more nuanced. By assessing the proximal zone of the child, the situation, the environment, and the child's interests, the adult can employ different strategies or content to adjust and customize their support [61].

Perhaps the largest limitation of digital social agents is their inability to collect external contextual data in order to make inferences and decisions about how to best support the child [13]. Depending on the expertise and experience of the child, the adult needs to be flexible, constantly adjusting and switching their role; sometimes taking more of a supporting role than directing role, and knowing when to let the child individually problem solve [35; 37]. The ability to interpret the child's needs, adjust the form of scaffolding required, and then provide that support in a timely manner that acknowledges the child's process and interests is uniquely human, and something that digital tools cannot accomplish alone. Rather than using children's data to build more robust digital social partners that replicate or replace the role of the human, these data should be used to prompt and support the human adult in having meaningful social interactions and engaging in the child's narrative process.

In response to other digital systems for children's storytelling either ignoring the importance of human connection in children's learning or attempting to replace humans with inadequate digital social partners, we propose the Learning Loops system, which takes the first known steps at accounting for the important social role in children's learning by using digital tools to augment and support human social engagement in the narrative process.

2.1.2 Introduction to the Learning Loops System

Learning Loops creates small-scale coach-family networks centered around digital storytelling tools. Through harnessing the power of technology to enhance human capabilities and connect coaches and families, these networks aim to promote children's narrative development by empowering children as authors, scaffolding children's storytelling, and

encouraging family involvement in the narrative process. This system is unique in two main ways: 1) it documents children's narratives to build a comprehensive analytics system to measure narrative development, and 2) it accounts for the important social role in children's learning by using digital tools to augment and support human social engagement in the narrative process.

Two core technologies are integral to the Learning Loops program: StoryBlocks, an open-ended storytelling app for children to create unique comic-style stories, and the Coach Console (referred to as Console), a custom-built portal for our trained volunteer coaches.

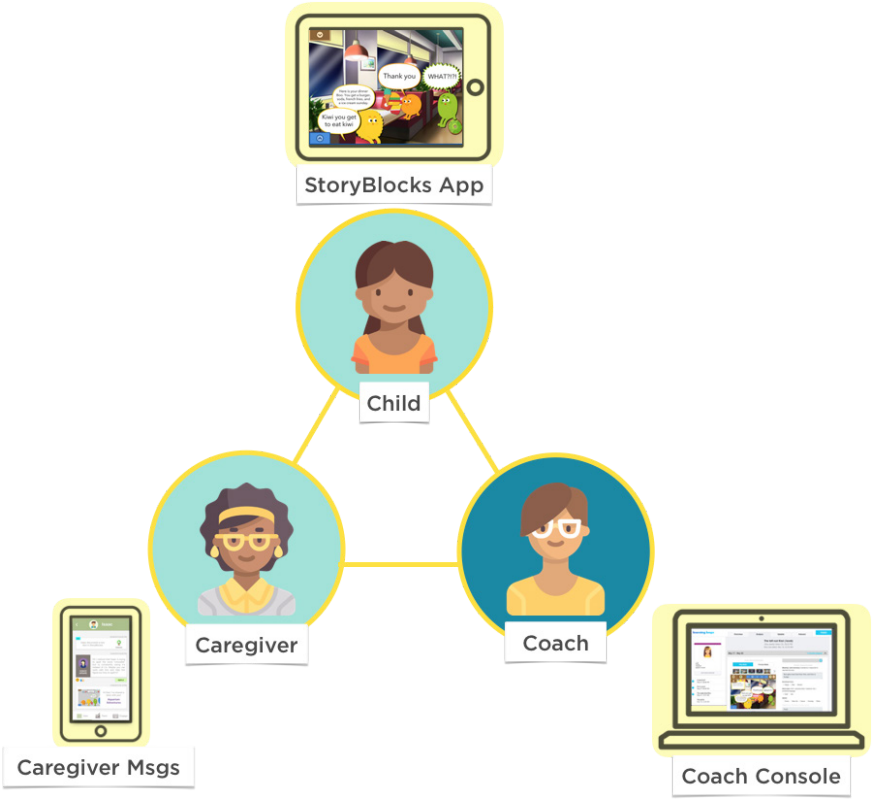


Figure 2.0 The Learning Loop

Figure 2.0 displays the whole learning loop and the three main stakeholders within it — the child, the caregiver, and the coach. While children play with StoryBlocks, every tap and click is recorded, capturing both the details of what children make (i.e., the products of their play) and how they make them (i.e., the process of their play). These data are streamed to the Console, where our data analytics system combines human and machine analysis to identify meaningful learning patterns in children's freeplay and track their narrative development over time. The coaches take these learning moments and translate them into short, two-sentence updates that they send to children's caregivers via text message. These updates also include a short, contextualized activity that the child and their caregiver can do together to reinforce what the child is learning. Additionally, coaches can reach back into the app and send feedback, suggestions, or prompts directly to the child's story to scaffold children's learning and expand their sphere of exploration through play.

The Learning Loops approach consists of four key components: (1) literacy learning apps, (2) Family Learning Coaches (referred to as coaches), (3) narrative analytics tools, and (4)

family engagement. Each part of this full-stack approach is integral to the development of a digitally-mediated system for documenting and supporting children's narratives. The design and development of the first three components are described below.

2.1.3 Guiding Principles of the Learning Loops Approach

In response to the background literature, Learning Loops adheres to a "tech-assisted, human-powered" [50] approach to learning by inserting a human coach into the system and using the power of machine techniques to augment the coach's skills and loop caregivers into the process. Taking a blended approach is a core tenant of the Learning Loops program, and is embodied in the child-driven, machine-guided StoryBlocks app, as well as the coach-driven, digitally-supported Console.

In order to build a blended, playful, and child-driven literacy learning system for children and families, Learning Loops was built upon aspects of the pedagogies of the theorists Seymour Papert, Maria Montessori, and Lev Vygotsky. There are four guiding principles of the Learning Loops program: 1) Playful Learning, 2) Social Learning, 3) Play Analytics, and 4) Scaffolded Learning.

Curiosity and the drive to learn about the world and one's self are central driving forces of children's learning. Learning Loops seeks to design fun, engaging experiences that tap into each child's natural instincts to play and explore, while guiding children towards learning outcomes. Seymour Papert believed that the primary agency in the learning process should remain with the child, enabling the child to construct her own learning environment through personally-meaningful, project-based play [62]. Papert believed that technology could serve as a fundamentally new material for learners. Building on Papert's guiding ideas combined with data analytics to understand child development, the Learning Loops team designs tools for children to develop skills in self-expression, literacy, and dialogue through natural mediums of written language, pictures, and stories that are evolved for person-to-person communication.

Learning Loops champions the belief that literacy is an inherently social activity. The role of caregivers, peers, and others that form a child's most intimate social learning community is critical to the child's development [63]. For younger children, these social networks have an even greater impact on the child's development. Although learning technologies have unique affordances, research continues to demonstrate that technology alone is not enough, and app creators must acknowledge the critical role that caregivers play as guides and role models [50]. Educational apps designed for caregiver-child dyads have the potential to empower caregivers to engage in the learning process [18]. The Learning Loops approach focuses on three main players: the child, the caregiver, and the coach. This coach-in-the-loop system is designed to encourage child-driven, playful learning that involves members of the child's learning community within the learning process.

Montessori's pedagogy required constant observation and analysis of children to guide individual development [64]. Learning Loops embraces this idea by developing Play Analytics, which leverage data-driven tools to augment human observation and analysis by surfacing data and visualizing play traces to help human analysts identify intentional higher level patterns. The Console is powered by Play Analytics, which enables a coach to rapidly inspect play traces collected from a child's activity and pull out their salient achievements, or meaningful learning moments. These Play Analytics are intended to document narrative development and encourage children's storytelling, but not to force their stories to fit a specific mold. Like Montessori,

Learning Loops sees immense potential for revealing insights into a child's developmental trajectory grounded in rich, longitudinal, behavioral data. These insights provide the basis for Learning Loops' tech-assisted, but human-powered learning approach.

According to Lev Vygotsky, learning largely happens within the Zone of Proximal Development — a range of skills that the child hasn't yet mastered on her own, yet can perform with some amount of help [37]. The opportunities for such learning frequently arise in the process of self-directed play, as the child often sets goals beyond her current reach. Supporting the child to achieve such goals is important for maintaining her interest and engagement with the system. Guiding the child through an open-ended play requires getting to know what the child's interests and goals actually are, and providing subtle helpful hints for achieving these goals. Coaches use two steps to guide children. First, they analyze trends in play data and identify children's intentions or personal learning goals through their stories. Next, they scaffold children's narrative development by both providing feedback on children's stories that directly align with the child's narrative goals and prompting new stories that expand the child's sphere of exploration. By using the Play Analytics as a guide to inform their feedback and prompts, coaches better identify the strengths of children's stories in order to help children develop the narratives that they want to tell.

2.1.4 History of the Development of Learning Loops

The Learning Loops system was developed using a Design-Based Research approach (DBR) [65], taking the learnings from previous research and using it to drive changes to the current system and technology. Three research pilots were conducted that led to the formation of the Learning Loops system and approach. All of these pilots used the foundational literacy learning app, SpeechBlocks (referred to as SB) [66]. SB is an open-ended literacy app that promotes phonemic awareness through explorative wordplay for children ages four to six years old [67; 68]. In SB, children could pull apart and put together letter blocks that would sound out their creations using the phonetic rules of English. The first research pilot in the spring of 2016 consisted of a ten-week user study of the SB app in a kindergarten preparatory classroom with 16 children (ages four to five years old). This pilot led to the creation of two foundational aspects of the Learning Loops approach: Play Analytics and social learning. Since SB was open-ended and every tap and click was recorded, the child's play could be reconstructed from the data logs and presented in an easily digestible visualization (i.e., PlayTrees [69]) to view not only the products of children's play, but the process as well [70]. With this new ability to visualize the process of children's play, the questions became who would view this data, and how could it be used to socially support children's literacy learning? In answer to these questions, the coaching system for SB was designed and implemented. The first pilot of the coaching system for SB was conducted in the spring of 2017, with three researchers serving as coaches for 16 children (ages four to ten years) and their families over ten weeks. The purpose of this second pilot was to design the role of the coach and the first iteration of the coach tools (i.e., the Console). Findings from this pilot indicated that the coaching system gave parents increased visibility into their child's in-app literacy play [71; 72].

To further examine these findings, we conducted a randomized control study on the coaching system for SB in the spring of 2018 with 64 children, ages four to eight years, and six Speech-Language Pathology graduate students serving as coaches over eight weeks. Two researchers served as Coordinators, training and supporting coaches throughout the study.

Children and families were randomly assigned to either the control condition (without a coach), or the treatment condition (with a coach). Children and families played with SB in the home for eight weeks and families in the treatment condition received personalized coach updates about their child's in-app wordplay one to three times a week, whereas families in the control condition received automated "coaching tips" with generic updates about how children could play and learn from SB. The implementation of the randomized control study led to the development of the coach training and resources, the suggested words feature (i.e., creating a pathway for coaches and children to interact by suggesting relevant words and prompts for children to create in SB), and the in-person workshops. A new iteration of the Console was developed and automated analytics were incorporated to help direct coaches in systematically surfacing meaningful learning moments in children's wordplay. Initial findings from this study indicated that parents in the treatment condition had an increased awareness of their children's in-app play, recounting almost twice as many words that their children created than the families in the control condition ($p=0.013$). One trend, though not statistically significant, suggested that parents in the treatment condition reported co-engaging more with their children ($p=0.1$). Another finding indicated that children in the treatment condition played with SB more frequently than children in the control condition ($p=0.018$) [73][1]. Caregivers, children, and coaches gave consistent feedback about expanding on the content of the SB app to include more expressive literacy opportunities, such as storytelling. In response, we used the data and feedback to iterate on the structure and approach of the coaching system and redesign it for storytelling; leading to the creation of Learning Loops.

Over the course of the three pilots, multiple strains of research were also being conducted to develop the literacy apps and tools that informed both the StoryBlocks app and the Console (e.g., Sneha Makini's PictureBlocks [74]). DBR techniques, such as co-design workshops with target users, rapid-cycle prototyping and continuous user-testing, were used to develop the technology tools and resources employed by the Learning Loops program.

The remainder of this section will describe the design and development of StoryBlocks, the coach role, the Console, and the Play Analytics system within the Console.

2.2 StoryBlocks Design: A Digital App for Children's Narrative Expression

2.2.1 Background Literature that Inspired StoryBlocks

Given the variant nature of children's stories at different stages of their development, designing a platform for children's narrative expression needs to be open-ended and customizable for children to create multiple types of stories. The majority of educational apps on the market prescribe to the instructionist paradigm of delivering literacy lessons, where the main mode of interaction is directed, such as selecting one of two predefined options in a "choose your own adventure" story [15]. However, research suggests that these structured, rewards-based games do not always lead to the best learning outcomes for children [15]. In contrast to this, activities focused on creation help children to develop a deeper understanding [75], especially in relation to literacy development. One proponent of this in the field of literacy learning is Maria Montessori, who believed that children should learn writing, the literary form of creation, before reading [76]. This idea that child-centered, creative environments facilitate deeper learning among children also lies at the core of Papert's (1987) constructionist approach to learning [62].

[1] Further publications on the results of this study will be released with the dissertation of Juliana Nazaré.

The goal of constructionist, or design-based learning environments is to create an open space which allows for learners to find projects that are personally engaging and intellectually interesting rather than instructor-directed learning activities. Resnick, Bruckman, and Martin (1996) proposed two principles of design-based learning that contribute to rich learning experiences: personal connections, which increase relatedness and motivation; and epistemological connections, which encourage new ways of thinking through the iterative design process [75]. Similarly, work by Gee (2005) on educational games, suggests that significant learning occurs through doing, exploring, and creating; where experiential learning through contextualizing the material lends itself to a deeper understanding by applying knowledge to solve problems, rather than just memorizing facts [77]. This is especially pertinent for literacy learning and storytelling technologies, because storytelling is inherently a constructionist activity [7]. Given the purposes of narratives to convey meaning and form a sense of identity, more open-ended platforms are necessary to support the constructionist nature of storytelling.

A group of researchers developed a framework with guidelines to determine the educational quality of children's learning apps [14]. There are four guidelines, known as the four pillars: engage in active learning, provide multiple pathways of engagement, encourage meaningful learning, and support some form of social interactivity. All of these pillars must be met while simultaneously in pursuit of a clear learning goal [14]. This framework is consistent with the literature on the importance of social nurturance by caregivers and adults and active participation for the development of children's narrative skills, especially for early and middle childhood [34]. One study found that older preschool children's narrative skills were higher for children whose mothers engaged them in more joint book reading [46]. Similarly, another study found that children who were given active-choice during story-related activities showed greater narrative skills gains than those students who were in the no-choice condition [47]. In other words, active participation and choice within narrative activities, such as storytelling and re-enactment, relate to the development of higher-level thinking, social skills, language development, and cognitive skills [43; 5]. Trends in children's narrative development, such as children feeling motivated to tell stories of their personal experience [1; 2], reinforce the need for open-ended opportunities for children to share their own voice through stories.

Despite the evidence that children's narrative skills thrive when they can actively create their own stories and receive support from caring adults, very few open-ended storytelling apps exist for school-aged children. A report that analyzed 183 of the most popular literacy apps for children ages 0-8 found that none of the apps aimed to support children's creative and written expression [15]. While some storytelling apps for children do exist, very few of them include a level of social interactivity, and none of them use the child's story data to track or support the child's narrative progress [15; 52; 14; 21].

In light of this literature, we have built the app, StoryBlocks, which is designed to be an open-ended platform for children's narrative expression.

2.2.2 StoryBlocks Design

StoryBlocks aims to promote creative expression, literacy development, and social-emotional development through storytelling for children ages six to ten. In this app, children create personally generated, comic-style stories by inserting characters, setting emotions, typing dialogue, using words to insert images that customize scenes, and recording their voices to narrate their unique stories. With StoryBlocks, we can collect a corpus of

children's stories in order to build analysis tools that can document children's narrative development over time. StoryBlocks also incorporates social support by coaches, who provide personalized scaffolding for children's narratives directly through the app.

Each child has a StoryBlocks account in which they can create multiple stories, consisting of up to ten frames (or scenes). There are two main screens in StoryBlocks: the home screen and the create screen. Figure 2.1 displays the home screen, where children can start new stories, edit past stories, and edit the titles of their stories. Figure 2.2 details the create screen with the navigation drawer at the top. Features within the navigation bar are to return home (thereby saving the story), record and play the audio narration for each frame, toggle between frames and play the character dialogue for each frame, and add or delete frames. At the bottom of the create screen is the create drawer. Figure 2.3 displays all the features of the create drawer — i.e., setting the background, selecting characters and emotions, inserting dialogue bubbles and typing speech, and using vocabulary to search and insert items.

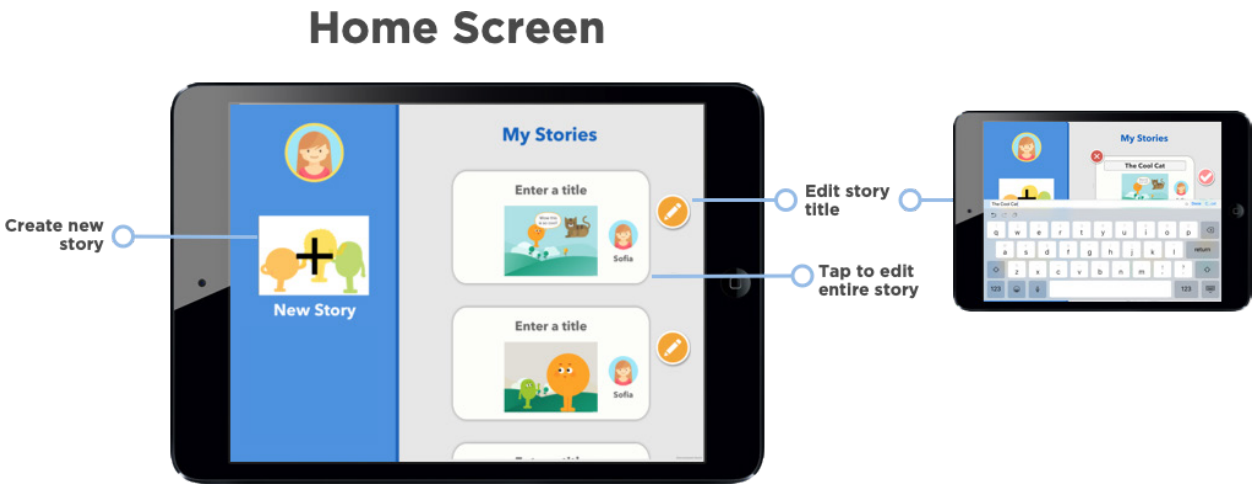


Figure 2.1 StoryBlocks Home Screen with Edit Title Feature

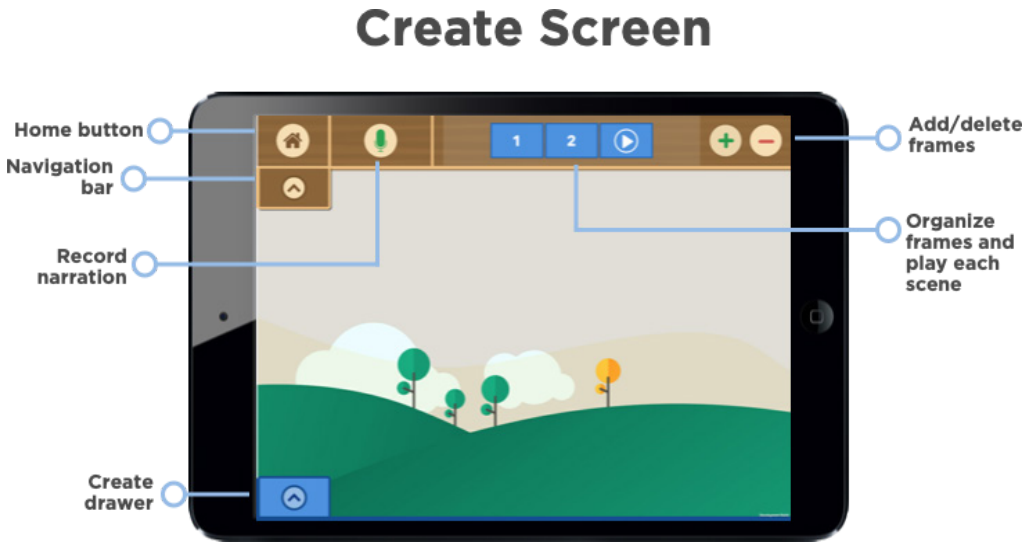


Figure 2.2 StoryBlocks Create Screen with the Navigation Drawer and Features

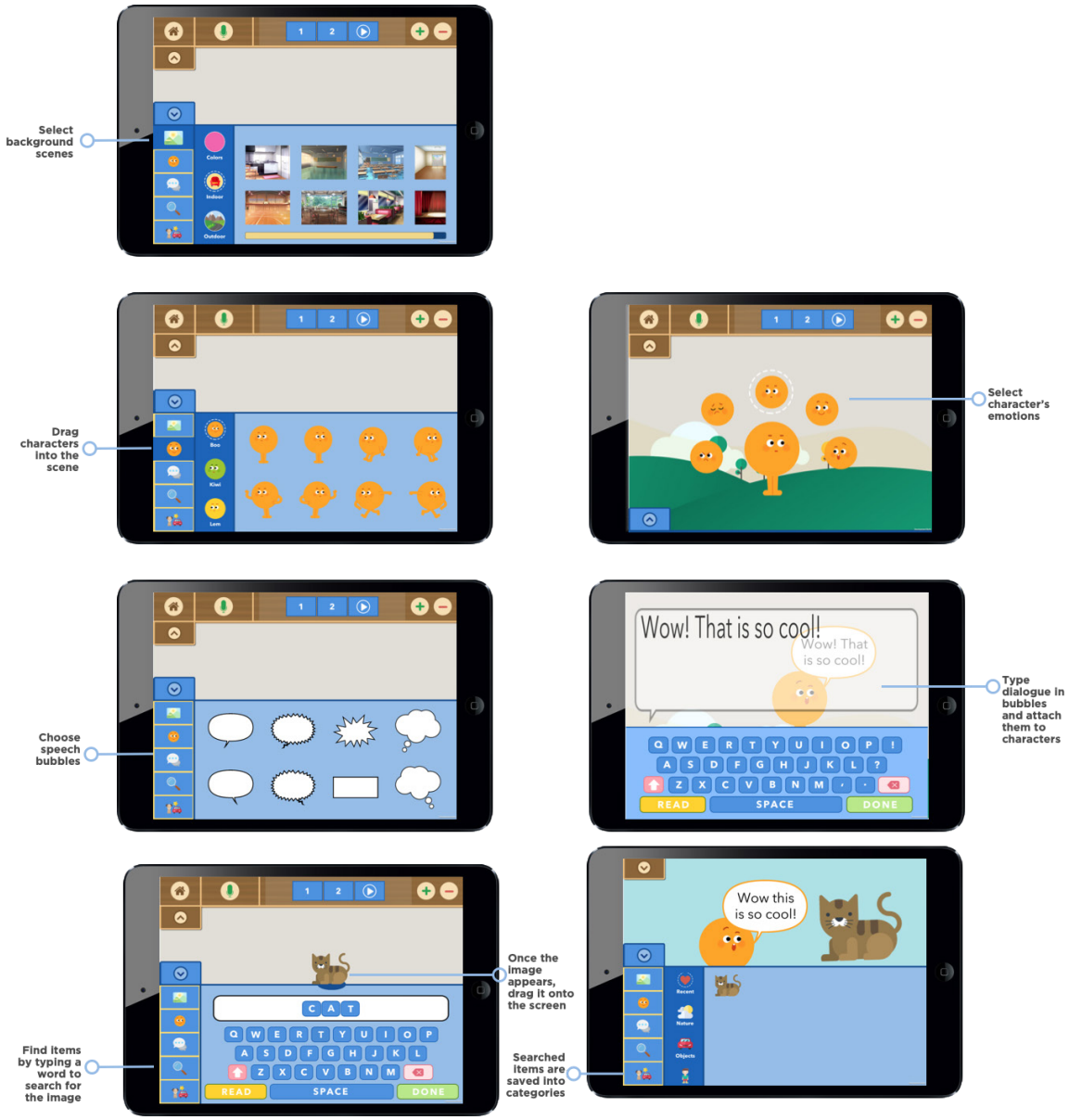


Figure 2.3 StoryBlocks Create Screen with the Create Drawer and Features

The design of each feature was guided by our underlying pedagogical principles and have been iteratively developed and play-tested by children. For example, to align with the open-ended nature of constructionist play, children can select from 20 outdoor scenes, 14 indoor scenes, or 30 colors, and they can use the search feature to search and insert over 2,300 images[2] to customize their setting. In this way, children have full agency to build their backgrounds and tell their own story, and they are not limited by the choice of background scenes. Similarly, while there are only three characters in StoryBlocks— Boo, Kiwi, and Lem— these characters were developed in collaboration with Sesame Workshop, and were intentionally designed to be novel and ambiguous in order to adapt to any characters that children would want to represent in their stories. These characters, combined with the ability to search and insert items in place of

[2] Items courtesy of Flaticon ©.

characters (e.g., insert the image for "dog" to serve as a character), gives children agency over the main characters of their story.

One example of the iterative development of StoryBlocks features is the item search feature. This feature was an adaptation of the constructionist literacy app, PictureBlocks, which pilot findings suggested highly engaged children's exploration of spelling and vocabulary concepts while promoting a sense of authorship as they created personally-meaningful digital pictures [74; 78]. Other features were co-designed with children, such as the emotion selection feature. Play-tests and co-design sessions of StoryBlocks features revealed certain design considerations to help scaffold children's narratives, such as incorporating a "read" button within the keyboard so that children could hear their typed text read aloud in the character's voice to aid in spelling and punctuation (e.g., for inflection). All of the modifications and adaptations to the design helped create a more open-ended and child-driven app for children's narrative expression. See Appendix A for the development of StoryBlocks and history of design.

As a first step to align with the social learning guiding principle and to accommodate the social dimension of children's narratives, we designed the Story Stickies feature for coaches to scaffold children's narrative development by providing feedback on their stories. Figure 2.4 demonstrates the reception of a Story Sticky within StoryBlocks. Once a coach sends a Story Sticky, the child gets a notification on the home screen to indicate that the story has a new Sticky. When they click on the story, they can view the Story Sticky on a specific scene. To support a large age-range of children with various reading skills, children can hear the sticky read aloud to them, or they can read it themselves. To increase children's sense of agency and authorship, they have the ability to delete the Story Stickies by the coach whenever they would like.

Figure 2.4 StoryBlocks Notification and View of Coach Story Sticky

To align with the Learning Loops approach, StoryBlocks was designed to be a smart, expressive medium. StoryBlocks is an expressive medium because it allows children to use words, images, and voice to create and save personally meaningful stories about anything they would like. StoryBlocks is a smart medium because it is responsive and it remembers. When a child constructs stories, the medium responds by pronouncing the dialogue using the phonetic rules of English to speak in the character's voice, and converting over 2,300 words into images to customize each scene. StoryBlocks remembers in the sense that all interactions within the medium are recorded at fine granularity with time stamps. This collection of longitudinal data enables the analysis of child behavior, abilities, trends, and learning trajectories. In order to make this rich data meaningful, a human coach is needed.

2.3 Family Learning Coaches

Family Learning Coaches aim to promote children's literacy skills and narrative development through play and support family engagement in children's learning process. In order to be successful, the coach must form a positive and trusting relationship with the family, have a background knowledge of children's language and literacy development, and align with a constructionist pedagogy; following a playful definition of learning.

The role of a coach in supporting children's narrative is two-fold. Coaches both support families in understanding and contextualizing their children's narrative learning process in order to empower parents to co-engage with their children, and directly support children's narrative development by using the data from children's StoryBlocks stories to provide feedback and scaffold the storytelling process.

In order to be a successful Family Learning Coach and add value for the children and caregivers participating in Learning Loops, coaches have five main responsibilities. Coaches must: (1) build a positive, trusting relationship with families; (2) maintain positive, responsive communication with families; (3) use the Console to analyze play, interact with children, and compose and send updates and activities to caregivers; (4) foster community-building between families at the in-person workshops; and (5) connect with Coordinators and support fellow coaches.

To become a coach, coaches attend a one-day training facilitated by Coordinators (i.e., research staff who have previously served as coaches). During this training coaches use the Coach Handbook (see excerpts from Coach Handbook in Appendix B) to guide them in learning the responsibilities of a coach, how to use the Console, best practices for communicating with families, how to facilitate in-person workshops, and provide hands-on examples and additional resources. After the training, coaches receive continued professional development from Coordinators during bi-weekly video check-ins and a private coach messaging thread. The purposes of these communication channels with Coordinators and fellow coaches are to share announcements, ask questions, provide support, share resources, and brainstorm ideas.

The majority of the coach's responsibilities are carried out through the Console, which allows coaches to both serve families at a distance and adapt their coaching time to their specific schedules. The Console was specifically designed to support the role of a coach.

2.4 Coach Console Design: Digital Tool for Viewing and Supporting Children's Narratives

2.4.1 Design of the Coach Console for Children's Narratives

The Coach Console is the custom-built tool for coaches that allows them to communicate with children and caregivers and analyze story data. Through the Console, coaches can message parents, analyze play, interact with children via Story Stickies, compose and send updates and caregiver-child activities to families, and connect with Coordinators. The goal of the Console is to provide a digital platform for coaches to analyze children's narratives and support children and families in the narrative process in a systematic and efficient manner.

The design of the Console for StoryBlocks is modeled on the Coach Console for SpeechBlocks, where each coach task is separated into tabs that a coach must go through to carry out their responsibilities. However, since the process of analyzing and supporting narratives is

more complex than spelling and vocabulary, the Console for StoryBlocks has more capabilities and requires more interaction from the coach. The Console for StoryBlocks consists of three pages: the home screen, the caregiver messages, and the coach info screen. Within the home screen, coaches can see each of the children they coach. When they click on a child, they have access to five tabs corresponding to their responsibilities: (1) overview, (2) analyze, (3) interact, (4) update, and (5) finish.

Figure 2.5 shows the home screen of the Console. The home screen is the initial screen after the coach signs into the Console. The tiles represent all the children that the coach works with, and notifies the coach of new play since they last checked the Console as well as any new caregiver messages.

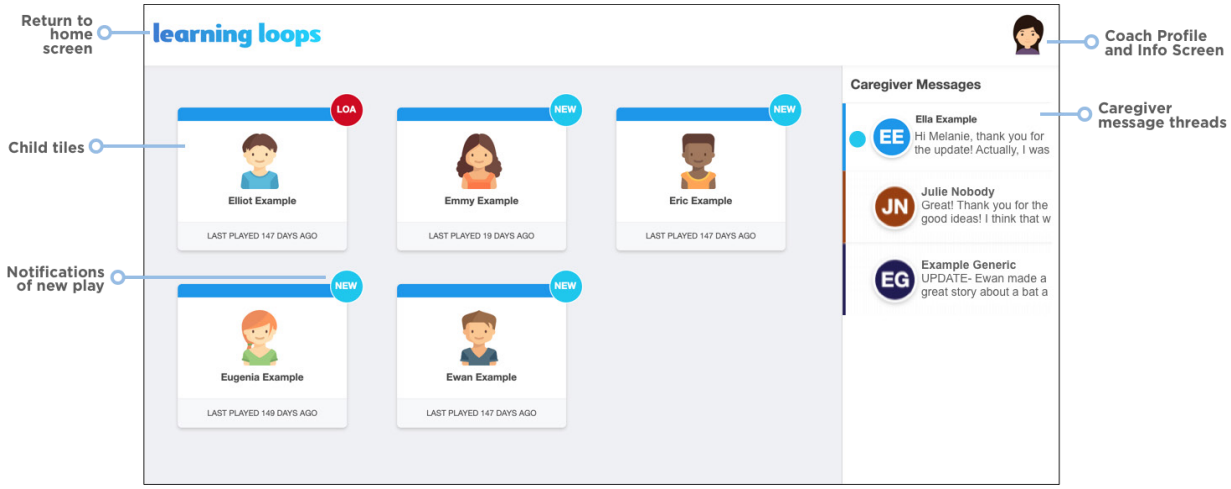


Figure 2.5 The Home Screen of the Coach Console.

When the coach selects a child's tile, they enter into the child's play with access to the five tabs. The first two tabs of the Console (i.e., overview and analyze) are powered by Play Analytics, which are described in more detail in the following section. In the overview tab (see figure 2.6) coaches can view a summary of the accumulation of the Play Analytics (i.e., Story Stats and Story Annotations) across all days of StoryBlocks play for the child. The overview tab is meant to represent the overview of the child's progress and play patterns (e.g., minutes of play) over time. The data from the overview tab is derived from the individual instances of play and annotations in the analyze tab.

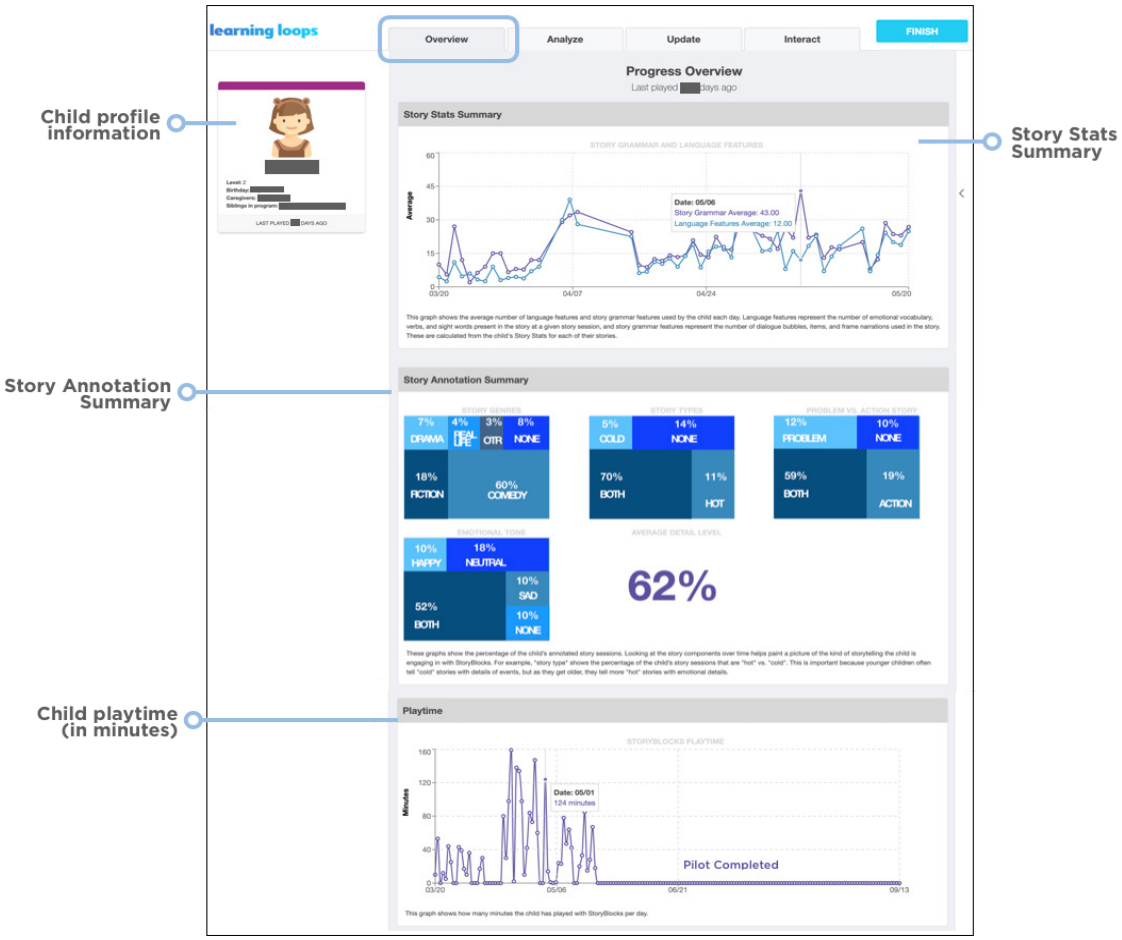


Figure 2.6 The Overview Tab within the Coach Console.

The next tab is the analyze screen (see figure 2.7) for each individual story. The stories are divided into story sessions (also known as time markers), which are defined as the play between each coach-sent caregiver update. Coaches select one of the stories from the story bar on the left to view and annotate each story session. In the analyze tab, coaches can view the story itself either frame-by-frame in the Play Mode, or as a sped up video of the child's entire story process in the Process Mode. If children recorded audio narration for a given frame, they can click on the speaker button to hear the child's audio clip. Below the story are the Story Stats, which are the automated story data related to learning patterns pulled from the child's story (e.g., items searched, items used, characters, emotional vocabulary) and presented as a list for coaches to review. The purpose of the Story Stats are to present a snapshot of data to complement the child's story and inform the coach's Story Annotations. Story Annotations are a coach's two-minute, supplemental analysis of elements of the story that cannot be automatically detected by algorithms. Story Annotations are crucial to analyzing the story holistically and include the meaning and plot of the story, whether the story follows a coherent sequence, and the level of detail used in the story. Coaches are expected to create Story Annotations for each story that a child worked on during a given story session (usually about 2-3 days). To aid in their interpretation, coaches could view the child's story from the Play and Process Modes, providing extra insight into the child's intentions for the story.

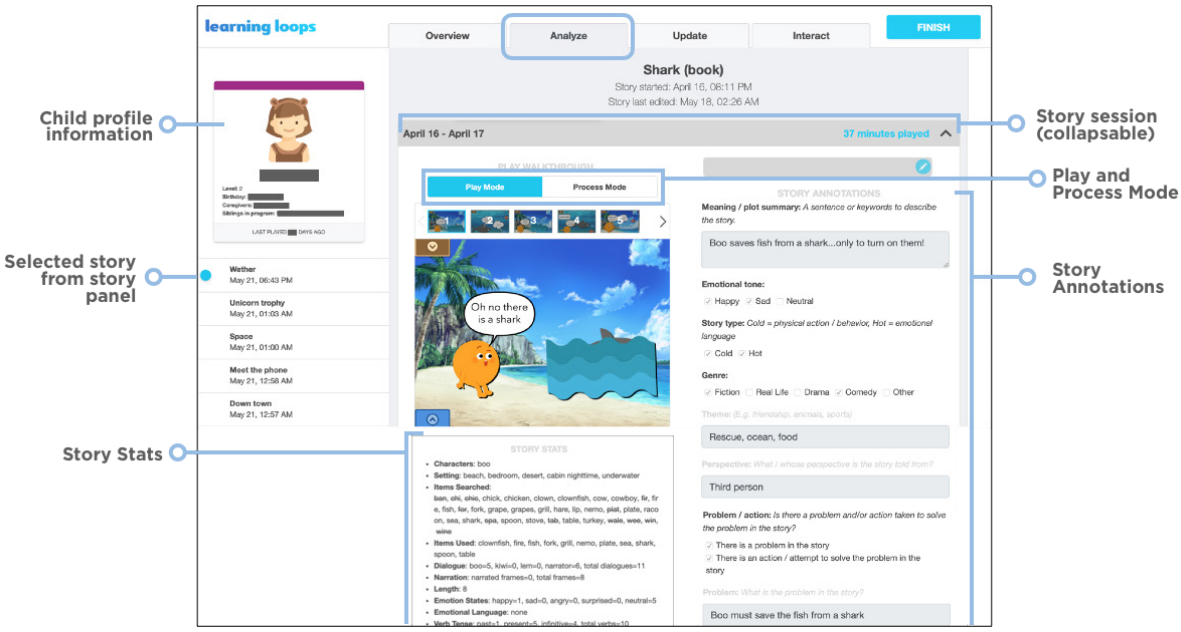


Figure 2.7 The Analyze Tab with Story Stats and Story Annotation in the Coach Console.

After analyzing the story, coaches use the interact tab to directly interact with the child by selecting a story within the current story session and giving feedback via Story Stickies (see figure 2.8). Coaches can toggle between their analysis and the interact tab to use their annotations to inform the content of their feedback. Coaches can place their Sticky onto any part of the scene, and make multiple Stickies per story. Previously resolved Story Stickies on a given story are displayed below for reference.

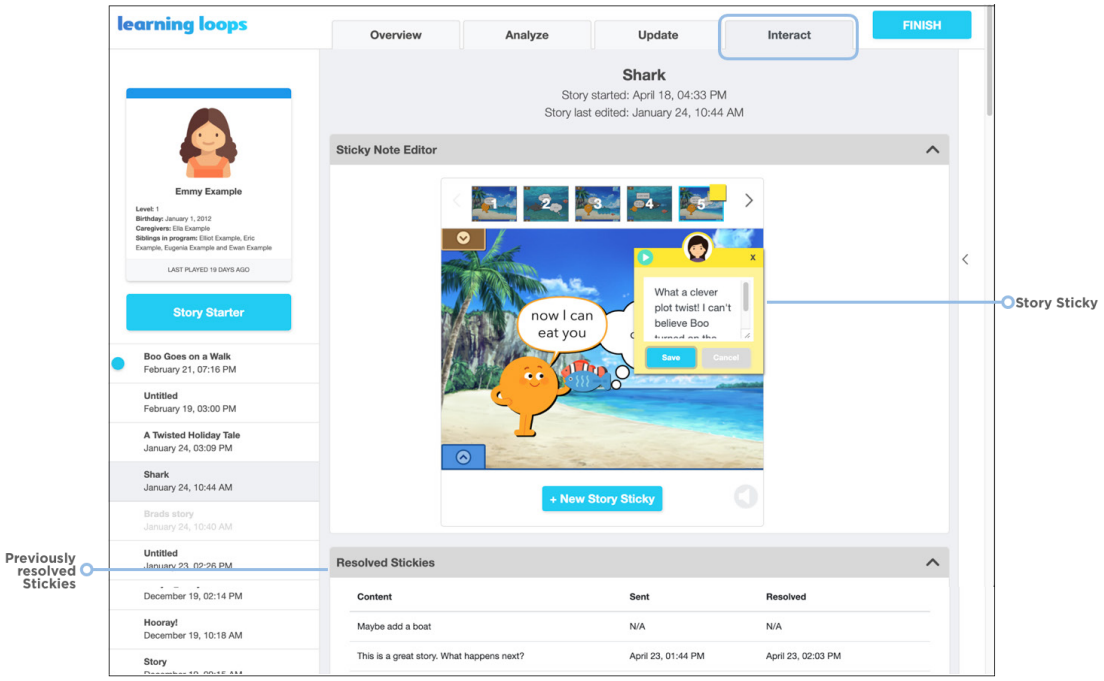


Figure 2.8 The Interact Tab with Story Stickies in the Coach Console

In the update tab coaches compose short, two-sentence caregiver updates about the learning moments that occurred in the story session (see figure 2.9). This update is sent to the caregivers via text message. To compose an update about the child's play, the coach first categorizes the update by selecting a category from the dropdown menu, and then types the update in the textbox. Coaches can use the "change prompt" button to select from different sentence prompts to help structure caregiver updates. Each week, coaches must send one caregiver-child activity along with their update by using the textbox below the update to write in an activity that relates to the update being sent. Previously sent updates are displayed below for reference. These updates and the activities are informed by the Story Annotations.

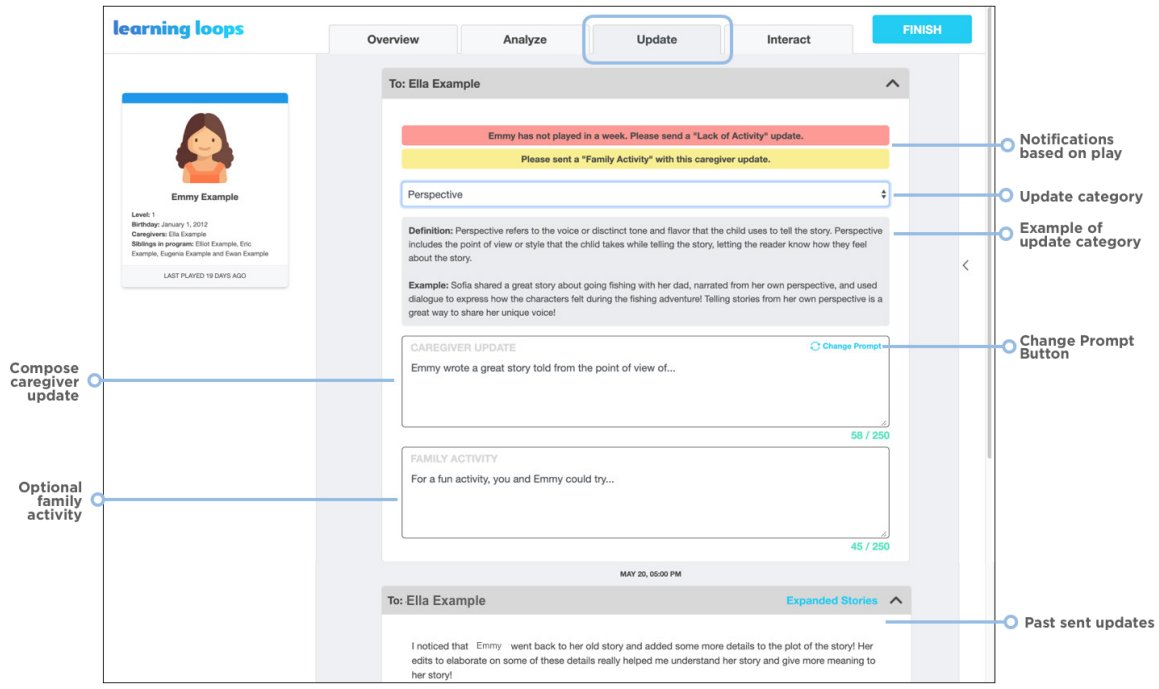


Figure 2.9 The Update Tab with Caregiver Updates and Activities in the Coach Console.

The final tab is the finish button (see figure 2.10). Once coaches analyze, interact, and compose updates, they click on the finish tab to review and schedule caregiver updates, and send Story Stickies. Caregiver updates and activities are scheduled to send directly to the caregiver's phone on Monday, Wednesday, and Friday at 5:00pm. Coaches may create and edit updates any time before the scheduled send time. For Story Stickies, these are sent directly to the child's StoryBlocks device as soon as the coach clicks the "send" button.

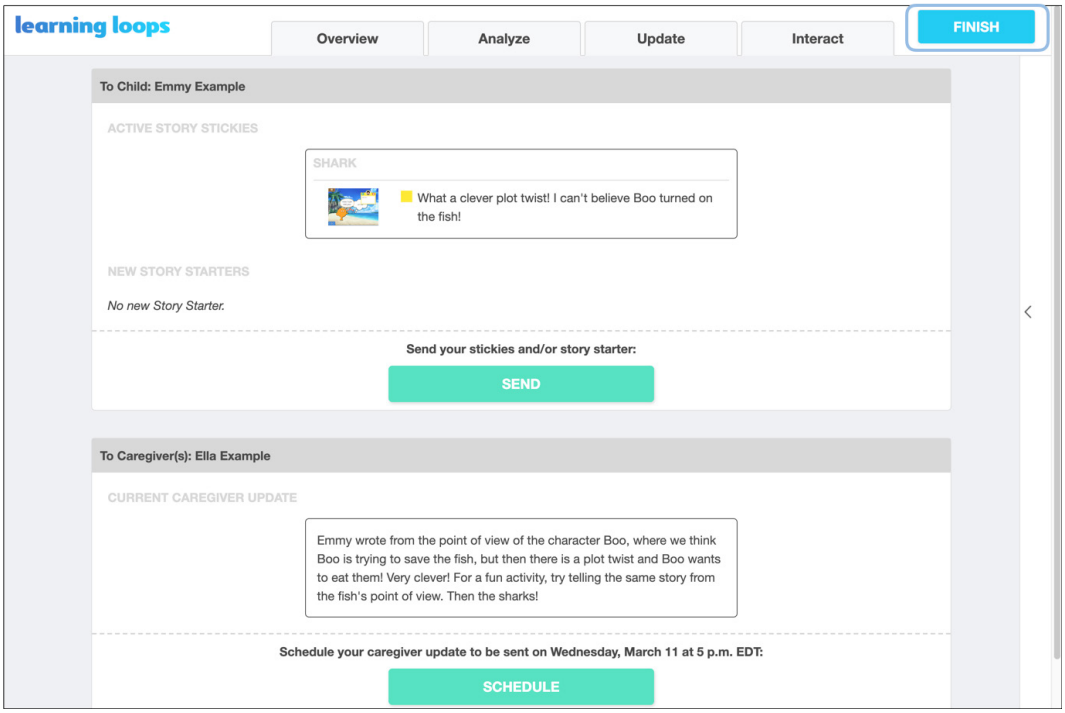


Figure 2.10 The Finish Tab in the Coach Console.

Another important responsibility of the coach is to maintain responsive communication with caregivers. In order to do this, the Console includes a messaging feature called caregiver messages (see figure 2.11). Coaches can access caregiver messages by clicking on a caregiver within the home screen. This feature resembles a traditional messaging service, where coaches can view all their communication with the specific caregiver (e.g. updates sent, caregiver text messages) within a given text thread. More information about the caregiver is displayed on the right, and coaches can call the caregiver's cell phone by using the blue button. On the left are all the caregivers that a coach is assigned to, and coaches can view the message thread with any caregiver by selecting the caregiver name on the left. To protect the personal information of the coaches and caregivers, coaches and families are given pseudo phone numbers that connect to the Console and the caregiver's phone. Additionally, rather than connecting the coach's phone directly, the Console sends an alert text to the coach when a caregiver has sent a message, prompting the coach to login to the Console to view and respond to the caregiver message. This is to ensure that all text message communication between coaches and caregivers are documented through the Console.

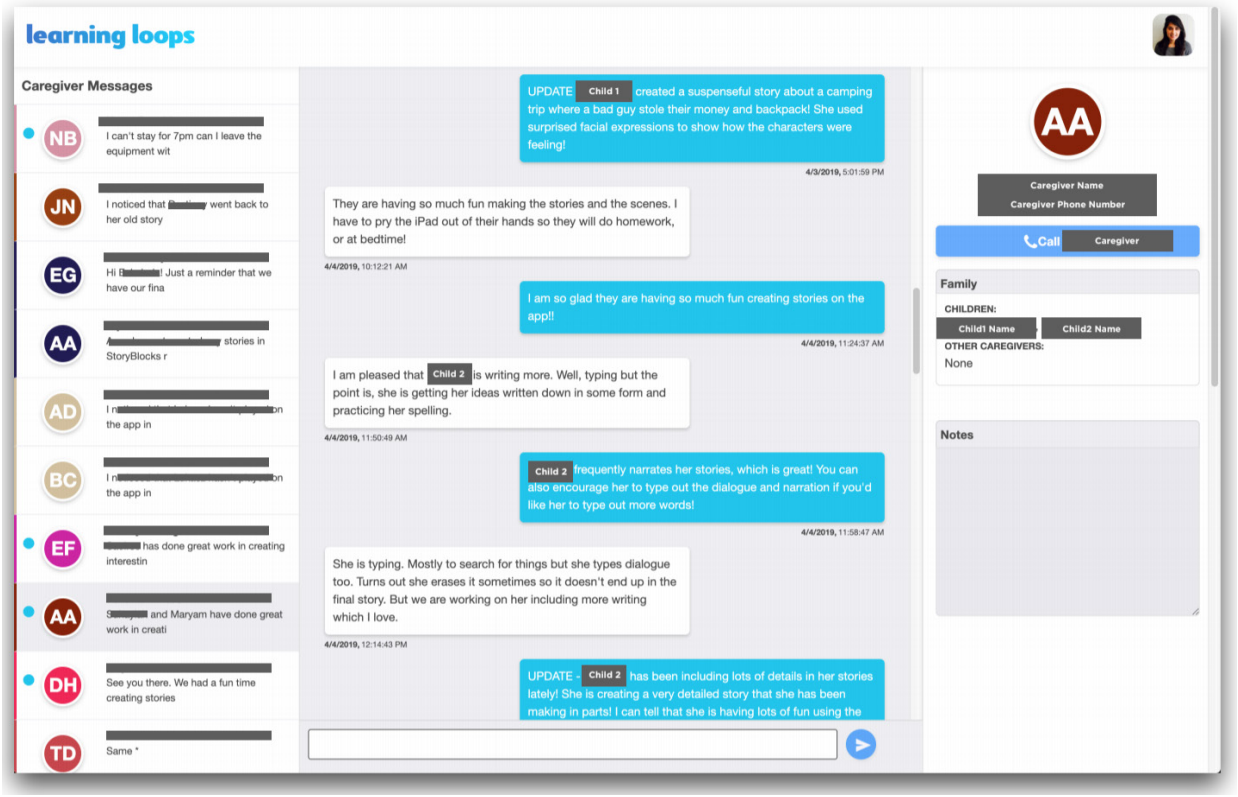


Figure 2.11 Caregiver Messages Screen in the Coach Console.

The final screen of the Console is the coach info screen (see figure 2.12), which is accessed by clicking on the coach photo in the top right corner of the Console. This screen provides the necessary resources and links to supports for coaches. This page links to a digital PDF of the Coach Handbook, which provides all the material covered during coach training and provides a how-to guide for the Console. To create a supportive community of coaches, this page links to a private Coach GroupMe Channel that coaches can use to message each other, ask questions, share ideas, or provide feedback and support. Once every other week coaches use this page to join the Coach-Coordinator Check-ins via Google Hangouts, where Coordinators share information and provide ongoing support for coaches during the program. Finally, this info screen contains coach profile information, such as the coach's email address, pseudo phone number (their Learning Loops number), and the logout link.

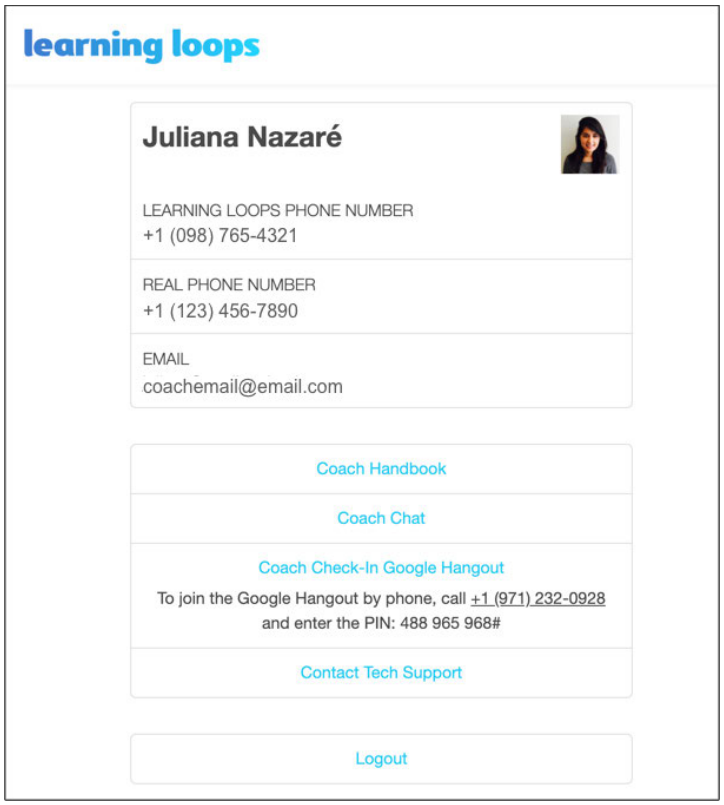


Figure 2.12 The Coach Info Screen in the Coach Console.

The Console's design embodies the Learning Loops approach in several ways. First, by sending Stickies and coming up with creative activities for families to do together, the Console supports coach engagement in their own playful learning process. Second, the caregiver updates and caregiver messages encourage social learning by promoting co-engagement and communication between a supportive community learning network. Third, the Story Stickies feature allows coaches to tailor their scaffolding to meet the child's needs and support the narrative process. Fourth, the Console is powered by Play Analytics, which combines human and machine analysis skills to document and analyze children's narratives.

2.5 Play Analytics for StoryBlocks: Documenting and Analyzing Children's Narratives

2.5.1 Background Literature that Inspired Play Analytics for Children's Narratives

In order to align with an open-ended platform for children's narrative expression, the method of analysis must be able to encompass many types of stories and account for a range of narrative skills so as not to punish children for engaging in various styles of creative expression [23; 12]. The few standardized metrics that exist to measure children's narrative skills are insufficient. The majority of them do not measure children's personally-generated narratives, but instead measure a child's retelling of a less than inspiring story [1; 2]. There are two known standardized measures that are the exception, examining either children's stories based on prompting pictures or children's personally-generated narratives: The Test of Narrative Language (TNL-2) [79] and the Narrative Language Measures' Test of Personal Generation (TPG) [80].

The largest limitation for both of these measures is that they only focus on the mechanics and structure of children's stories, most likely because these are more easily measurable [13]. A further limitation of the TNL-2 is that children's scores are negatively impacted when they tell more creative stories inspired by a picture [79].

This focus on the mechanics and deincentivication for creativity is especially concerning given the purpose of storytelling to construct and communicate meaning. This trend to create narrow measures that focus only on one, easily testable aspect of a greater complex concept is not unique to narrative development, but can also be seen in the reluctance to measure learning through play [42]. Creating insufficient measures by isolating or fragmenting aspects of a complex phenomenon, such as narrative development, blinds researchers to the holistic perspective and masks the important interconnections between related concepts [81; 7; 13]. To only analyze children's narrative development by looking at mechanics and story grammar paints an incomplete picture because it ignores the meaning the child is communicating and severs the links between the child's social, emotional, and cognitive contexts, which motivate the content [23; 7; 81]. Instead, an integrative, dynamic approach to analyzing children's stories is needed; one that accounts for the complexity of narrative development by encompassing multiple aspects of narrative [23; 13; 7].

Some of the crucial aspects of children's narrative development which are less explored include: ordering and understanding experience (sequencing, perspective-taking, canonicalization, intentionalization, metacommentary); emotional expression and mastery (empathy, rearrangement, symbolization, repetition, emotional transformation); social understanding and transformation; construction of the self (representation of identity, expressions of self-efficacy, agency, narrative voice); and creativity (imagination, flexibility, adaptability) [7; 2; 12; 6; 3; 24; 82; 83]. While many of these aspects of children's narratives are important for taking a holistic approach to analysis, to our knowledge there are no known metrics which aim to identify and measure them [23].

One major affordance of technology is its ability to document stories and collect data that can help identify trends in children's narrative development [84]. However, these analytic systems are limited in their ability to document trends in the more complex aspects of children's narratives because they are not easily testable, and therefore difficult to automate [13; 85]. Despite recent advances in machine learning and natural language processing for summarizing and categorizing narratives, these artificial intelligence (AI) tools are not adequate when trying to analyze children's story fragments [86; 7]. Although machine algorithms have strong pattern recognition capabilities, they are unable to make inferences and draw conclusions based on external data, such as the immense contextual information and knowledge about the child as a thinking, emotional, and living human being [84; 77]. To understand children's story fragments, we need to understand their meaning and perspective [7; 77]. Taking the perspective of the narrator is something that machines cannot do, it is uniquely human. Engel (1995) highlights this when she states, "Unlike a computer, we are always seeking and creating meaning. And meaning is what is most important about narratives. The author's meaning is what drives a story, determines the shape it takes, and gives the listener the impulse to understand the story" (p 64) [7]. In other words, machines alone cannot analyze children's stories, we need a human in the loop. This need for a human analyst is further supported by the research on the limitations of learning analytics and educational data mining, where the fine-grained data is automatically

analyzed and clustered, but then requires a human to interpret the data and make it meaningful [84; 85].

Therefore, we propose the development of an analytics system that is not just holistic in its approach to include multiple aspects of narrative development beyond the mechanics, but is also dynamic in its approach by combining the strengths of both machine and human analytical skills to systematically document children's narrative development through their StoryBlocks stories.

2.5.2 Developing Play Analytics for StoryBlocks

The current version of the Learning Loops analytics system attempted to use the design principles and pedagogies detailed above to address the limitations of the narrative analysis approaches expressed in the background literature. The goal of Play Analytics for StoryBlocks was to develop a framework for understanding children's narrative development through their play with personally generated stories. Since few good, comprehensive frameworks exist for analyzing children's personally generated stories, our Play Analytics combined many different analyses and practices that people use to tutor and assess children's stories. We intentionally designed our Play Analytics to analyze children's non-traditional stories (e.g., stories not centered around a "problem", story fragments, children's scripts). We tried to take a holistic approach, splitting our analytics framework into three main categories in order to accommodate a wide variety of stories and perspectives.

In an attempt to take a holistic approach that both accommodated a broad definition of narrative and attempted to elucidate the immense learning moments that occur while children create their own stories, the three categories of analysis that we defined were: (1) Story Grammar and Story Sequence, (2) Meanings, Emotions and Story Types, and (3) Language Features. These three categories helped us identify and organize both the automated data into the Story Stats benchmarks, as well as the prompts for the coach's Story Annotations. These three categories were not specified within the Console's analyze tab, but were used internally during the creation of the analytics in an effort to make sure multiple aspects of children's narratives beyond just the mechanics were considered.

The Play Analytics for StoryBlocks was our first attempt at combining the powers of both human and machine narrative analysis skills to more equally represent structural analysis (e.g., story grammar) and content analysis (e.g., story idea development). The coaches used our Play Analytics system to better understand children's stories, view children's narrative progress, and provide feedback to support children's narrative development. In this way, the purpose of these analytics were to document narrative development and be used as guidelines by coaches to encourage children's storytelling of the stories that they want to tell, not to force their stories to fit a specific mold.

The Play Analytics for StoryBlocks were created before the compatible version of StoryBlocks existed, making it impossible to know exactly what data would be produced from children's StoryBlocks stories and how to represent and analyze those data. At the time, StoryBlocks existed as a completely different app (see Appendix A), and the only hint at the new version was a collection of early sketches and a bullet point list of desired features. Therefore, in order to build the Play Analytics for StoryBlocks, I considered the features we believed StoryBlocks would have and estimated the data output of those features. Inspired by the literature from narrative researchers [7, 24], current narrative analysis measures, school

curriculums and state writing standards, and best practices, I developed our three categories of analysis to take a holistic approach to analyzing children's stories. I then created benchmarks within those categories that aligned with our projected data output (see figure 2.13). Next, I made my own sample stories from oral accounts of real children and manually designed them as if they were StoryBlocks stories. By hand-annotating the data I believed our system would be able to detect, I analyzed these stories in order to test out whether our analytics system would work before building it. This process led to the first iteration of the Story Stats and Story Annotations, which both constitute the current Play Analytics system for StoryBlocks.

	Story Stats	Story Annotations
Story Grammar & Story Sequence:	• Characters • Setting • Items • Dialogue • Narration • Length	• Problem/High Point • Action / Attempt • Complete Story • Coherent Sequence
Meanings, Emotions, & Story Type:	• Emotion States • Emotional Language	• Meaning/Plot • Emotional Tone • Cold Vs. Hot • Genre • Themes • Perspective
Language Features:	• Verb Tense • Capitalization • Punctuation • Spelling and Sight Words • Grade-Level Readability Score	• Level of Detail

Figure 2.13 Story Stat and Story Annotation Benchmarks Divided into Three Analytics Categories

We used the Coach Console to document, display, and annotate all of the analytics from children's StoryBlocks stories. Within the Console, the Play Analytics system was split into three main parts: (1) Story Stats, (2) Story Annotations, and (3) Overview of Progress. The goal of these three parts was to help coaches quickly make sense of the learning moments that occurred while children created stories in StoryBlocks.

2.5.3 Play Analytics for StoryBlocks: Story Stats

Story Stats include the more easily automatable elements of children's narratives (e.g., characters used in the story, emotions used in each scene, punctuation used in the dialogue). In the first version of the system, Story Stats were set for each StoryBlocks level to help coaches identify important literacy milestones and trends that occurred during play. StoryBlocks levels were based on a combination of children's pre-scores on the TNL-2, children's age, grade level, and sibling order. The story data of the Story Stats were intended to help coaches see progress over time, identify areas in which a child may need additional support, and create caregiver-child activities and Story Stickies to support the expansion of children's play. Story Stats were based on a combination of the Common Core State Standards, the Massachusetts English Language Arts (ELA) and Literacy Framework [87], the NLM [80], and the TNL-2 [79], and were modified to imagine ways in which those benchmarks would be met through playful exploration

in StoryBlocks. The 13 Story Stats that were included in the Play Analytics for StoryBlocks were:

- Characters: whether and which characters were used in the story (Boo, Kiwi, Lem).
- Setting: whether and which settings were used to set the tone of the story.
- Items: items that were searched for and items that were used in the story.
- Dialogue: whether speech bubbles were used and whether they were associated with a particular character.
- Narration: whether a narration was recorded by the child to narrate the scene.
- Length: The number of scenes in the story.
- Emotion States: the emotion/facial expression selected for each character in a scene.
- Emotional Language: whether the dialogue in the speech bubbles contains emotional language or vocabulary that refers to emotions (e.g., “angry,” “mad,” “upset,” “jealous”).
- Verb Tense: of the verbs used in the character’s dialogue, how many are past, present, or future tenses.
- Capitalization: the number of capital letters used in the dialogue.
- Punctuation: the number of punctuation marks used in the dialogue.
- Sight Words: the number of age and grade appropriate sight and spelling words used in dialogue (based on several lists of common irregularly spelled sight words and spelling words by grade and age).
- Grade-Level Vocabulary Score: the readability score of the dialogue within a story (tool examines the number of syllables per word to assess grade level of sentence structure).

The automated Story Stats were presented in two ways. First, in the analyze tab for each individual story, coaches could see the frequency and content of each Story Stat benchmark (see figure 2.14). Second, in the Overview tab, under the Story Stats Summary, a graph showed the average number of language feature stats and story grammar stats per day across all stories for that child (see figure 2.15). The intended purpose of the Story Stats was to help coaches quickly identify meaningful learning moments and to focus their attention on specific learning trends through the presence of narrative skills.

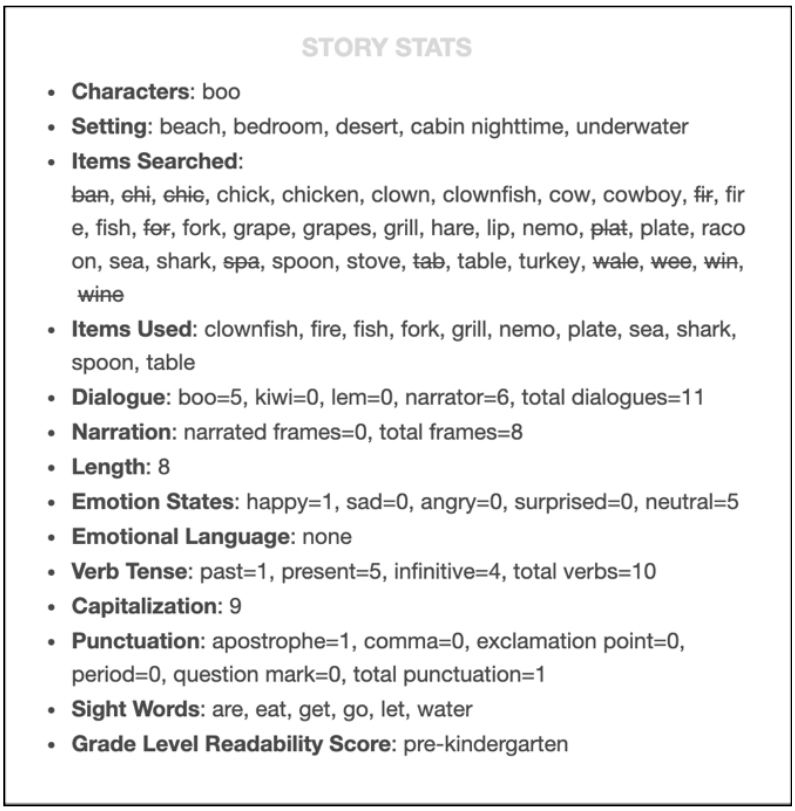


Figure 2.14 Example of Story Stats in the Analyze Tab for Child's Individual Story.

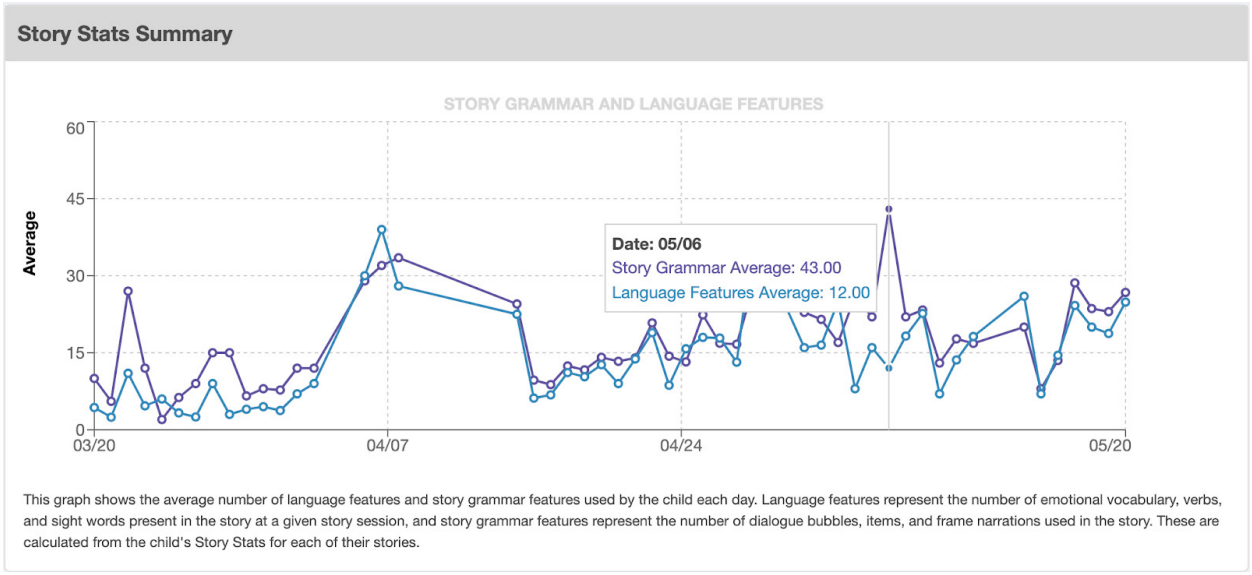


Figure 2.15 Example of Story Stats Summary in Overview Tab Across All Child's Play.

2.5.4 Play Analytics for StoryBlocks: Story Annotations

Coach Story Annotations are crucial to supplementing the automated story analysis in order to holistically analyze children's stories. In an effort to better interpret the less easily automated elements of children's stories (e.g., meaning, plot, coherence), coaches could use Story Stats and the Play and Process Modes of children's stories to inform their annotations.

Similar to Story Stats, Story Annotations were also based on a combination of the Common Common Core and Massachusetts ELA Standards, the TNL-2 and NLM standardized tests. Beyond those measures, Story Annotations were also inspired by best practices, such as 826 Boston's Writer's Guide [88] and theoretical frameworks such as Bruner's features of narratives [24] and Engel's three-part analysis [7]. To limit the time it took coaches to complete the annotations, I identified only ten Story Annotation benchmarks:

- Meaning / Plot: In a sentence or with keywords, what is the plot of the story, or what meaning is the child trying to communicate with this story?
- Emotional Tone: Is the overall emotional tone of the story positive, negative, or neutral?
- Cold versus Hot: Cold stories are about physical action or the behavior of characters. Hot stories are more emotional in language and description. Is the story hot, cold, both, or neither?
- Genre: What is the genre of the story (e.g., fiction, real life, drama, comedy, other)?
- Theme: Does the story have a main theme (e.g., friendship, animal, sport, family, obstacle, routine, conflict)?
- Perspective: From what or who's perspective is the child telling the story? Is the child using dialogue, the narration box, or the voice recording to convey this perspective? Is the child using the scene and images in the scene to portray perspective?
- Problem / Action: Does the story have a problem or a high point? If yes, in which frame does the problem occur and what is the problem? If there is a problem, are there any actions or attempts from the characters to solve the problem? If yes, in which frame does this action occur and what happens? If no, are there any actions that are central to the story?
- Complete Story: Does the child tell a complete story? If no, what questions do you want to ask the child about the story? What about it seems incomplete?
- Coherent Sequence: Does the story follow a logical sequence that makes sense and has meaning? If no, what might be missing, or what does not make sense?
- Level of Detail: How many images has the child used to set the scene, dialogue, emotions, length, and content? Age, narrative skill, and story type may influence the amount of detail included in a story.

The Story Annotations were completed for each story within the analyze tab of the Console. Coaches were prompted with a few quick questions to answer about the story for each story session (see figure 2.16). The annotations were then used in two ways. First, they were meant to serve as a way to help the coach consider what to write in their caregiver updates and Story Sticky feedback, encouraging coaches to copy and paste directly from their annotations. Second, a summary of the Story Annotations were presented in the overview tab (see figure 2.17), documenting the percentage of children's annotated story sessions along the Story Annotation benchmarks to demonstrate trends and progress across all stories over time.

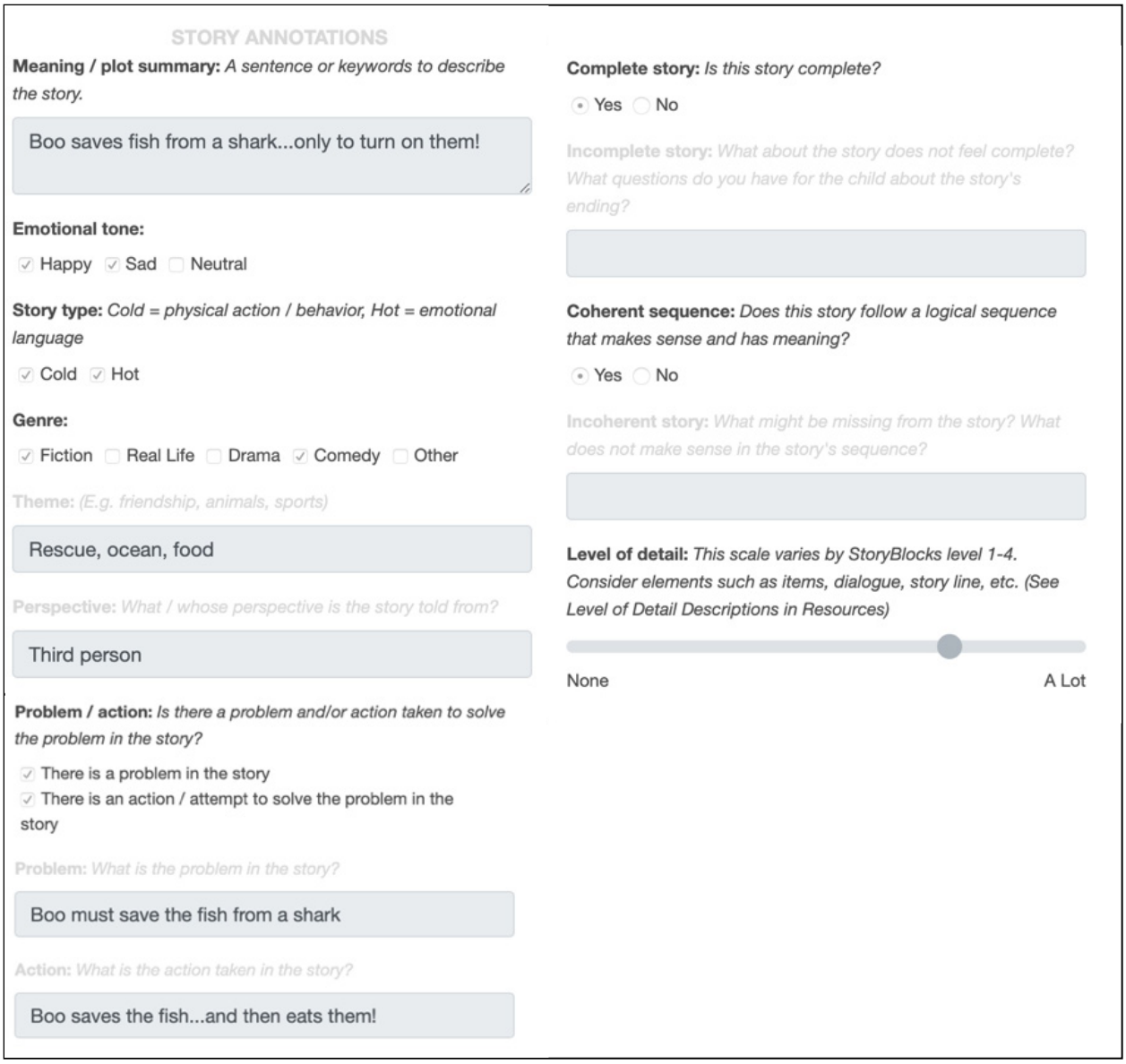


Figure 2.16 Example of Completed Story Annotation in the Analyze Tab for Child's Individual Story.

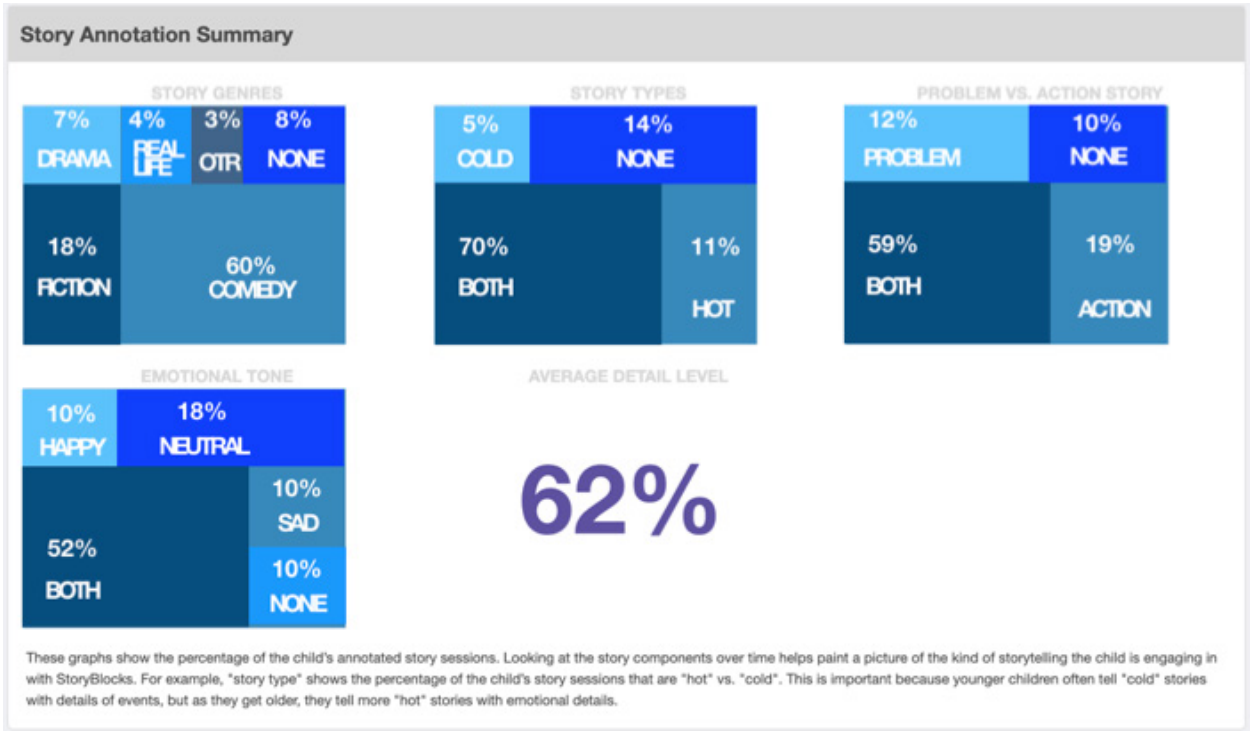


Figure 2.17 Example of Story Annotations Summary in Overview Tab Across All Child's Play.

2.5.5 Play Analytics for StoryBlocks: Overview of Progress

The Overview of Progress provides a historical view of the accumulated Story Stats and the percentage of Story Annotations across all play sessions for a given child. The Overview of Progress is presented within the overview tab of the Console, and was intended to help coaches highlight trends and document narrative progression over time. Not all benchmarks within the Story Stats and Story Annotations lent themselves to being presented over time. In the Story Stats Summary (figure 2.15), the graph shows the average number of language features (i.e., emotional vocabulary, verbs, sight words) and story grammar features (i.e., dialogue bubbles, items, frame narrations) used by the child each day. In the Story Annotation Summary (figure 2.17), the graphs show the percentage breakdown of the child's annotated story sessions at the present time. The percentages change as more stories are annotated. The benchmarks included in the Story Annotation Summary were story genres, story types, problem vs. action story, emotional tone, and average detail level. Finally, the amount of child's play time, in minutes per day, was shown in a line graph at the bottom of the overview tab.

2.5.6 Computational Approach for Play Analytics

In typical storytelling and play practices, one of the most time-consuming aspects is documenting children's stories. Yet, documentation, along with taking the time to analyze each story, are two of the most important aspects for measuring children's narrative development. Therefore, the goal of the computational approach for our Play Analytics system was to not only provide an effortless documentation process for children's personally-generated stories, but also to augment the analysis process for coaches through a combination of human and digital techniques. Specifically, we aimed to combine techniques from learning analytics and behavioral

analysis in order to create a dynamic system that harnessed the power of both human and machine analysis skills to more efficiently measure complex storytelling metrics than either could produce alone (e.g., plot summary, emotional vocabulary).

While our intention was to incorporate machine learning techniques into the Play Analytics for StoryBlocks, the time constraints of our pilot and the limitations of our technical resources halted our ability to explore deploying machine learning techniques for our first version. Instead, we adapted our goal to examine the roles of human manual analysis and of technological automated analysis to consider how and where machine learning techniques might have the most impact for the efficiency and effectiveness of the next iteration. Therefore, the current computational approach of Play Analytics consisted of three main techniques for analyzing children's StoryBlocks stories: (1) Automated Algorithms, (2) Human Analytics, and (3) Combined Human-Digital Approach. Figure 2.18 demonstrates the benchmarks that were measured by the different techniques.

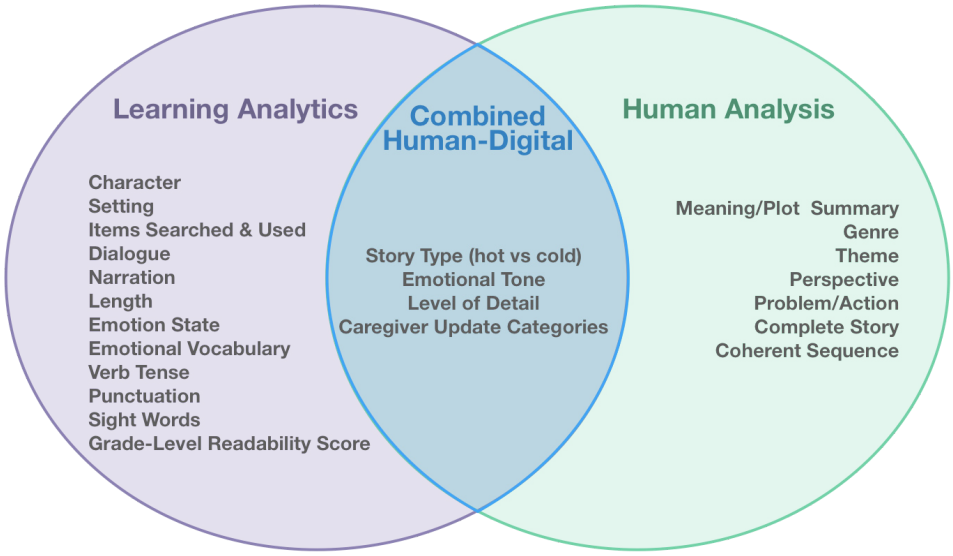


Figure 2.18 The Distribution of Benchmarks Along the Three Analytic Techniques.

All of the Story Stats were machine-generated by the automated algorithms we wrote. In our first version of the analytics, we followed a similar approach used by many Learning Analytics (LA) practices. LA is defined as the process when "sophisticated analytic tools are used to improve learning and education" [85]. In other words, it is the process of measuring, collecting, analyzing, and reporting data about learners and their contexts. While the opportunity space for LA is broad, the ways in which LA tends to be implemented is narrow [85; 84]. Most of the time, LA is used for built-in student tracking functionality, without capitalizing on the modelling capacity of the analytics to make predictions, act on them, and then use the results to improve the predictions overtime. In future computational approaches, we plan to use both the student-tracking functionality of LA, as well as attempt to broaden the way learning analytics have traditionally been implemented by incorporating a human-machine element, and creating a cyclic share of knowledge. However, for the current Play Analytics system, we only implemented the student-tracking approach.

There are two kinds of algorithms we created to automatically analyze the Story Stats benchmarks from children's story data. First, we wrote scripts to pull the information directly from the StoryBlocks log data, such as characters, settings, items searched, items used, dialogue, text narration, length, and emotion states. Second, for other benchmarks, such as sight words, capitalization, punctuation, and emotional vocabulary, we wrote algorithms that took information from the logs and compared it to predetermined lists to validate whether they met the criteria of the benchmark or not. For example, for the emotional vocabulary benchmark, we compared the logs of the child's typed words in the dialogue bubbles to a list of emotional vocabulary words. If the child used any emotional words, and if they were spelled correctly, then the word would appear in the Story Stats as an emotional vocabulary word. This way, coaches do not have to keep a running list in their head about which words are considered emotional vocabulary words. Alone, the Story Stats benchmarks were not the most exciting, but they were relatively easy to automate given the data from StoryBlocks, and the goal of them was to help coaches identify and keep track of some of the structural and linguistic elements of children's stories.

Certain benchmarks cannot be automated by a machine, and require uniquely human analysis skills. These benchmarks are analyzed by the coach in the Story Annotations and include meaning/plot summary, genre, theme, perspective, problem/action, complete story, and coherent sequence. Having coaches complete the Story Annotations helped them identify trends and use their annotations to quickly reference or access specific stories without having to reread the entire story. Rather than wasting time analyzing elements such as language features and story grammar that can easily be automated, the analytics were designed for coaches to spend their time documenting more complex narrative components (e.g., plot summary) in order to more efficiently and effectively use data to support children's narrative development.

In the middle of the diagram in figure 2.18, there is a sweet spot, which combines both human and digital techniques for analyzing children's stories. As we continue to improve our analytics system, the goal is to increase the benchmarks that rely on these combined techniques, since algorithms alone are often not sufficient, and only relying on human analysis can be an extremely heavy burden and inhibits scale. Unfortunately, for our current Play Analytics system, the benchmarks under the human-digital approach section were more reliant on information from the automated algorithms informing the coach's annotations, and less inherently designed in the analytics to make that connection salient. For example, to annotate the emotional tone of the story, the coach used the emotion states of the characters and their assessment of the story's plot to identify the overall tone. Similarly, the presence of certain Story Stats, such as characters, items, dialogue, narration, length, and emotions informed the Coach's annotation about the level of detail in the child's story. While the original intent was to pre-populate these annotation fields with the corresponding Story Stats, we were not able to implement this feature into the first version of our Play Analytics.

2.5.7 Limitations and Future Directions

Every first version has some known limitations and initial constraints before it is deployed, and our Play Analytics for StoryBlocks are no exception. Our first limitation, as stated above, was that we neither had a working prototype, nor a finished design of StoryBlocks before we started designing and developing the Play Analytics system. This limitation was perhaps the source for which all our other limitations stemmed. First, when building the StoryBlocks app, we wanted to allow children to always be able to revise their stories, making stories always editable

and never complete. Due to this, we were not able to conduct our analysis at the story level, because there we could not identify a complete story. Instead, we created an arbitrary unit, called a time marker (also known as a story session), in which the stories were broken up by the time between each coach update (i.e., Monday, Wednesday, and Friday at 5:00pm). Story Stats were generated and coaches had to write annotations for each story session, resulting in multiple annotations of a single story. Not only did this story session solution create confusion and added work for the coaches, but we were not able to run the analytics across multiple stories, but instead had to calculate accumulation of Story Stats per day. Additionally, since coaches often did not complete the entire annotation field for a story in which they already annotated a previous story session, many fields were left blank, drastically skewing the percentage summaries of the Story Annotations and rendering them useless. Our design constraint to make the children's StoryBlocks infinitely editable created a major limitation that we knew would impact the organization, production, and presentation of our analytics system. Unfortunately, we did not have enough time before deployment to redesign the app, and instead had to create a series of temporary fixes (e.g., the "copy last annotation" button in the Console) in order to account for the absence of a story unit to analyze stories. For the second iteration of both StoryBlocks and the analytics system, I plan to address this limitation by having children indicate when their stories are complete in StoryBlocks, and then only allowing coaches to analyze completed stories, so that the analytics can be generated at the story-level, rather than the arbitrary story session level.

The second known limitation of Play Analytics was that it was knowingly built on narrow, standardized metrics. Since the intention for the StoryBlocks app was to be more open-ended and allow for any type of child-generated story, we broadened our definition of narrative development and attempted to account for it in our analysis framework. Even though our definition of narrative was broad to allow for any type of child-generated story the inspiration for developing our benchmarks, such as Common Core guidelines and narrative language measures, are relatively narrow in what they consider to be a narrative. As a result, the majority of the measures we automated focused too much on the structure of the story (e.g., story grammar). Therefore, although children were able to make multiple types of narratives in StoryBlocks, our analysis approach favored stories that followed a traditional narrative style, focused around a problem, and contained a beginning, middle, and end. I attempted to account for this limitation by incorporating the coach's interpretation of less structural elements. However, there became a delicate balance between over-burdening the coach and under-analyzing the interpretive elements of a story. Some blindspots I identified in our analytics approach were assessing children's representation of self and identity, analyzing children's oral narrative skills through their audio recordings, and analyzing children's visual representations through the composition of their scenes. For this first iteration of a Play Analytics system, we opted towards lessening the coach burden until we could collect enough children's story data to inform new algorithms and redesign a more advanced computational approach for coaches to more efficiently focus on the interpretive elements of children's stories.

Finally, the third limitation of our Play Analytics system was that most of the data relied heavily on being presented within a dashboard. While data visualizations and dashboards can be helpful in presenting information from learning analytics, one common pitfall in data analytics dashboards for teachers and educators is that they are often uninterpretable or useless [85]. In response, our intent was to create a simple and meaningful dashboard without any complicated

visuals. We wanted to engage the coach in a cyclic share of knowledge, where they used the data to inform their expertise, and then their expertise produced more sophisticated data sets with more context and meaning. However, in implementing the analytics system and connecting it with the StoryBlocks app, time and resource constraints led to us cutting features of the analytics that connected the automated data with the coach annotations (e.g. pre-populating automated data to inform relevant Story Annotation fields). Before deploying, we knew that some of the Story Stats and Overview of Progress fields would be less useful for coaches. For the next iteration of the analytics system, I aim to make simplicity and usefulness a top priority in the design and implementation of the Console.

To study each of the designs and implement the full Learning Loops program, we conducted a pilot of the entire system. The next section of this dissertation analyzes the Spring 2019 pilot to examine Learning Loops' ability to document and support children's narrative development.

3.0 Learning Loops Spring 2019 Pilot Study

3.1 Methodology

3.1.1 Pilot Goals and Research Questions

The goals of this pilot were threefold. First, we wanted to understand how children played with StoryBlocks for an extended period of time in their home over eight weeks. Second, we aimed to insert our storytelling app, StoryBlocks into our previously tested coaching system [71; 72] to examine our ability to create a digitally-mediated system centered around children's narratives. Third, we wanted to continue iterating on our materials, tools, and training for coaches so that they could better support children's narrative development and engage families in the storytelling process. Given these goals, our formative research questions were: (1) How did children engage with StoryBlocks? (2) What trends can we observe in children's stories? (3) Can our system document children's narrative progress through their StoryBlocks stories? (4) Did the presentation of story data in the Console help coaches see progression? (5) Did coaches use the data in the Console to support children's narrative development? The findings from this pilot will help us improve our system and tools.

3.1.2 Participants

We conducted the first pilot study of the Learning Loops program with 14 families (21 children, ages six to ten years old) and five volunteer coaches (graduate students in education-related fields, ages 24-31 years old) for eight weeks in the Greater Boston Area. Each coach served between three to six children. Two research staff served as Coach Coordinators, training and supporting coaches during the pilot program. Participants were recruited through collaborations with existing community partners and universities. Families were recruited through an after school and youth writing program. The majority of families spoke a language other than English in the home, lived in a traditionally underserved community in the Boston area, and attended public school or were homeschooled. Coaches were recruited through the Speech-Language Pathology graduate department at Northeastern University and the Harvard Graduate School of Education department.

3.1.3 Procedure

In preparation for this pilot, we iteratively developed two core technologies that are integral to the Learning Loops program: (1) the StoryBlocks app, which children used to create their own comic-style stories, and (2) the Coach Console (referred to as Console), which coaches used to analyze stories, view children's progress, give feedback on stories, and communicate with caregivers.

Before the pilot, coaches completed a fifteen-minute pre-survey about their previous experiences and expectations of becoming a coach. They also completed a one-day coach training with the coordinators which introduced the Learning Loops approach and trained coaches how to use the Console, communicate with families, and facilitate in-person family workshops. During the training, coaches were provided with a Coach Handbook (see Appendix B) to use as a resource throughout the pilot. Coaches completed a brief feedback survey after the training. To provide continued support, coaches attended a fifteen-minute group video call with the coordinators every other week (five times during the study) and had access to a private

Coach GroupMe chat channel to share information and questions with fellow coaches and coordinators.

In order to participate, caregivers completed a fifteen-minute onboarding survey and children completed the Test of Narrative Language (TNL-2) assessment with trained members of the research team to personalize the analytics level to the child's narrative skills. At the launch of the pilot, coaches and families attended a one-hour in-person workshop in order to meet each other and start building a trusting relationship. Families were given iPads with StoryBlocks and optional wifi hotspots to take home with them for eight weeks. The research team helped onboard families onto the app and create their own personal logins.

Throughout the eight week pilot, children played with StoryBlocks in the home. There was no prescribed amount of play, but families were asked to try to play with StoryBlocks at least once a week, if possible. While children played with StoryBlocks, each tap and click was streamed to their coach via the Console. Three times a week (Monday, Wednesday, and Friday), coaches were prompted to review children's play in the Console. If there was play, coaches used the Console to: (1) analyze the story and complete the Story Annotations for each play session, (2) compose a caregiver update to communicate the child's learning moments, (3) include a relevant family activity that caregiver and child could go together to reinforce what the child was learning, and (4) send feedback and questions directly to the child's story through Story Stickies. The caregiver updates were sent to caregivers as a text message between one to three times a week, depending on the child's play time, and once per week the update contained a relevant family activity. Story Stickies were sent at least once per week, depending on how much the child played. Caregivers and coaches could communicate back-and-forth between text messages and the caregiver messages in the Console.

Caregivers completed a fifteen-minute mid-way program survey at week three, prior to attending the second workshop. At week four coaches and families attended the second, one-hour in-person workshop. During the second workshop coaches and caregivers had a mid-pilot check-in, children attended a focus group with the research team about the app, and coaches and families played storytelling-related games together. Children and families were notified to submit one of their StoryBlocks stories for the final book, *StoryBlocks Tales*. Coaches completed a brief feedback survey after the second workshop.

At the end of the pilot, week eight, families and coaches attended an hour-long celebration workshop, where they returned the technology, played story-related games with their coaches, and received their published book, *StoryBlocks Tales* (see example in Appendix C). Families completed a final post-program survey and coaches completed a post-program survey.

3.2 Findings

3.2.1 Children's Use and Engagement with StoryBlocks

Twenty-one children created a total of 563 stories in StoryBlocks (average of 27 stories/child; maximum stories/child is 151; minimum stories /child is 2), playing for a total of 418 hours (average of 20 minutes/day/child; 2.3 hours/week/child) over the eight weeks. The accumulated statistics for each StoryBlocks feature, derived in large part from the Story Stats, is presented in figure 3.0, below.

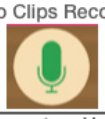
Features	Total	Relevant Stats
Dialogue Bubbles Written	3,219	Average of 5.7 dialogue bubbles/story, with a maximum of 33 dialogue bubbles in story and a minimum of 0.
Audio Clips Recorded 	1,363	Average of 2.4 audio recordings/story, with a maximum of 10 audio clips in a story and a minimum of 0.
Characters Used 	645	Boo was most used character.
Background Selected 	823	Bedroom was most common background.
Emotions Selected 	3,104	Neutral was the default and most common (1,630), happy was second most common, and sad was least common emotion used.
Items Searched 	1,781 unique items	10,948 total searches typed (not unique), 73.7% of searches (8,068) resulted in imageable icon. Of the unique items searched, 62.8% of searches (1,118) resulted in imageable icon
Items Used 	16,813	Most commonly used items were: car (90), wig (76), sun (76), star (73), window (71), boy (66), poo (62), TV (58), money (56), baby (56).
Frames Created 	1,885	Average Length of 3.4 frames/story

Figure 3.0 Overview of statistics for each feature of StoryBlocks from the pilot.

The most used feature of the app was the item searches (with 10,948 total searches and 1,781 unique word searches). During the second workshop (week four) children were put in a focus group and asked to share their likes and dislikes of the StoryBlocks app. They expressed that they especially loved "creating their own stories about anything," getting "feedback from their coaches," and being able to "search for images." In the Family Mid-Program Survey, one caregiver validated her children's excitement by stating that her children were "obsessed with the app." These reports aligned with the number of stories created and the high volume of features used (e.g., images searched) during the pilot indicate that the majority of children were highly engaged with StoryBlocks during the pilot.

3.2.2 Observed Trends in Children's StoryBlocks Stories

We analyzed trends in children's StoryBlocks stories by analyzing the content of children's stories from the StoryBlocks logs. Figure 3.1 shows an overview of all StoryBlocks

stories for all children, broken down by the Story Annotations. Two-hundred and eleven stories were annotated for their themes. The top five most common themes in children's annotated stories were friendship (22%), family (21%), animals (17%), conflict (15%), and adventure/travel (11%). Coaches annotated the genre for 212 stories. Since they were able to select multiple genres per story, 266 genres were selected for the 212 annotated stories. Of the 212 stories annotated for genre, 102 stories were categorized as real life (48%), 89 stories were considered fiction (42%), 62 stories had elements of drama (29%), and 11 stories were comedies (5%). None of the coaches selected "other" for the genre. Across all 212 annotated stories for action/problem, coaches identified six stories that contained only actions (3%), 55 stories that contained only problems (26%), and 79 that contained both actions and problems (37%). Of the 193 stories annotated for completeness, 98 stories were marked as complete (51%). Across 185 stories annotated for coherence, 148 were marked as coherent (80%). On average, the level of story detail was medium (average of 54%).

Themes	Total Themes	Percentage
Total Stories Annotated	**211**	
Friendship	47	22.27%
Family	45	21.33%
Animals	36	17.06%
Conflict	32	15.17%
Adventure/Travel	24	11.37%
Media	17	8.06%
Sports/Activities	17	8.06%
Food	16	7.58%
Fantasy/Monsters	14	6.64%
Nature	14	6.64%
School	11	5.21%
Negative Emotions	10	4.74%
Positive Emotions	9	4.27%
City	7	3.32%
Art	6	2.84%
Space	5	2.37%
Transportation	5	2.37%
Apocolypse	4	1.90%
Technology/Science	4	1.90%
Crime	3	1.42%
Holiday	3	1.42%
Money	3	1.42%
Heroism	2	0.95%
Humor	2	0.95%
Politics	2	0.95%
Unknown	2	0.95%
News	1	0.47%
Strangers	1	0.47%

Genres	Total Genres	Percentage
Total Stories Annotated	**212**	
Real Life	104	49.06%
Fiction	89	41.98%
Drama	62	29.25%
Comedy	11	5.19%
Other	0	0.00%

Emotional Tone	Total Tones	Percentage
Only Sad	50	23.58%
Only Happy	95	44.81%
Only Neutral	67	31.60%
Mixed Emotions	24	11.32%
Total Happy	103	48.58%
Total Sad	65	30.66%
Total Neutral	68	32.08%
Total Annotated	**212**	

Story Content	Total Content	Percentage
Action Only	6	2.83%
Problem Only	55	25.94%
Both	79	37.26%
Neither	72	33.96%
Total Annotated	**212**	

Story Type	Total Types	Percentage
Hot Only	28	12.84%
Cold Only	190	87.16%
Both	89	40.83%
Total Hot	101	46.33%
Total Cold	206	94.50%
Total Annotated	**218**	

Completeness	Total Complete	Percentage
Complete	98	50.78%
Incomplete	95	49.22%
Total Annotated	**193**	

Average Detail	Min Detail	Max Detail
54.32%	9%	96%

Coherence	Total Coherent	Percentage
Coherent	148	80.00%
Incoherent	37	20.00%
Total Annotated	**185**	

Annotation Type	Totals
Total Stories	**563**
Plots Annotated	222
Exploratory Stories Excluded	167

Figure 3.1 Overview of Story Annotations Across All StoryBlocks Stories for All Children (n=21). Since coaches could choose multiple themes for each story and there was no way to indicate priority of theme, we counted each theme that coaches identified with equal priority, where the number of themes tagged were 363 for 211 stories. This is the same for genres. The percentages are calculated out of total annotated stories for each category.

To further examine trends in children's StoryBlocks stories, we compared some of the Story Annotations (e.g., number of stories created, percentage of story genres, percentage of story themes, percentage of stories with actions, percentage of stories with problems, average percentage of story detail, percentage of complete stories, percentage of coherent stories) based on certain independent variables gleaned from the Family Onboarding Survey and the StoryBlocks log data. Our independent variables were child age (six, seven, eight, nine, and ten years old), child gender (male, female), and coach (01, 02, 03, 04, 05).

We first examined trends in children's stories by age. Of the 21 participants at the completion of the program, 2 six-year-old children created 180 stories, 4 seven-year-old children created 173 stories, 6 eight-year-old children created 60 stories, 5 nine-year-old children created 84 stories, and 3 ten-year-old children created 19 stories. One child in this study was five years of age, and we excluded his data in our analysis of trends by age. On average, older children tended to make fewer stories than younger children; 2 six-year-old children made 180 stories and three children at ten years of age made only 19 stories. The descriptive statistics for stories by age are presented in figure 3.2. Looking at the story genres annotated for six and seven year olds' stories, six-year-olds made more fictional stories (35 of 89 six-year-old stories, 63%, and 15 of 74 seven-year-old stories, 23%, were categorized as "fiction"), whereas seven year olds made more stories about real life (41 of 74 seven-year-old stories, 64%, and 10 of 89 six-year-old stories, 18%, were categorized as "real life"). Eight-year-old children made fewer complete stories than children of other ages (6 of 26 eight-year-old annotated stories, 23%, were marked as complete). While about three-quarters or more of the annotated stories for each age group were marked as coherent, all 11 of the ten-year-old annotated stories were coherent. Looking just at the top five themes identified by coaches, eight year olds made many stories about friendship (10 of 27 annotated stories, 37%), seven and nine year olds made many stories about family (25 of 63 seven-year-old annotated stories, 40%; 13 of 27 nine-year-old annotated stories, 29%), and six year olds made many stories about conflict (22 of 55 annotated stories, 40%) and animals (16 of 55 annotated stories, 29%). Seven year olds had the highest average level of story detail (65%) and ten year olds had the lowest average level of story detail (41%).

Age	Total stories	Annotated Genres	Total Real Life	Total Comedy	Total Drama	Total Fiction	Annotated Complete	Total Complete	Annotated Coherence	Total Coherence	Total Problem Stories	Total Action Stories	Annotated Themes	Total Friendship	Total Family	Total Animals	Total Conflict	Total Adventure/ Travel	Average Story Detail
6	180	56	12 (21.43%)	4 (7.14%)	38 (67.86%)	35 (62.50%)	54	32 (59.26%)	55	46 (83.64%)	48	29	55	14 (25.45%)	1 (1.82%)	16 (29.09%)	22 (40%)	11 (20%)	54.55%
7	173	64	41 (64.06%)	3 (4.69%)	15 (23.44%)	15 (23.44%)	54	29 (53.70%)	50	43 (86%)	31	22	63	8 (12.70%)	25 (39.68%)	6 (9.52%)	4 (6.35%)	3 (4.76%)	65.21%
8	60	28	17 (60.71%)	2 (7.14%)	2 (7.14%)	14 (50%)	26	6 (23.08%)	25	18 (72%)	14	9	27	10 (37.04%)	3 (11.11%)	4 (14.81%)	3 (11.11%)	3 (11.11%)	43.46%
9	84	46	27 (58.70%)	1 (2.17%)	6 (13.04%)	14 (30.43%)	39	22 (56.41%)	36	29 (85.56%)	31	20	45	9 (20%)	13 (28.89%)	3 (6.67%)	2 (4.44%)	3 (6.67%)	59.56%
10	19	11	7 (63.64%)	1 (9.09%)	1 (9.09%)	4 (36.36%)	11	6 (54.55%)	11	11 (100%)	9	5	11	3 (27.27%)	2 (18.18%)	1 (9.09%)	1 (9.09%)	3 (27.27%)	41.09%
Total	516	205	104 (50.73%)	11 (5.37%)	62 (30.24%)	82 (40%)	184	95 (51.63%)	177	147 (83.05%)	133	85	201	44 (21.89%)	44 (21.89%)	30 (14.93%)	32 (15.92%)	23 (11.44%)	

Figure 3.2 Descriptive Statistics for Selected Story Annotations Grouped by Child Age.

We then examined trends in children's stories by gender. Of the 21 children participating, 13 were female and eight were male. Females created a total of 285 stories out of the 563 stories, and males created a total of 278 stories. The descriptive statistics for stories by gender are presented in figure 3.3. Two-hundred and twelve stories were annotated for genre, with coaches choosing at least one genre for 122 stories created by female participants and 90 stories created

by male participants. Girls made more real life stories (73 of 122 female stories, 60%, and 31 of 90 male stories, 34%, were categorized as "real life"), whereas boys made more fictional stories (50 of 90 male stories, 56%, and 39 of 122 female stories, 32%, were categorized as "fiction") and dramas (39 of 90 male stories, 43%, and 23 of 122 female stories, 19%). About half of the annotated stories that both boys and girls created were complete stories, and over three-fourths of the annotated stories created by both genders were coherent. In reviewing the themes of children's stories by gender, girls created many stories about family (39 of 119 female stories, 33%; 6 of 92 male stories, 7%), whereas boys created more stories about animals (30 of 92 male stories, 33%; 6 of 119 female stories, 5%) and conflict (26 of 92 male stories, 28%; 6 of 119, 5%). Interestingly, similar trends among the themes in preschool-aged children's spontaneous oral stories by gender were found by Nicolopoulou (2008). She found that boys tended to focus their stories on what she termed the "heroic-agonistic genre" where characters of power are brought together via conflict, and girls tended to focus their stories around the "family genre" where characters have pre-existing relations and seek harmony [89]. Lastly, on average, girls tended to create stories with slightly more detail than boys (girls average level of detail was 59% and boys average was 49%).

Gender	Total stories	Genre Annotations	Real Life	Comedy	Drama	Fiction	Complete Annotations	Complete Stories	Coherence Annotations	Coherent Stories	Total Problem Stories	Total Action Stories	Theme Annotations	Friendship	Family	Animals	Conflict	Adventure/ Travel	Average Story Detail
F	285	122	73 (59.84%)	4 (3.28%)	23 (18.85%)	39 (31.97%)	106	54 (50.94%)	97	80 (82.47%)	70	46	119	26 (21.85%)	39 (32.77%)	6 (5.04%)	6 (5.04%)	8 (6.72%)	58.70%
M	278	90	31 (34.44%)	7 (7.78%)	39 (43.33%)	50 (55.56%)	87	44 (50.57%)	88	68 (77.27%)	64	39	92	21 (22.83%)	6 (6.52%)	30 (32.61%)	26 (28.26%)	16 (17.39%)	48.89%
Total	563	212	104 (49.06%)	11 (5.19%)	62 (29.25%)	89 (41.98%)	193	98 (50.78%)	185	148 (80%)	134	85	211	47 (22.27%)	45 (21.33%)	36 (17.06%)	32 (15.17%)	24 (11.37%)	

Figure 3.3 Descriptive Statistics for Selected Story Annotations Grouped by Child Gender.

Next, we examined trends in children's stories grouped by their coach. Each coach served an average of 4.2 children. Coach 01 served three children from one family (due to attrition, Coach 01's other family left the study after the first week), Coach 02 served six children from four families (one week into the study a sibling of a participating child on the cusp of the age range joined the study and Coach 02 agreed to coach that child), and Coach 03, Coach 04, and Coach 05 all served four children each from three families. The descriptive statistics for stories grouped by coach are presented in figure 3.4. Children who had coach 05 made more real life stories (59 of 65 annotated stories, 91%) and many of their stories centered around the theme of family (36 of 62 annotated stories, 58%). The children who had Coach 01 created the highest number of stories, made more dramatic stories (58 of 87 annotated stories, 67%), and had the highest average level of story detail (average of 60%). All coaches marked the majority of their children's annotated stories as coherent.

Coach_id	Total Stories	Genre Annotations	Real Life	Comedy	Drama	Fiction	Complete Annotations	Complete Stories	Coherence Annotations	Coherent Stories	Total Problem Stories	Total Action Stories	Theme Annotations	Friendship	Family	Animals	Conflict	Adventure/ Travel	Average Story Detail
1	269	87	21 (24.14%)	8 (9.20%)	58 (66.67%)	45 (51.72%)	86	62 (72.09%)	87	78 (89.66%)	73	46	87	22 (25.29%)	2 (2.30%)	18 (20.69%)	27 (31.03%)	12 (13.79%)	59.67%
2	105	33	6 (18.18%)	1 (3.03%)	1 (3.03%)	25 (75.76%)	35	16 (45.71%)	34	21 (61.76%)	22	13	36	8 (22.22%)	5 (13.89%)	7 (19.44%)	2 (5.56%)	11 (30.56%)	36.41%
3	41	14	10 (71.43%)	2 (14.29%)	2 (14.29%)	6 (42.86%)	13	3 (23.08%)	14	10 (71.43%)	7	6	14	3 (21.43%)	1 (7.14%)	5 (35.71%)	3 (21.43%)	0	44.50%
4	27	13	8 (61.54%)	0	1 (7.69%)	6 (46.15%)	13	2 (15.38%)	12	12 (100%)	4	3	12	6 (50%)	1 (8.33%)	1 (8.33%)	0	0	38.08%
5	121	65	59 (90.77%)	0	0	7 (10.77%)	46	15 (32.61%)	38	27 (71.05%)	28	17	62	8 (12.90%)	36 (58.06%)	5 (8.06%)	0	1 (1.61%)	69.30%
Total	563	212	104	11	62	89	193	98	185	148	134	85	211	47	45	36	32	24	

Figure 3.4 Descriptive Statistics for Selected Story Annotations Grouped by Coach.

The purpose of observing these trends is to understand how children use StoryBlocks and explore the types of stories children tell. These trends are not meant to prove differences among ages or genders, nor should they be generalized to other storytelling situations. However, these StoryBlocks stories are one of the first known corpora of children's digital stories. Therefore, it is important to examine the possible trends within these stories, and, once our corpus of digital stories continues to grow, compare the trends in children's digital stories with trends in their oral or written stories.

3.2.3 Systematic Documentation of Children's Narrative Progress

It is important to distinguish between the question of whether children made progress, and asking our actual question, which is whether our tool had the capacity to document potential progress. Therefore, rather than only presenting data that shows whether all children made progress, I will instead show examples of the fine-grained data our system collects and how we can analyze it to document potential progress.

From the StoryBlocks log data, every tap was recorded and screenshots were taken of each frame in the story after every major action or change to the story (e.g., inserting a character, searching an item, inserting dialogue). These data and the screenshots were compiled and presented within the Console in the form of Story Stats and the Play and Process Modes of the child's story. Coaches completed Story Annotations for each story to supplement the automated Story Stats. The StoryBlocks log data and Console log data were combined to create a complete dataset for each story. From this fine-grained data of a single child's play, we can look at both an individual story, as well as any of these data points for each story over time. One way we could use this fine-grained data to document a child's narrative progression would be to chart the number of occurrences of each Story Stat and Story Annotation within a child's story, organized chronologically by story end date. To demonstrate this, we will pick one Story Stat, such as verb usage. Verb usage was represented in the Story Stats. We integrated a third-party package called spaCy[3] to run through each word in the speech bubble to first determine if the word is a verb, and if so tag it as past, present, or infinitive using spaCy's classifiers. We can look at a child's progression of verb usage from the dialogue bubbles in their stories over time. For example, by analyzing two stories from a six-year-old, Roger[4], we can see the growth in his use of verbs from one of the first stories he created in StoryBlocks (figure 3.5), to one of the last stories he created in StoryBlocks at the end of the pilot (figure 3.6). In the first story, Roger used two verbs, "am" (from "I'm") and "love". In the last story, Roger used 23 verbs in total. Controlling for length of story by frame, Roger's first story had an average of 0.5 verbs per frame and his last story had an average of 2.3 verbs per frame. This indicates a growth in verb usage over time.

Furthermore, our system can not only present this fine-grained data by comparing the first and last stories of each child, but it can also chart the occurrences of these stats, such as verb usage, for each story over time to get a more comprehensive view of the incremental shifts throughout the course of the pilot. For example, figure 3.7 charts the average verb usage per frame for all of Roger's stories during the pilot, organized by story end date. Finally, with our data, we can go even further, by not just calculating the total verbs used, but also looking at the

[3] spaCy's Linguistic Features: https://spacy.io/usage/linguistic-features

[4] Every name of the children, caregivers, and coaches in this entire dissertation have been changed to protect the privacy of our participants.

breakdown of verb tense. For example, Roger's first story had two present tense verbs and his last story had three past tense verbs, nine present tense verbs, and 11 infinitive tense verbs. Roger's trend in using increasingly varied verb tenses aligns with the research finding that young children start telling stories using the present tense and increase to the past and future tenses as their storytelling skills get more sophisticated [34].

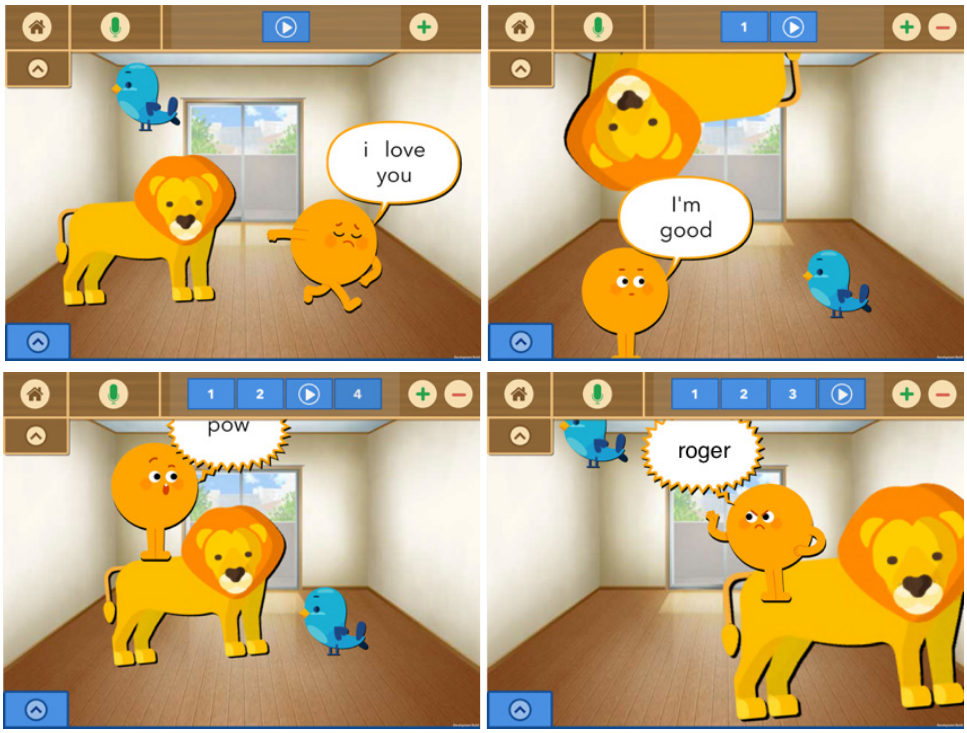


Figure 3.5 Six-year-old Roger's First Complete Story Created in StoryBlocks.

Figure 3.6 Roger's Final Complete Story Created in StoryBlocks.

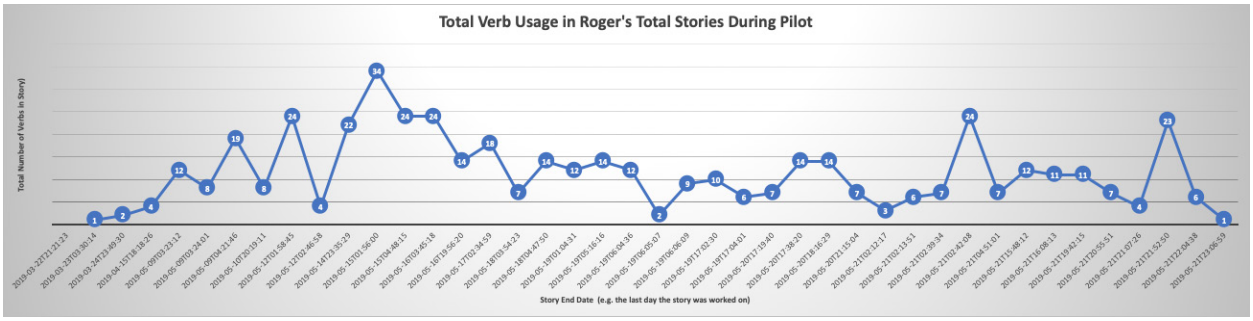


Figure 3.7 Line chart of Roger's total verb usage in each story, organized by story end date.

For the less easily automatable elements of a story, such as identifying the story's genre, the completeness of a story, and the coherence of a story, coaches annotated each story the children created using the Story Annotations. Similar to the fine-grained way our system can analyze the Story Stats, our system can compile and analyze coach annotations to look at elements that relate to story progression, such as story completeness. Returning to Roger's examples in figures 3.5 and 3.6, the coach annotated Roger's first story as incomplete, and the last story as complete. We could then use the data in each story to chart the progression of complete stories across all of Roger's stories, organized chronologically by end date.

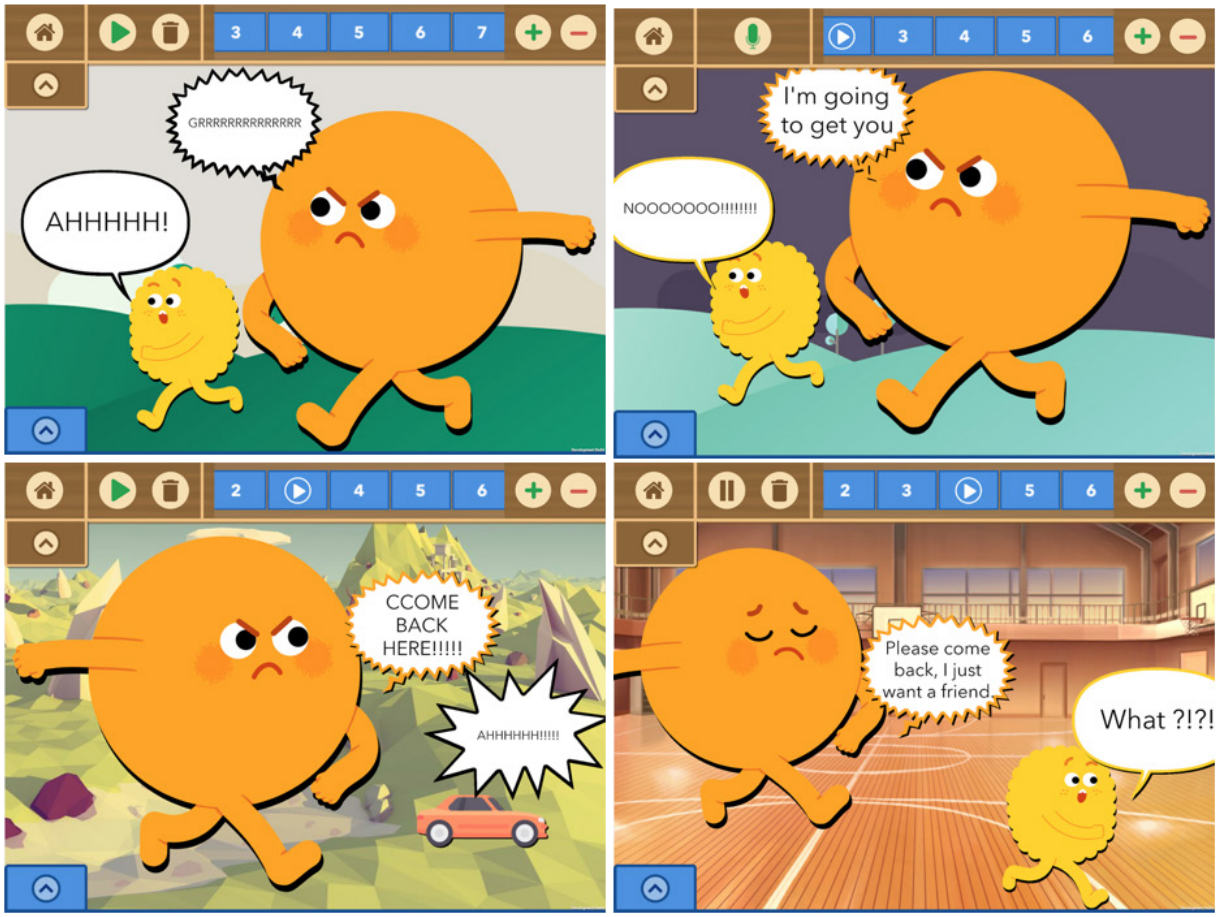
Given the fine-grained data captured and compiled by our system, it is reasonable to conclude that our system has the ability to document children's narrative progression from their StoryBlocks stories. However, in order to truly make that claim, we need to define narrative progress and identify which measures align with our definition. Since our original design of the analytics system aimed to take a broad definition of narrative beyond just the mechanics of narrative, we cannot base our definition of narrative progress on the measures of the Story Stats and Story Annotations, alone. Things like verb usage and verb tenses are only a small part of a much larger picture of what constitutes a narrative, and what we can observe as narrative progress. For example, revisiting Roger's two stories, we can see that while his verb usage did increase, his last story was way more complex than his first, indicating that there are many other elements contributing to progression (e.g., linguistic complexity, coherence, compositional complexity, emotional complexity, complexity of plot). Focusing solely on something like verb usage, even with its correlation to other aspects of narrative language and story grammar features, only documents a small part of what makes Roger's last story more sophisticated. While these are still important to measure, we want to make sure we are not presenting these pieces of data as the whole picture to coaches. Therefore, the data captured by our system suggests that it is possible to document progression on certain narrative skills or elements (e.g., linguistic features), but that we cannot conclude whether we have documented children's narrative progression without first creating a comprehensive definition of progression. In order to do this, we will need to create a theoretical framework for how we define and analyze narrative.

In analyzing our system's ability to document potential narrative progression, we can also look beyond the Story Stats and Story Annotations, at the coach's caregiver updates. One of the roles of a coach was to communicate children's learning moments during play to caregivers through their caregiver updates, thereby using the Console to document potential progress that may or may not have been captured by the Stats or Annotations. I organized each coach's update for each child in chronological order and manually annotated for evidence of progression. Only children who had updates that met the inclusion criteria were analyzed. To be included, a coach

must have sent at least five updates to the child's caregiver specifically about the child's stories (this excludes Lack of Activity updates). All updates for 15 of the 21 children were analyzed. Analysis revealed that the updates for 12 of the 15 children documented strong narrative progression, and slight narrative progression for the remaining three of the 15 children. My annotations yielded four categories of progression communicated through the coaches' updates: progression of story completeness, story coherence, expression (emotional expression and character development), and story complexity. Coaches also made note of specific trends they saw in children's stories, such as themes among siblings, influence of story genres, and expanding or editing stories in response to an experience or a coach's feedback. Furthermore, to make sure these depictions of progression were accurate, I went back to children's stories to see if I could find evidence of the documented progress.

To validate the progress communicated through the updates, each update was mapped to its relevant story for evidence of the learning moment expressed in the update. Figure 3.8 shows an example of this mapping with 13 stories (some with several drafts) by seven-year-old Rachel, and the relevant caregiver updates and Story Stickies from Coach Natalie. In Rachel's stories, one can see an increase in story completeness. At first, Rachel's stories did not contain either an ending solution or, sometimes, a middle action. However, halfway through the pilot with prompting feedback from Coach Natalie, Rachel's third draft of *Donald trump* had a clear beginning, middle, and end. Rachel then created her own complete story in *Shark*, and Coach Natalie's caregiver update noted the increasing complexity that Rachel included through creating a clever plot twist. Comparing the first and second drafts of Rachel's *The sad tree* demonstrates Rachel's continued increase in story completeness with a clear resolution and story complexity through representing the character's emotional reactions to the situation. Towards the middle and end of the pilot, Rachel consistently created complete stories with increased complexity through shifting perspectives within the story to narrate scenes (i.e., *Evil boo*), visually representing plot twists and cliff hangers (e.g., *Theif lem, Unicorn trophy*), introducing multiple problems and solutions in one story (i.e., *Unicorn trophy*), and adding more visual details and dialogue to tell stories about complex topics (e.g., *Space, Tree ghost*). Finally, Rachel's later stories contained more fleshed out character development and emotional expression of the characters (e.g., *Giant boo*, *Xbox and cookies*). Progression of story completeness, complexity, and expression were all documented and communicated through Coach Natalie's caregiver updates.

Angry Giant (March 21-22)



Wow!!! Plot twist! It was just Boo wanting a friend all along!

3/22/2019

Coach Natalie 3/22/2019

Update - Rachel is also doing a great job at introducing a BIG problem to her story! Boo has become a giant and doesn't know how it happened! The next step will be for her to add more detail on how to resolve this problem! I can't wait to read more.

Boo's Pet's - Draft 1 (March 29-April 01)

Coach Natalie 4/1/2019

Update - Hi Karen, Rachel's latest story is about how Boo has a ton of pets, but doesn't want to share them with Kiwi! It's a tough problem, and I look forward to seeing what she comes up with next to solve the problem.

I love all the pets! So cute! Is there a reason Boo doesn't want to share?

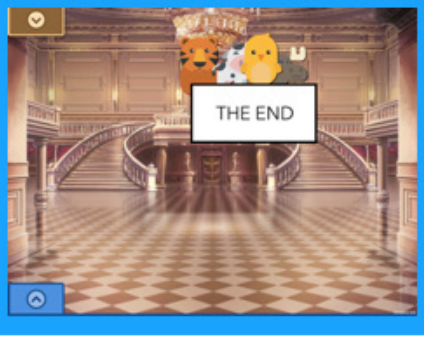
3/30/2019

What will Kiwi do now?!

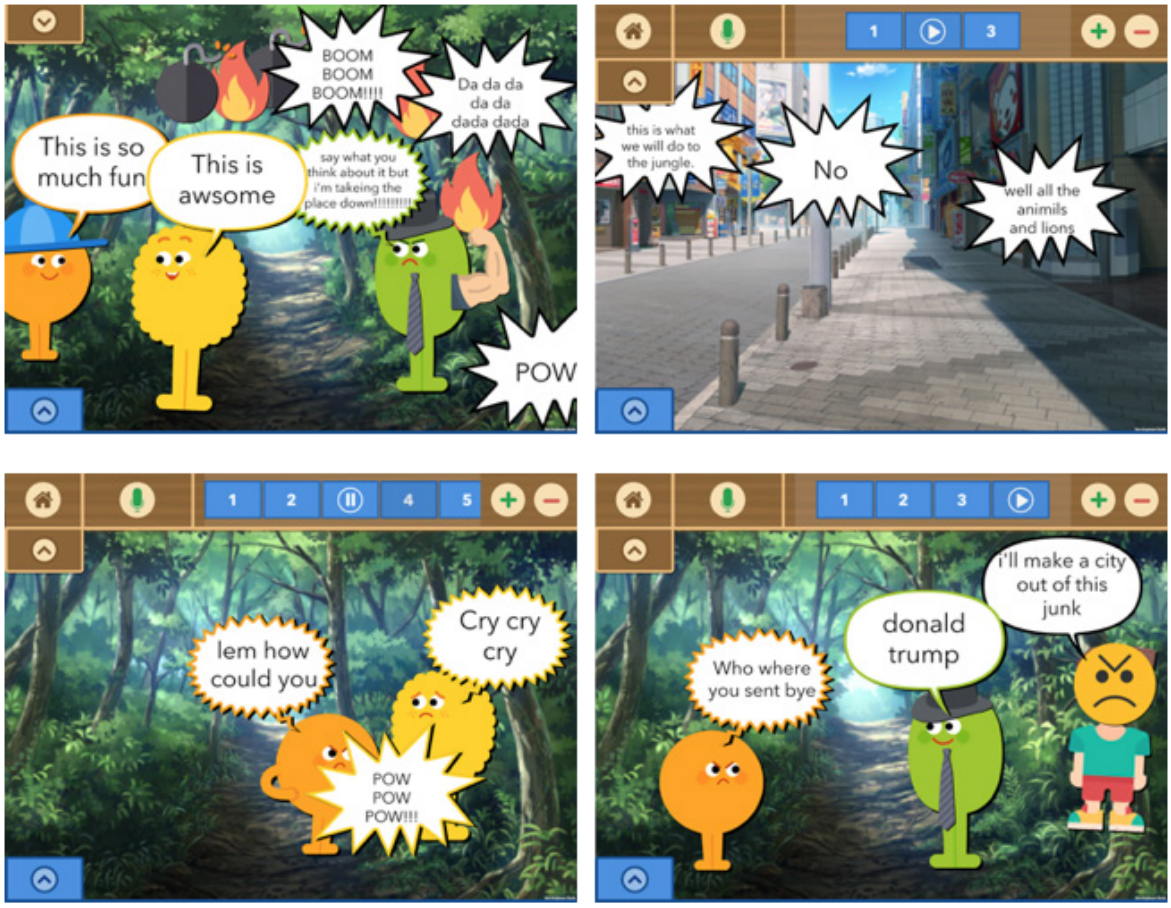
3/30/2019

Boo's Pet's - Draft 2 (May 10-13)

+



Donald trump - Draft 1 (April 03-05)



Coach Natalie **4/5/2019**

Update - Rachel just started to write a very interesting story about Donald Trump's henchmen coming to destroy the jungle and turn it into a city. Fascinating plot to this story, and I can see how she is incorporating ideas from real life into this story.

Oh my, this has taken a dramatic turn! How will Boo and react to Donald Trump's henchmen?

4/5/2019

Donald trump - Draft 2 (April 05-08)

Coach Natalie **4/8/2019**

Update - Rachel's story about saving the jungle from DT continues! Rachel is in the process of creating the part of the story where Boo stands up to DT. A real cliff hanger!

Oh WOW this story is so dramatic!!! Will Boo be able to save the jungle? I can't wait to see what happens next!

4/8/2019

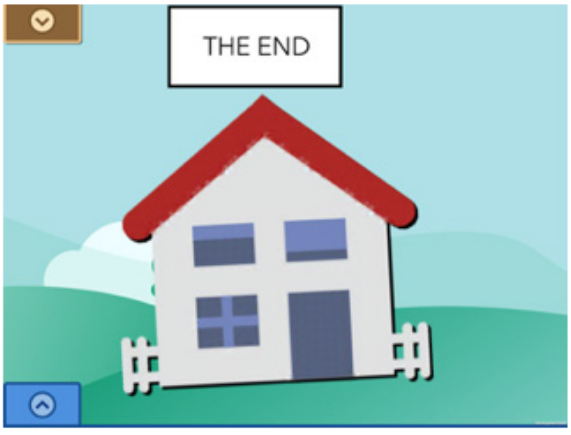
Donald trump - Draft 3 (April 08-12)

Shark (April 16-17)

Coach Natalie 4/17/2019

Update - Rachel already has a nice complete story ready for her book! And it's hilarious! Boo saves some fish from a shark, but then there is a surprise plot twist! You should check it out if you haven't read it yet. :)

Wether (April 18-19)



Coach Natalie **4/19/2019**

Update - Check out Rachel's story about the weather! It is so creative and adorable! I love that she is incorporating this part of our everyday lives into her stories.

The sad tree - Draft 1 (April 17-18)

This is so sad, poor Boo :(. Is there anything they can do in the face of this sad news?

4/19/2019

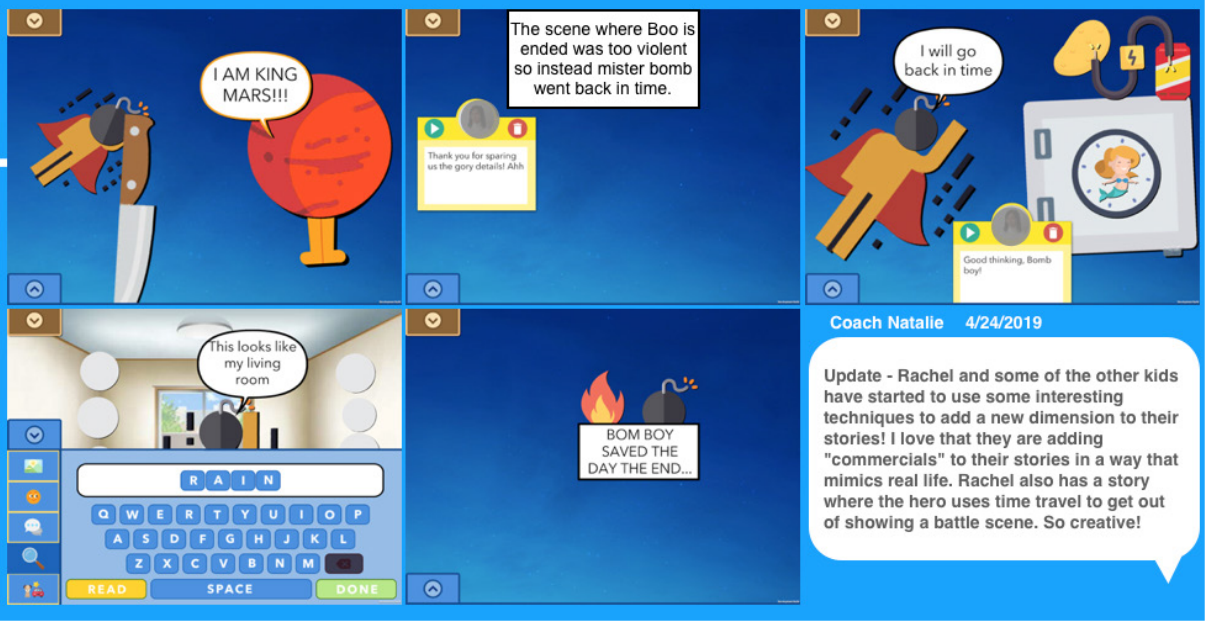
The sad tree - Draft 2 (April 18-22)

Coach Natalie 4/22/2019

Update - Check out Rachel's story "the sad tree". She just finished the ending and I love it!

Evil boo - Draft 1 (April 21-22)

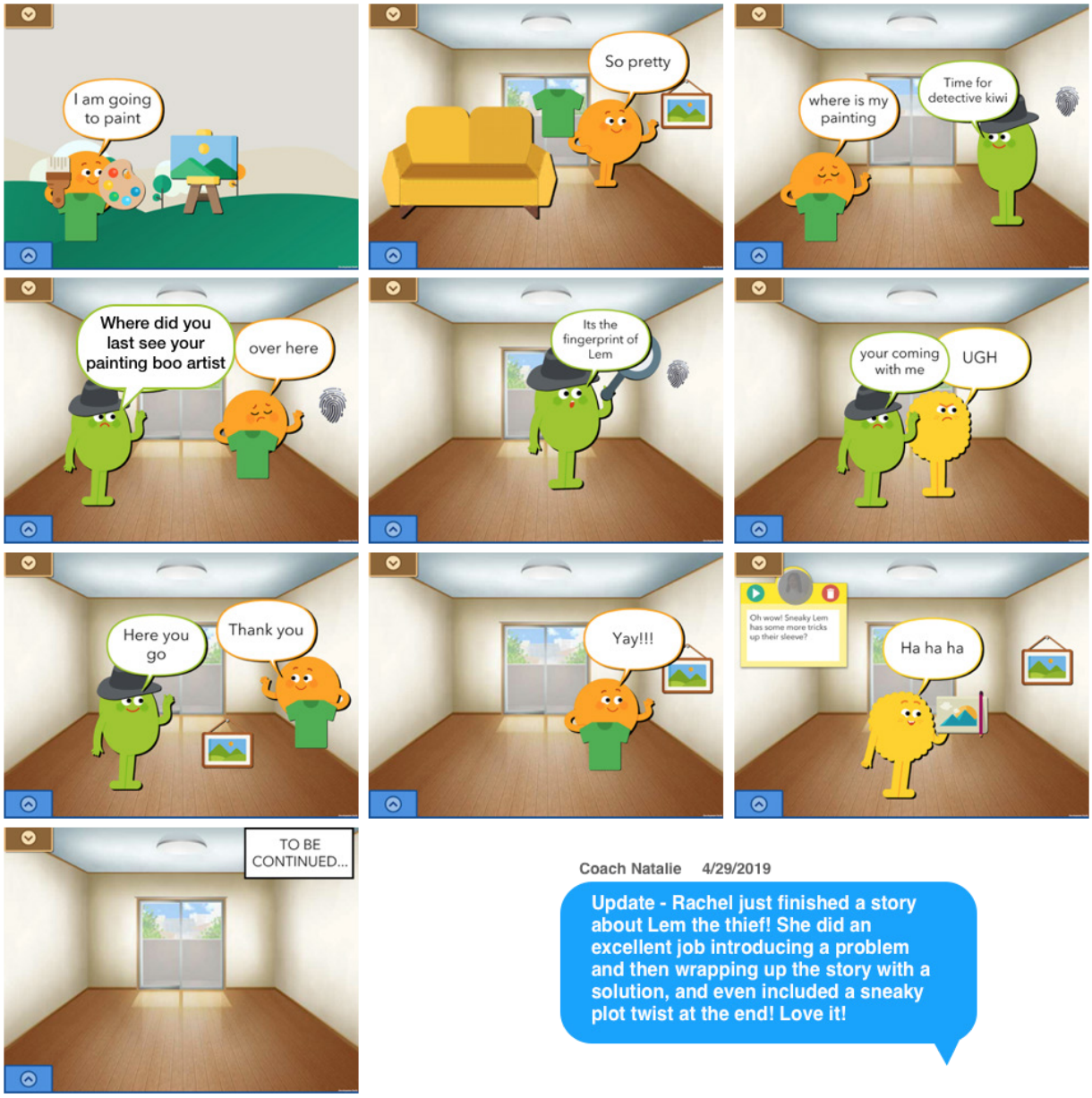
Evil boo - Draft 2 (April 22-24)



Coach Natalie 4/24/2019

Update - Rachel and some of the other kids have started to use some interesting techniques to add a new dimension to their stories! I love that they are adding "commercials" to their stories in a way that mimics real life. Rachel also has a story where the hero uses time travel to get out of showing a battle scene. So creative!

Theif lem (April 28-29)



Coach Natalie 4/29/2019

Update - Rachel just finished a story about Lem the thief! She did an excellent job introducing a problem and then wrapping up the story with a solution, and even included a sneaky plot twist at the end! Love it!

Tree ghost (April 28-29)

OMG A GHOST! Lem was right!!!

5/1/2019

Coach Natalie 5/1/2019

Update - In Rachel's story "Tree Ghost" we see the appearance of her first ever ghost character!! I love that she didn't just include the ghost, but also gave it a face to show it's emotions!

Space (May 01-03)

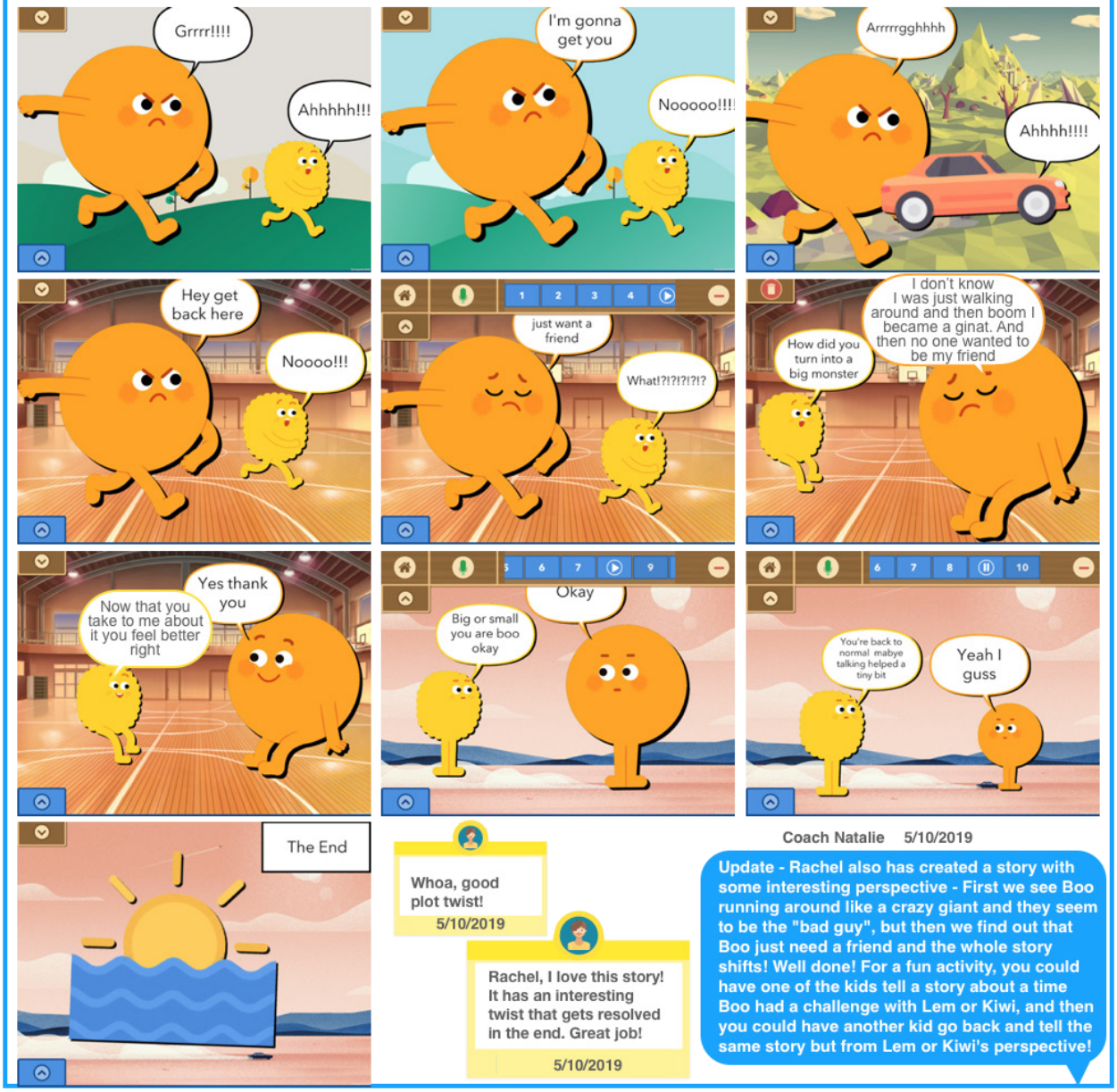
Good thing you found that helmet for Lem to use in outer space!

5/3/2019

Coach Natalie 5/3/2019

Update - I love Rachel's story about Lem's discovery in outer space! The story has lots of great detail and is so unique! I hope you all have a nice weekend and a good start to [celebrated holiday]! Maybe for a fun activity you and the kids could take turns sharing your favorite [celebrated holiday] stories!

Giant boo (May 09-10)



Whoa, good plot twist!

5/10/2019

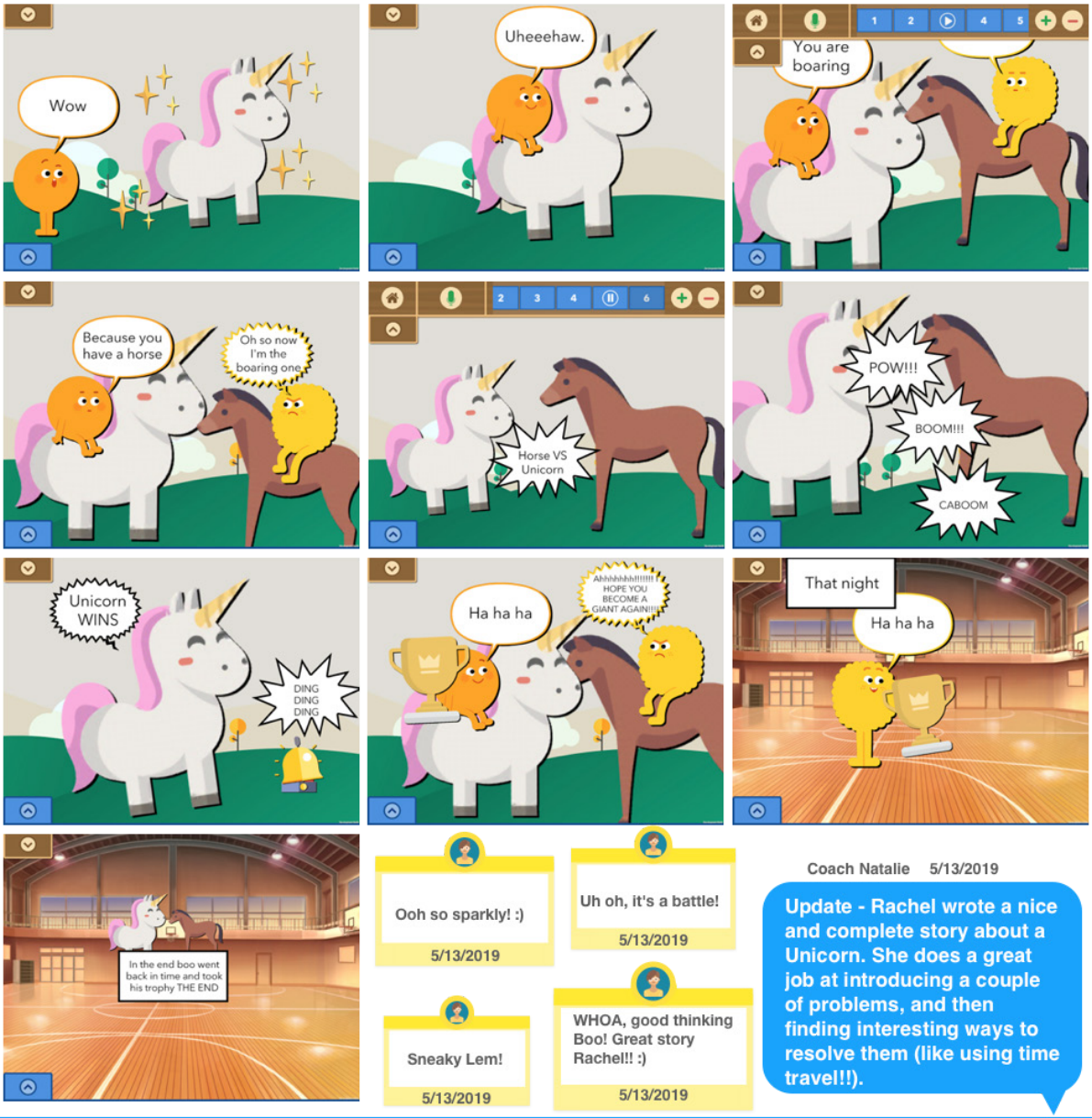
Rachel, I love this story! It has an interesting twist that gets resolved in the end. Great job!

5/10/2019

Coach Natalie 5/10/2019

Update - Rachel also has created a story with some interesting perspective - First we see Boo running around like a crazy giant and they seem to be the "bad guy", but then we find out that Boo just need a friend and the whole story shifts! Well done! For a fun activity, you could have one of the kids tell a story about a time Boo had a challenge with Lem or Kiwi, and then you could have another kid go back and tell the same story but from Lem or Kiwi's perspective!

Unicorn trophy (May 10-13)



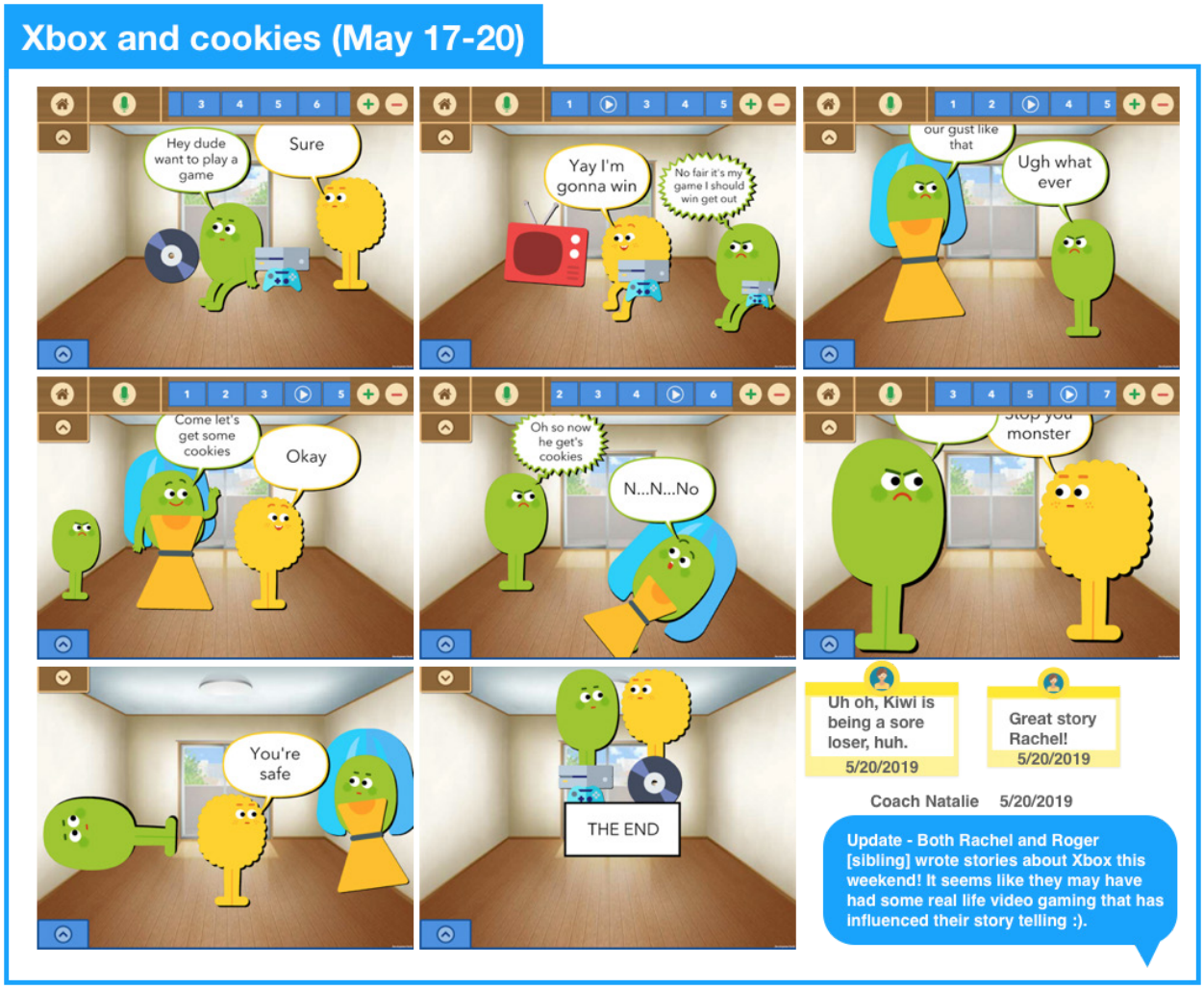
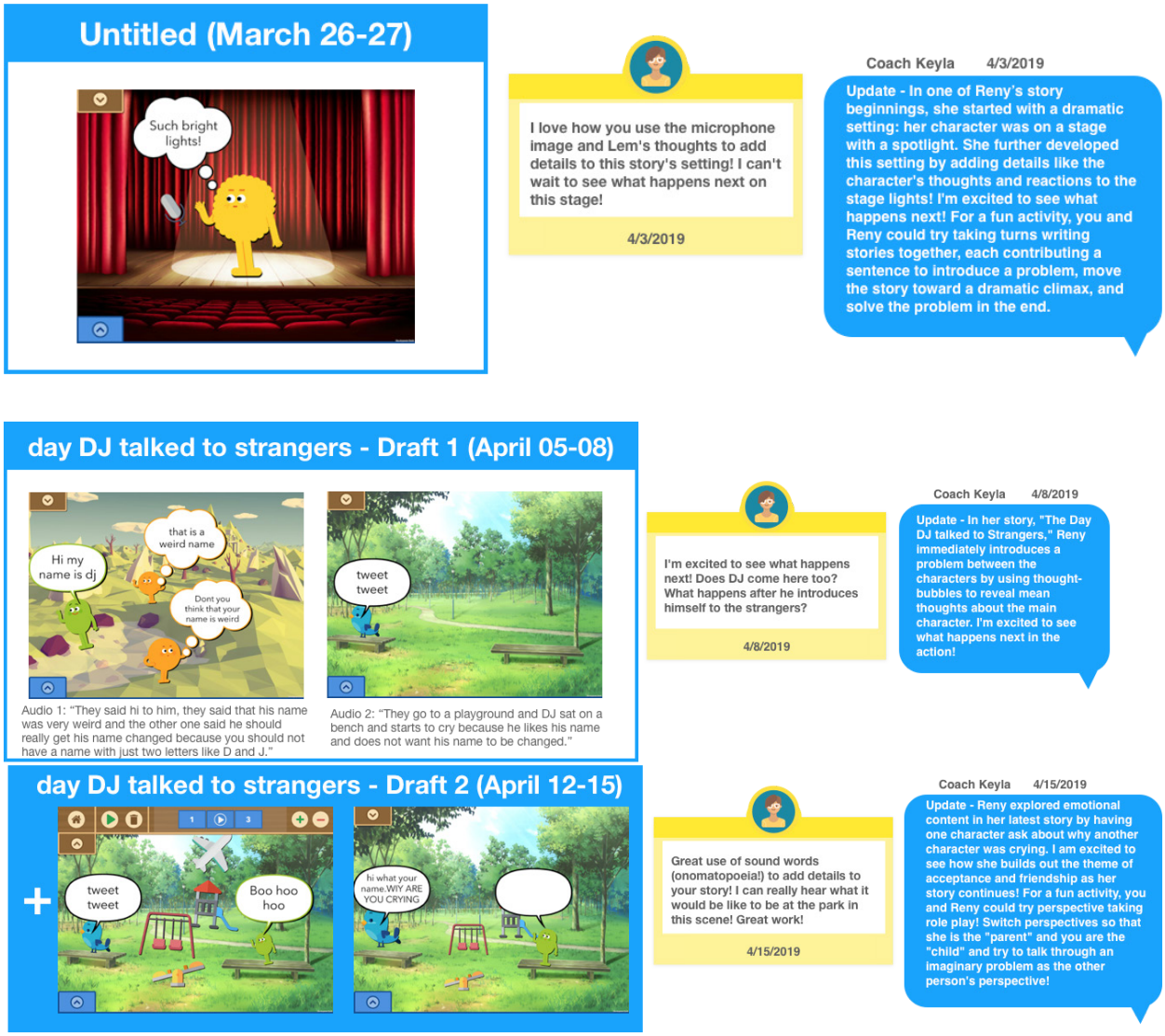


Figure 3.8 Thirteen stories by Rachel, age seven, mapped to Coach Natalie's Story Stickies and Caregiver Updates.

Many coaches documented progression through story completeness in their Caregiver Updates. Completeness was identified as stories with a clear beginning, middle, and ending, and were sometimes centered around a problem with actions or reactions, and a final solution. Some children showed progression in story completeness by starting to write incomplete stories that only had a beginning or an action, and then towards the end of the pilot started to write complete stories with a beginning, middle, and end. For example, figure 3.9 shows three stories created by eight-year-old Reny, one from the start, midpoint, and end of the pilot, along with relevant Story Stickies and caregiver updates by Coach Keyla. In *Untitled*, Reny created one scene which started to set up a problem and present the character's mental state, but did not have a middle or ending (this occurs in other early stories by Reny). Coach Keyla noted this in her caregiver update, and tried to come up with activities that caregiver and child could do together to encourage creating stories with endings. Similarly, Reny's first draft of *day DJ talked to strangers*, started to set up a problem, but had no action or solution (also noted by Coach Keyla in the caregiver update). However, in her second draft, Reny added a middle action, where DJ reacts to the problem by crying, but there was still no solution or ending. Finally, in her last story, *The Trick*, Reny's first draft again set up the context, but it was not until her second draft at the

end of the pilot, where she created her first complete story with a clear beginning, middle, and end. Coach Keyla supported the development of this complete story through her feedback in the Story Stickies, and communicated Reny's progression of story completeness through her Caregiver Updates.



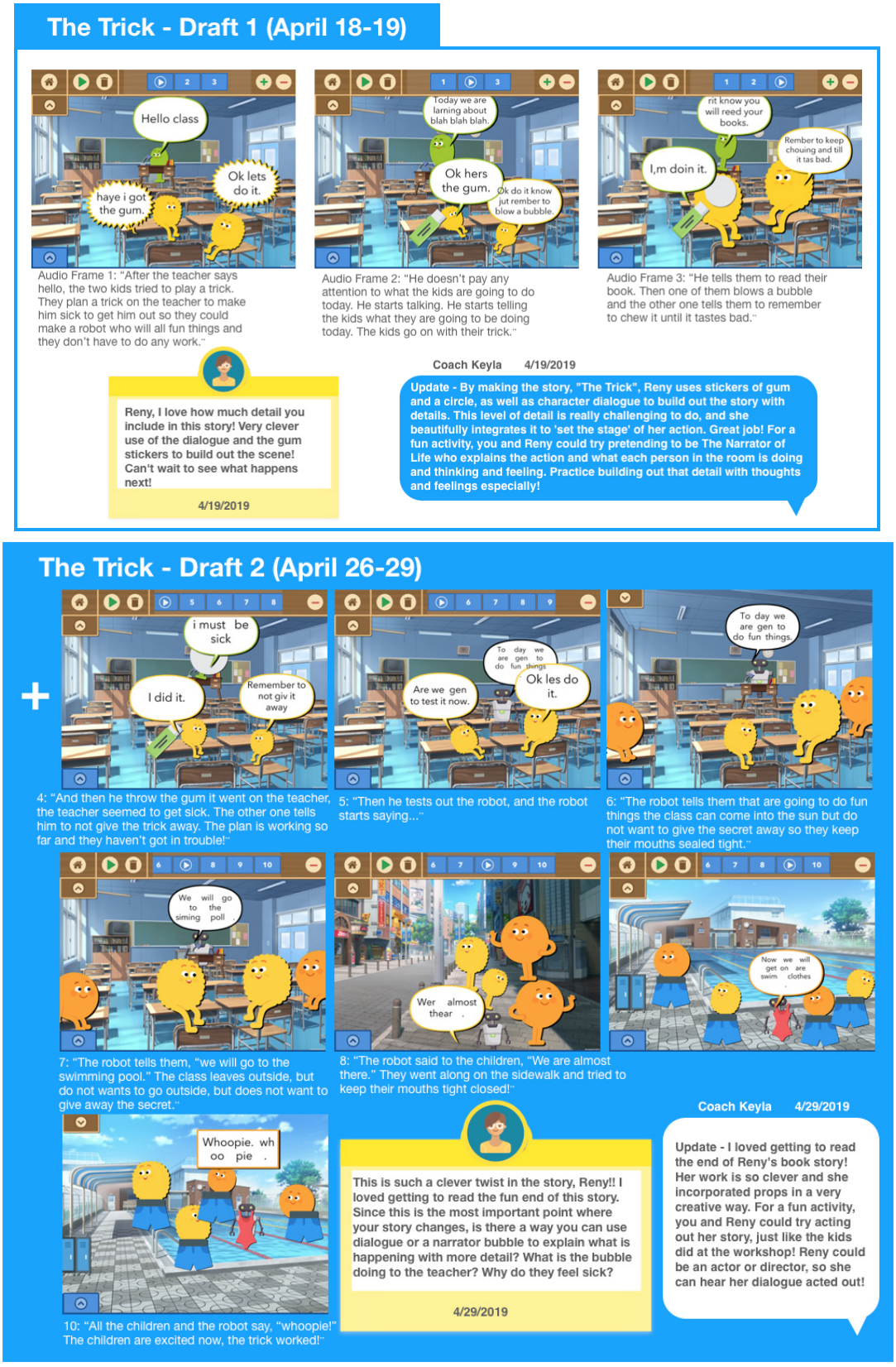
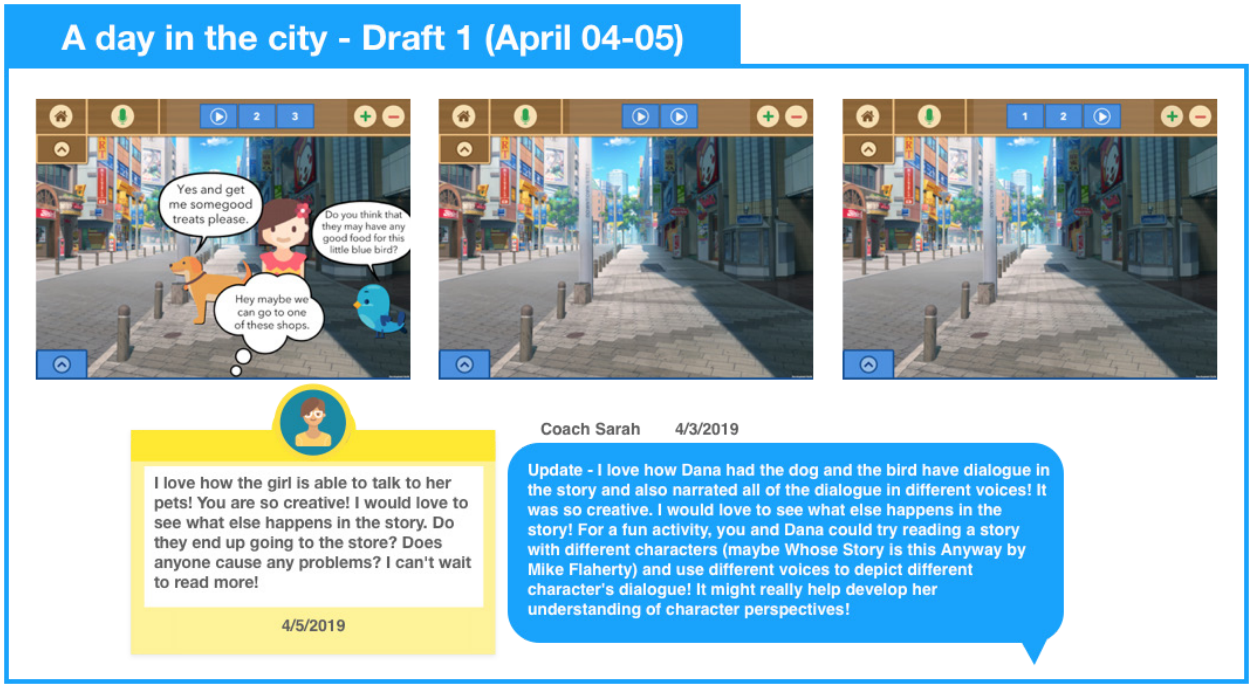
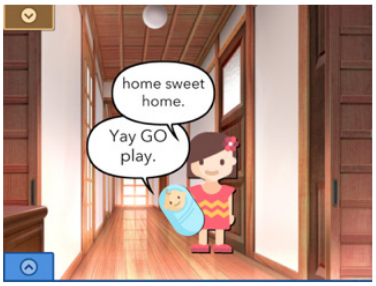


Figure 3.9 Three selected stories by Reny, age eight, mapped to Coach Keyla's Story Stickies and Caregiver Updates to demonstrate Progression of Story Completeness.

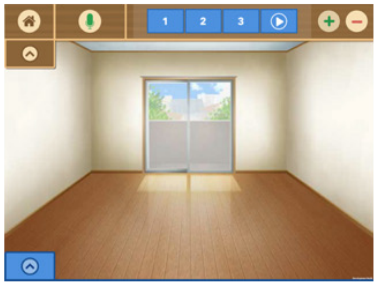
Similar to story completeness, several coaches also documented progression through story coherence in their updates. Progression in story coherence was identified as shifts between creating stories about a single event, a chain of unrelated events, a logically sequenced chain of events, and a focused chain of events centered around a plot or theme. Figure 3.10 presents five stories by seven-year-old Dana at the start, midpoint, and end of the pilot, and the relevant Story Stickies and updates from Coach Sarah. In the first draft of *A day in the city*, Dana created a single event with no chain of sequence, and Coach Sarah noted this in her caregiver update. Later, in *One day to go shopping*, Dana created her first short chain of events, which were somewhat sequentially related, but were not centered around a specific theme or problem. Again, Coach Sarah noted this trend in her update by acknowledging the realistic plot of grocery shopping, and encouraging Dana and her caregiver to include details to identify a problem. Mid-way through the pilot, Dana wrote her first long focused chain story in the second draft of *The cat and the wetch*. While this focused chain was longer, it was still slightly scattered and not centered around a central problem or action. In her second draft of *A day never ends*, Dana was prompted by Coach Sarah's Story Stickies to continue her story and insert her first problem. This focused chain story introduced a problem (i.e., the cat not being able to carry the bone) with a causal action in response (i.e., the dog coming to help). Coach Sarah documented the first insertion of a problem and solution in her caregiver update. Finally, Dana revisited her first story, *A day in the city*, and as her last story, made a third draft. While this story was still a focused chain of events not centered around a problem, Dana added dialogue and narration details to center the story around a girl's birthday and tell it over the course of two days. Coach Sarah documented the increased level of detail and completeness of the story, which added to the increase in coherence.



One day to go shopping (April 09-10)



Coach Sarah 4/10/2019



I love how this story is so realistic! I would love to see what else happens before or after they go shopping!

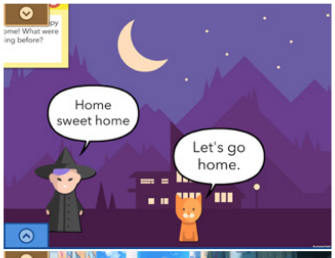
4/10/2019

Mom and her baby are both so tired! Did something happen during the day that made them so tired?

4/10/2019

Update - I noticed that Dana created a story about a mom and baby going shopping together at the grocery store! It seemed like a very realistic plot and I wonder if she could add some details into the story based on her experiences going grocery shopping! It might help her identify problems and solutions to develop her story further! For a fun activity, you and Dana could try writing some problems that you both have encountered down on pieces of paper and put them in a "story problems box." Each week, Dana can pick a problem out of the box that will occur in her next story! She will have to use her problem solving skills and creativity!

The cat and the wetch. (April 15-17)

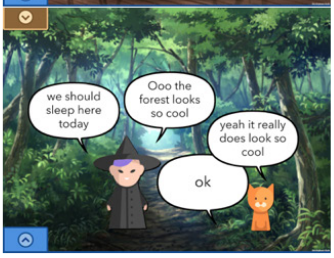


They seem really happy to be home! What were they doing before?

4/17/2019

Oh no, the girl seems scared of the witch! Does the witch ever talk to her?

4/17/2019



Wow, did the cat betray her friend the witch? How does that make the witch feel?

4/17/2019

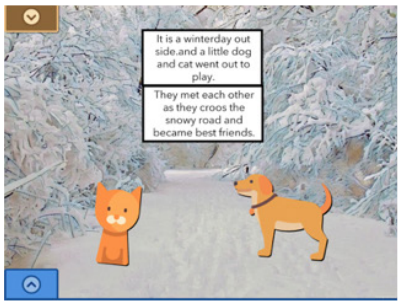
I love how you added so much more to this story. It was so much fun to read more!

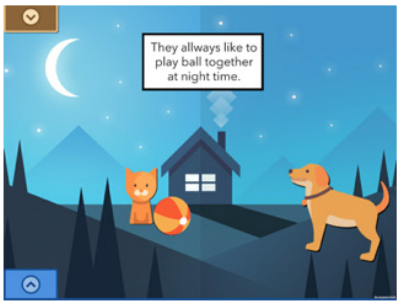
4/17/2019

Coach Sarah 4/17/2019

Update - I noticed Dana went back to her witch and cat story and made it longer! Her edits to elaborate on the plot really made me engaged in the story. Editing is a wonderful practice in storytelling!

A day never ends - Draft 1 (April 18-19)

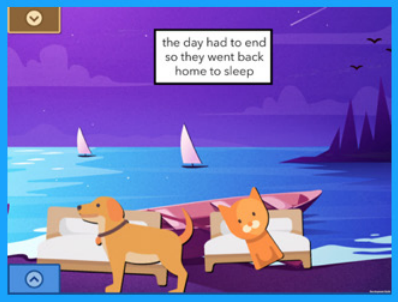




This seems like it's going to be a really fun story about a dog and a cat! Does something crazy or really fun happen on this night? Do they go on an adventure together? I'm excited to see!

4/19/2019

A day never ends - Draft 2 (April 19-22)



That's so cool that they went around the world! Which places did they see?

4/22/2019

Coach Sarah 4/22/2019

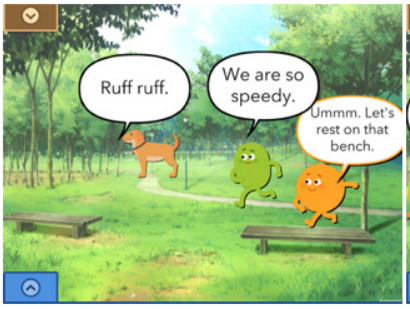
Update - Dana added more details to her cat and dog story and even added in a small problem and solution, as well as describing the cat and dog's adventures throughout the day. Her edits to elaborate on the story's plot made it much more complete and engaging!

Figure 3.10 Five selected stories by Dana, age seven, mapped to Coach Sarah's Story Stickies and Caregiver Updates to demonstrate Progression of Story Coherence.

Figure 3.11 demonstrates another example of progression of story coherence from three selected stories at the start, midpoint, and end of the pilot by a seven-year-old, Matthew. In *Untitled*, Matthew presented a chain of events and included two nested problems and solutions with the dogs all looking alike, and overcoming boredom with soccer. However, frames within this story, such as the pineapple and the wood, broke up the chain of events and were unrelated to the other plots of the story. Halfway through the pilot, in *Going for a walk*, Matthew again created a chain of event story, but it was more cohesive than the previous story and included more complex detail, such as the internal mental states of the characters. Finally, in *My birthday memories*, Matthew completed a story, in collaboration with his caregiver, with way more detail and a logical sequence of events that included transitions between the events (e.g., after winning

the game they get to go celebrate his birthday). Although this was done in collaboration with his caregiver, it is easy to distinguish the caregiver's voice from Matthew's voice in the story. Unfortunately, while progression of coherence is clearly demonstrated through Matthew's stories, the corresponding caregiver updates created by Coach Melanie only slightly reflected and documented this progression.

Going for a walk (April 24-26)



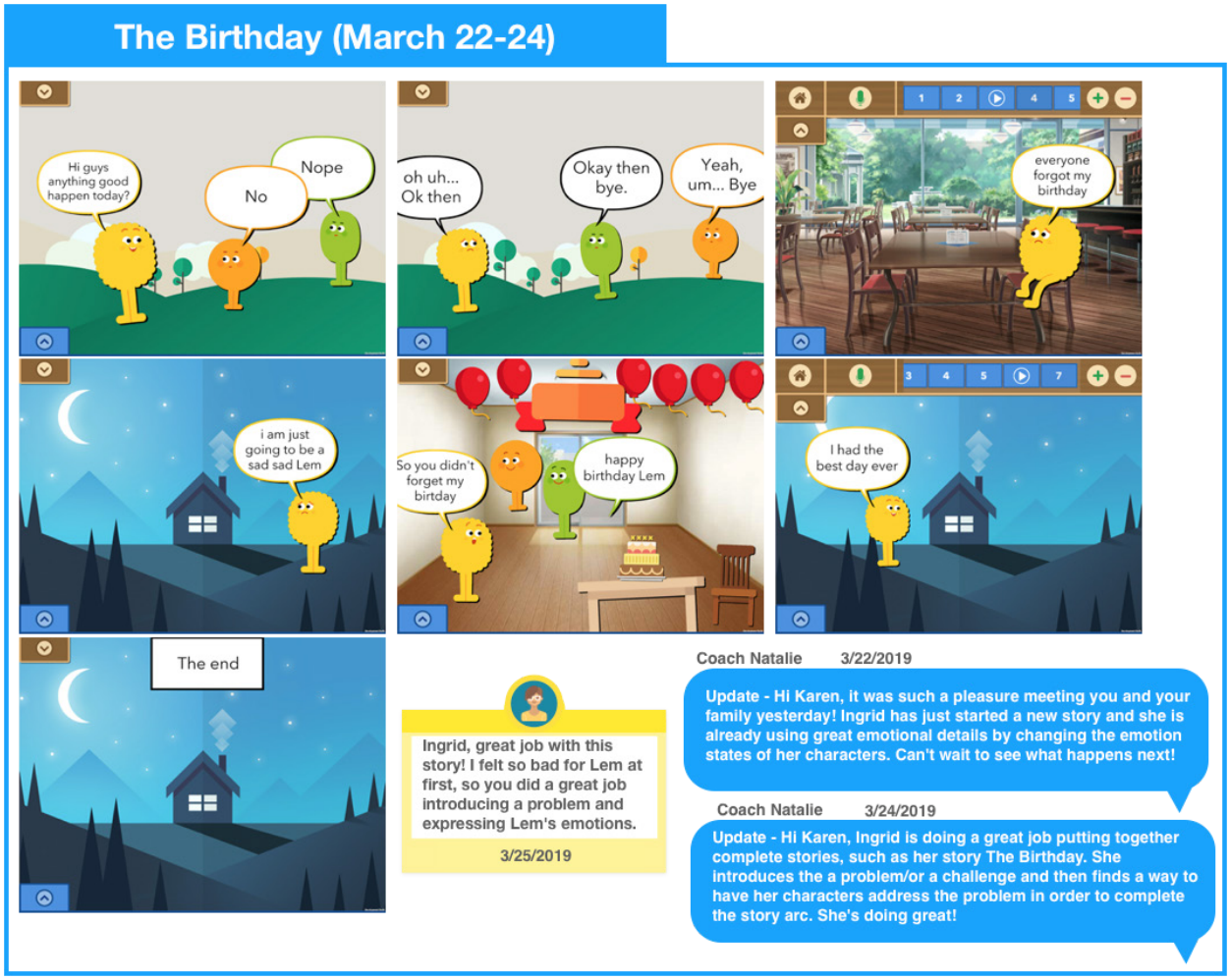
Coach Melanie 4/22/2019

Update - I noticed that Matthew used thought bubbles and dialogue bubbles in his story this week. These details really helped me to understand what the characters in his story were thinking and feeling!

Figure 3.11 Three selected stories by Matthew, age seven, demonstrating progression of story coherence, and mapped to Coach Melanie's Story Stickies and Caregiver Updates.

The third category that coaches documented was progression of expression, both in including more emotional expression of the characters, and in character development through representing character mental state. For example, figure 3.12 shows four selected stories by nine-year-old Ingrid from the start, midpoint, and end of the pilot, along with Coach Natalie's corresponding updates and Story Stickies. In her first story, *The Birthday*, Ingrid represented the emotions of the characters through facial expressions and the use of emotional language (e.g., "sad sad Lem"), which aligned with the plot of the story. Coach Natalie noted this in her caregiver update. In her first draft of *The left out Kiwi*, Ingrid again used character expressions

and emotional language to represent emotions, however the emotion changed without any action or solution to the problem. After receiving feedback from Coach Natalie, Ingrid edited her second draft to include a cliffhanger that indirectly answered why Kiwi's emotions changed dramatically from scene four to scene five. Towards the second half of the pilot, Ingrid created *Bad day pt 1*, in which she set up the context and provided insight into Boo's mental state to express his embarrassment and anger. Coach Natalie documented this shift by empathizing with the main character in her update (e.g. "We've all had those moments!"). Towards the end of the pilot, Ingrid continued the story in *Bad day pt 2*, where she included flashbacks (i.e., frames three and five) to replay the characters' memories, creating lots of emotional tension by having reactive characters that do not understand why each is feeling that way. This story is a powerful example of character development and emotional expression with complex undertones about human communication and understanding. Coach Natalie documented the progression of expression in Ingrid's story in her caregiver updates.



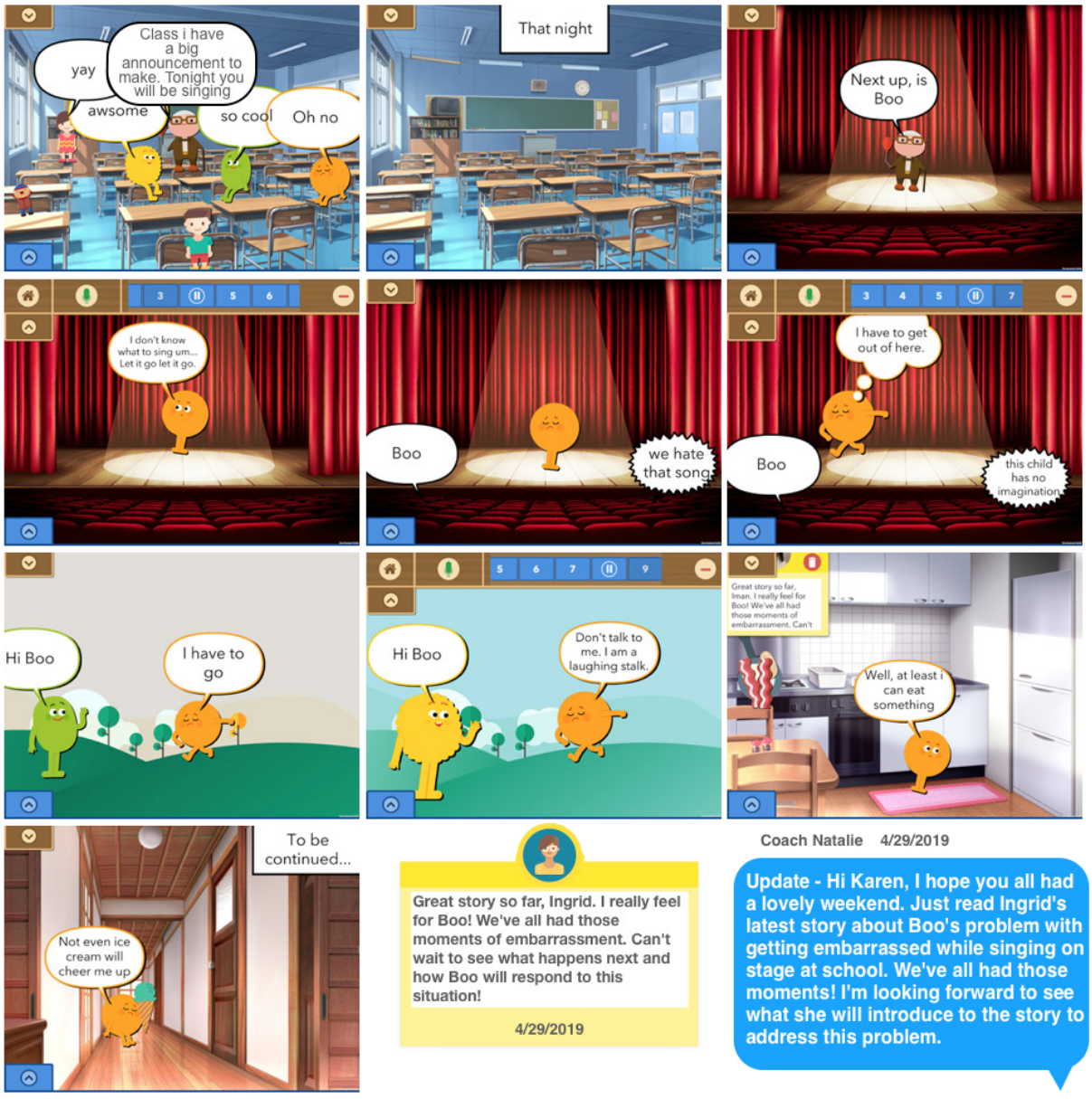
The left out Kiwi - Draft 1 (April 03-05)

The left out Kiwi - Draft 2 (April 15-17)

Coach Natalie **4/17/2019**

Update - Hi Karen! It looks like Ingrid has chosen a story for her book! It has one of my favorites scenes in it where Kiwi gets only a kiwi for dinner! What a creative problem, and perhaps we can get Ingrid to elaborate more on how Kiwi ends up feeling better in the end.

Bad day pt 1 (April 27-29)



Great story so far, Ingrid. I really feel for Boo! We've all had those moments of embarrassment. Can't wait to see what happens next and how Boo will respond to this situation!

4/29/2019

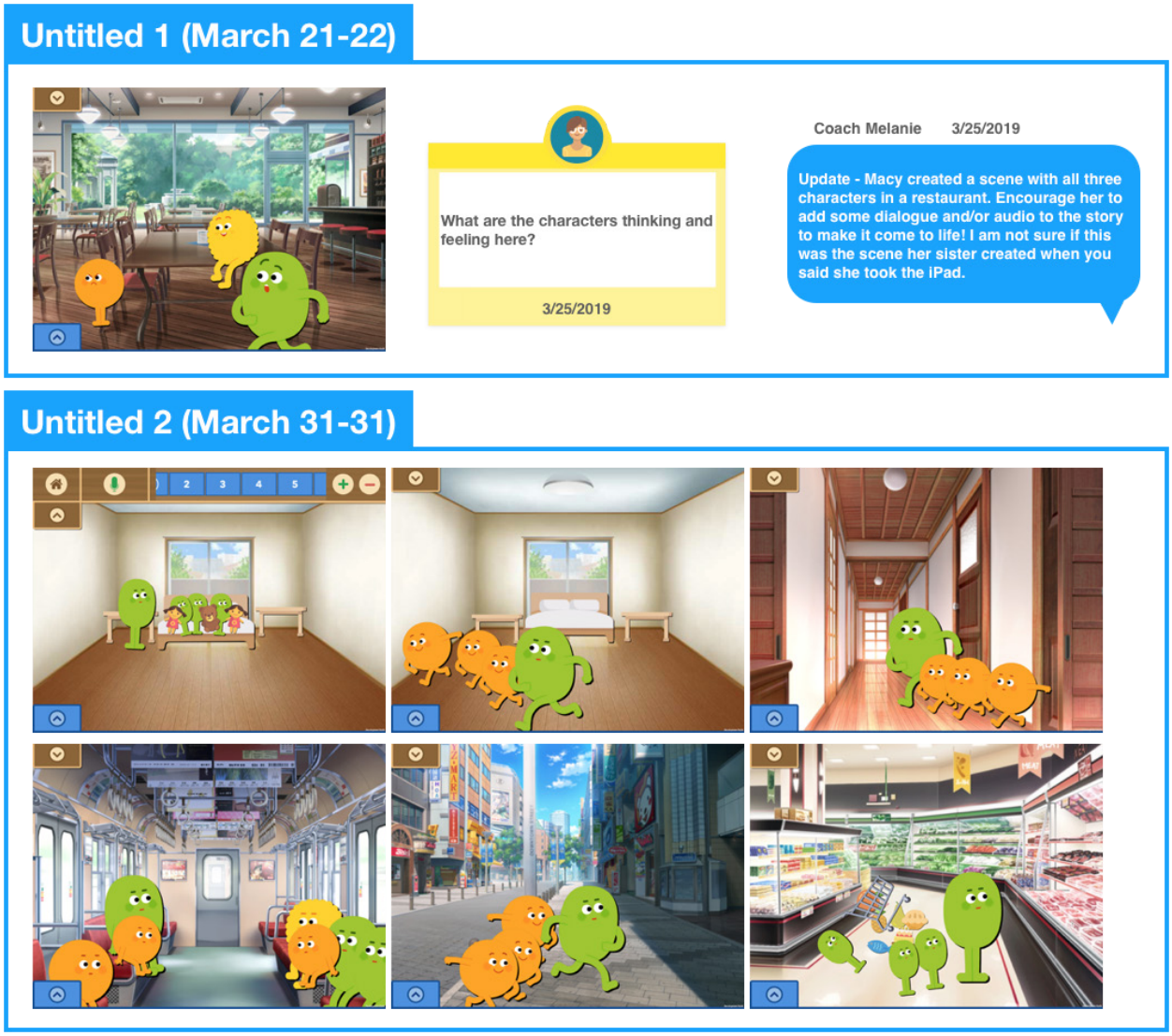
Coach Natalie 4/29/2019

Update - Hi Karen, I hope you all had a lovely weekend. Just read Ingrid's latest story about Boo's problem with getting embarrassed while singing on stage at school. We've all had those moments! I'm looking forward to see what she will introduce to the story to address this problem.

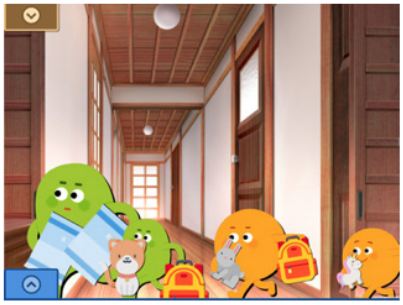
Figure 3.12 Selected stories by Ingrid, age nine, and Coach Natalie's Caregiver Updates, demonstrating progression of emotional expression and character development.

As children's stories increased in completeness, coherence, and expression, they became increasingly complex. Almost all coaches documented progression in children's story complexity. Story complexity was identified by incorporating high levels of detail (e.g., items, dialogue, narration), creating more complex and sophisticated plots (e.g., humor, plot twists, cliff hangers, side plots), using the composition of scenes to represent meaning or action, using more sophisticated language in dialogue bubbles or audio recordings, representing different perspectives within a story, and elaborating on events, characters, or context within a story to provide more meaning. These elements of story complexity can be seen in all the previous

examples. Figure 3.13, below, shows five selected stories created by Macy, a seven-year-old, and Coach Melanie's relevant caregiver updates. These stories and updates documented progression of story complexity, specifically in increased use of details such as dialogue bubbles and items, increased use of composition to represent scenes and actions, and expanded elaboration of story to communicate meaning.

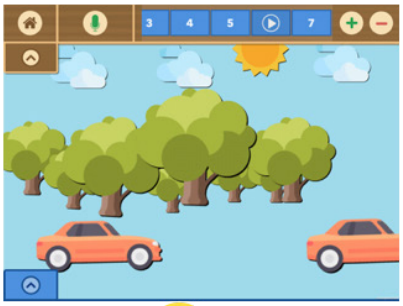


Moving Part 1 (April 03-05)

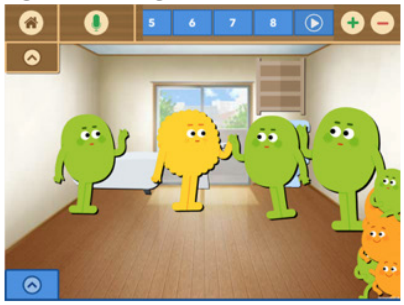


Audio: "Wake up!" "Alright, mom."

Audio: "I'm a cowboy!" "Ah, you scared me!" "Sorry!" "It's okay."



Audio: "Who gets to the car first wins!" "I'm gonna win!" "I'm gonna win!"



Audio: "Tomorrow the movers come. Tonight you'll have to sleep on the floor." "I never knew houses came with fridges, stoves and counters, cool!"

What is happening in this story? Why aren't the characters playing with the toys anymore? Where are they running?

4/5/2019

Coach Melanie **4/5/2019**

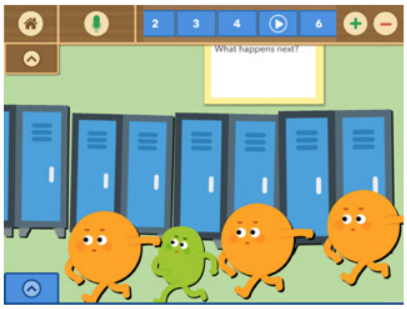
Update - Macy has been including lots of details in her stories lately! She is creating a very detailed story that she has been making in parts! I can tell that she is having lots of fun using the app!!

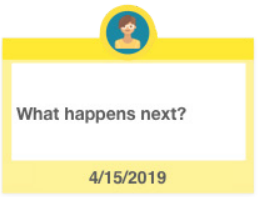
Macys story - Draft 1 (April 03-05)

Audio: “We’re gonna play dolls!” “Can I play?” “Uh, sure.” “Well, they’re not dolls, they’re animals I guess.”

Audio: “Hm, what should we name her?” “Eleto!” “mm, I don’t like that name.” “No! Her name has to be Eleto! And her middle name has to be Teresa! Ahh, I’m chasing you!” “No!”

Audio: “Let me introducing our newest student.”





Macys story - Draft 2 (April 17-19)

+

Coach Melanie 4/19/2019

Update - I noticed that Macy went back to her old story, and in response to a question I had about what would happen next, added more details and dialogue! Her edits to elaborate helped me understand her story and how it is progressing!

Figure 3.13 Selected stories by Macy, age seven, documenting narrative complexity, and mapped to Coach Melanie's Caregiver Updates.

The clear progression documented by the coaches in their caregiver updates suggests that our system does, in fact, have the ability to document children's narrative progression beyond the mechanics (e.g. language features, story grammar) that the Story Stats and Story Annotations provide. The four categories of progression (i.e., completeness, coherence, expression, complexity) emphasized by the coaches and later identified from their updates are important for

us to include when creating our definition of narrative progression. Now that we are confident in our system's ability to document children's narrative progression, we must consider the impact that grouping the data and presenting the Story Stats and Story Annotations have on coaches' ability to view children's progress and support their narrative development.

3.2.4 Presentation of Data in Console for Viewing Narrative Progression

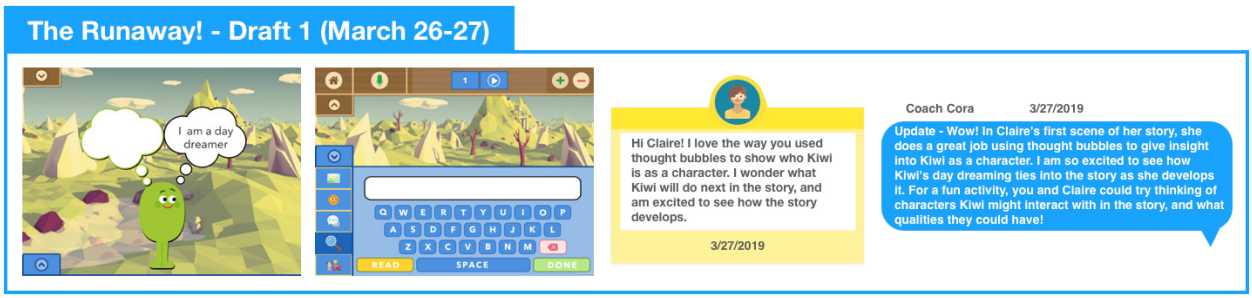
I analyzed coaches' self-report from the Coach Post-Survey as a proxy to assess whether the presentation of the data in the Console helped coaches view children's narrative progression. Many coaches spontaneously reported seeing narrative progress over the course of the pilot. For example, in response to being asked their most rewarding experience of being a coach, one coach said, "Seeing how excited the kids were about sharing their stories was really rewarding. Reading the stories was a highly entertaining experience, and there were many 'aha' moments were I could see the kids making progress." When asked to rate the extent to which they found the Console helpful in carrying out their responsibilities, all coaches surveyed found it helpful in analyzing children's stories (2 of 4 "strongly agreed"; 2 of 4 "somewhat agreed"), half the coaches surveyed found the Story Stats helpful in identifying trends in children's story data (1 of 4 "strongly agreed"; 1 of 4 "somewhat agreed"; 1 of 4 "neither agreed nor disagreed"; 1 of 4 "somewhat disagreed"), and half the coaches surveyed found the overview screen helpful for documenting children's narrative development over time (2 of 4 "strongly agreed"; 1 of 4 "neither agreed nor disagreed"; 1 of 4 "slightly disagreed"). When asked about the least used features of the Console, two coaches reported not using the overview of stories feature. In response to what features could be improved in the Console, one coach reported that she would like the tool to better document changes from children's story drafts. Therefore, while coaches reported seeing their children make progress during the pilot, their feedback on the Console indicated that the presentation of the data (specifically the Story Stats and the overview screen) was not highly effective in helping them view narrative progression.

Beyond coach self-report data, I looked at some examples of coach behavior to see whether they were able to view progression through the Console enough to communicate it to caregivers in their caregiver updates. As the updates and example stories above indicate, most of the coaches were able to view progression of children's stories from the Console among the four categories: completeness, coherence, expression, and complexity. This suggests that the presentation of the data, at least in story form, contributed to being able to see some progression within the Console. However, not all coaches documented progression in a way that aligned with the child's stories (e.g., Coach Melanie's updates about Matthew's stories in figure 3.11). For example, while Matthew's stories clearly demonstrated progression of story coherence, Coach Melanie's updates did not reflect or document specific progression on coherence. This suggests that the design of the Console to support coaches in identifying progression was not effective for all coaches or categories of progression. Therefore, we cannot assume that presenting the stories, alone, helped coaches view and document that progress in a systematic way. Our current Console presented the stories, but, as expressed in coach feedback about the Console, did not effectively present the supplemental data to focus coaches towards trends in progression. Instead, we need to redesign the Console to present the stories and supplemental data in a way that directs a coach's focus towards identifying these specific forms of progress in a systematic way both within an individual story and across multiple stories.

3.2.5 Presentation of data in Console for Supporting Narrative Development

Coaches supported children's narrative development directly by sending feedback to the child's stories through Story Stickies, and indirectly by encouraging caregivers to engage in their child's narrative process through text message communication, caregiver updates, and relevant family activities. A total of 292 Story Stickies were sent by five coaches to give feedback on the stories of 21 children (average of 14 Story Stickies/child). Coaches used Story Stickies to give feedback, give praise, ask questions, use strategies to encourage reflection (e.g., distance prompting), demonstrate active listening through relevant reactions, and encourage exploration or elaboration. Certain Story Annotations (e.g., story coherence, story completeness) were intended to inspire coach Story Stickies. In response to the helpfulness of the Console in interacting with the child via Story Stickies, 75% of coaches surveyed found it helpful (2 of 4 "strongly agreed"; 1 of 4 "somewhat agreed"; 1 of 4 "neither agreed nor disagreed"). In providing feedback on the Console, one coach stated that, "While Story Stickies were helpful, I wish students could reply or have a separate space to comment or add questions to us." Therefore, according to coach feedback and report, while the Console was helpful in supporting children's narrative development through Story Stickies, more opportunities for back-and-forth communication between coaches and children would improve the opportunities for and effectiveness of coach support.

To validate coaches' reports in the helpfulness of Story Stickies in supporting children's development, I annotated drafts of selected stories to find evidence of children's story edits in response to coach feedback via Story Stickies. My annotations yielded three different types of edits/responses to coach feedback, which correspond to three implications about the presentation of data in the Console for supporting narrative development. First, in response to coach Story Stickies, some children went back to earlier frames of their story and added more detail to set the context. For example, figure 3.14 shows three drafts of a story, *The Runaway!*, by eight-year-old Claire, and the corresponding Story Stickies and caregiver updates by Coach Cora. In the first draft, Claire wrote down some thoughts in Kiwi's head, and Coach Cora responded by wondering how the story will progress. In response, Claire's second draft included another character in the first scene and then two more scenes about them running away from birl. Coach Cora created a Story Sticky asking for more context about birl and why they are running from it. In response, Claire created draft three, which she not only added more scenes in the story so that it was more complete and coherent, she also went back to her previous scenes and added more context via text boxes to explain what birl is. Within the Console, Coach Cora's Story Annotations documented a change in story coherence from draft one to draft three, suggesting that her focus on increased coherence of the story through adding context could have been influenced by the Console's emphasis on coherence in the Story Annotations.



The Runaway! - Draft 2 (March 29-April 01)

What an adventure! This scene makes me wonder why Lem and Kiwi are running from the bird. Did something happen in the past? Maybe add in some audio to a scene that explains some of it. Great job!

4/1/2019

Coach Cora 4/1/2019

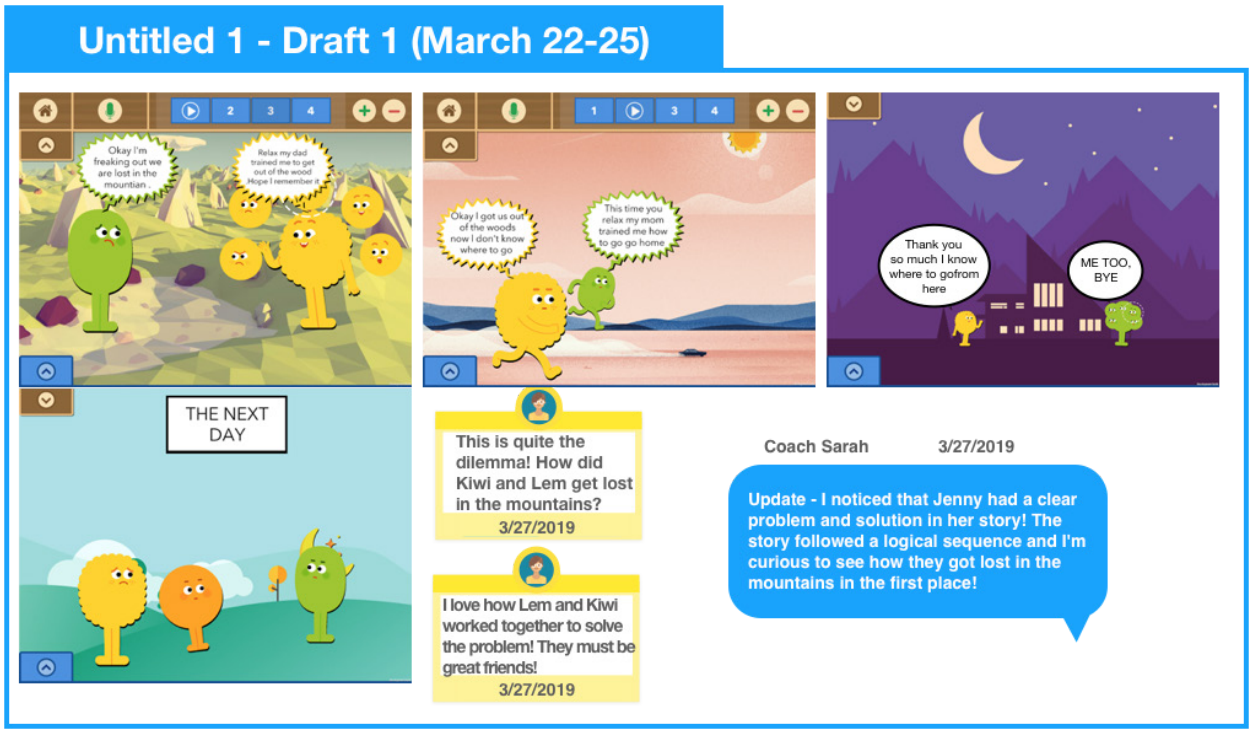
Update - Claire added some high energy action into her story about Lem and Kiwi this week! She is balancing both the internal thoughts of the characters and adding in action to make the story really interesting. For a fun activity, you and Claire could try brainstorming the next two or three actions that happen in the story as Lem and Kiwi are on the run.

Figure 3.14 Selected drafts of *The Runaway!* By Claire, eight years old, and corresponding Story Stickies and Caregiver Updates by Coach Cora.

Similar to editing by adding more context, the second type of response to coach Story Stickies was editing to elaborate on a story's ending. The first example of this can be seen in Rachel's story, *The sad tree* (figure 3.8), where in the first draft Rachel ended the story on frame five by having the character cry over the tree. In response to Coach Natalie's Story Sticky about whether there is anything Boo can do, Rachel created draft two, which changed frame five to a solution (i.e., planting seeds for a new tree), and ends on frame eight with a full resolution. Similarly in Ingrid's story, *The left out Kiwi* (figure 3.12), Ingrid changed the ending of her story in frame six in response to Coach Natalie's question about what made Kiwi's emotions change. Coach Natalie encouraged Ingrid and her family to consider elaborating on Kiwi's emotional

change both in the Story Sticky and in her caregiver update. In the Console's Story Annotations, Coach Nataie reflected changes in both of these children's story completeness from one draft to another, suggesting that the Console's emphasis on story completeness may have influenced the direction of Coach Natalie's support for both Rachel and Ingrid.

The third type of edit that children made in response to coach Story Stickies was direct response to a question or observation that a coach made. Two examples of this can be seen in the two stories written by Jenny, a ten-year-old girl, and the corresponding Story Stickies and caregiver updates by Coach Sarah (figure 3.15). In both of her stories, *Untitled 1* and *Untitled 2*, Jenny responded to Coach Sarah's questions by elaborating on the ending of her stories to add more detail. However, in frame 2 of *Untitled 1*, you can see that Jenny added the speech bubble, "They r." in response to Coach Sarah's observation that Kiwi and Lem must be good friends. Similarly, in draft 2 of *Untitled 2*, Jenny added a text box that said "yes" in response to Coach Sarah's question about whether the characters asked the lifeguard for help. In both of these stories, Jenny used speech bubbles and inserted them into her story to respond directly to her coach. This type of response aligns with coach feedback that having more opportunities for coaches and children to have back-and-forth interactions beyond the one-sided communication of Story Stickies could be beneficial in supporting children's narrative development. Therefore, these findings suggest that in practice, while the data presented in the Console may have helped coaches support children's narrative development for certain structural elements (e.g., completeness, coherence), it was less effective in supporting coach use of reflective strategies and back-and-forth communication between children and coaches for both the elaboration and interpretation of the meaning of children's stories.

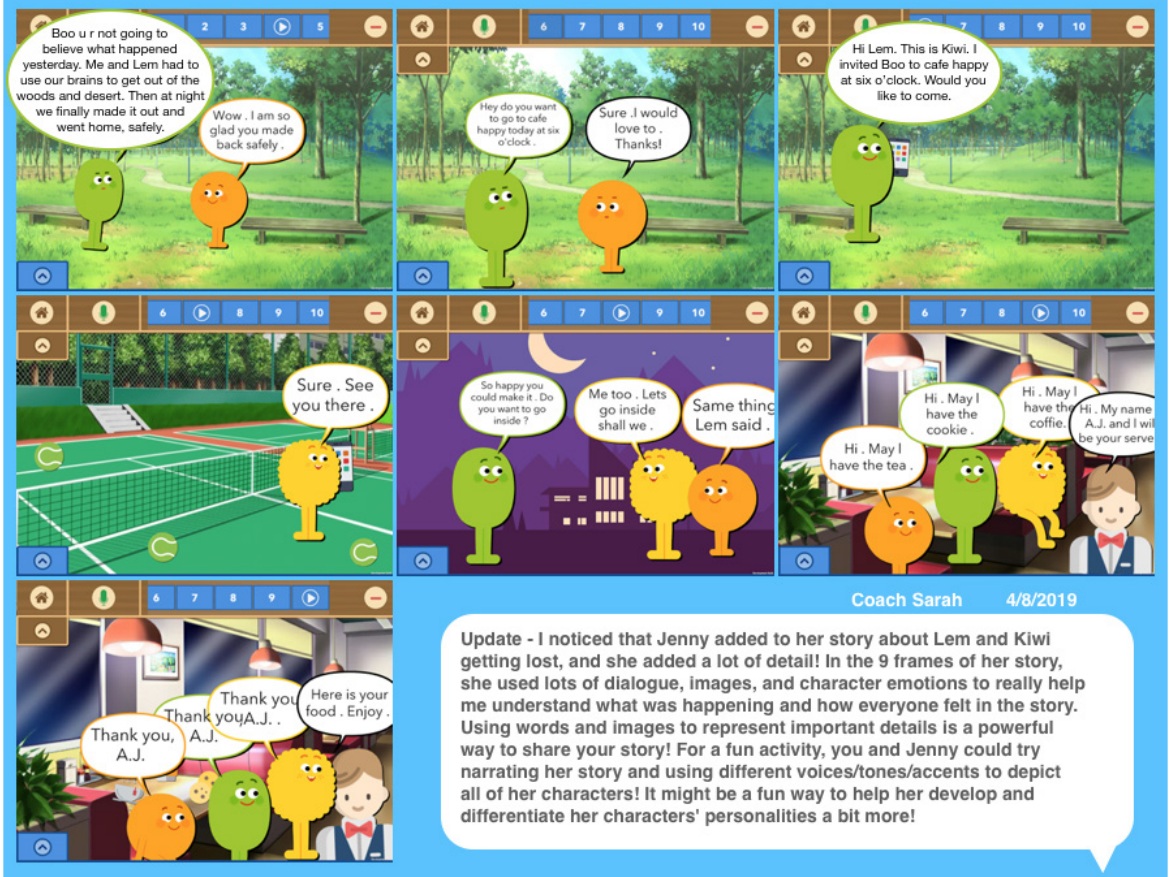


Untitled 1 - Draft 2 (March 29-April 01)

Coach Sarah **4/1/2019**

Update - Jenny builded onto her story about Kiwi and Lem's adventure in the woods! I liked how she incorporated another character at the end for Kiwi to share the story with from his perspective. It really brought his emotional reaction to the event to life!

Untitled 1 - Draft 3 (April 05-08)



Coach Sarah **4/8/2019**

Update - I noticed that Jenny added to her story about Lem and Kiwi getting lost, and she added a lot of detail! In the 9 frames of her story, she used lots of dialogue, images, and character emotions to really help me understand what was happening and how everyone felt in the story. Using words and images to represent important details is a powerful way to share your story! For a fun activity, you and Jenny could try narrating her story and using different voices/tones/accents to depict all of her characters! It might be a fun way to help her develop and differentiate her characters' personalities a bit more!

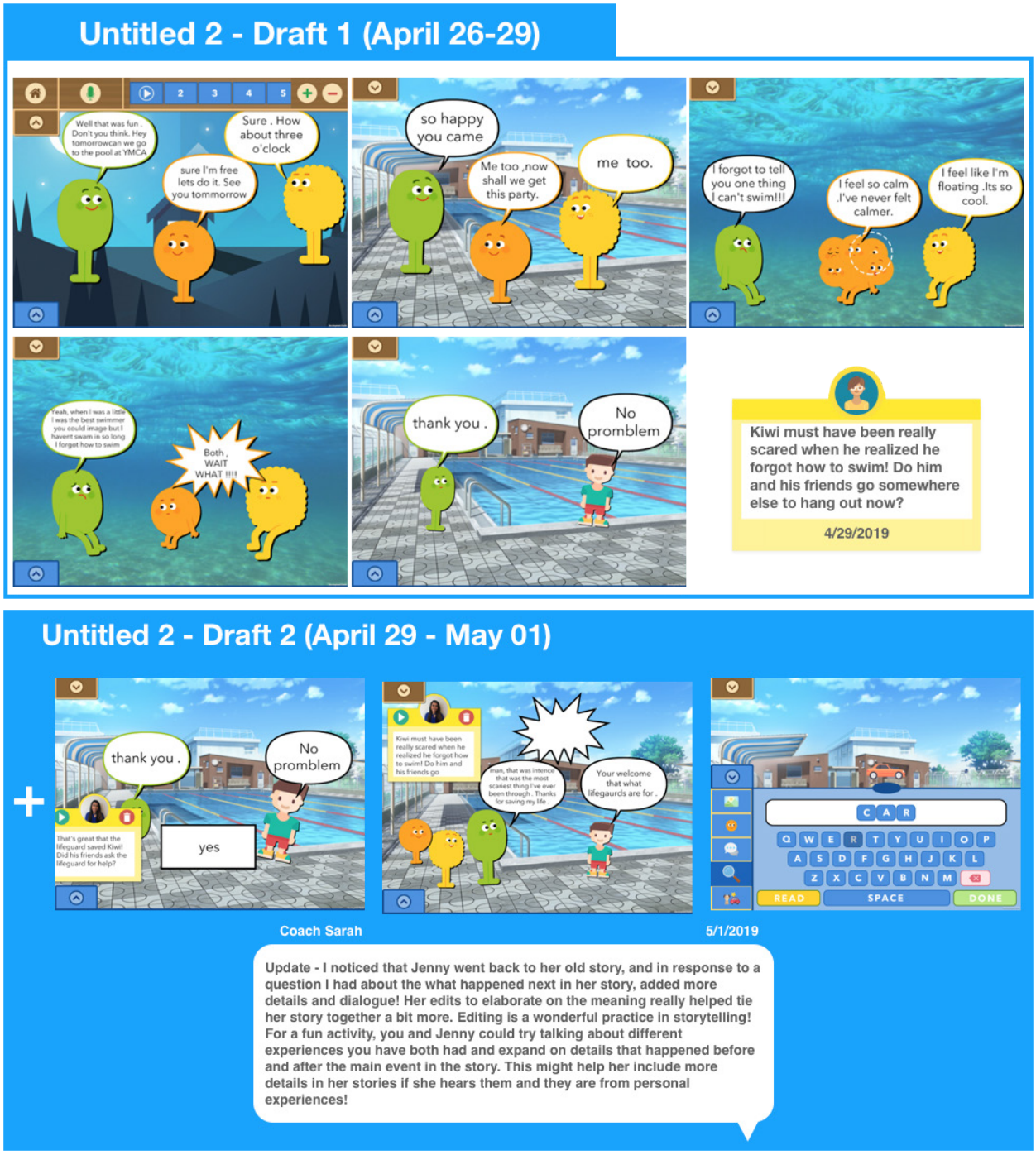


Figure 3.15 Selected drafts of *Untitled 1* and *Untitled 2*, by Jenny, age ten, and corresponding Story Stickies and Caregiver Updates by Coach Sarah.

To understand whether the Console helped coaches indirectly support children's narrative development through communication and interactions with caregivers, I examined the caregiver updates (including the caregiver messages), caregiver reports of their co-engagement, and caregiver perceptions of their child's progress and coach impact. During the eight week pilot, five coaches and fourteen families shared a total of 485 text messages, including caregiver

updates and family activities (average of 35 texts/family and 4.3 texts/family/week). Each coach's caregiver update reflected the progress that the child made in their story edit, and some (e.g., Coach Cora's caregiver update on 3/27/2019 and 4/1/2019 in figure 3.14) included an activity that the caregiver and child could do together to further reinforce and support what the child was learning. Some caregivers would respond to their coach's updates and activities, asking questions or acknowledging receipt. Figure 3.16 shows a text message exchange between a coach and a caregiver. The updates and exchanges between the coaches and caregivers demonstrates that the Console's design was effective in allowing coaches to communicate progress to caregivers and indirectly support children's narrative progress.

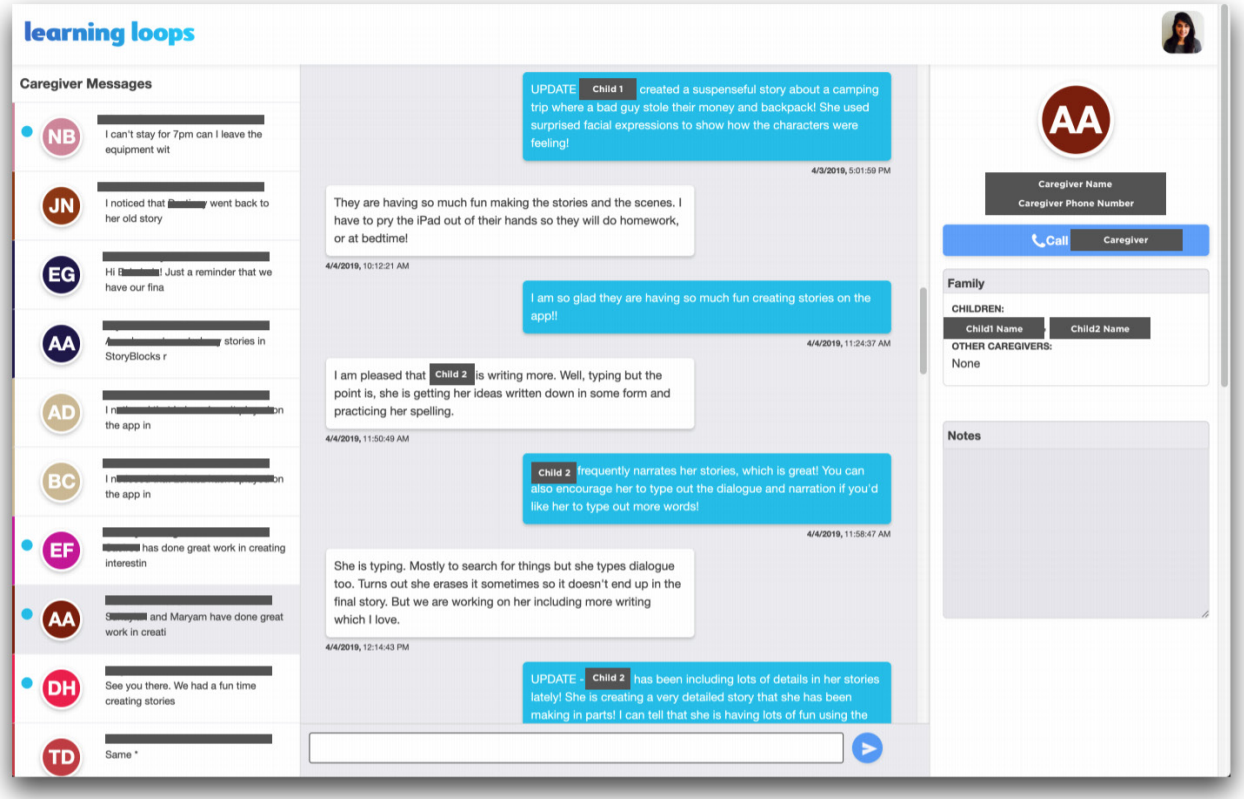


Figure 3.16 Example of a text message exchange between coach and caregiver within the Console.

Furthermore, we wanted to examine whether the coaches indirectly supported children's narrative development through encouraging caregivers to co-engage in their children's narrative process. In the Family Mid-Program and End-of-Program Surveys, all caregivers surveyed (12 of 12 on Mid-Program and 11 of 11 on End-of-Program) reported reading the updates (10 of 11 reported "always"; 1 of 11 reported "most of the time" on End-of-Program) and 75% of caregivers who completed the Mid-Program Survey (9 of 12) and 73% of the caregivers who completed the End-of-Program Survey (8 of 11) reported completing the coach suggested activities. The data communicated by the coaches in the caregiver updates not only encouraged some caregivers to support their children's narrative process, but also increased caregiver's perception of their own children's narrative development.

The two questions from the Family End-of-Program Survey about children's learning through playing with StoryBlocks and caregiver's learning about their child's narrative

development through the coaching updates served as proxies for assessing caregivers' perceptions of their children's narrative progress during the pilot. All caregivers surveyed reported feeling confident that their children were learning something while playing with StoryBlocks (8 of 11 "strongly agreed"; 3 of 11 "somewhat agreed"; average response was 4.8125 on a five-point Likert scale). All caregivers surveyed reported learning about their child's narrative development from the coaching updates (6 of 11 "strongly agreed"; 5 of 11 "somewhat agreed"; average response was 4.526 on a five-point Likert scale). During the open responses, some caregivers reported seeing progress on their children's storytelling skills during the pilot program. For example one caregiver wrote, "It was great for creativity and building concrete storytelling skills." Similarly, another caregiver stated, "The kids really enjoyed it, they worked on writing skills and spelling." Other caregivers expressed seeing progress in their children's motivation, such as, "I found it really made a huge difference for [my child]. He was not interested in learning to read before and Learning Loops totally changed that and gave him an outlet to express himself and be creative. I loved that his characters always had the expressions on their faces to reflect his stories. He put so much time and effort into his stories and he learned to stay within the story theme he was writing about." Through the survey responses and feedback from the caregivers, we can see that caregivers perceived that their children demonstrated narrative progress during the pilot program, and it was supported by their coaches.

These data suggest that the Console helped coaches both directly support children's narrative development through Story Stickies, and indirectly support children's narrative development through communicating progress with caregivers and encouraging caregiver involvement. However, these data also identify areas for improvement, such as presenting the data in a way to encourage coach interpretation and support of less structural elements of narrative (e.g., interpretive and reflective elements) and designing more opportunities for back-and-forth communication between children and coaches.

3.3 Summary of Findings and Implications

3.3.1 Summary of Findings

The findings from our pilot suggest that most children were highly engaged with StoryBlocks. I used our corpus of children's personally-generated digital stories to understand the types of narratives children created and look for trends among the children in our pilot by age and gender. I found trends in story themes among gender that resembled the findings from another research study of preschool children's spontaneous oral stories where girls told more stories about family and harmony and boys told more stories about conflict and power [89]. To my knowledge, these StoryBlocks stories are one of the first corpora of young children's personally-generated digital stories to exist. As our corpus of stories continues to grow, we plan to investigate this space further by analyzing the trends in children's story data and comparing them to the trends in other story forms (e.g., oral, written, dramatized).

I addressed the remaining research questions by examining three different parts of our system: (1) the process of data collection and documentation of potential progress, (2) the synthesis and presentation of data to help demonstrate progress, and (3) the capability to use data to support narrative development and communicate progress. Our findings suggest that our system does have the ability to document some elements of narrative progress, but a concrete definition of narrative progress is needed to systematically document the more complex or abstract elements of narrative development. Coach feedback and behavior indicated that while

the presentation of the data in the Console helped some coaches see narrative progress, key features such as the Story Stats and overview screen were less effective, and the data did not always help orient coaches towards identifying progress. Finally, the Console seemed to be effective in helping coaches both directly and indirectly support children's narrative development overall, though some modifications were suggested, such as increasing opportunities for back-and-forth communication between coaches and children.

3.3.2 Implications

Inspired by our findings, I will take two steps in order to better understand what data to combine and how to design the Console to document and present narrative progression, as well as help coaches support narrative development. First, I will create a theoretical framework for children's narrative development, and use this to inform both our definition of narrative (and through this, our definition of narrative progression) and the redesign of our analytics system. As our findings demonstrated, our system has the ability to document progress on many fine-grained details of each story, yet each of these details, alone, does not define story progression. Instead, they are all part of a more complex picture. By developing a theoretical framework for children's narrative development, I will be able to reorganize and analyze our data to better understand how we can best document children's narrative progression. Second, I will redesign the Console and present the fine-grained data to better direct the coach's attention to details related to our new definition of progression, including the four categories of progression that coaches documented in the updates (completeness, coherence, expression, and complexity). Guided by these four categories and our theoretical framework, I will redesign the presentation of the data (e.g., Story Stats) to be explicitly connected to the story itself, and inform the Story Annotations. In this way, the data will be connected to the greater meaning of how it represents certain trends in progression, helping coaches recognize progress, and impacting how coaches use that data to support children's narratives both directly and indirectly. This reorganization of the presentation of data will be made both for each individual story, as well as across stories, so coaches can better identify trends in children's stories overall.

In the next section of this dissertation, I will develop a theoretical framework for children's narrative development, and apply this framework to our Learning Loops system in order to inform our findings and iterate on our analytics system.

4.0 Building a Theoretical Framework for Children's Narrative Development

4.1 Introduction to Developing a Theoretical Framework

For the last seven years I have been delving into the literature on children's narrative development, wading through the depths of articles, books, blogs, and essays. And during this time, I have felt lost in the sea of literature, constantly searching for something that might not exist; searching for a theoretical framework or practical approach to studying children's narratives that encompasses the complex, multicomponent nature of children's stories. I've tread through the major waves of the 1970s, 1980s, 1990s, and early 2000s. I have floated through the currents of linguistics, psychology, education, literature, sociology, and still, nothing. Glimmers of hope from terms like "narrative intelligence" and "interpretive approach" serve as my life raft, keeping me afloat and motivating me through the churning waters of research. Yet they don't provide full answers, and so still I question, have I overlooked something? So, after seven years of searching, I have decided to take the pieces of the research that I can use, put them together, and create my own answers.

In the majority of the research I have found over the past seven years, there seems to be a disconnect between the theories on how and why we develop narratives, the rigid and disparate definitions of narrative, and the approaches for understanding and analyzing narrative. For the existing theoretical approaches to understanding and analyzing narratives, specifically, there are several limitations that have taught me which aspects I believe are important to creating a comprehensive theoretical framework. As a scientist, I recognize that many of the existing approaches ignore crucial data by focusing on only one aspect of the narrative (e.g., protagonist goal attainment). There is a lack of cohesion among the disciplines that study narratives [13; 23]. Rather than collaborating or combining approaches, most researchers only analyze the structure or mechanics of children's narratives, while others only focus on the content [7].

As a developmental psychologist, I recognize that many of the existing approaches, by ignoring the multitude of skills the child demonstrates through their story, become blind to the motivation for, and meaning behind the story. Unfortunately, many researchers use methodologies that demotivate the child, asking them to retell an uninspiring story or using lackluster prompts to elicit narratives from the children [2; 1]. In order to truly understand children's narrative development, researchers must create interesting ways to captivate and motivate their participants to share stories that are aligned with their narrative skills. And as a human, a story-being, I recognize that almost all of the existing approaches ignore the purpose for storytelling; the synthesizing quality, the meaning-making, the ability to both understand and communicate who we are and what we believe.

Through experiencing frustration at these limitations, I have learned what I have been searching for in an approach to studying children's narratives. In order to reconnect the definitions, theories, and approaches to how we understand and study narrative, we must strive to develop a holistic approach, one that integrates the multiple aspects of narratives, allows children to tell the stories that are meaningful to them, and connects to the purposes of why we create and share stories.

Therefore, in this section of the dissertation I will build upon the rich theories of narrative development and synthesize them into an attempted holistic theoretical framework for children's

narrative development in order to inform the design of the Learning Loops program. In the paragraphs below I will conduct a literature review on the definitions of narrative, the functions of narrative, and the existing theories, trends, and approaches for understanding children's narrative development. I will then build upon the literature by presenting our theoretical framework, the Two-Lens Approach, and apply it to children's stories as an example for how this framework can be used in practice.

4.2 Literature Review on Narrative Definitions and Narrative Theories

4.2.1 Definitions of Narrative

There is no one, comprehensive definition of narrative, as it is a rich and complex set of concepts, which are defined differently by the various disciplines that study it. According to the field of narrative intelligence, one unifying theme among these disciplines is that narrative is a fundamental organizing principle of the human experience [13]. A more common definition of narrative is the telling, writing, or re-enactment of self-generated stories, known tales, books, or the recounting of personal experiences [34]. Early studies of narrative, such as Labov and Waletzky (1997), defined narrative as the use of specific linguistic techniques in order to recount past events [1]. This more narrow definition allowed researchers to make the complex field of narrative more analyzable by looking at the linguistic mechanics of people's personal stories. In contrast, McCabe and Peterson (1991) consider the multiple functions of narrative by referring to it as a "linguistic crossroads of culture, cognition, and emotion" for the purposes of sense-making and self-representation [90; 91]. In this way, when defining narrative, some researchers stress the importance of taking a broad definition in order to serve multiple cultures and a wide age range [91; 23; 81]. Definitions of narrative and features of narrative have a cyclic relationship; it is important to understand what narratives contain in order to create a definition, yet by defining a narrative one concretizes what one considers narrative features.

4.2.2 Narrative Features

Narratives contain an account of experiences or events (real or imagined) that are sequenced over a period of time to convey meaning [7; 82]. In order to study narrative, researchers focus on different features of narratives, some are more rigid, such as Stein and Glenn's (1979) story grammar, which states that the predictable structure of narratives can be split into two main categories: a setting and an episode. Within these categories, narratives must contain character, initiating event, internal response, plan, action, consequence, and reaction [92]. Building on story grammar, Stein and Albro (1997) go a step further in their definition, explaining that a "good" story contains a goal-directed action of a protagonist. In order to accomplish this, the story must contain four dimensions: 1) a protagonist with intentional actions, 2) explicitly stated goals or desires by the protagonist, 3) actions that service the protagonist's goals, and 4) outcomes that are related to goal attainment [93]. In later work, the necessity of temporal cause and effect in creating a "good" story is emphasized [94].

Separating from the structure of a story, Bamberg (1997) took a linguistic approach, focusing particularly on the role of language and its use to distinguish between what he believes to be two important dimensions of children's narratives: viewpoint and agency [91]. Similarly, Labov (1997) took a sociolinguistic approach, stating that oral personal narratives had a beginning, middle, and end. Within those narrative speech acts there were six main features, not all having to occur in one story: abstract (summary of events to spark interest), orientation

(setting of the story), complicating action (events of the story over time), evaluation (implicit or explicit reference to the point of why the story is being told), resolution (the conclusion), and coda (the relevance of the story to every-day life) [95]. In this approach, the importance of temporal sequencing in stories, where time is represented linguistically, is emphasized as a crucial feature of narrative analysis [40]. Labov's more nuanced approach was the first time that unedited, oral personal narratives of everyday people were studied, which changed how researchers studied narrative by shifting the focus towards narrative features that were present in people's unfiltered stories [95; 2]. The act of telling a narrative requires complex meta-cognitive and linguistic abilities by using language to convey meaning through context setting [34]. For children's stories, specifically, Engel (1995) states that, "the most important thing about a story is that by relating people, actions, objects, place, and time, the storyteller conveys a meaning… In children's stories particularly, where sequence and plot are not always clearly developed, the key to understanding, appreciating, and responding to the story often lies in understanding the meaning, the perspective of the narrator." (p 18) [7]. Therefore, in considering the features of narratives, it is important to take the child's perspective and not judge a story solely on its representation of structural and linguistic features.

Other researchers are more theoretical in their understanding of narrative features. Jerome Bruner (1986) proposed that narrative is one of two modes of thought for constructing reality [96]. In his essay, Bruner (2003) described ten features of narratives as instruments for constructing reality: 1) narrative diachronicity, 2) particularity, 3) intentional state entailment, 4) hermeneutic composability, 5) canonicality and breach, 6) referentiality, 7) genericness, 8) normativeness, 9) context sensitivity and negotiability, and 10) narrative accrual [97]. Stories have narrative diachronicity in that they contain events that happen over time. However, unlike Labov's (1997) linguistic representation of temporal sequencing, Bruner (2003) stated that time is related not chronologically or by moment-to-moment significance, but rather, time is relative to the meaning through which the author perceives it, and the sequence of time may be represented in non-linguistic ways (e.g., flashbacks, premonitions, dreams) [97; 98]. According to Bruner (2003), our mental models underlie the unique patterns of representing events over time through narrative, and this is one element that makes narrative so special and unique over other forms of discourse [97].

The particulars of a narrative are the details embedded in the story that act as the vehicle through which a generic or predictable plot is carried out. While the particular could be any number of things, it does not change the overall predictiveness of the plot [97]. Intentional state entailment suggests that all characters are personified because they have intentional states (e.g., beliefs, theories, values, morals, desires, emotions), and the events that befall a character must be relevant to the character's intentional states. These states indicate the character's feelings, not their actions, because the characters have agency (e.g., freedom of choice). Therefore, rather than explicit causal linkages in narratives, most reasons for character actions must be interpreted by the reader [97].

At the core of Bruner's (2003) theory was the hermeneutic composability feature. While completely inaccessible without a dictionary, the idea is really quite simple. Basically, since there is neither a rational method for uncovering, nor an empirical method for verifying truth in narratives (narratives deal in "verisimilitude" — the appearance of truth), the only way to understand a narrative is to interpret the meaning of the text [97]. This reliance on interpretation, Bruner (2003) argued, justifies the need for a human to be involved in the narrative analysis

process. Two important elements central to interpretation, for which humans are more equipped than machines, are: 1) understanding intention, and 2) understanding and linking to background or contextual knowledge [97]. These two elements of interpretation make up another feature of narrative, which Bruner (2003) called context sensitivity and negotiability [97]. The hermeneutic composability feature of narrative is perhaps one of the biggest contributing factors to what makes narratives so difficult to study in a comprehensive, systematic way. This is because meaning can only be interpreted by the reader, and there are many contextual factors that the reader may not have access to that impact the writer's intention and contribute to the meaning. This feature also contributes to the challenges of using machine learning and other automated narrative analysis methodologies. In many ways, this feature relates to Mateas and Senger's (2003) description of the paradoxical nature of narrative research, as it is too complex and ambiguous to be a field of study with measurable features [13].

A more familiar feature of narrative is canonicality and breach. Narratives have breaches of canonical scripts; there is an element of disruption of the predictable path where something happens that is out of the ordinary, unpredictable, and creates uncertainty [97]. This feature is more commonly referred to as the problem in the story, the high point, or the precipitating event. While the breach itself does not have to be unique, some of the best writers are able to present this feature in an inventive way that helps the reader see a new side or perspective in the ordinary [97]. In order for the breach to occur, there has to be some established norm, or normativeness that the narrative follows, which is another feature of narrative [97]. The feature of referentiality refers to the concept that narratives, even fiction with entirely new worlds, must have some grounding or reference to a shared reality in order to be interpreted and understood by the reader [97]. The feature of genericness refers to the genre of the story, which has an impact on both the writer and the reader. Specifying a genre can help categorize stories with common language, styles, themes, and goals. For the writer, this can be helpful in formulating the story, and for the reader, it can be helpful in understanding how to interpret the story [97].

Finally, the tenth feature of narratives is narrative accrual. Narratives accumulate into a whole, in which histories, traditions, and even cultures are born. We use narrative accrual to create our autobiographies and develop our notion of self. We also use narrative accrual to tell the history of our family, to build our story as a company or business, and to develop traditions as a culture [97]. In short, it is important to look at an individual narrative, but it is also important to look at the accumulation of narratives (or across multiple narratives) to understand how we develop and communicate constructs of ourselves, our beliefs, and our cultures. These features are important to keep in mind because, while they are not all easily testable or measurable, they relate to the function of why we tell narratives, and we must develop analyses that encompass these important features and functions within and across children's narratives.

4.2.3 Functions of Narratives

Research highlights two functions of narratives: the mathetic (cognitive) function, telling stories to make meaning and understand the world; and the communicative (social) function, telling stories to communicate with others [7]. The mathetic function for storytelling aligns with the constructivist philosophy of learning, where children build stories to re-invent their world [7]. By telling stories, children both experience the feelings and thought processes of others, and distance themselves from their own experiences in order to better process and understand them [91; 5; 81]. The telling and repeating of stories both shapes children's communicative skills and

forms a picture of themselves to others, while internalizing and gaining a sense of mastery and identity with each story [7; 24; 83].

In turn, the act of listening to and digesting a narrative also serves similar mathetic and communicative functions through what Marshall Ganz (2009) calls a "teaching of our hearts" [99]. When we hear a story, we empathize with characters and internalize (and sometimes embody) their emotions. Through this emotional experience, we come to understand the material, not just as a cognitive concept, but as a lesson of the heart [99]. This aligns with the research, where the benefits of children's active involvement in narrative activities on emotional expression and emotional regulation are well documented [100; 36; 6; 42]. It is in this emotional function, Ganz (2009) argues, that the power of narrative lies [101]. Through these emotional lessons we learn not only about our world, ourselves, and how to communicate, but also in making sense of the world we learn a greater skill, we learn how to deal with uncertainty. Exposure to narratives serves an important function in helping us deal with uncertainty [101]. Bruner (2003) argued that the breach or disruption of the predictable path into uncertainty is what makes stories so appealing [97], so it stands to reason that through this disruption and the reactions and outcomes of the characters, we learn, both cognitively and emotionally, how to cope in the face of uncertainty. Through the choices, actions, emotions, and experiences of characters in narratives we learn to both become choiceful human beings, and to communicate our choices, shaping who we are [99; 97; 7].

While some definitions account for the functions of narratives, many do not include the social, cognitive, and emotional functions that narratives serve. Similarly, approaches for understanding and studying children's narratives often neglect the mathetic and communicative functions for why we create narratives. Instead, most approaches focus on the linguistic or structural mechanics within children's narratives, as these are easier to identify and measure [13]. Unfortunately, these easily measurable components of narratives don't tell the whole story. Moreover, structuralist approaches often fail to accurately capture the child's progress and misrepresent digression when children explore new narrative strategies in their stories, come from a culture that values different aspects of narratives than the European-American culture, or use advanced narrative strategies where their goals are implicit and require human interpretation to identify [102; 91; 23]. Therefore, I plan to create a broad definition of narrative, one that encompasses the functions of children's narratives, in order to develop a more holistic theoretical framework.

4.3 Literature Review of Developmental Trends and Existing Theoretical Approaches to Studying Children's Narratives

4.3.1 Trends in Children's Narrative Development

Researchers, linguists, and psychologists have highlighted multiple trends in narrative development. According to some linguists, the development of narratives starts around two years old with *proto-narratives*. These multiply and transform between the ages of two and three and a half years and are usually made up of past experiences that contain evaluative information without a particular sequence [34]. As children reach four and five, their narratives transition from almost no storyline, plot, or cause and effect, into narratives that reflect the development of a more sophisticated knowledge of event sequences, linguistic and cognitive skills, and mental states (i.e., emotions, dispositions, thoughts, intentions) [34]. The development of these early

narratives are part of later language development because they form much of the content of conversations in older childhood and adulthood [34; 12].

Other developmental psychologists highlight the social influence on children's narrative development. Children start by telling germs of stories, and storytelling begins largely as conversations with parents or other adults [12; 102; 98]. To study the influence of the child's social interactions on their earliest stories, researchers measure the subtle yet systematic changes in adults' conversational behaviors with young children as a function of the child's age [102]. The interactions and focus of caregivers during early tellings of stories through conversational narratives shape many aspects of children's later narrative skills, particularly along the dimensions of plot, orientation, causality, and reported speech [103]. By around three years of age, children's stories tend to be more about novel experiences, told with a clear beginning, middle, and end. Children can describe events in story form, usually for and with their peers. They also start to include more details about others [7]. Between the ages of four to seven years old, storytelling is an important form of social, symbolic play [7]. By five years of age, children develop more distinctive story styles, they know the elements that comprise a good story, and they integrate or adopt community customs into their storytelling style [7]. Numerous research studies have reported the influence of peers in the content of children's stories [4; 36; 6; 5; 42; 3]. When children engage in narrative activities, such as storytelling and story acting, they create a sort of classroom miniculture [104; 3; 4] both by building upon each other's themes, as well as by creating characters and character actions to include their peers in the story acting process [3; 6; 5]. While caregivers and peers play a major role in shaping children's narrative skills and influencing story content, there are still many aspects of narratives that children have full agency over (e.g., the selection of content chosen, the amount of previously reported details, their reflection and evaluation of the story, the sharing of personal identity and presentation of their role in the story) [103].

Narratives have been described as a vehicle for identity formation [23]. Through the representation of time (the meaningful order of events) and space (the position through which the story is told) in narratives, a complex concept of self emerges [98]. Pseudodialogues, the precursor to conversational narratives, between infants and caregivers are the first indication to the child that there is a self separate from another. We use these relationships to help organize and shape human experience, which influence our perceptions and representations of self through narrative [98]. As children's narrative skills progress, they tend to integrate more personal identity, character mental states, and plot development into their stories. Around six years of age, children move from *focused chains* ("and then…" statements) towards *true narratives*. These stories are focused around an incident, have a clear plot, character development, and sequence of events that are temporally, causally, or referentially related; often occurring in the physical world [105; 106]. Children start to add a dimension of their personal identities into their stories, taking on multiple perspectives, incorporating past experiences, and sharing future imaginings that extend the self into their characters or story [7; 29; 107]. At first, children's characters may seem simple and predictable because they are personifying canonical examples of self-images in order to interact with and understand their world and the people in it [98]. As they get older, around seven years of age, children's stories include explicit or implicit references to the mental states of the characters, and describe the character's motivations in a more nuanced way [106]. Around this age, children start to distinguish between fact, the events,

and their own perspective. Their narratives tend to be more direct and less dynamic or descriptive [7].

Despite its clear presence in children's narratives and its role in the function of why we tell stories, identity formation is an understudied dimension of children's narratives. Valuation theory uses the methods of self-reflection, self-confrontation, and the analysis of I-positions in narratives to reveal a person's feelings, perspectives, beliefs, and potentially underlying motivations [98]. However, while this methodology has been adapted for younger children, it is not recommended for children under fifteen years of age [98].

4.3.2 Theoretical Approaches: Stages and Levels of Narrative Development

Researchers have formalized some of these trends into frameworks that categorize the stages, levels, and types of narratives in order to better study children's narrative development. One of the most influential researchers to analyze children's stories by focusing on the development of structure was Applebee (1978). He reanalyzed an extensive corpus of stories from two to five-year-olds, looking specifically at structure and plot complexity through centering on a topic and chaining events together in a sequence. From his analysis, Applebee (1978) categorized children's narrative development into six stages:

1. Heaps - two year olds contribute unrelated statements or one-word descriptions;
2. Sequences - children between two and three years old tell statements related to a central topic;
3. Primitive Narratives - children between three and four years old create story sequences that are perceptually but not temporally linked;
4. Unfocused Chains - four year olds tell stories with temporally linked events, but there is no central topic;
5. Focused Chains - children's stories between four and five years old are temporally related around a central topic; and
6. True Narratives - children between the ages of five and seven years old can tell temporally related stories centered on a topic with a theme or moral [108; 94].

In support of Applebee's sixth stage, Aksu-Koç and Aktan-Erciyes (2018) described in their extensive literature review that between the ages of five to seven years, children start to integrate multiple skills (e.g., cognitive, linguistic, theory of mind) required for coherence, cohesion, and pragmatic adequacy, allowing them to start producing episodically composed narratives that contain meaningful intentional structure related to the organization of events and to a global theme [109]. In other words, by the ages of five to seven years, children are starting to develop and use the skills necessary to tell a traditionally cohesive and coherent narrative. Applebee's six stages shifted the field's focus from analyzing the symbolic content of stories towards analyzing the objective structure of children's stories in order to understand children's narrative development.

Further transitioning the field of narrative analysis towards the study of narrative structure, Stein and Glenn (1979) developed the theory of story grammar, which identified the main elements of a story, such as character, problem, and actions/attempts [92]. Extending Applebee's (1978) stages, Glenn and Stein (1980) created their narrative levels analysis, which

outlined six developmental levels of story grammar to align with their definition of a "good" story. These levels are:

1. Isolated Descriptions - unrelated descriptions of a character, surrounding, or action without causal or temporal links;
2. Descriptive Sequences - multiple descriptions with some related elements;
3. Action Sequences - related descriptions that have a chronological order but are not causally linked;
4. Reactive Sequences - actions that are temporally and causally linked, but no obvious goal-directed behavior;
5. Abbreviated Episodes - built on reactive sequences by including character goals, intentions, and some level of causality, but while the behavior is premeditated, the internal response is less explicit or obvious; and
6. Complete Episodes - episodes that contain both an entire goal-oriented behavior sequence and a theme or moral, similar to true narratives [58]. Glenn and Stein (1980) elaborated on complete episodes, separating them further into either complex episodes (where multiple, often incomplete episodes may be embedded within a complete episode) or interactive episodes (where two characters have goals and actions that influence each other) [110].

In aligning with their definition of a "good" story, Glenn and Stein's (1980) main focus was on the protagonist's goal attainment. Unlike Applebee's stages, Glenn and Stein's levels did not specify age ranges, but focused more on the structural properties of the stories. Stadler and Ward (2005) found that while Glenn and Stein's levels were successive, children's story levels and their age were not strongly correlated [94]. There were also methodological differences between Applebee's approach and the approach of Glenn and Stein. First, Glenn and Stein focused on slightly older children, around elementary school age. Second, the elicitation of stories differed, where Glenn and Stein relied more on retellings and story stems. However, both were fictional stories, rather than eliciting personal narratives. The field of narrative analysis has been heavily influenced by Stein and Glenn's story grammar, and many of the studies conducted since have used the same elicitation methods of prompting and retelling stories.

Combining elements of both Applebee's stages and Glenn and Stein's levels, Stadler and Ward (2005) developed their own five levels of narrative development, which are:

1. Labeling - stories with nominal labels and repetitive syntax which describe the combination of various and unrelated thoughts;
2. Listing - stories with lists centered around topics or perceptual attributes or even strings of character actions with no temporal or causal relationship between list items;
3. Connecting - stories with a central topic including characters and actions that link characters or events and might even use pronouns, but may not contain a temporal link;
4. Sequencing - stories that answer when and why, and use advanced language such as "but" and "because" in order to create consistently correct temporal sequences and cause and effect; and

5. Narrating - stories that include connecting and sequencing and are centered around a developed plot with evidence of planning, goals, and character mental states [94].

Similar to Glenn and Stein's levels, Stadler and Ward (2005) do not have age ranges, and found that children are capable of producing stories that fall within different levels. In fact, contrary to their hypothesis, they found that children who were younger (three year olds) were capable of telling more sophisticated stories, in one case a narrating level story, when they were retelling familiar stories, such as a known fairytale [94]. This suggests that children's story levels are not correlated with their age, but a child's ability to produce a story at a certain level may be influenced by the content of the story.

The above approaches radically influenced the field of narrative study and have continued to permeate the research papers and theoretical frameworks of researchers today. One of the reasons for their prominence is that they have managed to identify objectively measurable components of children's narratives and organize them in a compelling framework that aligns with the features of narratives. In fact, by applying these approaches to the StoryBlocks stories, such as Dana's stories in figure 3.10 in the previous section, we can see examples of focused and unfocused chains, reactive sequences, and listing. In this way, these approaches will serve as the foundation for how we can analyze the structural elements of children's narratives by helping us identify specific dimensions of narratives. However, these approaches have limitations. First, while these approaches may help identify features of narratives, they do not address the function of children's narratives. Second, the elicitation method researchers used influenced the type of narratives children told, making these approaches difficult to compare because they analyzed different corpuses of data.

The elicitation methods of the researchers impacted the different narrative genres that children were asked to create. The above approaches focused more on fictional stems or retellings of fictional children's stories. Starting with Labov and Waletzky (1997), researchers started to elicit stories of children's personal accounts [1]. This changed the corpus of stories children created, and spurred a new focus into the structural development of children's personal stories. It also started to bring into question the sociocultural context of the children, and whether that impacted the narratives they tell. For example, McCabe (1997) identified four stages of children's development of oral, personal narratives by age for white, middle-class American-European children [103]. Her four stages are:

1. One Event Narratives - around two years old children produce oral narratives with one event;
2. Two Event Narratives - around three years to three and a half years old children's stories contain two propositions about one event or two related events;
3. Leapfrog Narratives - around four years of age children's stories contain more than two events, but they are either told out of sequence or omit key information, especially when related to negative actions;
4. End-at-the-High-Point Narratives - around five years of age, children's stories tend to be in sequential order, but their endings do not properly resolve the issue in the story; and
5. Classic Narratives - by around age six children's stories follow a traditional narrative arc centered around a high-point with multiple events

and a resolution. Sometimes children pause and reflect on the high-point of their story, bringing the story back to the present tense [103].

McCabe also noted that children between the ages of six to nine years old tend to tell longer personal narratives as they age and include commentary to orient the listener through their story [103]. McCabe's classification of children's personal, oral narratives brings into question how the content of the story impacts the structure.

The story type or content determines the way the child tells the story (presentation) and which narrative skills are represented in that story. When telling more social problem stories, children tend to be brief, direct, lack much detail, or recollect unrelated details. However, when children are sharing stories about maintaining friendships, their stories are lengthier, more embellished, and tend to be told in a more collaborative style [7]. The story form also varies for the type of emotional content. Happy stories focus on re-creating the moment, and are less dynamic or action-oriented, whereas stories with anger or fear are more conventional and contain a high point or conflict in the middle of the story [7]. Children's use of genre or story type can vary by age. Personal narratives tend to develop earlier than fictional ones for young children, and these two genres progress in different ways at different times in development [109]. However, by four years of age, most children, when telling spontaneous stories to adults, tend to tell fictional stories over stories of personal experience [23].

In a different vein from the above approaches, Hedberg and Westby (1993) focused on the organization of children's stories based on content by formalizing five types of narratives children tell in relationship to their development [111]. The five types of narratives are:

1. Scripts - when children use the second person point of view and present tense to express knowledge of a familiar, recurring event;
2. Recounts - when children use the past tense to tell a personal experience in response to a prompt;
3. Accounts - when children explain, unprompted, a personal experience, usually to a listener who wasn't present for the event;
4. Event Casts - when a child explains a current or ongoing activity, a factual scene, or explains a future plan; and
5. Fictional Stories - when a child relates past, present, or future events that aren't real but still center around someone or something attempting to attain a goal [111].

Hedberg and Westby started to categorize the different genres of children's stories, which Bruner has expressed is an important feature of narrative. Therefore, I will want to incorporate this categorization into my theoretical framework when looking at the structure of children's stories and how it influences their telling.

Building on Hedberg and Westby's five types of narratives, Moffett and McElheny (1996) developed an approach to analyze three aspects of language that represent how the child's viewpoint influences the genre, or type of narrative children tell. The three aspects of language that they looked at were:

1. Time and tense;
2. Self and/or other involvement; and
3. Involvement versus detachment [91].

It is important to consider the content, genre, or type of narrative a child is expressing since different types of narratives use different narrative strategies or demonstrate various mechanics

(e.g., language). Furthermore, identifying the narrative strategies children demonstrate through their story is a methodology many researchers use to understand, track, and document children's narrative development.

While still focusing on the structure of children's narratives, Moffett and McElheny's approach is different from the above formalist approaches because it looks at something objectively measurable (i.e., the structure of language) to help interpret more abstract concepts (e.g., child's active involvement in the story and identification with the story). Considering the child's active role in the story she tells may help the reader better interpret the child's deeper attachment to the story and correlate with the deeper meaning of the story. This approach is influential to my theoretical framework because it is an example of the possibility of taking objective or structural aspects of a child's narrative, such as language, to help inform subjective interpretations of the function of the story. This is my ultimate goal for creating a holistic theoretical framework; using observable data from children's stories to help understand the underlying meaning and document multiple aspects of children's narrative development.

4.3.3 Nicolopoulou's Interpretive, Sociocultural Approach

While the above approaches are helpful in thinking about how to categorize narratives in order to better understand children's narrative development, they are formalistic in their scope, only analyzing the structural or linguistic elements of children's stories, and not considering the critical mathetic and communicative functions of children's stories. That is why Nicolopoulou (1997) calls for a more interpretive, sociocultural approach [112]. Echoed in my observations in the introduction, Nicolopoulou highlights several limitations with these formalist approaches. First, they are incomplete because they ignore a key dimension of narratives, the meaning. Second, they do not consider the crucial dimension of narrative as a form of social symbolic action, which requires interpretation of identity formation and cultural influences. Third, if they consider the social dimension of narratives, they do not ground the meaning into the larger cultural context of the child. And fourth, since many of these approaches were developed from the stories of older children and adults, when they are used to analyze young children's stories, they present an inaccurate picture of deficiency rather than analyzing the child's story for its own sake [112].

In order to move towards an interpretive, sociocultural approach, Nicolopoulou (1997) builds on Bruner and Feldman's (1996) narrative genres and cognitive modes, Vygotsky's (1978) sociocultural psychology and social symbolic play, and Geertz's (1973) theoretical approach to highlight five key lessons [104; 113; 114; 112].

1. Consider how individual and cultural experiences inform and organize narratives when interpreting them;
2. Consider the function of narratives as a form of symbolic action to make sense of the world, including our social world;
3. Consider the role of narrative as a vehicle for forming individual and group identity;
4. Consider how narratives express emotions and embody the interplay between cognition and emotion; and
5. Remember that narratives use emotion to make cognitive lessons salient (similar to Ganz's description [106] that narratives are a teaching of our hearts) [112].

Nicolopoulou then puts these key lessons into practice by analyzing the gendered trends in the themes and order of preschool children's stories [112].

4.3.4 Addressing the Limitations of Pre-existing Theoretical Approaches

Clearly there is a lack of cohesion among the fields that study narrative [13]. Linguists and developmental psychologists tend to focus more on the structure of children's narratives, analyzing the mechanics of story grammar and linguistic cohesion; whereas clinical psychologists tend to focus more on the meaning, analyzing the content for narrative coherence [7]. Despite the strong appeal of Nicolopoulou's argument for an interpretive, sociocultural approach, very few approaches have been developed in the past 20 years that encompass these social and interpretive dimensions. Instead, while many theories and reported trends highlight the importance of these two dimensions, there still remain gaps in translating these theories into practical approaches. Furthermore, of the few interpretive approaches that exist (e.g., Herman's valuation theory), they are often not generalizable to young children or other narrative contexts.

Contributing to the absence of a cohesive, comprehensive approach to understanding and studying children's narratives is the lack of congruence among the methodologies researchers use and the types of narratives they study. Some researchers analyze oral accounts of stories, while others analyze written narratives. The methods for eliciting stories also varies. Some researchers use resources to prompt the retelling of stories, such as wordless pictures, known characters, or familiar children's stories. Other researchers encourage the creation of unique stories through conversations about past personal experiences, modeling stories, story stems, or introducing pictures. Fewer researchers scribed children's spontaneous stories, which were not elicited by any prompting. In light of the disparate methodologies, the documentation process of children's stories also varied (e.g., scribed, audio recorded, video recorded, written by the child). These variations make it extremely difficult to draw connections between the different approaches. A systematic approach for documenting children's narratives is needed in order to overcome these limitations.

The above theories, trends, and approaches have inspired the development of my theoretical framework for understanding and studying children's narratives. In response to the limitations of the previous approaches, I aim to expand upon Nicolopoulou's interpretive, sociocultural approach in order to develop a holistic theoretical framework.

4.4 The Two-Lens Approach: Learning Loops' Theoretical Framework

4.4.1 Purpose of Theoretical Framework

The purpose of this framework is to create a process to understand children's narratives and develop more comprehensive methodologies to study them. In an effort to develop a holistic approach to studying children's narratives, I must use the literature and examinations of prior approaches in my justification for *why* it is important to create such an approach, and expand upon the literature by developing explicit, concrete guidelines for *how* we can understand and study children's narratives in a systematic and more comprehensive way. Many researchers before me have developed approaches that make strong arguments for *why*, yet these holistic theories and approaches rarely detail concrete steps for *how*. Therefore, my goal in this section is to create a holistic theoretical framework for understanding children's narratives that expands upon the literature above (especially Nicolopoulou's interpretive, sociocultural approach) by including concrete guidelines that propose *how* to study children's narratives in a comprehensive

way. In the rest of this dissertation, I will put this framework into practice by applying it to our current Learning Loops system to both understand the limitations of our system and inform the next iteration of the Learning Loops analytics system.

Before diving into the framework, I want to specify one important note on how to use it. While I am using this framework to apply it to our Learning Loops system, I have done my best to intentionally keep this framework broad enough for others to apply it to their own research contexts; highlighting what things might or might not be possible depending on the narrative context or environment one is operating under. By specifying guidelines, my hope is to create a framework that is concrete enough to be useful, yet flexible enough to be adapted to various environments. Therefore, please use this framework however you see fit, and I hope that it will provide a useful tool for future research.

4.4.2 Learning Loops Definition of "Narrative"

Inspired by both the broad definitions of narrative [90; 91; 13] and the functions of narrative [7; 99; 90], I define narrative as: *the culmination of cognition, emotion, and culture presented in various story mediums (e.g., written, oral, physical, mental) to express ideas, experiences, events, or imaginings for the purposes of communicating, sense-making, and identity formation.*

Narratives contain many features, and especially for children's narratives, we recognize that all of these features may not be present, may be implicit, or may not be identifiable within a single narrative. While we encourage children to make any type of narrative they would like within our Learning Loops system, I identify a minimum set of features that must be present in order to be considered an "analyzable" narrative. The minimum features an analyzable narrative contains are: *characters and at least one complete event or action represented through language, composition, or imagery that can be summarized into a plot.*

The two stories below depict the distinction between an analyzable narrative and a non-analyzable narrative. In story A, the author is the character, and the action is tripping on a crack and breaking the mother's back (the mother is another character). While in Story B, the bugs may be characters, but there is no action or event happening.

> Story A: "One time I went walking and I tripped on a crack and broke my mother's back!"
>
> Story B: "Bugs, bugs, and more bugs! Flies, ants, and grasshoppers. Just a big bug soup!"

Similarly, figure 4.0 shows two StoryBlocks stories, Story A meets the minimum criteria of an analyzable story with two characters (the mom with baby and the kid, Billy) and two actions (mom tells Billy to go outside, Billy responds that he wants to be left alone because he won his video game). Story B does not meet the minimum criteria because there is only a description of the fish, but no action or event about what the five thousand fish are doing in the sea.

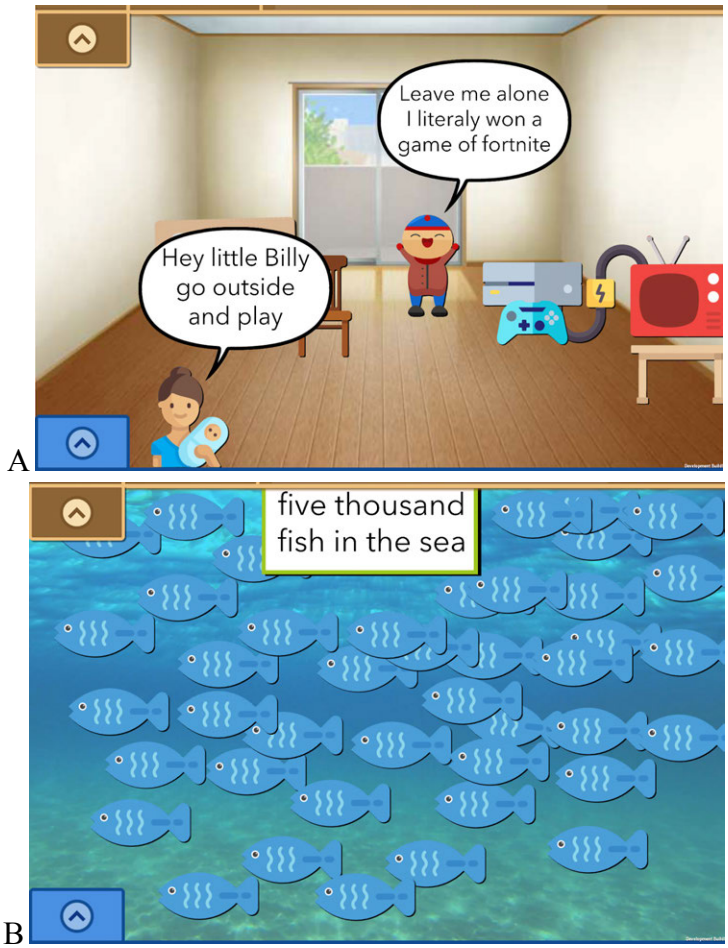


Figure 4.0 Two StoryBlocks stories. Story A meets the minimum criteria of an analyzable story, Story B does not.

With our broad definition and minimum criteria for what we consider an analyzable narrative, we will be able to create a system that distinguishes between stories that should be analyzed by a coach, and those that children can make, but do not need to be analyzed by a coach. For the analyzable narratives that children create, there are many other narrative features that I want to investigate. These features, which I call narrative dimensions, will be described in greater detail below.

4.4.3 The Two-Lens Approach: Our Proposed Theoretical Framework

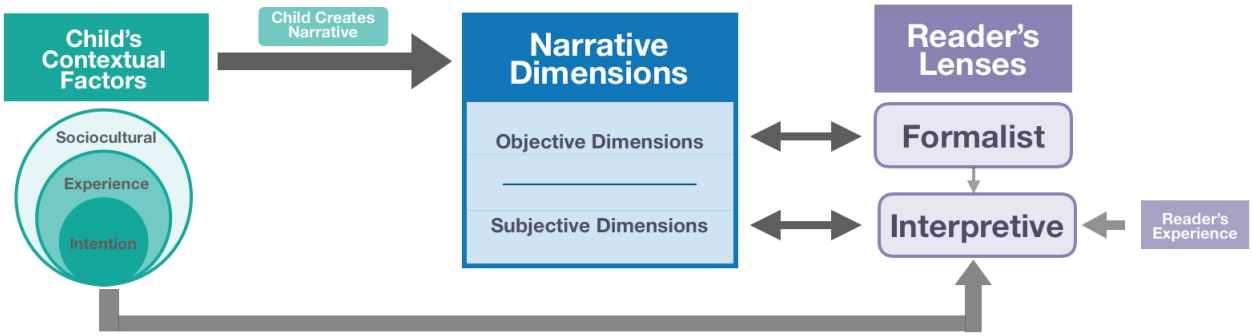


Figure 4.1 Diagram of the Two-Lens Approach

My theoretical framework is titled The Two-Lens Approach because it uses two lenses through which to analyze the specified dimensions of children's narratives: a formalist lens and an interpretive lens. The flow of the Two-Lens Approach is as follows:

1. There are certain **contextual factors** that influence the narrative the child creates.
2. The child creates a narrative, which has specific **narrative dimensions**. While a story does not need to have all of these dimensions present in one story, at least some of these dimensions must be present in order to be considered a narrative. These dimensions are organized into two categories: **objective dimensions**, which comprise the structural elements of a story, and **subjective dimensions**, which comprise the interpretive elements of a story. These dimensions are examined through the two lenses.
3. The two lenses are then used to identify and understand the narrative dimensions and the relationships between them.
    a. First, the objective ***Formalist Lens*** is used to view the structure and mechanics of a narrative. It asks, "Does the objective dimension exist? If so, how is it constituted?" For example, character is an objective dimension, and using the example from Story A (i.e. "One time I went walking and I tripped on a crack and broke my mother's back!"), the formalist lens would identify that characters are present in the story and they are represented by the author and the mother.
    b. Next, the contextually grounded ***Interpretive Lens*** is a product of combining the information from the formalist lens and the contextual factors to interpret the subjective dimensions of a narrative. The contextual factors are used to consider the impact of the child's context and experiences on her story, allowing the reader to more accurately interpret the child's story. The interpretive lens asks, "What is the greater meaning behind the subjective dimensions that the child is expressing and how might the child's contextual factors influence these dimensions?" For example, using the subjective dimension of story purpose, if we knew that the author of Story A was a four year old in an American preschool classroom, we might interpret that her story was influenced by the common nursery rhyme, and so her story of tripping on a crack is her way of internalizing and cognitizing the rhyme. Context is extremely important here, because we would interpret the subjective dimensions very differently if we knew that this story was created by a 15 year old high school student. Two important notes on the interpretive lens:
        i. The intentions, experience, and sociocultural context of the reader is going to influence how s/he interprets the child's story.
        ii. The interpretive lens is most accurate if informed by both the formalist lens and the child's contextual factors, as expressed in Bruner's context sensitivity and negotiability feature [97]. However, if the contextual factors are inaccessible to the reader, the reader can still interpret the story informed by the formalist lens alone, but the interpretation may be more difficult (and potentially less accurate).

To understand this theoretical framework more clearly, I will go into each part of the framework; the contextual factors, the dimensions, and the two lenses. I will then use my own childhood story that I wrote in first grade (six years old), to exemplify how a story can be analyzed through this framework. Finally, in the remaining sections of this dissertation, I will

apply this framework to our larger Learning Loops system to inform our system's design and ability to document and support children's narrative development.

4.4.4 Child's Contextual Factors

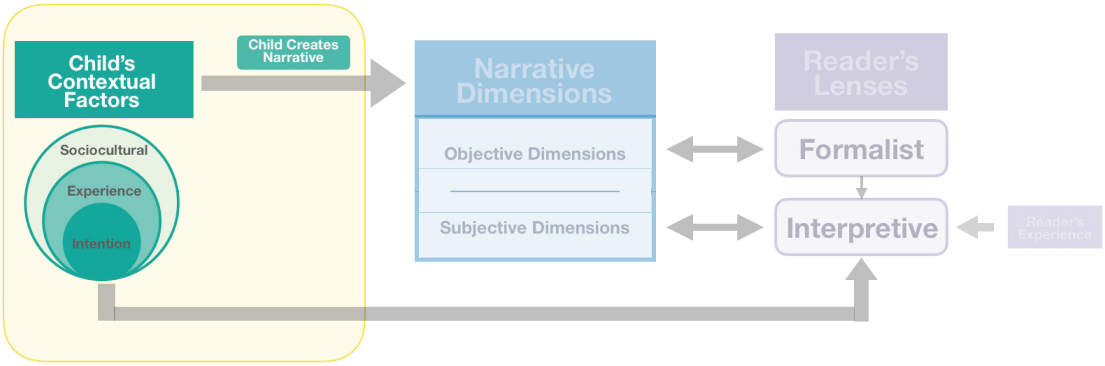


Figure 4.2 The Child's Contextual Factors of the Three-Lens Approach

The literature above highlights the influences that children's intended story goals, personal experiences, and sociocultural context have on their narratives. These three influences make up what I call the child's contextual factors. In this framework, I have specified six factors that should be considered when analyzing children's narratives:

1. **Child's Intended Goal** - The goal, genre, story type, or lesson that the child is intending to achieve through her story can influence the content and narrative strategies used. For example, a child who writes a story as a journal entry where she recounts the events in her day might use different narrative strategies than when she is trying to write a comedy story about a dog superhero.
2. **Child's Intended Audience** - The audience the child is writing her story for, or intending to communicate her story with influences how she might tell her story. For example, a child may use different narrative strategies or highlight different parts of a story when she is communicating it to her friends versus her parents.
3. **Child's Personal Experience** - The individual experiences and direct interactions a child has will influence the stories she creates. There are many ways in which the child's personal experiences can influence the types of stories and the narrative strategies children use to tell their stories. For example, a child who loves fairytales and is often exposed to them is likely to incorporate fantastical themes and language into her stories. If a child is feeling left out at school, her stories might center around the theme of feelings of belonging. If a child is exploring moral development through the moral actions of characters, she may have a hard time creating a story where the big bad wolf blows down the pig's house.
4. **Child's Age** - The age of the child, including her subjective age [97; 98] can influence the narrative strategies she employs and the perspectives she takes. For example, a five year old child might write a very different story than a ten year old child because they have different experiences and are coming from different developmental stages.
5. **Child's Narrative Skills** - The narrative strategies and skills a child possesses can impact how she tells her story and the ways in which she decides to represent these skills. However, it is crucial to remember that a child may have certain narrative skills

that she does not represent in her stories. While considering a child's narrative skills in order to understand her narrative skills seems like a cyclical conundrum, it is important to have a basic understanding of the child's narrative skills at the beginning to know how to support her growth and the development of new skills.

6. **Child's Sociocultural Context** - Since narratives, like language, do not exist in isolation but are closely connected with the culture and society in which they are created and shared, it is important to consider the child's sociocultural context when analyzing narratives. The relationships, cultures, ideologies, societal norms, social interactions and experiences, group identities, and institutional systems that the child is part of are all aspects of the child's sociocultural context. These aspects influence children's stories in various ways. For example, children who are part of a certain faith are exposed to certain religious stories, which may shape their own stories. Cultures have different narrative norms (e.g., European-American cultures tend to value stories with detailed plots, Hispanic cultures tend to value stories with detailed interpersonal and familial character descriptions [103; 102]), and these narrative norms can shape the narrative strategies that children employ in their stories. Similarly, children's relationships play a massively influential role in not only what they value in stories, but also in how they tell stories, as children tend to mimic narrative language, expressions, and strategies that they hear from family, peers, and familiar novels [4; 36].

These six factors are not meant to be a complete list, nor are they meant to be treated as determinants. Instead, I believe that identifying these six factors is a first step in the right direction towards developing a more holistic, sociocultural approach.

One way of understanding the relationship between a child's development and his/her contextual environment is the ecological systems model [63]. This model has inspired my perspective on the relationships between the child's intentions, experiences, sociocultural context, and narratives. The Ecological Systems Model has several layers which radiate out from the center in order to use proximity to describe the systems that both directly and indirectly impact the child's development. At the center of the model is the individual child with individual factors (e.g., age, health, skills). The next layer is the microsystem, the people and environments in which the child has direct contact or experience with (e.g., family, peers, school). The mesosystem connects the microsystem with the exosystem, which is the environments and social circles that the child indirectly interacts with (e.g., neighbors, politics, media, industry). Finally, the macrosystem is the outer layer, which includes the larger norms, attitudes, ideologies, and cultures that the child is a part of [63]. We can apply our contextual factors to a simplified version of this model, where the child's intentions are the individual layer, the child's direct experiences are part of the microsystem, and the child's sociocultural context is part of the macrosystem.

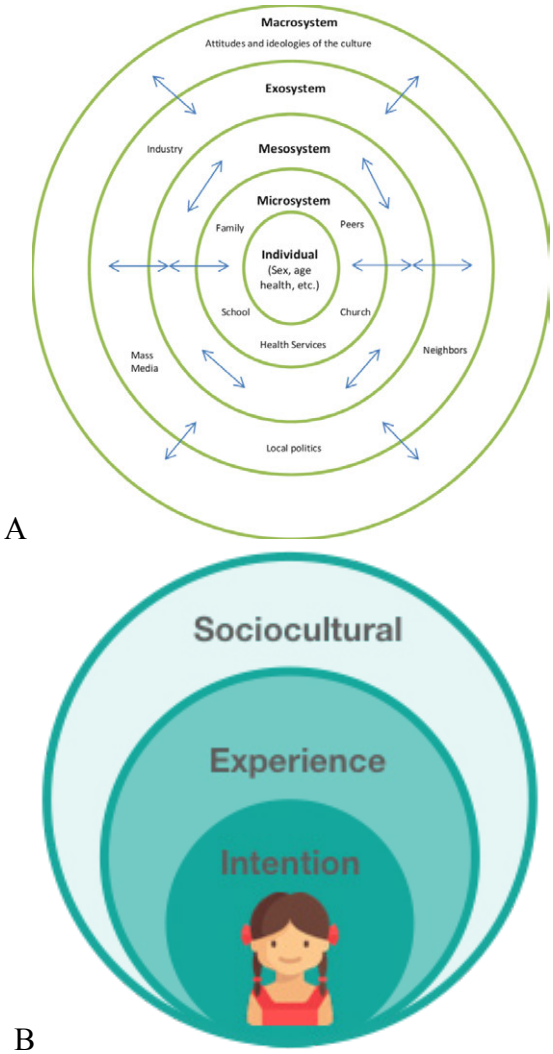


Figure 4.3 A) Bronfronbrenner's Ecological Systems Model [63]
B) Aligning the Contextual Factors to the Ecological Systems Model

Whether children are consciously aware of these contextual factors or not, they all play a key role in shaping the child's story. The first two factors— child's intended goal and audience— are conscious intentions of the child. Sitting more in the subconscious are the child's personal experiences, in which children have direct interactions and experiences that shape their stories, but they may or may not be consciously aware of the amount to which these factors are influencing their stories. The child's sociocultural context plays a big part, both consciously and unconsciously in shaping a child's narrative. A child may write a story about something that happened to her friend, or she might purposely write a story about a specific religious theme during a holiday she practices. However, children may also be unconsciously influenced by the cultural norms they follow, such as including descriptions of a character's familial relationships to align with their cultural values. In this way, the ecological systems model serves as a good framework to view the level of intentionality and proximal interactions that these contextual factors have.

In the Two-Lens Approach, these contextual factors take two paths. The first is to influence the child's narrative, which is explained above. Second, if the reader has access to

these contextual factors, is to inform the interpretive lens by directing the reader to consider the impact these factors have on the child's story. This will be explained in more detail below in the interpretive lens section.

4.4.5 Story's Narrative Dimensions

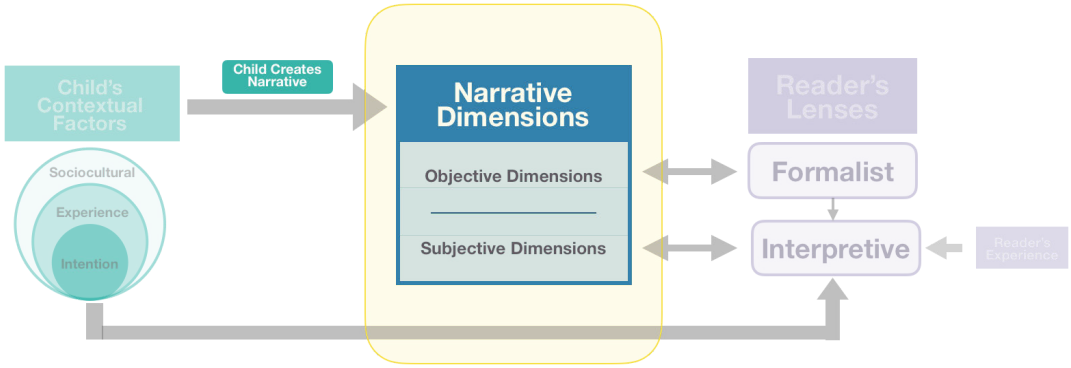


FIgure 4.4 The Narrative Dimensions of The Two-Lens Approach

In aligning with our definition of narrative and inspired by the literature, I have identified fourteen narrative dimensions that can be present in children's stories. From my literature review on the features of narratives, we learned that narratives contain *characters* who do *actions* that are situated within a certain *context*. These events are *organized spatially* (composition) and *temporally* (over time) to convey the *plot* or happening of the story. The author often uses *language*, told from a particular *viewpoint* (perspective) to communicate the *purpose* of the story. This story as a whole can be categorized into a specific *genre* with selected *themes* that help the reader understand how to interpret the greater *meaning*. These set the basis for the narrative dimensions. However, these narrative dimensions focus on one of two different aspects of narrative: structure or function. Therefore, I created two categories of narrative dimensions: objective dimensions and subjective dimensions, which are examined separately by their corresponding lens. Inspired by the formalist approaches summarized in the literature review, the objective dimensions constitute the structural aspects of a narrative and can be objectively measured; either the dimension is present in the story, or it is not. The nine objective dimensions I specify are:

1. **Characters** - The agents of action and emotion in the story.
2. **Events/Actions** - The act that is taken by a character in the story to do something or make something happen (e.g., character launches a toy rocket they built into the air), or the action that happens to a character (e.g., spaceship crashes into earth and hits the character). These are often the sub-elements of the plot.
3. **Setting/Context** - The background, scene, or environment that the story is situated in.
4. **Spatial Organization** - The composition of elements in the story (e.g., images, characters, backgrounds) that are situated in space and oriented to convey meaning, events/actions, expressions, and relationships. This is especially relevant for visual story mediums, such as StoryBlocks.
5. **Temporal Organization** - The linguistic and visual sequence of events/actions in the story to represent order and situate the story across a specific time. Time is not always

ordered linearly, and there are several levels of organization (e.g., unrelated, focused chains, coherent sequence).

6. **Plot** - The main happening of the story, what the story is about. The plot is often a summary of the string of events/actions. There are different types of plots. For example a disruptive plot (or traditional plot) contains a problem that disrupts the predictable path of the story, thereby "thickening" the plot. A descriptive plot elaborates upon a specific situation, character, or environment without presenting an explicit problem.
7. **Language** - the method of communication used to convey the story, often through character dialogue, character thought, or the author's external narration. This dimension is made up of many different language devices (e.g., emotional vocabulary, temporal markers, verb tenses, position statements).
8. **Viewpoint/Perspective** - the narrator's position in relation to the story being told (e.g., first-person, third-person).
9. **Theme/Genre** - stories may have recurring aspects or similar subject matter (themes). Stories can be categorized into genres (e.g., fantasy, personal account) based on similarities in theme, form, and style.

Rather than recreating the wheel, the objective dimensions are directly pulled from the formalist approaches. Applebee's six stages focusing on centering and chaining inspired the dimensions of plot, events/actions, and temporal organization. Stein and Glenn's story grammar inspired the dimensions of characters, setting/context, event/action, plot, and spatial organization. Labov and Waletzky's sociolinguistic focus of children's personal narratives inspired the dimensions of language and temporal organization. Finally, both Hedberg and Westby's categorization of narrative types and Moffett and McElheny's three aspects of language inspired the dimensions of genre/theme and perspective/viewpoint. These objective dimensions are examined through the formalist lens, which is explained in more detail below.

Moving beyond the scope of the formalist approaches, I identified five narrative dimensions that constitute the functional aspects of narratives, such as meaning-making and representation of identity. I termed these the subjective dimensions because they are the aspects of narratives that exist in verisimilitude, or the appearance of truth, but can never be objectively measured, only interpreted [97]. To aid in the interpretation of these dimensions, the interpretive lens asks the reader to consider the child's contextual factors and their potential influence on the representation of the objective dimensions. While certainly not an exhaustive list, the subjective dimensions I specify are:

1. **Meaning** - the significance behind the child's story, or certain elements of the story. Children may communicate their beliefs, ideas, values, reflections, lessons learned, or perceptions about the world through other dimensions in their stories (e.g., plot, organization, viewpoint, language). For example, a child's story about a monster under the bed could have a deeper meaning about her fear of the unknown.
2. **Purpose/Motivation** - the underlying reason or motivation for the child's story and why they are communicating it. This dimension is heavily influenced by the child's personal experience. For example, the purpose of a child's anecdotal story at the dinner table, such as, "Today, at lunch, we had jell-o!" could be to communicate an unexpected event that happened to the child that she was excited about because she loves jell-o.

3. **Values/Morals** - the underlying values and morals being explored and communicated through a child's story. The moral of the story is often represented through other dimensions, such as viewpoint, action, and plot. These values and morals may be heavily influenced by the child's cultural context. For example, the child's story about the boy who cried wolf communicates the underlying moral that it's important not to lie or overreact.
4. **Identity** - representations of self or identity through the characters' internal states, emotions, actions, and language in the child's story. This representation can be about personal identity or group identity. For example, a child's story about their reaction to having to move to a new house may communicate their feelings in the face of change and they may present themselves as adaptable through their actions.
5. **Empathy** - the representation of empathy through the emotional expressions and reactions of the characters that signify emotional understanding. Children may use many dimensions to communicate empathy, such as facial expressions, setting/context, language, and viewpoint. For example, in Ingrid's *Bad day pt 1* (figure 3.12 in section 3) she expresses empathy through her depiction of Boo getting nervous and embarrassed on stage.

It is important to note that these narrative dimensions are the elements within a narrative that are *most likely* present in a child's story. Therefore, I do not expect all of these dimensions to be present in a single story. Furthermore, these dimensions may be represented differently depending on the medium of the story (e.g., written, oral, digital) or the way the story is elicited (e.g., prompted, spontaneous, retelling). In this way, this is not meant to be a complete list of narrative dimensions, and I hope researchers will adapt these dimensions by adding, removing, or substituting narrative dimensions to align with their own research purposes.

These fourteen dimensions can be thought of as dependent variables within narratives, which are influenced by the six contextual factors, or the independent variables. I have developed The Two-Lens Approach to analyze these variables and understand the relationships between them. In this way, I examine these narrative dimensions through two lenses— formalist and interpretive— in order to take a holistic approach to understanding and analyzing children's narratives.

4.4.6 The Reader's Two Lenses (Formalist and Interpretive)

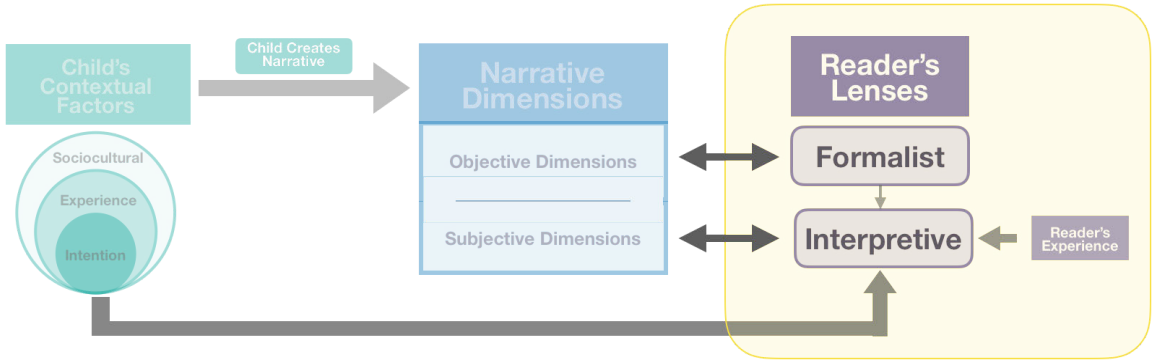


Figure 4.5 The Reader's Two Lenses

As the name of my theoretical framework suggests, the reader uses two lenses to understand and analyze the dimensions of children's narratives. The first lens is a formalist lens,

which aims to analyze the structure and mechanics of the story through the objective dimensions. This is the common method that most approaches outlined above take when analyzing children's narratives. However, I go beyond the pre-existing approaches by looking through the second lens, the interpretive lens, which aims to consider the child's contextual factors to understand how they may have influenced the child's narrative in order to interpret the subjective dimensions, such as the larger meaning and purpose behind the child's story. Through these two lenses, this framework answers Nicolopoulou's call for an interpretive, sociocultural approach by setting up a concrete method for holistically understanding and analyzing children's narratives.

In order to shift the reader's perspective, each of these lenses asks a different question when approaching their respective narrative dimensions. In this way, each lens has a slightly different goal, analyzing the structure or function of narrative. Therefore, for each lens I will outline the question, goal, affordances, challenges, and end with how the lens would view the example story, presented below.

> *Example Story from 4 year old:* "One time Daddy took me fishing. And caught me a great barracuda. And then he realized he couldn't put his thumb in its mouth because it had super sharp teeth. Yeah. And then he cooked it for dinner and then we had it. And then that's all!"

1. **Formalist Lens**
    a. *Question:* Does the objective dimension exist in the narrative? If so, how is it presented?
    b. *Goal:* The purpose of using this lens is to identify and analyze the structural elements of children's narratives.
    c. *Affordances:* The data from this lens is more easily identifiable, measurable, and (often) automatable.
    d. *Challenges:* The data from this lens does not show the whole picture because it does not account for the interpretive or social elements of the child's story; it can neither identify nor analyze the non-structural elements of a narrative.
    e. *Example:* The formalist lens would analyze the four year old's story by identifying the objective dimensions.
        i. There are three characters in this story, the dad, the author (four-year-old boy), and the fish (great barracuda).
        ii. The setting/context of the story is not explicit, but can be implied that it is some time in the past outside by a body of water.
        iii. The event is a fishing trip, with several actions: going fishing, catching a great barracuda, putting a thumb in its mouth, and cooking and eating it for dinner.
        iv. Spatial organization is not applicable to this story because it is an oral story and the scenes are not described in detail.
        v. Temporal organization is a focused chain, with a logical sequence of events centered around a topic: they go fishing, catch a fish, the dad can't put a finger in the fish's mouth because sharp teeth (causal link), cooked it for dinner, ate it.

vi. The plot of this story is about the author and his dad going on a fishing trip and catching a great barracuda with sharp teeth.
vii. We can look at many different linguistic features the child demonstrates, such as transitions with temporal markers (i.e., one time, and then), causal markers (i.e., because), reflective language (i.e., realized). He tells this story in the past tense, using past tense verbs (e.g., took, caught, realized, had, cooked, had).
viii. This story is told in the first-person from the child's perspective by the use of position statements (e.g., "me").
ix. The genre of this story is real life, or nonfiction. It is a recount, a personal account told to an audience who did not share in the experience.

2. Interpretive Lens

a. *Questions:* The interpretive lens asks two main questions: (1) How do the child's contextual factors (i.e., age, skill, intention, intended audience, experience, sociocultural context) influence the representation of the narrative dimensions? (2) Considering the contextual factors and structure of the story, what is the greater meaning behind the subjective dimensions that the child is trying to express through his/her story?

b. *Goals:* There are two main purposes of the interpretive lens: (1) to account for the function of children's stories by interpreting the subjective dimensions, such as purpose and meaning of the story, informed by a combination of the narrative's structural features and the child's contextual factors; and (2) to account for the individual and social components of children's learning by considering the contextual factors that influence children's narratives.

c. *Affordances:* The data from this lens helps identify and analyze the interpretive elements of a story, such as children's representation of self through characters. This lens is imperative for getting a holistic view of a child's narrative by supplementing the structural elements of a narrative with the purpose. Furthermore, the data from this lens aims to identify the social influences and communicative function of narratives. Through considering contextual factors such as sociocultural context, the data from this lens is less susceptible to culturally biased methodologies for analyzing stories.

d. *Challenges:* The data from this lens is not easily identifiable, measurable, or automatable, as a human is needed to make interpretations. Narratives exist in verisimilitude (i.e., the appearance of truth), and according to the hermeneutic cycle, we can never prove whether an interpretation is correct. For more accurate interpretations, access to contextual knowledge about the child is helpful, but not always known or accessible; making interpretation of the dimensions harder and more susceptible to misinterpretation. If contextual information is inaccessible, the interpretation has to be based on the information from the formalist lens only.

e. *Example:* The interpretive lens would analyze the four year old's story by first considering the child's contextual factors and then using them to interpret the subjective dimensions.

i. The known contextual factors for this child are presented in the following profile. The author is a four year old boy with above average reading and

literacy skills and attends a private preschool. He is part of a Chinese-American family living in an affluent neighborhood in the Greater Boston Area with his parents, twin brother, and older sister. He is quieter than his twin brother and adores his older sister. He loves reading, sharks, transportation (e.g., trains, cars, buses), fishing, and spending time with his parents. His family is very active in the community and often hosts community events in their house. This story was told to a babysitter who had asked for the child to tell a story about anything he wanted.

ii. The motivation or purpose of telling this story was in response to the babysitter asking for a story about anything. The child chose this story because it was a happy memory about him and his dad fishing.

iii. The value expressed in this story is spending time with family and loved ones.

iv. The child represents his identity in the story both as an active character (e.g., we had it) and as an observer (e.g., watching his dad catch, touch, and cook the fish).

v. There is not a lot of emotional expression or representation of empathy in this story. The child starts to describe the internal mental state of his dad (e.g., he realized), but this story is more descriptive of the actions that occurred than communicating the emotions experienced.

vi. The meaning behind this story might be that the child remembers a wonderful experience with his dad where they went fishing and caught their own food. The fact that his siblings aren't mentioned in the story might indicate that it was a special moment between him and his father. He explains that the dad caught the fish for him. The surprise that the fish had teeth was exhilarating in its danger, and the dad catching and cooking it could depict his dad as a hero.

The contextual factors are important in grounding the interpretive lens. For example, in looking at the example story above, your interpretation of the story might be different if you knew it was written by a 32 year old instead of a four year old. Just as we must consider the child's context and experiences in interpreting the story, we cannot ignore the impact that the reader's experience will have on the interpretation of the child's story. Therefore, similar to the child's contextual factors, we can use a simplified version of the ecological systems model to describe the reader's contextual factors and how they influence his/her interpretation of the child's narrative.

Figure 4.6 Aligning the reader's experience to the Ecological Systems Model

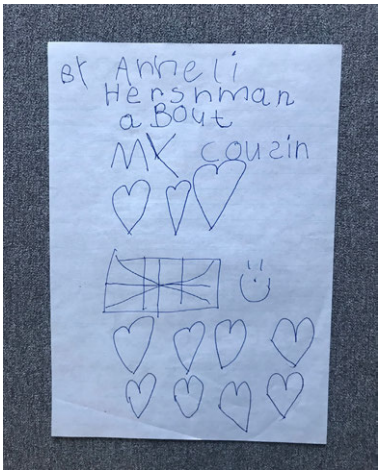
The interpretive lens provides immense value in several ways. First, as I have mentioned previously, it incorporates the mathetic and communicative functions of children's narratives through the contextual factors and the subjective dimensions. Second, by understanding the meaning and purpose of children's stories, the reader is able to respond meaningfully to the child's story. These meaningful back-and-forth interactions between reader and writer is the basis for forming a relationship, which in turn helps the reader learn more about the child and better interpret their later stories. Third, the value of the interpretive analysis is even more powerful when extended into the social space, where the reader can get an understanding of children's relationships with others, see their dynamics at play that influence their stories, and learn about children's motivations. The interpretive lens helps the reader begin to explore the relational space of children's narratives, which in turn builds trust between the reader and writer, and the writer is able to better understand and support the narrative goals of the child.

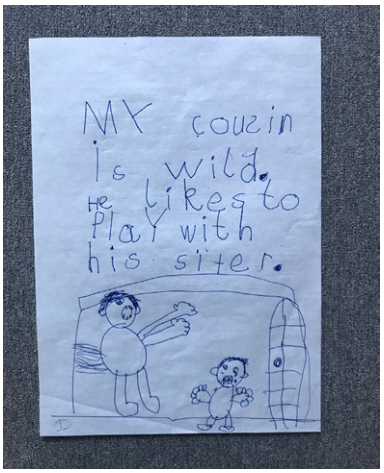
These three parts (contextual factors, narrative dimensions, and the two lenses) make up the Two-Lens Approach. Now I will explore how this approach works in action.

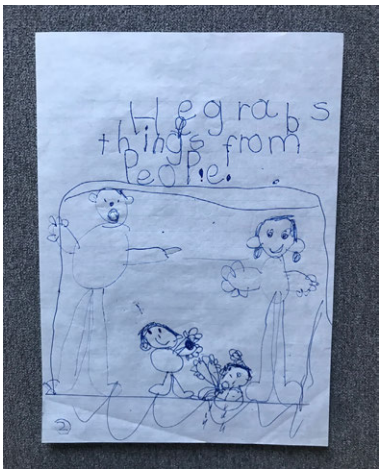
4.5 The Two-Lens Approach In-Action: Case Study with My First Grade Story

The purpose of running this story through my framework is to see how it works in action, and make sure that it can be applied to other stories and contexts outside of the Learning Loops system. In this section I will share a story I wrote about my cousin when I was six years old. I will then provide a profile of my six year old self and use the two lenses to examine the structural and interpretive aspects of my childhood story.

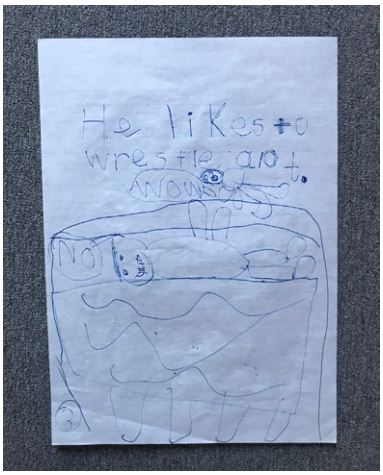
About My Cousin, by Anneli Hershman, Age 6

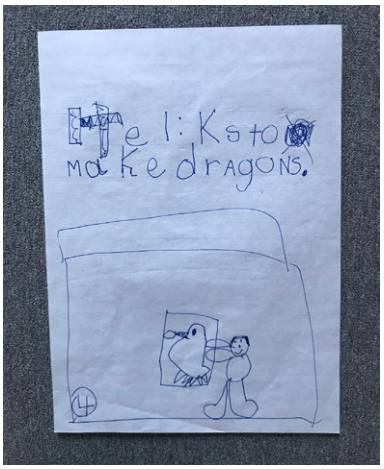


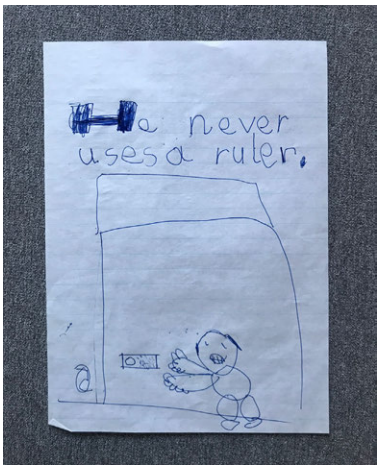




By Anneli Hershman about my cousin	My cousin is wild. He likes to play with his siter [*sister*].	He grabs things from peop!e [*people*]!







He likes to wrestle alot [*a lot*]. “Wow” “No”	He liks [*likes*] to make dragons.	He never uses a ruler.

Profile of Kid Anneli (relates to contextual factors):

- *Age:* six-year-old girl
- *School:* 1st grader at Westwood Elementary (public) in the suburbs of Cleveland, OH
- *Family:* Jake (brother, ten years old), Marie (mother), Cliff (father), Jordan (cousin, age five), Haley (cousin, ten months).
- *Interests:* Spice Girls, acting, singing, roller skating, storytelling, animals, drawing, horseback riding, soccer, skiing, playing with friends and family.
- *Routines:* Weekly dinner with extended family (cousins, aunts, uncles, grandparents).
- *Recent Experiences:* Just moved to a new home and switched school systems (from Montessori to Public School), just received the lead role in school play, making new friends, joined a new soccer team, learning how to jump horses, new baby cousin was born ten months ago.
- *Personality:* friendly, energetic, helpful, patient, strong-minded, imaginative, observant.
- *Narrative Skills:* strong oral narrative skills, difficulty with reading, writing, and spelling (diagnosis of dyslexia at 16, undiagnosed at 6).
- *Culture:* American-European, celebrates Jewish and French heritage
- *Story Context:* written at home (with help from father), intended for Aunt who lives in Boston and is an author. Story is spontaneous and was not prompted by an adult.

Formalist Lens (which objective dimensions exist and how are they presented?)

- *Characters:* Jordan (cousin), Haley (cousin’s younger sister), Adults (uncle and aunt), Anneli (narrator).
- *Events/Actions:* 0) Title Page; 1) Jordan plays with his sister (and makes her cry); 2) he grabs things from people; 3) he wrestles; 4) he draws pictures of dragons; 5) he doesn’t use a ruler.
- *Context/Setting:* Jordan’s house (living room, bedroom)
- *Spatial Organization* (composition by scene): 0) Flag of England, hearts, and a smiley face; 1) Jordan running in and screaming while Haley cries; 2) Jordan smiling with object in hand while Haley cries, uncle yells and points and aunt smiles; 3) Jordan jumps

through air to wrestle on the bed while uncle on the bed catches him and says “no”; 4) Jordan happily showing a picture (drawing) of a dragon; Jordan, teeth showing, either reaching for or throwing away a ruler.

- *Temporal Organization:* Related list, the scenes are ordered only by the numbers on the bottom of the page, but are not told over a specific time or linked together by causality. However, the five separate actions/scenes are all related by the content about the wild cousin, Jordan.
- *Plot:* This story is about a wild cousin who likes to play rough, isn’t always aware of his surroundings, and doesn’t always follow the rules (or use a ruler).
- *Language:* The kinds of language used in this story are dialogue (“wow” and “no”) and narration. Researchers may look at many different aspects of language or linguistic features, for the purposes of this example, we will look at the following aspects of language:
    - Emotional Vocabulary - wild, likes, wow
    - Onomatopoeia - n/a
    - Verb Tense - present
    - Pronouns - he, his
    - Temporal Markers - n/a
    - Causal Markers - n/a
    - Linguistic Cohesion - no particular order or linguistic connection of sentences.
    - Sentence Structure - complete, simple sentences
- *Viewpoint/Perspective:* third-person, told from the narrator’s (Anneli’s) point of view.
- *Theme/Genre:* This story is categorized as an account. It is an unprompted explanation about real events that the author experienced or witnessed. One clear theme in this story is family.

Interpretive Lens (how do the contextual factors influence the story and what is the larger meaning behind the dimensions in the story?)

Looking at the profile of Kid Anneli, we can get a sense of how some of the contextual factors may have influenced her story. To do this, we first look at the contextual factors that we know, and then consider how they might inform our interpretation of the meaning of the story. The following are a couple examples of ways that Anneli’s known contextual factors can be linked with her story. First, Anneli is six years old and interested in her cousin, Jordan, who is one year younger than her. Her infatuation with her cousin and the fact that he is a regular influence in her life (they meet weekly at family dinners) may have inspired the content of her story. Second, Anneli wrote this story for her aunt, who is an author because she was inspired to write a book just like her aunt. This could have influenced both the content of her story (writing about a family member they both know) as well as the style and structure of her story (writing it in a chain of events format with complete sentences). Third, Anneli’s father was helping her (she could not have spelled the word “wrestle” on her own), and she told her story using a written medium, which may have also influenced the list-like structure of the story rather than the temporal and causal linkages that she could produce in her oral narratives. Fourth, Anneli just moved from a Montessori school to a public school, where the rules and level of autonomy given to the students was very different. This experience could have influenced the values expressed in

her story. Fifth, the british flag on the title page, while unrelated to the story, may have been influenced by Anneli's obsession with Spice Girls at the time.

By combining the analyses from the formalist lens and Kid Anneli's contextual factors, we can interpret some of the subjective dimensions of her story. First, the representation of emotions throughout the story varied. Jordan's expression is yelling, happy, excited, happy, and mischievous; Haley's expression is crying in both scenes; Uncle's expression is scolding and scared; and Aunt's expression is happy. All expressions except for the aunt's are consistent with the story. When Haley cries, it is incongruent with the emotional tone of the narration in scene one (playing with his sister), implying that he likes to play but his sister does not and he might play too rough with her. This incongruence is similar to the uncle's expression in scene three during the wrestling. Second, the values expressed in this story are the importance of following rules and understanding how your actions impact those around you. Third, the narrator (Anneli) is talking about her cousin, who is a separate character. Her identity is not represented in this story, as she is distancing herself from the character of her wild cousin.

Given all of the narrative dimensions (objective and subjective) and contextual knowledge, my interpretation of the larger meaning behind this story is that Anneli is fascinated by her cousin and his ability to disregard the rules and be so wild as to not recognize how his actions impact those around him. Her focus on his lack of ruler use in scene five is particularly interesting, and may be interpreted as her expressing her confusion of moving to a new school and environment in which she is asked to follow more rules. She is intrigued by someone who doesn't seem to have any regard for the rules. By writing in the third person about her cousin, Anneli seems to be distancing herself from the wild actions of his character. In her depiction of Jordan playing in scene one while his sister, Haley, cries, Anneli may be identifying with Haley's character, as she is also a younger sister and may have experienced being unintentionally hurt while playing with her older brother. Without using language or other explicit structural elements, Anneli displays consequences within scenes one and three through the incongruence of the narration and the second character's emotional expression (e.g., Haley crying, Uncle's fear). This important nuance would not be detected if we were only analyzing the structural elements (e.g., story grammar) of this story. Yet within these two scenes, a lot is being communicated about Anneli's perception of her cousin's lack of awareness for how his wild actions impact those around him. In the end, this story is somewhat satirical in its portrayal of wild cousin Jordan.

4.6 Future Considerations of the Two-Lens Approach

Upon creating and applying the Two-Lens Approach, two important considerations became clear that need to be addressed. First, the medium of the story greatly impacts the narrative dimensions, especially the objective dimensions examined through the formalist lens. For example, young children tend to insert dialogue and describe the setting of the story later in their oral narrative development [34]. However, the digital medium of StoryBlocks encourages children to insert dialogue and immediately set the backgrounds, so young children's StoryBlocks stories are more likely to encompass those narrative dimensions than children's oral stories. Similarly, StoryBlocks is very visual, so the spatial organization or visual composition of a scene is more important for something like StoryBlocks, but would not necessarily be a relevant dimension for oral stories. Therefore, a major consideration for the Two-Lens Approach is to recognize which dimensions are relevant for certain storytelling mediums. In this way, the

narrative medium serves a similar function for the formalist lens as the child's contextual factors serve for the interpretive lens. Future iterations of the Two-Lens Approach should incorporate the influence of the story medium on the formalist lens.

The second important consideration that was highlighted by applying the Two-Lens Approach is the frequency with which the interpretive lens should be applied to stories. As previously mentioned, the interpretive lens is more powerful when examining group interactions and dynamics. In a similar way, the interpretive lens is also more powerful when examining the meaning and voice the child uses across a set of stories. My interpretation of my own six year old story, above, is very individual, bordering on the line of psychoanalyzing my six year old self from my story. While there is still some merit to examining the subjective dimensions of a single story, the reader is likely to find more success in interpreting the subjective dimensions from multiple stories, which provide numerous cues that combine to form the larger picture of the meaning expressed across several stories, rather than just one cue. With each additional story, the reader's interpretation becomes almost less subjective, because there is more evidence to support their interpretation. For example, if I had a collection of my six-year-old stories, I would be able to look for similar representations of my fascination with rule-breakers and chaos. If I found more evidence of that in other stories, it would strengthen my interpretation. For the Learning Loops system where children will be creating multiple stories over time, interpreting a set of stories will help coaches better see both the progression of trends, and the influence of the medium. Therefore, future implementations of the Two-Lens Approach should consider which subjective dimensions are analyzed for each individual story versus across a set or group of stories to aid interpretation. In the rest of this dissertation, while I believe the interpretive lens should examine a group of stories, I run individual stories through the Two-Lens Approach in order to show how this approach works for each story. However, upon completion of this dissertation, I intend to examine children's sets of stories using the interpretive lens.

5.0 Retrospectively Applying the Two-Lens Approach to Learning Loops

5.1 Using the Two-Lens Approach to Analyze StoryBlocks Stories

The purpose of this section is to put my proposed Two-Lens Approach into action by first applying it to analyze several StoryBlocks stories, and then mapping it to the current Learning Loops system to assess alignment and inform modifications. First, similar to how I analyzed Kid Anneli's story in the last section, I will use the Two-Lens Approach to analyze two different StoryBlocks stories (one long story and one short story) and identify whether the two lenses of my proposed approach hold up. Figure 5.0, below, revisits Dana's story, *A day never ends*.

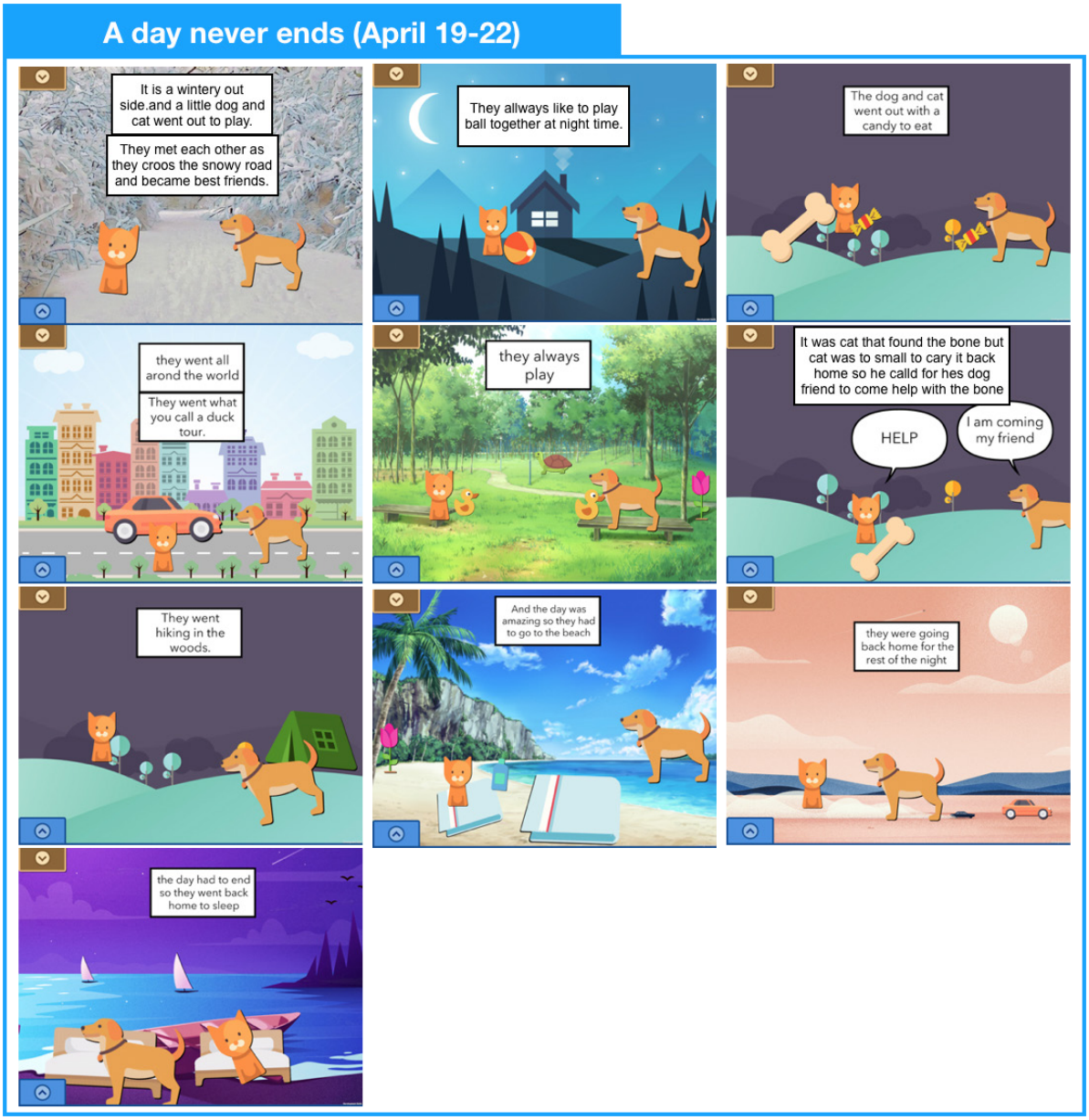


Figure 5.0 Seven-year-old Dana's StoryBlocks Story, *A day never ends*, Analyzed by the Two-Lens Approach

Profile of Dana (relates to contextual factors):

- *Age:* Seven-year-old girl
- *School:* 1st grader at Public School in the Roxbury area of Boston, MA.
- *Family:* Mother and Father, no siblings.
- *Interests:* Art (drawing, painting), reading, animals.
- *Recent Experiences:* recently had a birthday, her drawing was selected for the cover of her school book.
- *Personality:* shy, quiet, friendly, observant, generous.
- *Narrative Skills:* Average narrative language skills (as tested by the TNL-2), difficulty with spelling.
- *Culture:* Latinx, American
- *Story Context:* written at home after school on StoryBlocks device, unprompted.
- *Intention/Goal of Story:* Unknown.
- *Intended Audience:* Unknown.

Formalist Lens (which objective dimensions exist and how are they presented?)

- *Characters:* Dog and Cat.
- *Events/Actions:* 1) *Beginning:* Dog and Cat go out on a snowy day and meet at the crossroads and become friends; 2) They play ball at night (routine); 3) They went out at night and ate candy; 4) They went around the world and went on a duck tour in the city; 5) They play in the park (routine); 6) *Problem:* the Cat found a bone that was too big to carry home so he asked the Dog for help. *Solution:* the Dog came to help; 7) They hiked and camped at night (routine); 8) They went to the beach on a nice day; 9) They went back home after the beach; 10) *Ending:* they went home to sleep on their beach beds.
- *Context/Setting:* Outside (snowy day, yard at night, park at night, city during another day, park during the day, park during the night, sunny beach day, sunset in the desert, and beach night/home).
- *Spatial Organization* (composition by scene): 1) Dog and Cat on snowy road; 2) Dog and Cat in yard at night with ball; 3) Dog and Cat in the park at night with candy and a large bone; 4) Dog and Cat in a city on the road with a car; 5) Dog and Cat at park during the day (spring flower) with toy duckies; 6) Dog and Cat in the park at night with a big bone; 7) Dog and Cat in the park at night with a tent; 8) Dog and Cat at the beach with towels and sunscreen; 9) Dog and Cat walking home at sunset in the desert with cars; 10) Dog and Cat on their beds at night on the beach.
- *Temporal Organization:* This story is a focused chain of events that follow a logical sequential order with some temporal markers and causal links within and between the scenes (e.g., “the day was nice *so* they had to go to the beach”, “they were going back home for the rest of the night”). Some of the scenes also set the context for the friendship of the Cat and Dog by listing routines they have (i.e., “they always like to play all together at night time”, “they always play”).
- *Plot:* This story is about a Dog and a Cat who become best friends and play together. One night the cat finds a big bone that he cannot carry and the Dog helps him, then they go camping and the next morning they go to the beach and retire home at the end of the day.

- *Language:* The kinds of language used in this story are from the narration (in the text boxes) and the dialogue from the Cat and Dog in scene six. For the purposes of this example, we will look at the following aspects of language:
    - Emotional Vocabulary - like
    - Onomatopoeia - n/a
    - Verb Tense - past=15 (e.g., went, met, became, found); present=13 (e.g., play, eat, am); infinitive=7 (e.g., am coming)
    - Pronouns - they, he, hes [his], my
    - Temporal Markers - always, as
    - Causal Markers - so
    - Linguistic Cohesion - Uses "and" to connect the narration from different scenes.
    - Sentence Structure - complete, simple sentences, some run-on sentences.
- *Viewpoint/Perspective:* third-person, told from the narrator's point of view.
- *Theme/Genre:* This story is categorized as a fictional account. It is an unprompted explanation about events that the author created about a personified dog and cat. Two clear themes in this story are animals and friendship.

Interpretive Lens (how do the contextual factors influence the story and what is the larger meaning behind the subjective dimensions in the story?)

Looking at the profile of Dana, we can get a sense of how some of the contextual factors may have influenced her story. To do this, I first look at the contextual factors that we know, and then consider how they might inform our interpretation of the meaning of her story. The following are a couple examples of ways that Dana's known contextual factors can be linked with her story. First, Dana is seven years of age and likes animals, which may have influenced the themes (i.e., animals and friendship) and genre (i.e., fictional account) of her story. This aligns with the trends in research that children around seven years of age tend to tell more fictional stories about friendship and peers [23; 7]. Dana uses language that is relevant to her storytelling skills and age, and her spelling mistakes are common for her age (e.g., allways [always], croos [cross], arond [around]). Dana is quiet, shy, friendly and generous, and that could be linked to her focus on the routines of friendship between the Cat and Dog, and the Dog's immediate reaction to come to the Cat's aid. Lastly, Dana's sociocultural context may have influenced the nature of her story. For example, research shows that children from Hispanic-American cultures tend to focus more on character and familial relationships in their stories rather than focusing on a plot centered around a problem [103; 102]. Therefore, Dana's sociocultural context may have inspired her to focus her story more on the relationship and routines of the Dog and Cat, rather than a temporally coherent plot centered around a problem.

By combining the objective dimensions from the formalist lens and Dana's contextual factors, we can interpret some of the subjective dimensions of her story.

- *Purpose/Motivation:* This is unclear. It could be that she told this story because she loves animals and wanted to tell a story about friendship.
- *Values/Morals:* There are several values that underlie Dana's story. First, is the value of friendship, and what it means to be a good friend (e.g., always playing together, traveling together, helping each other), and that friends have history (e.g., demonstrating routines to show the strength of their friendship). Second, is the value of time and routine. Many of Dana's stories follow a routine over the course of a day or a couple of days, and this

story is no exception. Her scenes depict different times of day and different seasons, which indicate that the story is happening over multiple seasons, and the routines described in frames two and five further indicate the passage of time. But then the last scene indicates that it was a single day that had to end (reflecting the story's title). Therefore, Dana is showing that she values routines, the passage of time, and the time that friendships take to develop, but that her concept of time is not necessarily grounded in reality.

- *Identity:* The identities of the Cat and Dog continue to be developed throughout the story by elaborating on their likes and their interactions with helping each other. Dana is a very generous and friendly girl who is small, and she may identify with both characters in frame six, where the Cat is small and needs help carrying something big, and the Dog is a good friend and comes to the rescue right away.
- *Empathy:* Since the characters she used were items, Dana was not able to change their facial expressions, nor did she use much emotional language to represent emotional expression or empathy in the story. Furthermore, the story was told as a list-like account of routines and events, which research suggests tends to have less emotional detail [7].
- *Meaning:* My interpretation of the greater meaning of Dana's story is that it's a reflection of her love for animals and through those animals she is communicating what she believes builds a relationship and makes a good friend. Friends meet, build routines and history by doing activities they both enjoy over time, and they help each other out when in need. When you spend time with a good friend, you can go on many adventures, but it is also like time stops and it seems like only one day has passed. Dana demonstrates the bending of time in her story through the incongruence of the routines, changes in seasons, and changes in times of day. Through this story, Dana also communicates her worldview in scene four by saying that the cat and dog went around the world on a duck tour. Duck tours are unique to Boston, and while you can travel far and wide on a duck tour, you tend to stay within the city limits. Through this scene, Dana is not only representing her concept of time, but also of space. In the end, spending time with best friends can feel like transcending time and space.

Not all StoryBlocks stories contain multiple events, some are more story fragments or individual scenes that represent a single event. For example, figure 5.1 shows a single-frame story from ten-year-old Kevin. I will apply the Two-Lens Approach to Kevin's story to demonstrate how the two lenses hold up when analyzing short stories with fewer narrative dimensions.

Figure 5.1 Ten-year-old Kevin's StoryBlocks Story, *Traffic be like*, Analyzed by the Two-Lens Approach.

Profile of Kevin (relates to contextual factors):

- *Age:* Ten-year-old boy
- *School:* 5th grader at Public School in the Roxbury area of Boston, MA.
- *Family:* mother, father, and younger sister (age eight).
- *Interests:* Music, jokes, games, technology.
- *Recent Experiences:* Unknown.
- *Personality:* goofy, friendly, curious, observant.
- *Narrative Skills:* Average narrative language skills (as tested by the TNL-2).
- *Culture:* Somali-American
- *Story Context:* written at home after school on StoryBlocks device, unprompted.
- *Intention/Goal of Story:* Unknown.
- *Intended Audience:* Unknown.

Formalist Lens (which objective dimensions exist and how are they presented?)

- *Characters:* Hidden people in cars, at least three people (one for each car).
- *Events/Actions:* 1) Car Three rams into Car Two because of road rage at traffic, Car Two doesn't understand why Car Three is impatient, and Car One is confused by the commotion.
- *Context/Setting:* on a city street in traffic.
- *Spatial Organization* (composition by scene): three cars in a row on a street in the city with fire and sparks representing a crash and speech bubbles to represent yelling and thought bubbles to represent the mental states of the people in Cars One and Two.
- *Temporal Organization:* This is a one-point-in-time event. However, there is a temporal order within the scene where Car Three has to crash into Car Two before Car One wonders what's wrong.

- *Plot:* This story is about a person in a car with road rage during traffic time and the person takes matters into his/her own hands by ramming the car in front of it, causing commotion and confusion.
- *Language:* The kinds of language used in this story are from the text in the dialogue bubbles for the hidden people in each car. For the purposes of this example, we will look at the following aspects of language:
    - Emotional Vocabulary - confused
    - Onomatopoeia - BEEP
    - Verb Tense - past=1; present=5; infinitive=2
    - Pronouns - you, he, I
    - Temporal Markers - n/a
    - Causal Markers - n/a
    - Linguistic Cohesion - sentences string together from left to right.
    - Sentence Structure - complete, simple sentences.
- *Viewpoint/Perspective:* This story is told in first-person by each of the characters. The title signals a third-person's bird's-eye-view comment of the story.
- *Theme/Genre:* This story is an event cast, that could be based on real life or fictional. It is more like a commentary on a situation. The themes are traffic and road rage.

Interpretive Lens (how do the contextual factors influence the story and what is the larger meaning behind the subjective dimensions in the story?)

Looking at the profile of Kevin, we can get a sense of how some of the contextual factors may have influenced his story. He is a smart and curious child who likes to make jokes and lives in an urban area of Boston. It is very likely that he has encountered traffic and road rage, and wanted to make a comment on it with a humorous title.

By combining the objective dimensions from the formalist lens and Kevin's contextual factors, we can interpret some of the subjective dimensions present in his story.

- *Purpose/Motivation:* Since Kevin lives in an urban area of Boston, it is possible that he experiences a situation with traffic and used this story to represent it or comment on road rage that he saw.
- *Values/Morals:* Through the thoughts of the person in Car Two, Kevin depicts the raging driver of Car Three as silly or childish, showing that he values patience in a situation where no one has control (e.g., traffic). Similarly, the confusion of Car One also demonstrates the futileness of Car Three's anger and rash decision.
- *Identity:* While the characters are not visually present in the story, their identities are revealed by their commentary and actions. Separately, Kevin distances himself from all of the characters through his title, giving the impression that he is commenting on the situation as a bystander, rather than identifying with a specific character.
- *Empathy:* Without much emotional language or any emotional expressions, Kevin manages to convey a strong sense of emotion through Car Three's road rage, Car Two's exasperated thoughts, and Car One's confusion. Simultaneously, Kevin's title, "Traffic be like," sets up the reader to consider the states of each of the characters in traffic, encouraging empathy from the reader by relating a familiar situation.
- *Meaning:* The greater meaning of this story can be interpreted as representing the uselessness of anger and emotion in a situation where there is no control, such as traffic.

While it is common to get angry in traffic and want to release your inhibitions by screaming or ramming the other car, Kevin paints the situation in a slightly humorous light to show how pointless it is because it doesn't lessen the traffic. His title suggests that he is making a comment on traffic, showing how he experiences traffic in his city.

It is important to recognize that I know significantly less contextual information about Dana and Kevin than I did about Kid Anneli (in section four), and this will influence how much I can interpret the subjective dimensions of Dana's and Kevin's stories. This presents a good example of how important the contextual factors are for the interpretive lens. With the majority of the Learning Loops system occurring remotely, we may not have access to all the contextual factors that influence the child's story, and therefore, inherent in our design, we need to recognize that some of these factors can be shared through interactions with caregivers and children, and we must to be able to capture these dynamic factors and make them explicitly available for coaches to inform their interpretations. Similarly, we must recognize that our interpretations of these stories skew towards the individual. Though outside the scope of this dissertation, being able to apply the Two-Lens Approach to a set of stories told by a child to interpret the subjective dimensions across multiple stories would make our interpretive lens more powerful.

5.2 Applying the Two-Lens Approach to the Current Learning Loops System

In the rest of this section I will map my Two-Lens Approach to the current Learning Loops system in order to highlight the successes and limitations of alignment. To do this, I will take a high-level view of our current system.

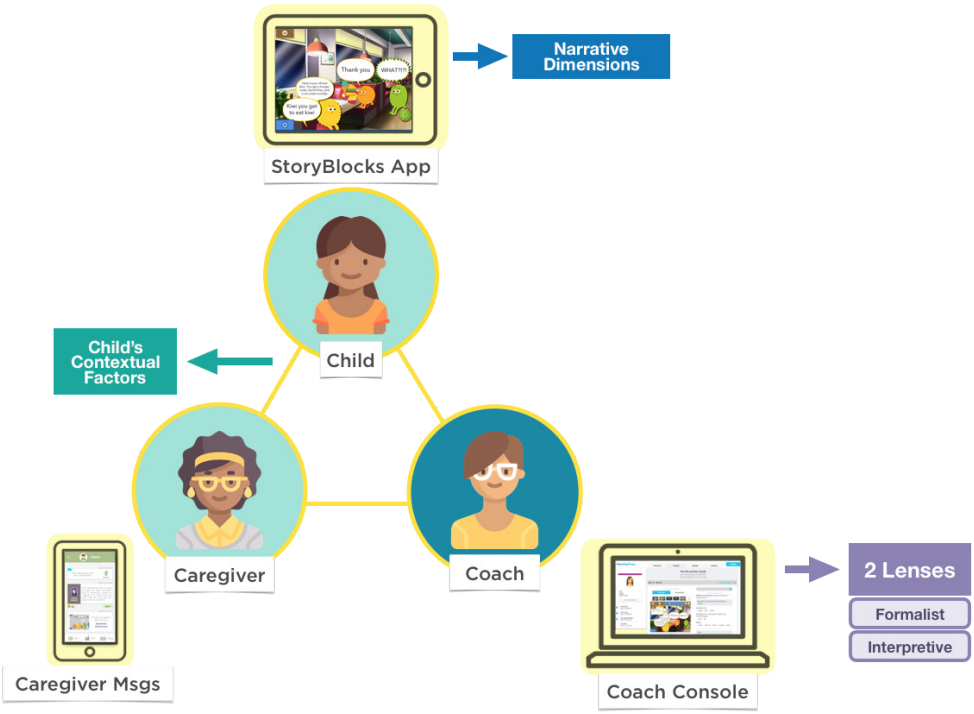


Figure 5.2 Applying the Two-Lens Approach to the Learning Loop

In the current Learning Loops system, a child plays with StoryBlocks to create their own personally generated stories. The app format determines the story medium (e.g., written), the type of data captured (e.g., written language, scene composition), and the identification and analysis of the narrative dimensions. To recap the features of StoryBlocks, the current design allows children to write stories about absolutely anything they would like, using written text in the form of dialogue and narration. The audio recording feature also allows children to tell stories orally, narrating each scene. Children use images to set the background, use characters (with emotional expressions), and type nouns to bring in items and compositionally represent the events of their scenes. They can use up to ten scenes to organize the events into a meaningful story. The output of StoryBlocks is a child's personally generated digital story. Children can make an unlimited number of stories, allowing the system to capture data within individual stories as well as across multiple stories.

5.2.1 Identifying Narrative Dimensions in Children's StoryBlocks Stories

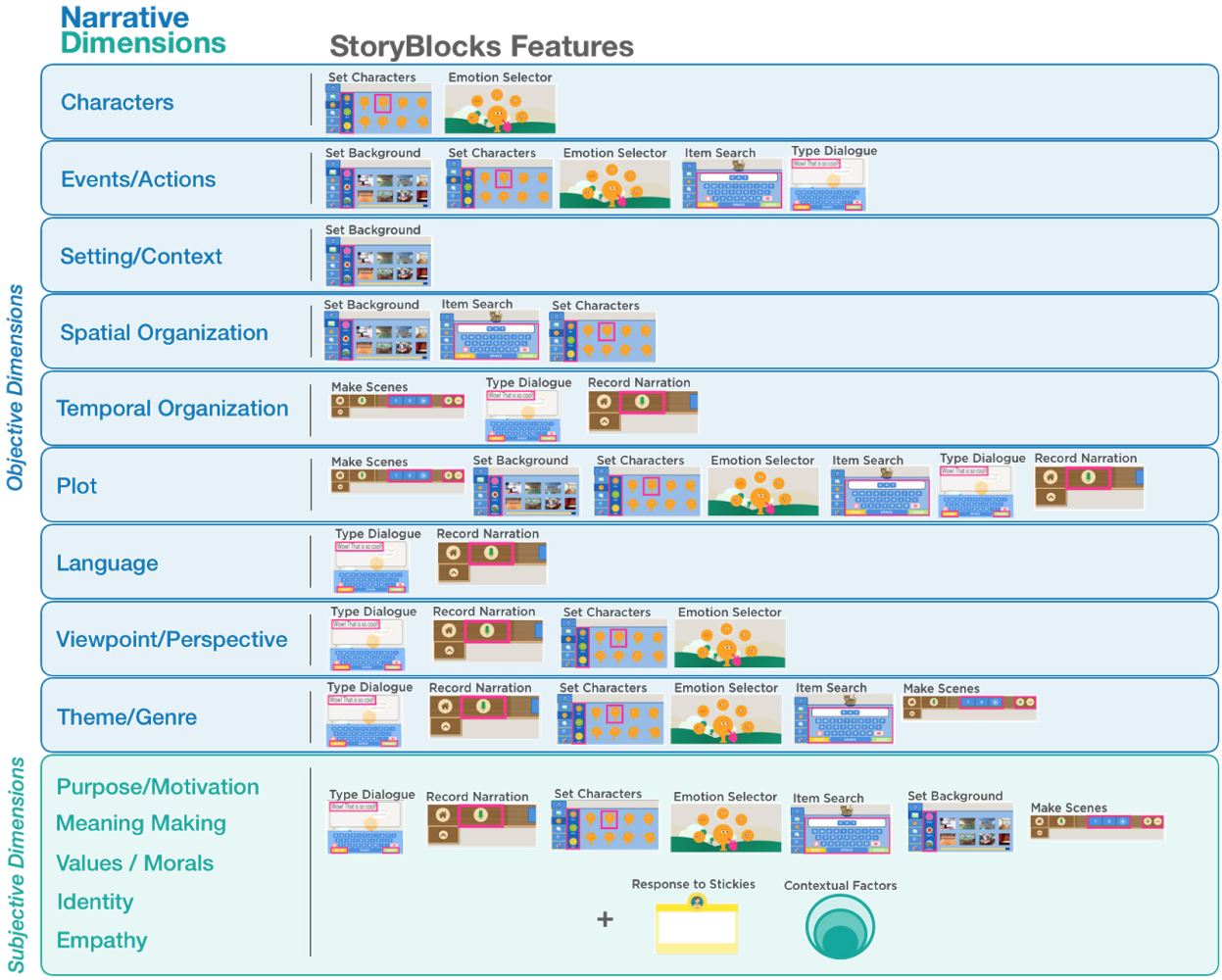


Figure 5.3 Mapping StoryBlocks Features to the 14 Narrative Dimensions.

The narrative dimensions are identified from the use of the different StoryBlocks features and the data captured from children's stories. Some objective dimensions are more complex and

are constituted by a combination of several features. For example, actions/events are identified by the scenes (frames), which are composed by the characters, text, and items in a particular scene (spatial organization). The temporal organization is represented by the ordering of the frames (scenes), along with any temporal markers identified in the written text or oral recordings. Other objective dimensions are more direct, such as the setting/context (determined by selecting a background image) and the characters (determined by selecting a character). All subjective dimensions can be identified by a combination of any of the StoryBlocks features, as well as the edits the child makes in response to the coach's feedback in the Story Sticky.

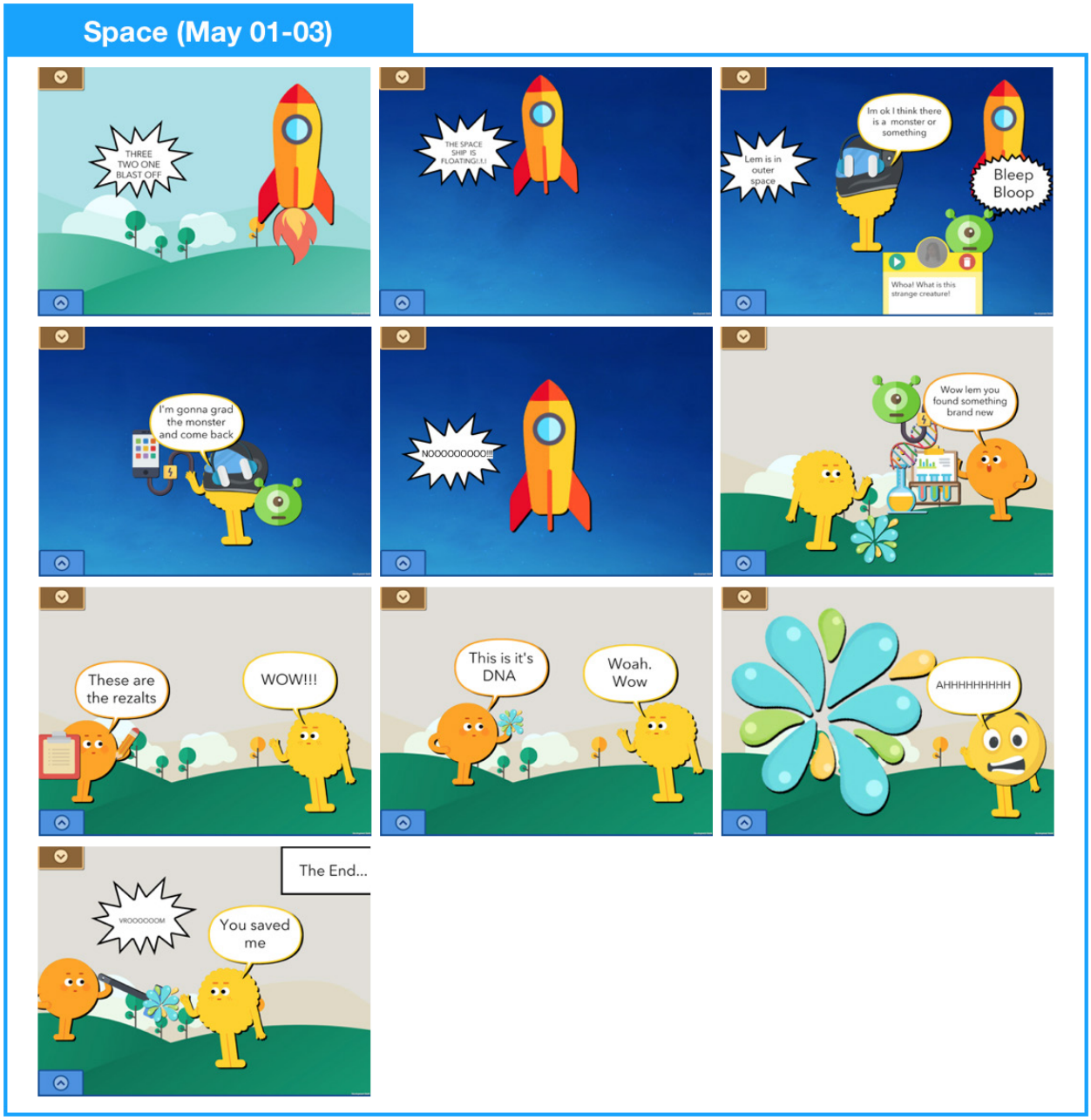


Figure 5.4 The story, *Space*, created by seven-year-old Rachel and analyzed for Narrative Dimensions

In figure 5.4, I revisit seven-year-old Rachel's StoryBlocks story titled *Space*, to look for the presence of the narrative dimensions. Rachel's story uses the features of StoryBlocks to represent all of the objective dimensions:

- Characters - Astronaut Lem (character), Space Monster (item), and Scientist Boo (character)
- Events/Actions - 1) *Beginning:* rocket (item) on land (background), blasting into space (fire item and dialogue bubble); 2) Rocket (item) floating in space (background and dialogue bubble); 3) *Initiating Event:* Astronaut Lem (character) finds a Space Monster (item) in outer space (background and dialogue bubbles); 4) *Character Reaction/Decision:* Astronaut Lem (character) tells command (items and speech bubble) that he will bring the Space Monster (item) back; 5) *Middle Scene Transition:* Rocket (item) travels back to Earth (background); 6) On Earth (background) Scientist Boo (character, emotions, and items) analyze (items and speech bubble) the Space Monster (item); 7) Scientist Boo (character) shares the results (items and speech bubbles) with Astronaut Lem (character); 8) Scientist Boo (character) shows Astronaut Lem (character) the DNA (items and speech bubbles); 9) *Problem:* the DNA (item) explodes on Astronaut Lem (character) who screams (speech bubble and emotion); 10) *Solution:* Scientist Boo (character) saves Astronaut Lem (character) by vacuuming up the DNA (items and speech and dialogue bubbles).
- Setting/Context - Outdoor park scene with blue sky → Space → Outdoor (on Earth) park scene with gray sky.
- Spatial Organization - She used items to represent the characters' jobs and actions (e.g., Lem wearing a space helmet, Boo working in a science lab) and backgrounds to represent the different locations of the scenes and set the context (e.g., on Earth, in space, and back on Earth with a different colored sky to distinguish the time).
- Temporal Organization - Looking at the scenes and the actions/events of each scene, the scenes are ordered in a logical sequence with the events being condensed into a single frame and flowing logically in time from one scene to the next. While there are no temporal markers or causal markers in the dialogue, the dialogue in the scenes help orient the event and give it more context (e.g., "the space ship is floating!", "the end…").
- Plot - To summarize the plot, you can look at the entire story, made up by each feature. Astronaut Lem goes into outer space and finds a mysterious space monster that he brings back to Earth. When Scientist Boo analyzes its DNA, something surprising happens.
- Language - Looking at the dialogue and speech bubbles, there are neither temporal markers nor causal markers. The narrations are in present tense (e.g., "Lem is in outer space") and most of the speech bubbles are in present tense (e.g. "I'm ok I think there is a monster or something") with the exceptions that Lem states his intentions in the future tense (e.g., "I'm gonna [grab] the monster and come back") and Boo references Lem's trip in the past tense (i.e., "Wow Lem you found something brand new"). Very few punctuation was used except to represent exclamations (e.g., "WOW!!"). Sound effects in the form of onomatopoeias were used (i.e., "Bleep Bloop", "vroooooooom"). Some invented spelling was used (e.g., "rezalts" for "results"). No emotional language was used, but exclamations of emotional reaction can be identified in the characters' speeches (e.g., "woah", "wow").

- Viewpoint/Perspective - Looking at the dialogue and speech bubbles, Rachel uses both the first person and third person. The narrator explains the scenes (e.g., when the space ship is floating) to represent third-person, and Astronaut Lem uses I-statements to indicate the first-person (e.g. "I'm gonna grab…").
- Theme/Genre - Reviewing all the features that make up this story, the genre is science fiction, and the themes are space, aliens, science, technology.

Identifying the subjective dimensions of the story *Space* requires looking at each of the StoryBlocks features that Rachel used and combining them together, much like how we looked at the plot. These subjective dimensions in Rachel's story can be interpreted in many different ways, I will present an example of one interpretation:

- Purpose/Motivation - unknown
- Values/Morals - Unknown
- Identity - Through the I-statements by Astronaut Lem, Lem seems like the main character that Rachel identifies with.
- Empathy - Rachel used some emotion to convey the expressions of the characters (e.g. Boo's surprised expression in frame six and Lem's surprise/fear in frame nine). Lem is a brave character who goes to space and seems to have a sense of wonder and curiosity through his actions (going to space and bringing the alien back) and his dialogue (exclaiming "Wow"). Scientist Boo seems to be relatively unemotional (neutral expressions besides the surprise in scene six) and be more of an analytical scientist (presenting the results neutrally), even quickly reacting to the problem by vacuuming the DNA without an expression. While there are some emotional reactions within this story, it is more focused on the alien and the science.
- Meaning - Unknown.

While I tried to interpret some of the subjective dimensions based on the StoryBlocks features, alone, I could not interpret all of them because the identification of the subjective dimensions was difficult without knowing Rachel's contextual factors. The only context we currently had for Rachel was that she is a seven-year-old girl. Therefore, while I can identify the objective dimensions within a story solely by the use of the StoryBlocks features, it is challenging to do the same for the subjective dimensions; more contextual information is needed to interpret the subjective dimensions.

5.2.2 Representing the Contextual Factors and Two Lenses in the Console

These narrative dimensions along with the actual story and the child's process of creating the story are synthesized and presented to the coach via the Console. The coach then uses the Console to view the story and analyze the narrative dimensions based on a combination of the two lenses. The StoryBlocks data can be viewed through a formalist lens by looking at the objective dimensions, represented by the Story Stats and some Story Annotations. Children's profile data combined with the responses of caregivers and children encourage coaches to consider the contextual factors when analyzing a story, further informing the interpretive lens. Finally, the interpretive lens is represented by the two modes of viewing a story (i.e., play mode and process mode), some of the long-form text responses in the Story Annotations, the process of writing feedback in the Story Stickies, and the process of composing caregiver updates.

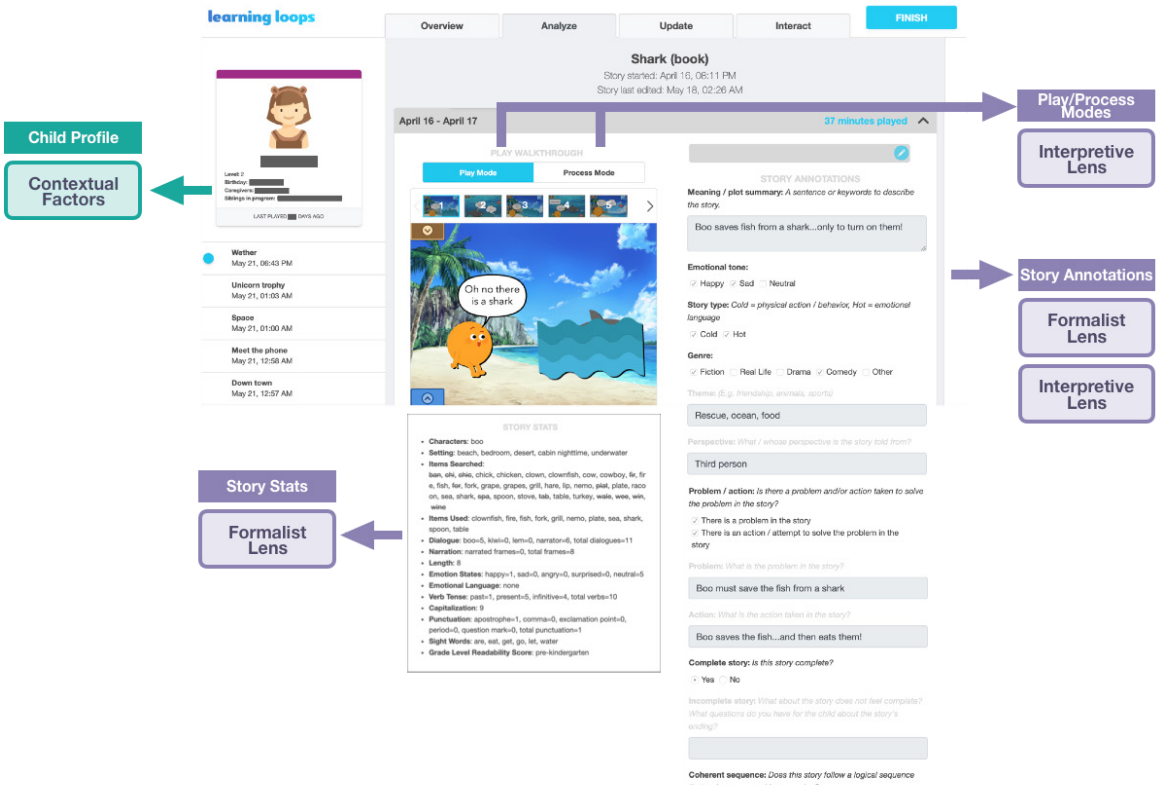


Figure 5.5 Mapping the Two Lenses to the Analytics Features of the Coach Console

The formalist lens is the most prevalent of the two lenses within the current Console because it is the easiest lens to automate. The Story Stats automatically identify many of the structural elements of the story and present them in a list-like fashion. Many of these stats address the formalist lens' question of whether and how the objective dimensions are present in the story. For example, the Story Stats identify the characters used in the story, the emotional language typed in the dialogue, and the items used in the story. For the less easily automatable objective dimensions (e.g., plot, theme, perspective) coaches manually identify them through the Story Annotations. For example, coaches identify whether the story follows a coherent sequence or not, whether there was a problem or action in the story, and categorize the story into themes and genres. These Story Stats and Story Annotations are recorded for each story within the analysis tab, and are also aggregated and presented across multiple stories in the overview tab.

The Console explicitly represents some contextual factors that coaches can use to inform their interpretations of the story. While analyzing the child's story, the coach has a persistent view of a couple of the child's contextual factors from their profile (i.e., age, skill level, family members). The coach can also access the notes panel on the right side of their screen to view any notes they took about the child's interests, experiences, or other observations. However, this feature was very rarely used. The majority of the contextual information that coaches used while analyzing stories was the feedback from caregivers and children. Coaches could send Stickies to the children's device to give feedback, praise, or ask questions. On many occasions, when coaches asked clarifying questions on children's stories, children responded to the Stickies through editing their story, giving the coach more context about their intentions (for examples, see figures 3.8, 3.12, 3.14, and 3.15 in section three). Caregivers were equally as likely as

children to provide contextual information in their responses to coaches after caregiver updates were sent. For example, after receiving an update one mother responded to her coach to let her know that the child was collaborating with her younger brother on a story about a boy who doesn't want to clean up toys. The coach was then able to account for the collaboration when analyzing that story. Another parent responded to her coach's update by providing context about the persistent themes in the child's stories, explaining that they go downtown a lot and soccer is always on the TV in their home because an older brother is obsessed. Children and caregivers can help give coaches a window into the intentions, experiences, and environments that influence children's stories.

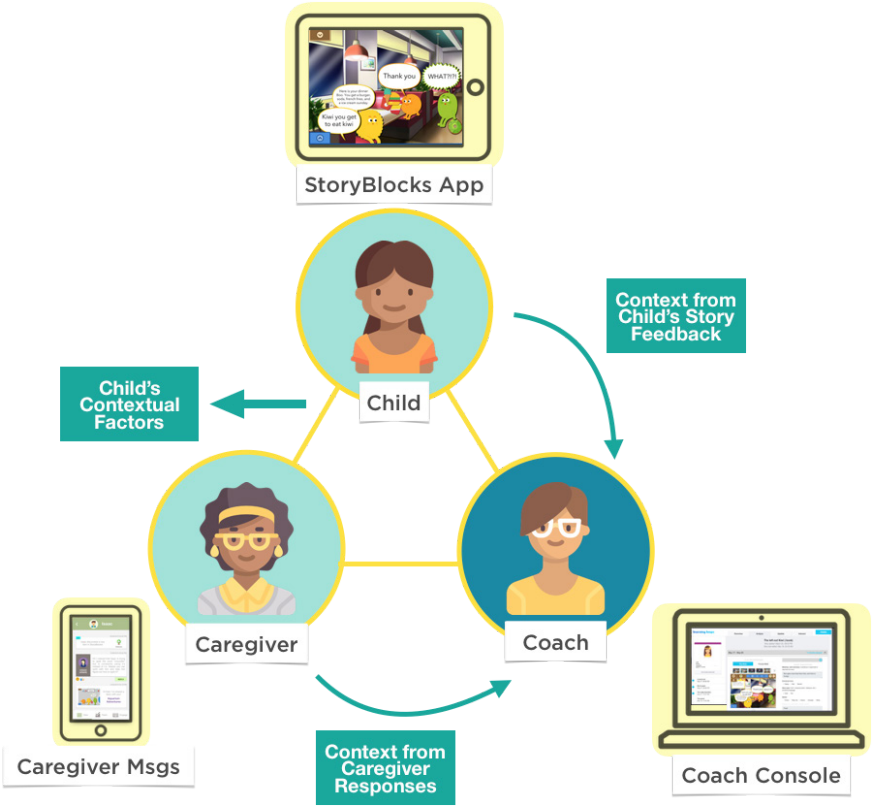


Figure 5.6 The Flow of Contextual Information Between Coach, Caregiver, and Child

Unlike the formative lens, the interpretive lens requires more active participation by a coach because it cannot be automated. To help inform the coach's interpretation, the Console displays the child's story through two modes. The first is the play mode, which is a frame-by-frame walk-through of the static scenes in the child's story. The second is the process mode, which is a sequence of screenshots condensed into a short animation video that shows the child's story creation process. The coach uses the child's story, the Story Stats, and any contextual information they have to complete the Story Annotations. While some of the items that comprise the Story Annotations are more structural (e.g., problem, action), several of the items are more interpretive (e.g., meaning/plot summary, incomplete story, incoherent story). For the latter items, coaches can write their interpretations of the story and/or its meaning, and use their interpretations to inform their caregiver updates and Story Stickies. For example, one coach's interpretation of the plot of an eight-frame story was "Boo meets Oob and finds out they are long lost twins." In the coach's caregiver update, the coach expands her interpretation by

telling the caregiver about the child's expression of emotion through the characters and asking whether the child has experienced similar feelings of fear and confusion with his siblings. Through the analyze and update process, the Console encourages coaches to use an interpretive lens when reviewing children's narratives.

5.3 Applying the Two-Lens Approach to Reassess Our System's Ability to Document and Support Narrative Progression

By applying the Two-Lens Approach to the entire Learning Loops system, I can reassess our system's ability to document and support children's narrative progression. First, in reviewing my definition of narrative — i.e., the culmination of cognition, emotion, and culture presented in various story mediums (e.g., written, oral, physical, mental) to express ideas, experiences, events, or imaginings for the purposes of communicating, sense-making, and identity formation — I can deduce that my definition of narrative progression must be more holistic. Aligning with the two lenses in my approach, my definition of progression must include both the improvement of the structural and linguistic narrative skills as well as increases along the interpretive narrative skills (e.g., sense-making, identity). In reviewing our system, our analytics tool did not necessarily support coaches in seeing meaningful changes in the objective dimensions of children's stories over time, nor did it particularly direct coaches' attentions to the subjective dimensions within individual stories or across stories besides the meaning of the plot and emotions of the characters. Despite this, coaches still managed to document children's holistic progression among four categories (i.e., completeness, coherence, expression, complexity) through their caregiver updates, and directly support children's holistic narrative progress through Story Stickies.

Even though the Console presented more of the formalist lens— i.e., directing the coaches towards analyzing objective dimensions such as language features and problem stories— the coaches still seemed to focus equally on communicating progress of the structural elements (e.g., story completeness, story coherence, complexity of story detail) as progress on the interpretive elements (e.g., emotional expression, elaborating on meaning, complexity of plot) of children's stories. For example, figure 5.7 shows nine selected caregiver updates from Coach Natalie about Roger's progress over the eight week pilot organized along a continuum. The updates in blue represent progression of the more formalist aspects of narrative and purple represent progression that is more interpretive in scope.

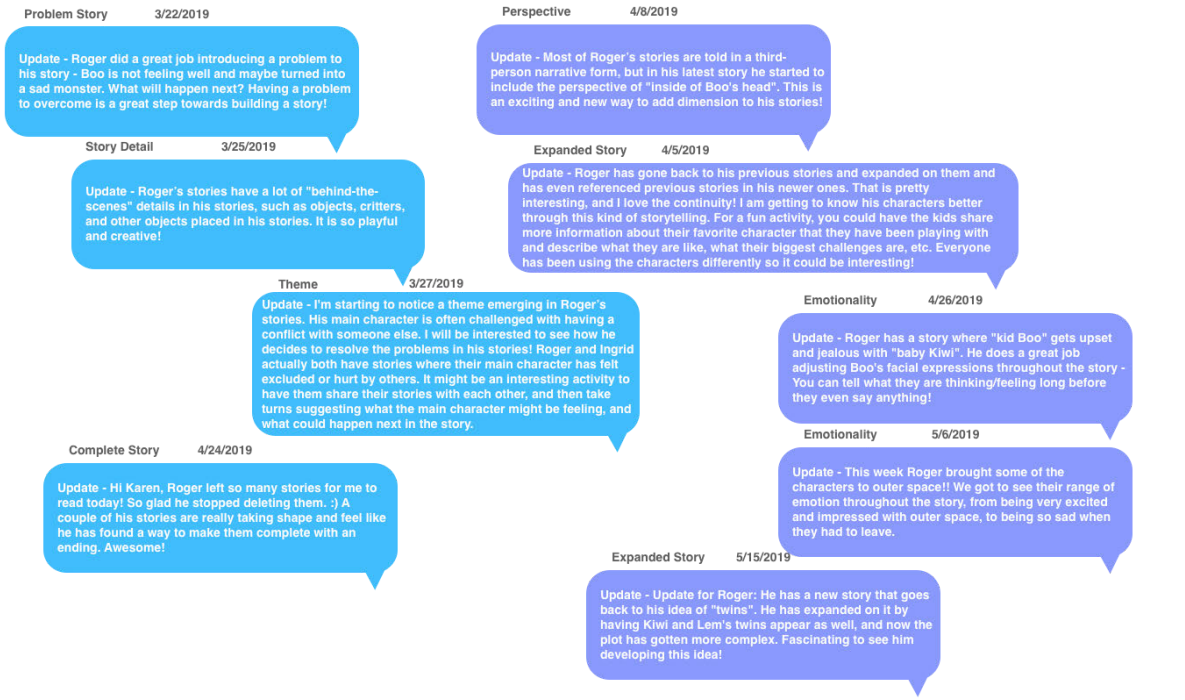


Figure 5.7 Selected Caregiver Updates by Coach Natalie About Roger's Formalist (blue) and Interpretive (purple) Narrative Progress.

To support children's narrative progression, coaches used Story Stickies to help children develop both structural and interpretive elements of their stories. For example, figure 5.8 revisits Macy's story and Coach Melanie's Story Sticky, which asks Macy to edit the structure of her story by asking, "what happens next?" Coaches also asked children prompting questions to help children elaborate and communicate meaning, context, and purpose through their stories. For example, figure 5.9 revisits Dana's story and Coach Sarah's Story Stickies. While Coach Sarah's Stickies also ask Dana to elaborate on some of the structural elements of her story, she uses prompting questions and reflective strategies to focus Dana's attention on more interpretive dimensions of the story, such as setting the context for the scene and elaborating on the witch's feelings and reactions. Coach Sarah could have easily focused her feedback on formalist dimensions, such as correcting spelling errors within Dana's story (e.g., wetch), but instead, Coach Sarah gently scaffolds spelling by modeling the words (e.g., witch) in her Sticky while giving direct praise about the narrative strategies that Dana used successfully (i.e., making the witch character like a real witch who doesn't want to be around people). Providing these types of feedback to children aligns with our pedagogies of scaffolding and constructionist learning that is child-driven. I believe that shifting the focus to include the interpretive lens encourages children to feel supported by their coaches in making their own stories that align with their goals and intentions, rather than feeling like their stories have to fit a specific mold and decreasing their motivation to use StoryBlocks to make their own personally-generated stories. This is an extremely important part of our model, and the tools of our system must reflect this by directly supporting coaches in providing relevant, interpretive feedback to children.

Figure 5.8 StoryBlocks Story by Macy and Coach Melanie's Story Sticky to Influence the Structure of the Story.

Figure 5.9 StoryBlocks Story by Dana and Coach Sarah's Story Stickies Asking Questions that Encourage Reflection and Inspire Elaboration of Characters' Emotions.

Therefore, we need to redesign the Console and analytics to help coaches first see the subjective dimensions of narrative and then better communicate them to caregivers and directly support them through Stickies. Furthermore, our Console and analytics must integrate the four categories of progression, especially those that are less structural (i.e., coherence, complexity, expression) and use the data from the formalist lens and contextual factors to direct the coach's attention towards the more interpretive aspects of children's narratives as they support narrative progression holistically and systematically. In order to do this, I must use the Two-Lens Approach to identify the limitations of our current system and use these limitations to inform the next iteration of our analytics system and Console design.

5.4 Limitations of the Current Learning Loops System Informed by the Application of the Two-Lens Approach and Future Implications

Applying the Two-Lens Approach to the current Learning Loops system highlights several limitations of both the StoryBlocks app and the analysis tools within the Console. There are four main limitations for StoryBlocks. The first two limitations were illuminated by the contextual factors. First, children do not identify the themes or genre of their story within StoryBlocks. Setting the genre or identifying themes can help the child in drafting their story, and will help give the coach more context while they are analyzing the story [97]. Second, the current version of StoryBlocks does not capture the child's intended audience for their story. There are two features we hope to build into StoryBlocks in the next iteration to account for this. We aim to create a social sharing feature, where children can select their audience and share their story digitally with the Learning Loops community. We also aim to create an export feature where children can export their stories to PDF and send them to whomever they would like (e.g., grandmother). The third StoryBlocks limitation is that the comic-style story design does not allow for long narration, which may be misrepresenting children's language and narrative skills through biasing the medium they use. For the next iteration of StoryBlocks, we must consider how to provide more opportunities for text. Lastly, StoryBlocks was designed so that children could always edit their stories, and because of this, there was no distinction between a completed story and an in-process story; in other words, there was no way for a child to indicate when a story was complete. This limitation hindered both the Console's ability to analyze and the coach's ability to interpret the child's story because it may have been incomplete. The next iteration of StoryBlocks must address this limitation by including the ability for children to indicate when a story is complete and ready for analysis.

Several limitations were discovered by applying the two lenses to the current analytics system within the Console. First, while the intention was to create a holistic analytics system, the current analytics mainly represents the formalist lens, identifying the structural elements of a story through the Story Stats and some of the Story Annotations. The Stats are mainly displayed as counts or lists which do not explicitly reference their significant link to children's narrative development. Therefore, the formalist lens becomes less useful in informing the coach's interpretation of the story. In a similar vein, while the current analytics system uniquely accounts for the interpretive lens, the Story Annotations focus more on supplementing the formalist lens by identifying the less easily automated structural elements of a story, rather than directing the coach towards taking a more interpretive perspective beyond the structure of the story. To account for these limitations, the next iteration of the analytics system must make the Story Stats and the Story Annotations salient to how they represent children's narrative progress, and present it to the coaches in a meaningful way to help inform their interpretations and make them more accurate. Finally, the dynamic contextual factors should be made more accessible to the coach on the Console. The current contextual factors are statically represented by the child's profile information and the sporadic context given by the story edits of children and responses of the caregiver messages. The next iteration of the Console should provide more contextual information and incorporate the supplemental context the caregivers share into the analyze screen in order to overcome this limitation.

In conclusion, by applying the Two-Lens Approach to the current Learning Loops system I was able to identify successes and limitations of alignment. The current Learning Loops system successfully takes a holistic approach by helping coaches view and analyze more than just the

structural dimensions of children's stories. However, the limitations of the current system shed light on ways we can improve the StoryBlocks app and analytics system. In the remainder of this dissertation, I will address the limitations expressed above by using the Two-Lens Approach to inform the next iteration of both the Learning Loops platform for narrative expression and the analytics system, in order to improve Learning Loops' ability to document and support children's narrative capacity in a more robust, holistic, and systematic way.

6 Design Document: Prospectively Applying the Two-Lens Approach to Design the Next Iteration of Learning Loops

This design document details design modifications for three integral parts of the system: (1) StoryBlocks, (2) Play Analytics, and (3) the Coach Console. Each of these parts of the system are interconnected, and their designs will impact each other. The redesign of StoryBlocks will inform not just children's interactions with the types of stories they can tell, but also the design of our analytics system and the type of data we can document and analyze. Our Play Analytics system will determine the process by which we document children's story data and analyze it to both represent children's narrative skills and understand their narrative progress. The Console will impact the process by which we present children's story data to coaches to help them view and communicate learning moments, influencing coach interactions with children and families.

6.1 StoryBlocks redesign features

Based on the learnings from our Learning Loops Spring 2019 pilot and the limitations gleaned from applying the Two-Lens Approach, there are several key modifications that need to be made to the StoryBlocks design. First, StoryBlocks should include more opportunities for text, allowing children to create different types of stories beyond just comics. Second, children should be able to indicate when a story draft is complete and ready for analysis. Third, children should be able to specify the genre, themes, and intended audience of their stories. Fourth, StoryBlocks should encourage opportunities for social interactions and story sharing among coaches, peers, and families in the Learning Loops community. Each modification is explained in more detail, below, along with a preliminary mock-up for how the feature could be designed.

6.1.1 Increasing Opportunities for Text

In order to support children's full narrative expression, the design of StoryBlocks needs to increase opportunities for text so that children can create different types of stories using multiple modalities (e.g., visual images, written text, spoken dialogue). In the current design of StoryBlocks, children can use all of these mediums, yet they are limited by the size of the speech bubble and size of the screen and frame. In this way, the current design may be biasing children's stories to include less written narration and more character dialogue. Similarly, we may be unintentionally misrepresenting children's written narrative skills because there is a barrier to inserting longer narrations or written detail. Therefore, we plan to increase opportunities for text into the StoryBlocks design to allow for children to create any type of story they would like, not just comic-style stories. In making this modification, we want to make sure that we do not obscure the important role that items, backgrounds, and other visual elements play in children's constructions of stories. Therefore, we want to give children the option to create both picture book-style stories and comic book-style stories. Figure 6.0 demonstrates a mock-up of the potential design and interaction of increasing opportunities for text.

Figure 6.0 Initial Mock-Up to Increase Opportunities for Text in StoryBlocks

In this new design, children can first choose which type of story they would like to make. Then, they can click on the page at the bottom of the screen to write down, in a long-form textbox, the details of their story. This transforms a child's story from a comic book to a picture book without changing up too many elements of the design or taking the focus away from the visual elements of the story. Children can then use the keyboard to type the text of their story. When they are finished, they can tap the arrow button at the top right to return to the visual scene of the frame. They can do this for each frame in their story.

6.1.2 Indicating Completion of Story Drafts

One of the major limitations of the current StoryBlocks app was the fact that children's stories were always editable and there was no way to indicate completion of a story draft. This caused complications for the entire Learning Loops system because since stories were always editable, there was no ideal time to analyze and annotate them, which led to the creation of artificial story sessions, breaking up stories inorganically and causing confusion for coaches. The lack of indication for completed story drafts impacted our analytics by not being able to view story data at the story level, only at the story session level, forcing coaches to sometimes annotate a single story multiple times and interfering with the Console's ability to display children's story data across multiple stories over time. For the child's experience, not being able to indicate when a story was complete meant that sometimes they got feedback on their stories when they weren't ready, or they wanted to play through a story and show it to someone but had to go to their story and click through each frame, accidentally messing up their story when they had not intended to edit it. Therefore, we plan to integrate a feature where children can indicate when they are finished with a draft of their story and ready for it to be analyzed or reviewed by a coach. There are several ways we could do this, ranging from implicit to more explicit indications. Figure 6.1 shows three designs that we could use to help children indicate when their draft is complete.

Figure 6.1 Three Possible Designs for Children to Indicate Completion of Story Drafts

The first design presents a more intuitive, less explicit way to indicate completion, by dragging a "the end" or "to be continued" sticker onto the last frame of the story. Many children did this in their stories naturally, and it served as a helpful signal to the coach that the child felt that their story was complete. However, not all children may use this feature, and so more explicit prompts may need to be introduced to encourage the child to indicate whether their story is complete or not. In the second design when the child taps the home button to return to their home page, a pop-up could appear that asks the child whether their story is complete or not. Alternatively, we could provide a second button next to the home button in the navigation bar that the child clicks to indicate a complete story. Either of these could be combined with the first design as a fail-safe to indicate story completion. Lastly, we could design StoryBlocks to make the process of indicating completion a more active process for the child. As an example, the last design shows a redesign of the home screen where children have to drag their story to the "publish" bookshelf to indicate that it is ready for review. However, children may not always do this on their own, so we would want to set up parameters, such as prompting a child to drag their book to the bookshelf if they have not worked on it in a couple days.

It is important to consider the impact this feature will have on the coaching process of analysis and the processing of the child's story data. Therefore, the design of this feature should be done in conjunction with the design of the Console and reflect the coach's responsibilities and interactions. Another consideration in designing the story draft completion indicator is that

children will need a different mode between an editable story and a published story. This inspires the need for a play-through mode of a story (see an example design in figure 6.2). Having a published or play-through mode will also allow children to share their stories with others, which will be explained in further detail below.

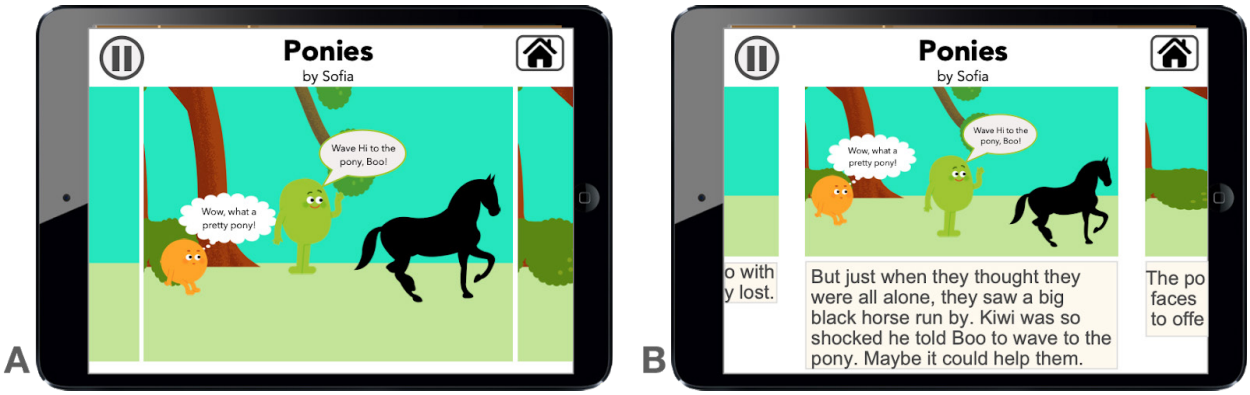


Figure 6.2 Example Design of a Play-Through Mode: A) Comic Book Story, B) Picture Book Story.

6.1.3 Specifying Genres, Themes, and Intended Audience

According to Bruner (2003) identifying the genre of the story impacts both the writer, by helping to formulate the story's language, style, themes, and goals; and the reader, by helping understand how to interpret the story [97]. In the current design of StoryBlocks, children do not indicate their story's genre or themes. Instead, it is up to the coach to interpret what the genre and themes are. Knowing the child's intended genre and themes will help the coach understand the child's intention and inform the coach's interpretation. This is an important contextual factor that is currently unknown, but would be easy to incorporate into the design of StoryBlocks. The question becomes whether children should indicate their story genre and themes at the beginning and/or end of the story. Returning to Bruner's explanation about the double impact of identifying the story genre suggests that identifying the genre at the beginning of the creation process could help the child formulate their StoryBlocks story. However, some children create stories with a more fluid process, making it up as they go along or exploring many features in a scene until they land on something that sets them off on creating a new story. Therefore, for children who don't follow a linear story process, it might be more helpful to identify the genre after they have created the story; almost like a summarization strategy. To appeal to a wide array of users, the design of this feature should resemble the feature for setting a title, where children can do this at any point in the story creation process. Figure 6.3 shows two designs of the potential feature for identifying the genres and themes within StoryBlocks.

Figure 6.3 Two Mockups of Potential Feature for Identifying Genres, Themes, and Audience in StoryBlocks.

Another contextual factor that the current StoryBlocks design does not yet capture is the child's intended audience. Similar to genre, this factor will also have impact by helping coaches interpret the story because they will know who the story is intended for. The current system defaults to the audience being the coach, but the child has no choice in sharing with the coach, and it is unclear whether the child is manually showing their story to others in their environment. Children tend to use different narrative strategies and styles depending on their audience. For example, as I write this dissertation, I am using language and style to appeal to a more academic audience. However, if I were writing a summary of my dissertation work to a participating family in the Learning Loops program, I would not include words like "verisimilitude", and instead I would focus on one or two examples to describe the whole system, shorten the findings, and use more anecdotes than statistics and numbers. Likewise, the stories that children create for their peers, family members, teachers, and other adults vary in their form and content.

The designs in figure 6.3 incorporate the intended audience feature, with the second design building on the ability to mark a story draft as complete. Once the child indicates a story draft is complete, a pop-up prompts them to indicate who this story is meant for by selecting from the icon options in the dropdown menu (e.g., coach-only, Learning Loops community, specific peer(s) + coach, family members + coach). With the feature of selecting an intended audience, we also want to build social sharing capabilities to send completed, play-through modes of stories specifically to the child's intended audience. Therefore, our next modification is to design more opportunities for social interactions and social sharing in StoryBlocks.

6.1.4 Creating Opportunities for Social Interactions and Social Sharing

One of the main functions of storytelling is communicative, and while our current system accommodates this social function by sharing stories with coaches who loop the caregivers into the child's storytelling process, we also want to design opportunities for children to have agency over what they share and who they share with. Once children select their intended audience, there are two modes of sharing their story. First, if children decide to share their stories either with the wider Learning Loops community or specific peers within their Learning Loops network, a "published" version (i.e., play-through mode) of their stories will be sent directly to the recipients' StoryBlocks accounts after they are analyzed by a coach. Second, if children want to share their stories with someone outside of the Learning Loops community (e.g., family members), then they can export and save their stories to PDF versions and those are sent directly to the desired recipient (e.g., sent to grandma via email). The home screens of figures 6.1 and 6.3 include a sharing button (located below the edit button) that children can select to share their specific stories. Children can also share their stories by selecting their intended audience once they mark their story as complete.

Beyond story sharing, we also want to increase social interactions between children and coaches, and children and peers. Inspired both by the feedback from our coaches and by increasing access to the contextual factors to inform the interpretive lens, we plan to modify the Story Stickies feature by allowing children to respond directly to their coaches. In the current design, children could not respond directly to the coach's Story Stickies, and could only respond indirectly by editing their story to reflect the coach's feedback. When coaches asked questions to help with interpreting the child's story (e.g., reflective questions), children were not able to respond and coaches had no way of knowing whether the children saw their questions or praise and ignored them, or whether they impacted the child. Modifying the design of the Story Stickies, represented in figure 6.4, will increase back-and-forth interactions between children and coaches that can provide more context for interpreting children's stories and help coaches gauge which feedback strategies have impact on the child's learning. Similar to how the design of Story Stickies accommodates readers with varying skills, this modified feature will accommodate the variety of our users' typing skills by allowing children to respond through typing text or recording audio.

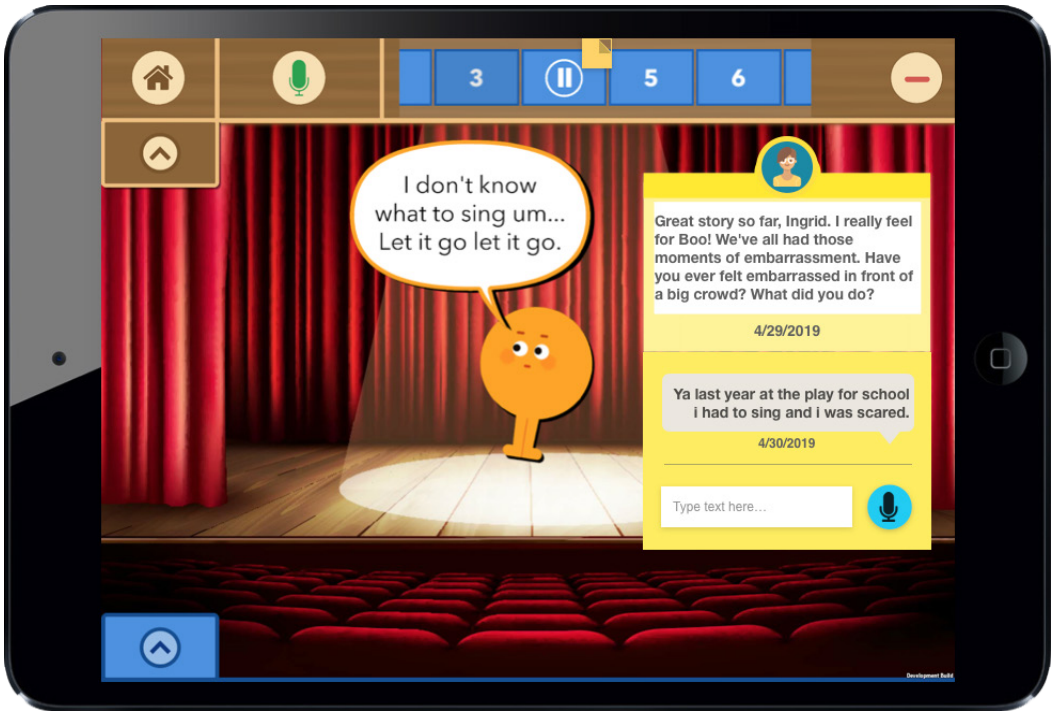


Figure 6.4 Mockup of Modified Story Stickies Design to Include Children's Responses.

The second way we plan to increase opportunities for social interaction between both children and coaches and children and peers is through the co-creation of stories via Story Starters. Story Starters are when coaches can create the first few frames of a StoryBlocks story within the Console and send it to the child's device, where they can open it as an editable StoryBlocks story that they can change and finish. There are many different strategies to provide scaffolding for children's narrative development, and research shows that when adults and peers engage in the storytelling process, children are more motivated and make greater skill gains [3; 26; 6; 7; 42]. Story Starters also serve as a means to increase children's exposure to different story mediums, genres, and strategies, as well as model techniques and remove children's fear of the blank page. We have already designed and developed the Story Starters feature for coaches and children, but have not tested this feature yet. We would like to extend this feature so that children in the same Learning Loops network can send Story Starters to each other and co-create stories together as a way of interacting. Figure 6.5 shows two wireframes of the current Story Starters feature; the first is how the coach creates a Starter within the Console and the second is how the child receives the Starter within StoryBlocks.

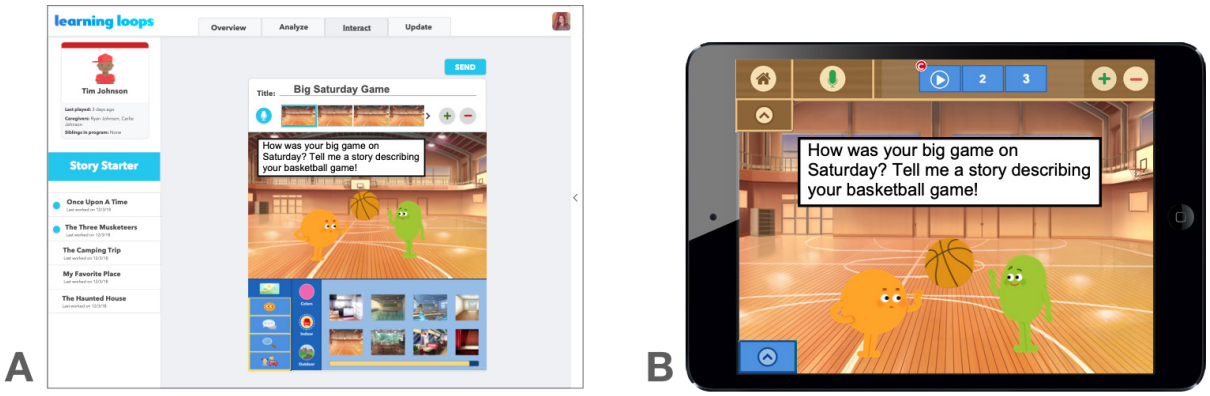


Figure 6.5 The Current Story Starters Feature: A) Coach Creates Starter in the Console. B) Child Receives Starter and Edits Story in StoryBlocks.

To modify the Story Starters feature to include interactions between children and peers, children could access the Starters by selecting "Create Story Starter" on their home screen in StoryBlocks, next to the "Create New Story" button (see home screens in figures 6.1 and 6.3). Children could then create one or two frames using the regular features of StoryBlocks, and then send it to whomever they choose rather than indicating it as complete. Implementing these modifications will increase the social interactions between children, coaches, and peers, which will increase the Learning Loops system's ability to support the social function of children's narratives.

6.1.5 StoryBlocks Roadmap: Towards a Scalability and Sustainability

Finally, there are several modifications we plan to make to StoryBlocks in order to transition from prototype to product and optimize its design for scale and sustainability beyond an eight-week pilot. We have been developing a product road map for a new version of StoryBlocks that identifies three modes of interaction within an animated story world environment. The three modes are: 1) Create, 2) Challenge, and 3) Social. The Create mode is most aligned with the current functionality of StoryBlocks, which incorporates the modifications detailed above and where children can freely create any kind of story they would like. In Challenge mode, children can enter into different minigame challenges, centered around elements of storytelling. One example of a challenge could be that children have to write a story about how to solve a current event (e.g., climate change) and then children can vote on the winning solution. Another challenge example could be writing details of a story or remembering clues to solve a murder mystery. These challenges will range in intensity and skill level, from personal timed challenges to full story creation. Finally, the Social mode will be the community for the new social sharing features, resembling a peer story sharing network. Children in the same Learning Loops community will be able to share stories with one another, co-create stories together, and access a library of stories— all moderated by a trusted coach or coordinator. While the design and implementation of these three modes are outside of the scope of this dissertation, I recognize that implementing the feature modifications of StoryBlocks explained above is the first step towards our product roadmap; creating a productized, sustainable, and scalable storytelling app that can document children's digital narratives.

In conclusion, by implementing these modifications, I am able to address one of my research questions presented at the outset of this dissertation (i.e., based on our theoretical

framework, how do we design the best platform for children's narrative expression?). Our findings from the Learning Loops Spring 2019 pilot suggested that the current StoryBlocks app proved to be a good platform for supporting children's narrative expression. By implementing the modifications informed by the Two-Lens Approach— i.e., opportunities for text, complete story drafts, identification of genre/theme/audience, and social interactions/story sharing— StoryBlocks will be a stronger open-ended platform for children's narrative expression.

6.2 New Play Analytics Redesign and Computational Approach

The learnings from the spring pilot and the Two-Lens Approach highlighted several limitations of the analytics system, specifically: 1) the overemphasis on analyzing the formalist elements of children's narratives, 2) the disconnect between the Story Stats and Story Annotations, 3) the disconnect between the contextual factors and the Story Annotations, and 4) the lack of clear definition and demonstration of narrative trends and progression within and across children's stories. In response, the Two-Lens Approach inspired five steps that I will take in order to redesign our analytics system. First, I will redefine our metrics of analysis to align with my definition of narrative, creating benchmarks that address both the formalist and interpretive elements of children's narratives. Second, in order to do this, I will restructure our Story Stats and the objective Story Annotations by directly linking the automated data with the annotations to identify the objective dimensions. Third, I will systematically capture any known contextual factors and make them explicitly accessible. Fourth, I will combine the available objective dimensions and contextual factors. I will link this story data to the annotations to inform the coach interpretations of the subjective dimensions that align with our interpretive metrics. Finally, I will reorganize the data to document progression of the structural metrics and highlight trends of the interpretive metrics across children's stories, guided by the four categories of progression identified by the coaches in the pilot (i.e., completeness, coherence, expression, complexity). This five-step process culminates in the proposed outline of the next iteration of a holistic analytics system for Learning Loops and suggestions for an improved computational approach, presented below.

6.2.1 Next Iteration of the Analytics System

In light of my broad, holistic definition of narrative, I have restructured the goals of our analytics system both for an individual StoryBlocks story and across multiple StoryBlocks stories. The goals of the analytics for an individual story are to: 1) document narrative skills demonstrated in the story's creation, 2) inform the coach's interpretation of the story's greater meaning and purpose, 3) surface learning moments— i.e., highlight new or learned skills or content that has not been present or shown in the creation of previous stories, 4) document total time (in minutes) spent on creating story, and 5) display story drafts and story edits made in response to coach's feedback. The goals of the analytics across multiple stories are to: 1) demonstrate trends across story content and subjective dimensions (e.g., genres, themes, global meaning, expression, identity), 2) document and display narrative progression among specific skills and objective dimensions (e.g., completeness, complexity, coherence, language skills), 3) connect changes in children's story trends and skills to their significance in children's narrative development, 4) document relevant contextual information and events (e.g., interests, birthdays) and align it to child's story play to identify potential impact, and 5) document trends in play time and history of play.

The new analytics are organized into five sections in order to more clearly identify content and skills, interpret the meaning within individual stories and across multiple stories, and surface skills progression and story trends. The first section is an outline of the features present in the story view. The remaining four sections of the new analytics (i.e., story content and skills, skills progression, story meaning, global story trends) are further broken down into benchmarks, which have metrics— or narrative dimensions constituted by relevant story data. For example, within the story content and skills section, the four benchmarks are story completeness, story coherence, expression, and complexity. The benchmark for story completeness consists of several metrics, one of them being actions/events, which is informed by the frames. The coach uses the data from the metrics to annotate the benchmarks. Through this process, this new analytics system integrates the story data more efficiently to inform the coach annotations and interpretations.

A first draft of the new analytics sections, benchmarks, and metrics are presented in the following outline.

1. **Story Views:** the persistent view of the child's story along with a view of the child's storytelling process. Coaches use the story views to read, understand, annotate, and interpret. When they annotate parts of stories, the relevant story data will be highlighted within the story view, directing the coach's attention to the salient trends. The story views present the who, what, where, when, and how of the story, which is further broken down by the content and skills. The "why" of the story is interpreted by the coach. The features present in the story view are:
    a. *Story Mode* - the visual representation of the child's story, displayed as a frame-by-frame play-through with a short snapshot overview of relevant story data below the images. Relevant sections from the story visual and story data are highlighted to inform annotations. The relevant story data displayed are:
        i. Story title
        ii. Play time and start/end date
        iii. Genre and themes
        iv. Intended audience
        v. Plot summary
    b. *Drafts Mode* - the persistent view of the child's story process and draft edits. Coaches can toggle to the process mode to view the drafts a child made, complete with the coach Stickies and the edits children made in response to coach feedback. Coaches can also see an animation of the child's entire story creation process.
    c. *Child Profile* - the persistent view of the child's contextual factors that help inform coach interpretations. This profile is always editable, so coaches can add or change information as they get to know the child. The child's profile may include:
        i. Child name
        ii. Family members
        iii. Group memberships
        iv. Birthday and age
        v. Narrative skill level
        vi. Personality traits

vii. Likes and interests
viii. Relevant/upcoming events
ix. Coach notes (e.g., copied from the messages or stickies).

2. **Narrative Skills:** children demonstrate narrative skills through the structure and content of their stories. Therefore, this section uses a mostly formalist lens to analyze the structure and mechanics within a single story, highlighting the child's narrative skills by identifying the presence of the objective dimensions. We analyze the narrative skills within a single story by looking at four benchmarks:
    a. *Story Completeness* - the degree to which the structure and content of the story feels complete; ranging from an incomplete story fragment to a complete story with a clear beginning, middle, and end. To annotate this benchmark, coaches answer the question, "how complete is this story?" by supplementing and reviewing the following metrics:
        i. *Context/Setting* - identification of where the story takes place and when the story takes place (across what period of time). The output of this metric is machine-generated classification of the setting (e.g., night sky background with stars and spaceship classified as "space"). The automated story data highlighted in this section are:
            1. Background setting for each frame [M]
            2. String of time for background setting (e.g., day to night) [M]
            3. Composition (e.g., items used in the background) [M]
        ii. *Story Length* - identification of the length of the story (in number of frames) and the time the child spent on creating this story (minutes played per story). The output of this metric is the machine-generated count of the length of story and duration of story creation. The automated story data highlighted in this section are:
            1. Frame count [M]
            2. Play duration in minutes [M]
        iii. *Actions/Events* - identification of the action/events within the story. The output of this metric is a machine-generated count of the number of actions, validated by the coach. The automated story data highlighted for this metric are:
            1. Frames (with composition, background, characters, items, emotions, dialogue) [M+C].
        iv. *Beginning, Middle, and End* - the identification of the beginning (context setting) middle (precipitating event) and end (resolution) of a story where something happens over time. The output of this metric is coach selecting where the beginning, middle, and end of the story are (by frame number) [C].
        v. *Problem and Solution* - the identification of any problems and proposed solutions within a story. The output of this metric is the coach selection of the frames that contain the problem(s) and solution(s) [C].
        vi. *Plot* - the identification of the main happening of the story, usually a summary of the actions, events, or problems of the story. The output of

this metric is the coach-generated one-sentence summary of the plot. The automated story data highlighted for this metric are:

1. Child indicated themes [M].
2. Machine-predicted themes (based on background and items) [M].
3. Child indicated genres [M].
4. Highlight any frames that have been annotated for beginning, middle, end, or problem/solution [M+C].

vii. *Completeness Level* - Based on the above data and supplemental coach input, the machine selects the level of completeness of the child's story on the completeness rubric, and the coach validates it or can change it manually.

b. *Story Coherence* - the structure and content of the story that comes together to make sense. To annotate this benchmark, coaches answer the question, "how coherent is this story?" by supplementing and reviewing the following metrics:

i. *Salience of Actions* - of the number of actions, the identification of related events or the relevance of the actions. The output of this metric is the machine-generated prediction of the relevance of actions by analyzing the similarities between each frame and the coach's validation of the relatedness [M+CV].

ii. *Logical Sequence of Events/String of Actions* - identification of the temporal organization dimension and validation of sequence of actions/events. The output of this metric is the machine prediction of the accuracy of the logic of actions based on the story data, and the coach validation of that prediction. The automated story data highlighted for this metric are:

1. Frame order [M]
2. Consistency of time in backgrounds (e.g., day, dusk) [M]
3. Consistency of emotional vocabulary and emotion state [M]

iii. *Linguistic Cohesion* - identification of the language dimension for understanding and the validation of temporal and causal ordering. The output of this metric is to draw the coach's attention to the cohesive language used in the child's story. The automated story data highlighted within the story for this metric are:

1. Temporal markers (e.g., first, then) [M]
2. Causal markers (e.g., so, because) [M]
3. Manually input other cohesive language [C].

iv. *Analysis of Plot* - analyzing the plot is important to considering the coherence of a story. The output of this metric is to populate the coach's previous summary of the plot so that they can consider it when analyzing the story's coherence. The automated story data and repurposed coach annotations highlighted for this metric are:

1. Identified story genre [M]
2. Identified story themes [M]
3. Coach-generated plot summary [M+C].

v. *Story Type* - identification of story structure as a solitary action, unrelated list, focused chain, or true narrative. The output of this metric is a coach-selected category of the story type from a checklist [C].

vi. *Coherence Level* - Based on the above data and supplemental coach input, the machine selects the level of coherence of the child's story on the coherence rubric, and the coach validates it or can change it manually.

c. *Expression and Character Development* - the representations of expression and development of characters through presenting internal mental state and character reactions. Unlike the previous benchmarks that are more structural in their focus, this benchmark focuses more on content by analyzing both the objective and subjective dimensions of children's narratives. To annotate this benchmark, coaches answer the question, "how expressive and developed are the characters in the story?" by supplementing and reviewing the following metrics:

i. *Characters* - identification of the main characters in the story [M]. The output of this metric is a list of story characters and coach validation of the main characters. The automated story data highlighted for this metric are:

1. Characters [M]

ii. *Emotional Expression* - the identification of the emotional expressions and emotional language used in the story to represent the characters' emotional reactions. The output of this metric is a machine-generated list of the emotional expressions and emotional language used. The story data highlighted for this metric are:

1. Emotion state of the character [M]
2. Emotional language used for each character [M]
3. The congruence or incongruence of any emotion states linked to emotional language [M].

iii. *Emotional Arc* - identification of the cadence of emotion throughout the story represented by the characters. The output of this metric is a machine-generated prediction of the emotional arc. The story data highlighted to inform this metric are:

1. Emotion states and emotional language for each scene classified into an emotional narrative archetype [M].

iv. *Emotional Response* - identification of any salient emotional responses or reactions to an event or other characters. The output of this metric is the coach directing their attention to any salient emotional reactions.

v. *Character Development* - identification of character personality and character development throughout the story. The output of this metric is a coach interpretive description of any relevant character traits, character mental states, or character development. The story data highlighted to inform this metric are:

1. Characters and emotion states [M]
2. Character's speech bubbles and thought bubbles to represent mental state [M]
3. Perspective Language (e.g., I-statements) [M]

vi. *Character Empathy* - identification of the empathy displayed by the characters. The output of this metric is a machine-generated prediction of whether the character(s) displayed empathy. The story data highlighted to inform this metric are:
    1. Congruence of character emotion state and emotional language associated with empathy [M].

vii. *Expression Level* - Based on the above data and supplemental coach input, the machine selects the level of expression of the child's story on the expression rubric, and the coach validates it or can change it manually.

d. *Story Complexity* - the structural (e.g., visual, linguistic) details and content that combine to communicate the intricacies of a situation or idea through story. This benchmark is especially tied to the contextual factors of a child's age and skill level. To annotate this benchmark, coaches look at various types of complexity, such as complexity of thought (e.g., plot complexity, creativity), visual complexity (e.g., composition, level of detail), and linguistic complexity (e.g., language level, perspective) to answer the question, "how complex is the child's story?" by supplementing and reviewing the following metrics:

i. *Level of Detail* - identification of the level of detail the child used in creating the story as indicated by the amount of features (e.g., items, dialogue) used. The output of this metric is a machine-generated prediction of the level of detail trained by our level of detail rubric. The story data highlighted to inform this metric are:
    1. Level of detail rubric, informed by items, characters, dialogue, narration, background setting [M]

ii. *Composition* - identification of the spatial organization of the frames and how that communicates meaning and action in the story. There is no output of this metric, it exists to direct the coach's focus towards the composition of the scenes by highlighting the following story data:
    1. Items used [M]
    2. Background setting [M]

iii. *Language Level* - identification of the linguistic conventions of the written text in the story (e.g., the dialogue bubbles, text box narration) and the oral language used in the story. The output of this metric is a machine-generated prediction of the language level used for the written text of the story, combined with any coach annotations about the oral conventions used in the story to validate the prediction. The story data highlighted to inform this metric are:
    1. Grade-level readability score [M]
    2. Sight/age-related vocab words [M]
    3. Verb-tense [M]
    4. Punctuation and grammar [M]
    5. Temporal and Causal markers [M]
    6. Perspective (e.g., I-statements, verb tense) [M]
    7. Oral narration [C]

iv. *Perspective* - identification of the perspective taken to tell the story (e.g., first-person, third-person) and any shifts in perspective throughout the story. The output of this metric is a machine-generated prediction of the perspective(s) this story is told from, and the coach can validate the prediction. The story data highlighted to inform this metric are:
    1. Text language (e.g., I-statements, verb-tense) [M]
    2. Oral Language (e.g., spoken narration) [C].

v. *Plot Complexity* - identification of the intricate details that create a sophisticated plot. The output of this metric is the coach-selected level of plot complexity. The story data highlighted to inform this metric are:
    1. Plot summary populated from story coherence section [M+C]
    2. Story type populated from the story coherence section [M+C]

vi. *Creativity* - the identification of particularly creative, novel, or unique elements that the coach believes are of-note and warrant attention. The output of this metric is the coach's interpretive summary of the child's representation of creativity. These creative elements may not be captured by any other metrics or benchmarks [C].

vii. *Complexity Level* - Based on the above data and supplemental coach input, the machine selects the level of complexity of the child's story on the complexity rubric, and the coach validates it or can change it manually.

3. **Skills Progression:** skills progression looks at the changes in children's narrative skills across all stories. To document children's narrative skills progression, we situate each story within the landscape of all the child's stories and run an analysis to see any instances of change or new occurrences of any of the skills represented in this story compared to all past stories. Rather than showing charts of all the data, our analytics tool only presents a high-level view of these changes represented by the benchmarks. Coaches can click on the benchmarks to see which metrics contribute to the changes along with any relevant story data. For any skills that show progression, a brief explanation of its significance for children's narrative development will be provided. The benchmarks and metrics that may demonstrate skills progression are:
    a. *Progression of Story Completeness*
        i. Progression of overall completeness (by rubric)
        ii. Progression of specific metrics related to completeness
            1. Story length
            2. Number of actions
            3. Problems (problems and solutions)
    b. *Progression of Story Coherence*
        i. Progression of overall coherence (by rubric)
        ii. Progression of specific metrics related to coherence
            1. Logical sequence
            2. Linguistic Cohesion
            3. Story Type
    c. *Progression of Expression*
        i. Progression of overall expression (by rubric)
        ii. Progression of specific metrics related to expression

1. Emotional Expression
2. Emotional Arc
3. Character Development
4. Character Empathy

d. *Progression of Story Complexity*
   i. Progression of overall complexity (by rubric)
   ii. Progression of specific metrics related to complexity
      1. Level of Detail
      2. Language Level
      3. New Perspective
      4. Plot Complexity
      5. Creativity Level

4. **Story Meaning**: children tell stories to make sense of their world and communicate their beliefs about themselves and the world around them. Understanding the meaning a child is communicating through their story is essential to documenting the trends, interests, and values of a child and supporting them as storytellers. This section uses mostly the interpretive lens to analyze the subjective dimensions of the child's story, informed by a combination of the child's known contextual factors and the previously identified objective dimensions. While the coach's interpretation may never be proven accurate, knowing the background and contextual data helps increase accuracy. Coaches interpret the meaning of the child's story by annotating the following subjective benchmarks:
   a. *Child's Purpose* - Coaches answer, "What was the child's motivation for telling this story? Why are they telling this story? For what purpose?" The data highlighted to inform this benchmark are:
      i. Story Data - plot summary, themes, genre [M]
      ii. Contextual Data - child's interests, relevant/upcoming events, coach notes [M]
   b. *Child's Values/Beliefs* - Coaches answer, "Are there any underlying values or beliefs that the child is communicating through their story?" The data highlighted to inform this benchmark are:
      i. Story Data - plot summary, themes, genre, emotional expression, problem/solution [M]
      ii. Contextual Data - age, family, groups, personality traits, likes and interests, coach notes [M].
   c. *Representation of Identity/Emergence of Self* - Coaches answer, "does the child represent themselves or their voice through their characters, or identify with a specific character or viewpoint in the story?" The data highlighted to inform this benchmark are:
      i. Story Data - character development, perspective, emotional response, audio narration, I-statements [M]
      ii. Contextual Data - personality traits, age, family, group, likes and interests, coach notes [M].
   d. *Empathy* - Coaches answer, "Do children use characters and situations to represent empathy in their stories?" The data highlighted to inform this benchmark are:

i. Story Data - emotional expression, emotional arc, emotional response, character development, character empathy, composition, emotional language [M]
ii. Contextual Data - personality traits, relevant events, coach notes [M].

e. *Global Meaning of Story* - Coaches answer, "What is the greater meaning that the child is communicating through their story or what are the global themes that the child is exploring through their story?" The data highlighted to inform this benchmark are:
i. Story Data - plot summary, themes, genre, all previous subjective dimensions [M]
ii. Contextual Data - all child's contextual factors [M].

5. **Story Trends:** In order to get a holistic picture of children's narrative development, we need to document the trends within children's narratives over time. Analyzing trends in children's narratives can help us learn more about the child and their development through their stories. Unlike the structural focus of documenting the progression of children's narrative skills, documenting the trends in children's stories focuses on the content, process, and meaning of children's stories. To document the trends in children's narratives, we situate the content and meaning of a single story within the landscape of all of the child's stories over time to look for patterns and the emergence of new trends. Similar to the progression section, trends that are relevant or newly emerging will be displayed, and a description of their significance to children's narrative development will be provided. The benchmarks and metrics that may demonstrate story trends are:
   a. *Trends in Story Genre*
   b. *Trends in Story Themes*
      i. Main Themes
      ii. Emotional Themes/Arcs
      iii. Themes and Items of Interest
   c. *Trends in Editing Process*
      i. Response to Coach Feedback/Stickies [M]
      ii. Response to Story Starter [M]
   d. *Trends in Global Themes*
   e. *Trends in Emergence of Self*
   f. *Trends in Representation of Empathy*
   g. *Trends in Values/Beliefs Expressed*

6.2.2 Next Iteration of the Computational Approach

A core tenant of our approach is to empower human agency, making sure that the algorithms and systems we create always put the final decision power into the human's hands, not the machine's. The need for reinserting human agency into technology-based educational systems for complex fields such as narrative and writing is especially important. In a recent interview, prolific author and philanthropist, Dave Eggers, explained this importance when he stated:

> "It's not the job of a machine to judge a 12-year-old's writing ability, and it never will be. And it shows so little regard for that student's work, that student's

> education, their soul, their artistry, what's inside them. If we're willing to give it to a machine to judge, it is throwing that person's education away. We have got to have respect for ourselves as a species, to say human writing is worth having humans judge it. And there will never be a machine that can read the way that we can read and to know meaning the way that we know meaning." [115]

To support human agency in analyzing children's narratives we use automated data to augment human abilities for complex tasks, such as making inferences or interpreting meaning, rather than replacing them.

Our new computational approach uses three main methods of analysis: 1) human, 2) machine, and 3) blended (machine-predicted and human-validated). Within the analytics outline above, each metric is categorized by how it is measured — i.e., coach (blue), machine (red), blended-predicted/validated (purple). Most of the metrics are informed by the highlighted story data. The majority of the story data is automated, denoted with [M] for machine, but the data that cannot be automated is supplemented by the human coach, denoted by [C] for coach. The story data that is supplemented by a coach and repurposed by the machine to inform another metric is denoted by [M+C], which stands for machine plus coach. Figure 6.6, below, presents a Venn diagram of the metrics for narrative skills categorized into the three methods of our computational approach.

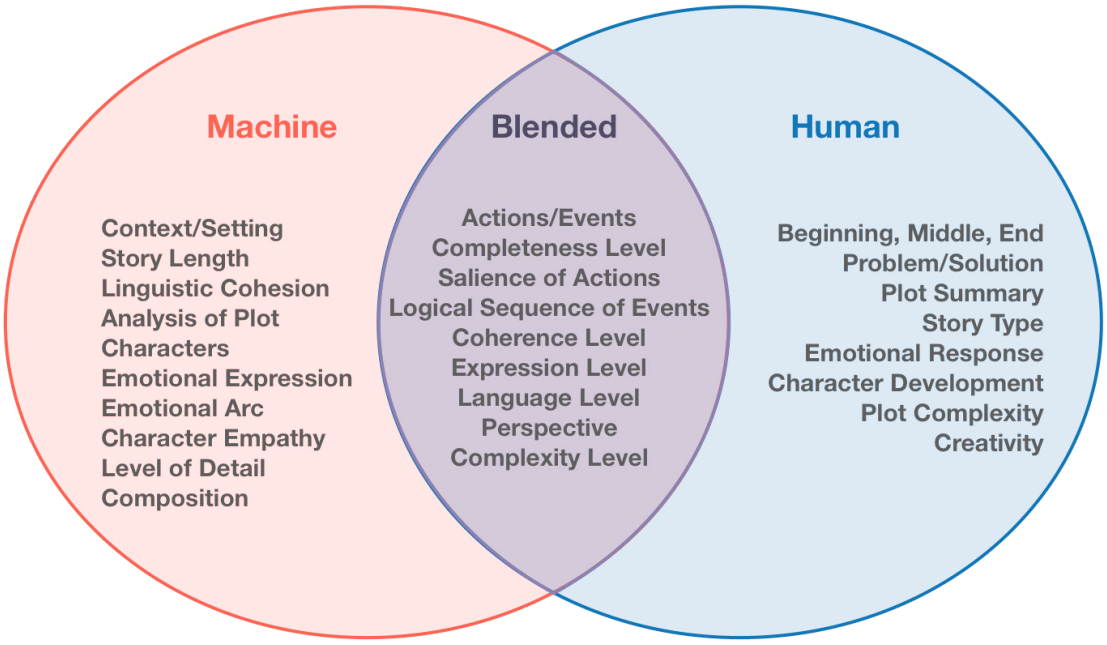


Figure 6.6 Venn Diagram of the Metrics Along Our Three Methods of Our Computational Approach.

In our previous computational approach for the first version of Play Analytics, the two main methods of analysis were machine (i.e., automated Story Stats) and human (i.e., coach Story Annotations), with no salient links between the Story Stats and the Story Annotations. In order to make the analytics process more efficient for coaches, I propose we iterate on our computational approach by expanding the use of the automated story data to create machine-generated predictions that coaches can validate and that can more systematically inform coach interpretations. In this way, we will rely more on the role of technology by developing

more sophisticated algorithms to automate story data and train models to make predictions. However, the role of the human coach will also expand by using their analysis skills to validate the machine predictions, thereby further training our models and redirecting their creative energy towards interpreting the meaning of children's stories, rather than just annotating children's stories for structure.

To see these three methods in action, I will use the story coherence benchmark. Two of the metrics — i.e., linguistic cohesion and analysis of plot— are measured only by the machine. For example, to analyze linguistic cohesion, we developed algorithms to identify any written words that are listed as temporal or causal markers. Only the story type metric is generated by the coach. While the machine highlights relevant story data to focus a coach's attention towards identifying the story type, the coach is able to process that data and make inferences about the meaning of the story to manually categorize the story type in a way that machines cannot accurately do because they cannot infer meaning. The remaining three metrics that contribute to story cohesion are salient actions, logical sequence of events/string of actions, and coherence level. These metrics are all examples of our blended machine-predicted and coach-validated approach. For example, to analyze salient actions, we can develop an algorithm that looks at the compositional make-up of each frame in a story (e.g., items, characters, backgrounds) to look for similarities or congruence of the content among each frame. We can then create a model that predicts the salience or relevance of the actions in the story based on the similarities detected. The output of this is a machine-generated prediction of the salience of the actions in the story. However, this prediction is based on certain assumptions — e.g., each frame represents an action, the child used the same content to depict their story in each frame. A machine, alone, cannot understand the salience of the actions because it cannot interpret the meaning behind each action, nor can it even detect the presence of an action unless it is depicted in a very specific way. Therefore, the coach looks at the machine's prediction and reviews the child's story to either validate the machine's prediction of salience, or correct it. In doing this, the coach both trains our models and gets a view into the data that informs this metric. Furthermore, this blended method not only creates a link between the automated story data and the coach interpretations, but it also connects the story data to the significance of how each metric relates to children's narrative development, making the story data more useful and the process of systematically analyzing children's stories more efficient.

6.2.3 Considerations and Conclusions

While the proposed redesign of the analytics system is more holistic in scope, there are still some areas that this proposal does not address, but that should be considered in future iterations of the system. First, there is rich oral narration data from the child's audio recordings that are not being analyzed in a systematic way. While the analytics encourages coaches to consider the child's oral storytelling skills, the automated techniques for parsing children's speech, transcribing it, and analyzing it is not advanced enough yet to include in a meaningful way. Once we are able to overcome this limitation, it will be important to run a full analysis on the child's oral narration to compare their written and oral narrative skills. Early ways to start documenting and parsing children's oral narration should be considered in this next design. A second consideration is to integrate analytics that document and encourage the use of narrative moments in children's stories. In storytelling, narrative moments are the rich descriptions that captivate the audience and bring them into the story by connecting through emotions and

experiences [101]. These moments not only capture the audience's attention, but also elicit the reader's empathy. This is a really important skill in telling a good narrative, and it is something that we should consider measuring and supporting in children's StoryBlocks stories. A third consideration is capturing and supporting the use of humor in stories. While children can categorize their stories as a comedy and coaches can comment on the use of humor in the creativity metric, we have no way to systematically document humor, nor do the analytics encourage coaches to support children's use of humor in an active way. Yet, humor is a joyful element of storytelling that can subtly communicate poignant information, and should be actively encouraged in StoryBlocks. Additionally, the StoryBlocks medium allows for children to communicate meaning through rich visual displays within their scenes, yet our analytics system does little complex visual processing to parse the meaning from these scenes. As image processing techniques continue to improve, we should consider how these techniques might add to our analytical abilities. Finally, we must consider the influence of the medium on the formalist lens and structure the interpretive lens to examine a set of stories, rather than each individual story.

Through the redesign of the analytics and computational approach proposed in the above outline, I am able to apply the Two-Lens Approach to inform our analytics, thereby addressing my research question of how we document and track children's narrative progress from their stories. By restructuring our analytics to connect the automated story data to inform coach interpretations, highlight both narrative skills and the underlying meaning of stories, and demonstrate progress and trends by situating each story within the child's corpus of stories, this redesign of the analytics system will help coaches better document, analyze, and view progression of children's narratives.

6.3 Coach Console Mock-Ups

The goals for the next iteration of the Console are to present children's story data to help coaches systematically analyze and efficiently interpret children's stories, view narrative trends and skills progression, communicate learning processes with caregivers, and support children's narrative growth by providing feedback and co-creating stories with children. Given the new analytics system inspired by the Two-Lens Approach and the limitations of the current Console gleaned from the coach feedback, there are several key design modifications that need to be made to the Console in order to achieve these goals. First, to reduce time and ambiguity, we should eliminate the tabs from the Console (i.e., overview, analyze, interact, update, finish) and design separate tasks for providing feedback to children's in-process stories and analyzing children's completed stories. All other modifications rely on this separation. Second, to simplify the process mode during analysis, the Console should clearly display children's story edits and drafts in response to the coach's feedback. Third, to increase the efficiency of the automated story data, the Console should eliminate listed data (i.e., Story Stats), and instead, integrate the automated story data into the annotations to inform coach analysis and interpretation. Fourth, to further inform coach interpretation of the meaning, the Console should capture the dynamic contextual information and present it in a persistent view. Fifth, to better display children's narrative trends and progression of skills, the Console should situate each individual story across all the child's stories during the analysis process. Sixth, to reduce data clutter and highlight the significance of progression, the Console should only display relevant or pertinent data, and any changes in skills or emergent trends will be linked to its significance for children's narrative

development. Finally, to increase the usefulness of the analysis process in informing the Caregiver Updates, the updates should be the output of analyzing a story.

The following section details each modification by walking through an example of a redesigned Coach Console. It is important to note that these designs are preliminary mockups, and will change in accordance with the designs and implementations of the StoryBlocks app and the analytics system.

6.3.1 Walk-Through of Coach Console Redesign Example

When the coach logs onto the Console, they enter the home screen and can view all the children they coach, the caregiver messages, and their own profile information (see figure 6.7). The Console uses notifications to indicate to the coach which tasks they need to complete for each child based on the child's play. If a child is in the process of creating a story, the Console will prompt the coach to send a Story Sticky. If the child has completed a story, the Console will prompt the coach to analyze the story and send a caregiver update. If the child has not played in awhile, the Console will prompt the coach to send the child a Story Starter.

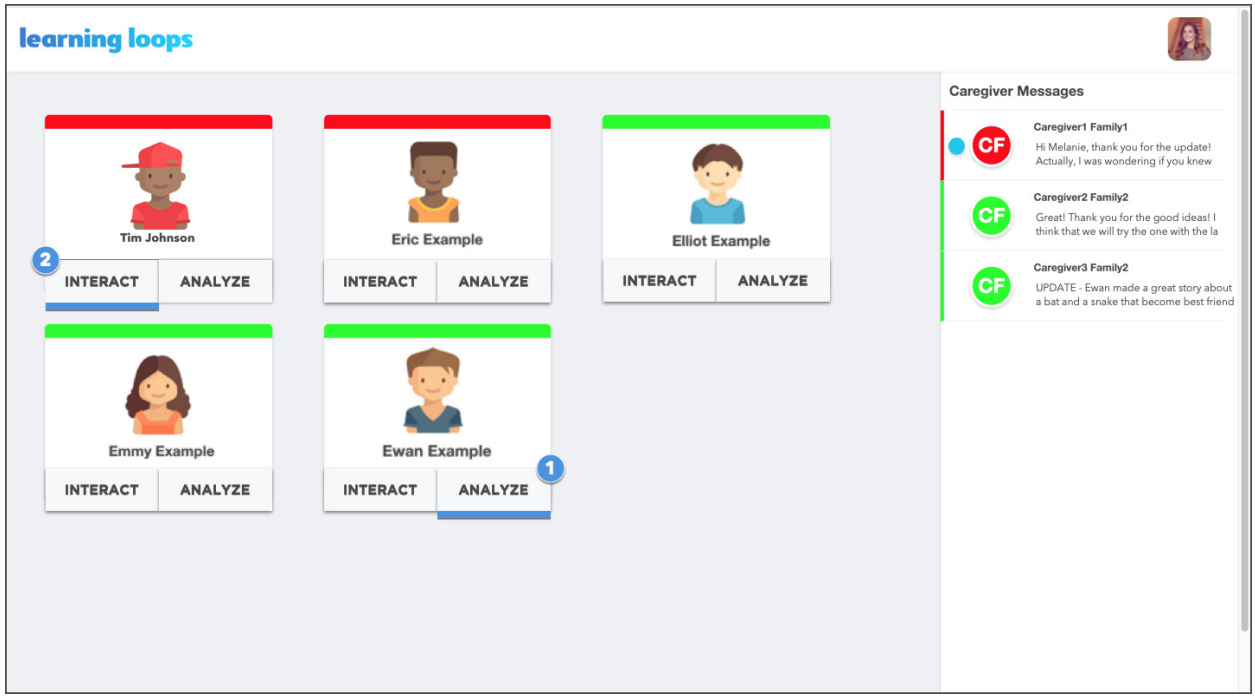


Figure 6.7 Mockup of New Coach Console Home Screen

By clicking on the "Interact" button for a given child, the coach is navigated to the interact screen, where they can either send a new Story Starter or provide feedback on a story in-process by sending a Story Sticky (see figure 6.8). This screen resembles the interact screen in the original Console, with the addition of accessing the story overview information to inform the coach's feedback.

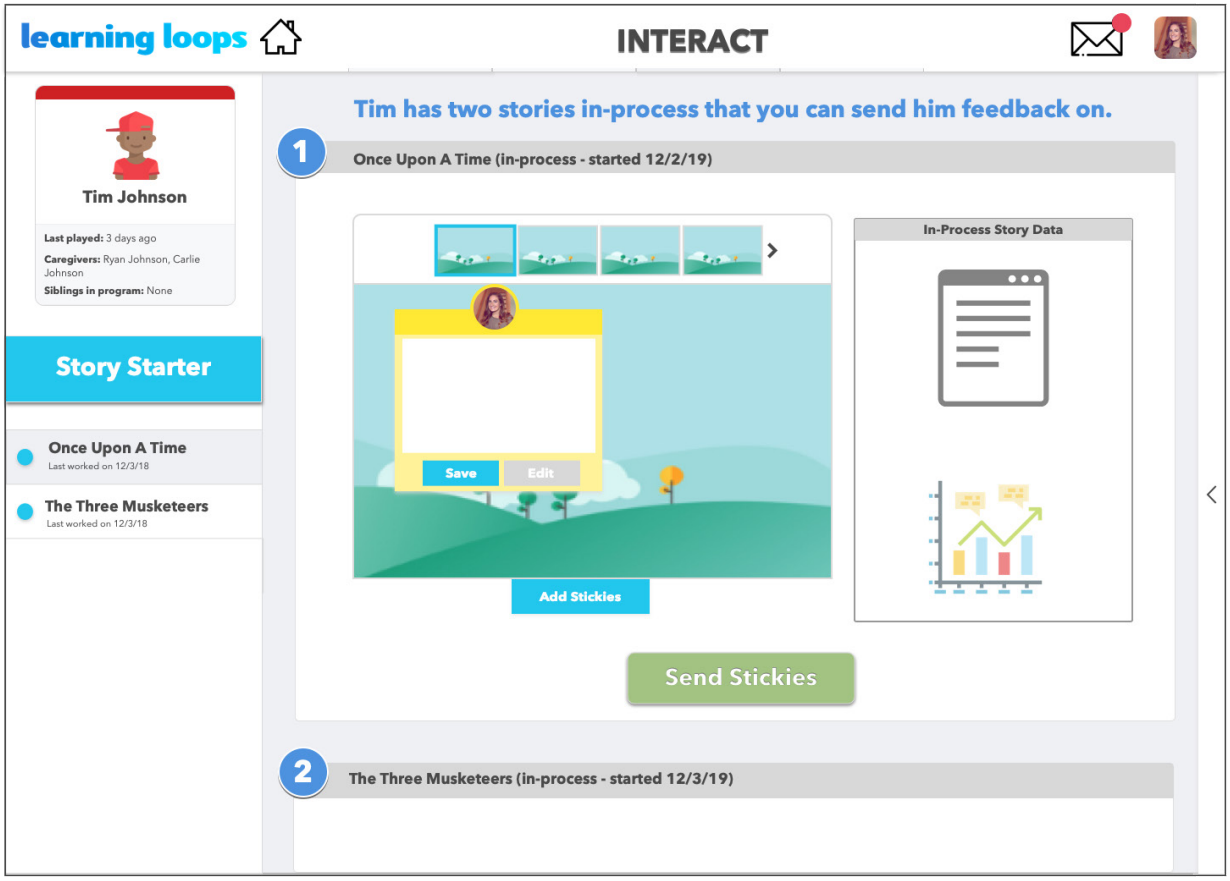


Figure 6.8 Mockup of New Coach Console Interact Screen

From the home screen, the coach can click on the "Analyze" button to view and analyze children's completed stories. This screen provides a persistent view of the child's profile, which includes the child's known contextual factors, and a persistent story view (see figure 6.9). The child's profile view is editable so that coaches can continually update the profile with relevant information. To capture the contextual information shared by the caregivers in the caregiver messages, coaches can easily copy and paste any text from the messages into the child's persistent profile view so that they can access these notes while analyzing and interpreting stories. In the story view, coaches can toggle between Story Mode, which displays the published draft of the story frame-by-frame, and the Drafts Mode, which shows previous drafts and highlights edits children made in response to coach feedback and the corresponding Stickies. Below the visual frames is relevant story data, such as the title, child-selected themes, genre, intended audience, and minutes played. Coaches can also input a brief summary of the plot, which will be repurposed in the analytics later.

Figure 6.9 Mockup of Persistent Profile and Story View in Analysis Screen

Once coaches read the story, they can review and supplement the analytics. The analytics are presented in a form-like structure, separated into two main sections. The first is narrative skills and skill progression (see figure 6.10). Coaches go through each benchmark, reviewing, validating, or supplementing each metric and using the highlighted story data to inform their analysis. By scrolling down, coaches can see the skills demonstrated in that particular story related to the child's past stories. This gives the coach a view of children's skills progression. Rather than presenting all of the available data, the Console only shows relevant or pertinent data (e.g., the emergence of a new skill), and explains the significance of the metric for children's narrative development. For example, if a child used four temporal markers in their story, then the benchmark of coherence would show an increase, and the metric of linguistic cohesion would highlight the four temporal markers. In the skills progression section, if this story contains the most temporal markers the child has used to date, the Console might say something like, "Jamie showed progress in linguistic cohesion by using language (4 temporal markers) to represent the sequence of time and tell a more coherent story."

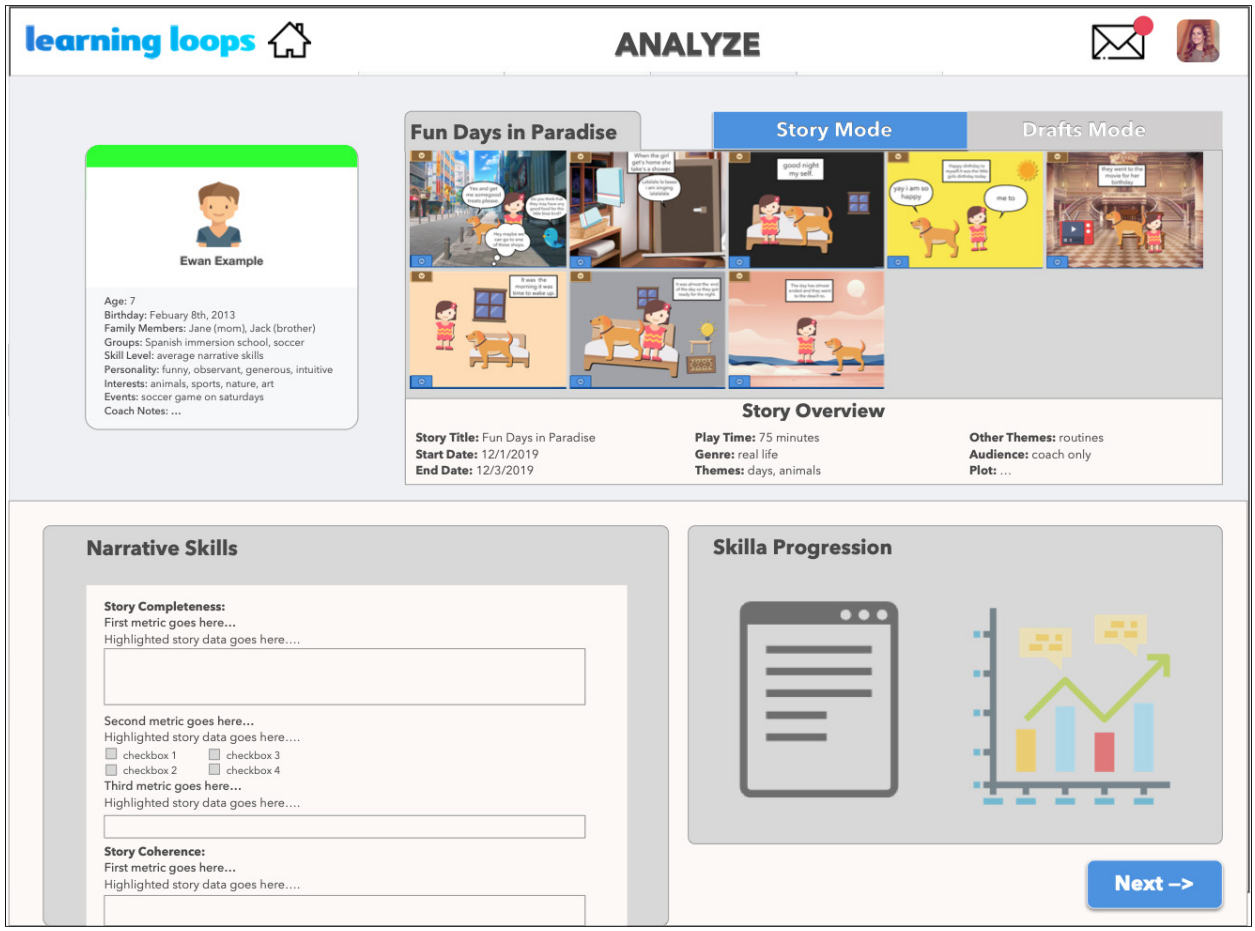


Figure 6.10 Mockup of Narrative Skills and Skills Progression in Analysis Screen

The second section of the analytics is meaning and story trends (see figure 6.11). After analyzing the narrative skills, the coach clicks “next” and follows a similar process to interpret the meaning of the child’s story. As they answer questions about the story’s meaning, the Console highlights relevant story data and contextual data (from the child’s profile) that can help inform the coach’s interpretation. By scrolling down, the coach sees the current story situated among the child’s past stories to view the relevant trends in the children’s stories. Once the coach is finished with their analysis, they can click “next” to go to the update and review page (see figure 6.12). The update and review page is the final part of the analysis process. On this page, coaches can see the story, the child’s profile data, and a summary of the analysis as they compose a short Caregiver Update. Below the update is a field where coaches can provide any comments to the child about their story (e.g., praise, questions). At the bottom of the page the coach selects “Send” to submit their analysis and send their caregiver update and optional story review.

Figure 6.11 Mockup of Interpreting Meaning and Reviewing Story Trends in Analysis Screen

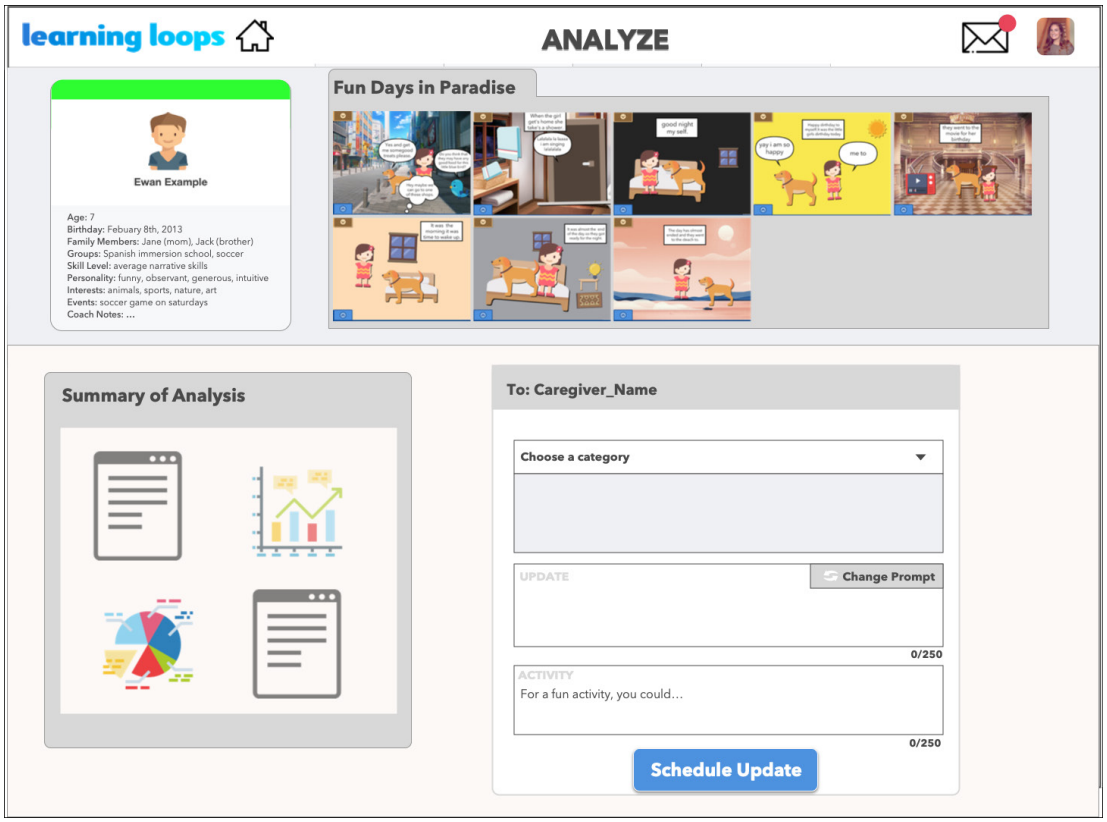


Figure 6.12 Mockup of Caregiver Update and Story Review in Analysis Screen

6.3.2 Considerations and Conclusions

There are several considerations that are not addressed in the proposed redesign of the Console. First, in simplifying the process mode, we lose some rich data about the process of how the child created the story. While this feature was not always used by coaches due to its time-consuming nature, we may want to consider more efficient formats to maintain the process view in the Console. In a similar vein, the second consideration is decreasing the coach's time spent on the Console. One main goal of this tool is to efficiently analyze children's narratives and support their development, and I believe that the digital scaffolds within the Console help coaches do this more systematically and quicker than they could do on their own. However, given the holistic nature of the analysis and the nascence of the technology, the process of analyzing a story is still more time consuming than desired. In order to decrease the time coaches spend on the Console, we will need to continue to iterate on our tools, identifying the metrics that are not useful and constantly integrating new analysis techniques to increase efficiency. Finally, as the design and features of StoryBlocks continue to be developed, the Console will need to accommodate those changes. For example, if children can co-create stories together, how do coaches analyze those stories? These considerations are outside the scope of this dissertation, but will need to be considered for the future implementation of the Learning Loops program.

In conclusion, the proposed redesign of the Console takes steps to accommodate the goals of both the analytics and the Console, as well as the coach's feedback from the pilot. Separating the tasks of interacting and analyzing and relying on the Console to inform the coach which tasks need to be done based on the child's play removes the ambiguity for coaches and ensures that the correct tasks get completed. Simplifying the process view into story drafts helps coaches see children's editing process in response to their Story Stickies. Eliminating the Story Stats and Annotations, restructuring the analytics so automated data can inform coach interpretations, integrating the overview into the analysis, and explicitly linking relevant data to children's narrative development improves the coach's ability to use data to both view narrative progress and support children's narrative growth. These improvements address my final research question by restructuring the Console to more effectively use children's story data to support children's narrative capacity. This design document will be integrated into the next iteration of the Learning Loops system in order to inform how the program defines, analyzes, and supports children's narrative capacity.

7.0 Conclusions

In summary, this dissertation presented Learning Loops as a novel, digitally-mediated family learning system for children's narratives and examined the system's ability to document and support children's stories by analyzing the Spring 2019 pilot study. Findings from the pilot suggested the need for a foundational theoretical framework to inform the design of the Learning Loops system. This dissertation proposed the Two-Lens Approach, a holistic framework for understanding the structure and meaning of children's narratives. By applying the Two-Lens Approach to the Learning Loops system, this work addressed the main research questions detailed at the outset of this dissertation. A design-based research approach was used to improve the program's ability to document children's unique digital narratives, systematically analyze children's narrative trends and progression, and build a digitally-mediated system that connects children's learning communities in order to support their narrative capacity.

The Learning Loops system was developed in response to the gaps in the literature on research and interventions that document, comprehensively analyze, and socially support the complex space of children's narratives. In order to address these gaps, the Learning Loops system used a blended approach to collect a corpus of children's personally-generated digital stories, combined human and machine techniques to holistically analyze them, and incorporated human social support aided by data-driven digital tools to encourage children and families. The two core technologies of the Learning Loops system were StoryBlocks, the open-ended comic-style storytelling app for children ages six to ten years old, and the Console, the custom-built analytics tool for coaches to analyze stories, support children, and communicate with families.

I examined the Learning Loops system's ability to document and support children's narrative development by analyzing the Spring 2019 pilot. Findings revealed that children were highly engaged with the app and customizable features (e.g., item search), the majority of stories were categorized as real-life stories, and the most common themes among stories were family and friendship. Findings from the pilot suggested that through the StoryBlocks stories, automated data, supplemental coach analysis, and coach Stickies and updates, the system was able to document and analyze children's digital narratives, show some evidence of narrative progression, and show some evidence of coach support on children's narrative growth. However, coach feedback indicated that the Console did not adequately present this data back to coaches, obfuscating their view of children's narrative progress as well as their impact on children's development. These findings propelled the need for a theoretical framework with a clear definition of narrative in order to improve the system's ability to document progress and support development.

In an effort to synthesize the literature on children's narrative development, I developed the Two-Lens Approach, a theoretical framework for understanding and studying the form, content, and context of children's narratives. I first defined narrative as *the culmination of cognition, emotion, and culture presented in various story mediums (e.g., written, oral, physical, mental) to express ideas, experiences, events, or imaginings for the purposes of communicating, sense-making, and identity formation.* I then developed a minimum set of criteria to determine whether a story is analyzable, stating that stories must contain *characters and at least one complete event or action represented through language, composition, or imagery that can be*

summarized into a plot. These definitions set the stage for my Two Lens Approach, which aimed to more holistically analyze children's narratives through both a formalist lens — building on previous approaches to look at the structure and mechanics of children's stories — and an interpretive lens — using the sociocultural context to look at the meaning and emotion of children's stories. In the Two-Lens Approach I identified six contextual factors (i.e., intended goal, intended audience, personal experience, age, narrative skills, sociocultural context) and 14 narrative dimensions. These narrative dimensions were split into two categories: objective dimensions (i.e., characters, events/actions, setting/context, spatial organization, temporal organization, plot, language, viewpoint/perspective, theme/genre) and subjective dimensions (i.e., meaning, purpose/motivation, values/morals, identity, empathy). The formalist lens analyzed the objective dimensions by answering the questions, "Does the objective dimension exist in the narrative? If so, how is it presented?" The interpretive lens used the contextual factors to consider the subjective dimensions by answering, "How do the child's contextual factors influence the representation of the narrative dimensions? Considering the contextual factors and structure of the story, what is the greater meaning behind the subjective dimensions that the child is trying to express through his/her story?" I then put the Two-Lens Approach into practice by using it to analyze and interpret several children's stories (within and outside of StoryBlocks) and determined that it provided a blueprint to holistically and systematically analyze children's personally-generated narratives.

Finally, I applied the Two-Lens Approach to the Learning Loops system in order to inform the next iteration of the program's design. This dissertation culminated in a design document that used our pilot learnings and the two lenses of my theoretical framework to address my three research questions: (1) how do we best design a platform for children's narrative expression, (2) how do we redesign the analytics to best document children's narrative progress from their stories, and (3) how can we best use children's story data to support their narrative capacity? The design document suggested modifications for StoryBlocks (i.e., opportunities for text, complete story drafts, identify genre/theme/audience, and social interactions/story sharing), the Play Analytics system (i.e., restructure benchmarks and metrics, examine objective and subjective dimensions, connect automated story data to inform coach interpretations, document progression of four categories and meaningful trends across stories), and the Console (i.e., separate feedback and analysis tasks, simplify process view, highlight story data within story view, integrate overview into analysis, explicitly link significance of data to child's development) in order to improve Learning Loops' ability to document and support children's narrative capacity in a more robust, holistic, and systematic way.

The contributions of this work are many. First, this work contributes to the field of narrative analysis by synthesizing the literature on children's narrative development and proposing a holistic theoretical framework for studying children's narratives. The Two-Lens Approach is not only theoretically-grounded, but also easily applicable. Researchers, practitioners, and educators can adapt this approach to their own methods and storytelling systems in order to holistically and systematically study children's narratives. By adopting this framework for studying children's narratives, researchers can take steps towards bridging the gaps in the literature and creating comprehensive standards for the field of narrative analysis.

Second, this work presents the design and development of a novel, digitally mediated system for documenting, analyzing, and supporting children's learning in complex content areas. As children learn and grow in an increasingly interconnected world, we will need more systems

that can harness the power of technology to build social learning communities that track growth and support the development of important 21st century skills, such as communication, critical thinking, and creativity. This dissertation contributes to the field of educational technology design by detailing each component of a blended system that successfully navigated the complex space of children's narratives. This work should be used as a blueprint for other researchers and programs looking to use technology to support children's learning in playful ways.

This benefit of this work has become sharply clear in the last several months as the world has been forced to socially distance due to the spread of the coronavirus, COVID-19. In this time of pandemic, sequestered virtual education is critically important. Our blended, tech-based coaching approach for child-driven content is particularly fitting for increasing socially connected learning while maintaining social distance. We are currently shifting our Learning Loops work to be responsive to the pandemic by adapting our coaching model to serve the immediate needs of children and families.

Finally, this work has implications for the future of the Learning Loops program. The work presented in this document set the foundation for the Learning Loops system, and will continue to inform the design and approach of the program. The design modifications suggested in this document will be implemented in order to optimize the program for future deployments, scale, and sustainability. Furthermore, this dissertation serves as an internal constitution for how the program will define, document, and support narrative development as Learning Loops transitions into a nonprofit.

8.0 References

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Appendix A: History of the StoryBlocks Design

The idea for StoryBlocks was first conceived in 2015 after working with my colleague, Ivan Sysoev on his SpeechBlocks app and seeing how children wanted to use the words they created in the app to share their own stories. I had long been an admirer of Vivian Paley's storytelling and story acting practice because we used it in the preschool classroom I taught at in 2013, and I saw how it engaged and motivated each child in the classroom. A year later in 2014, I was a one-on-one reading instructor for children with reading difficulties and I frequently used storytelling practices to get children up to the age of ten to understand the power of why we read, write, and share our stories. I'll never forget the way one nine year old girl's eyes lit up when she heard her story read back to her for the first time (I had been writing down her story word-for-word as she spoke it aloud). Suddenly she felt heard. Her words were captured, they existed in the world, and there was proof. From then on, she was way more engaged in the reading instruction, because she understood the power that the written word held. She understood how words could combine to share a story. And that is why the next year while piloting SpeechBlocks with children who were itching to share their stories, my focus pivoted from phonemic awareness to storytelling. I began sketching ways that children could share their stories, much like the practices I used in the preschool classroom and as a reading instructor (e.g., storytelling and story acting, problem stories curriculum). Physical versions of some of these sketches were created and play-tested with children over two years, but it was not until 2017 that the first digital version of StoryBlocks was actually implemented and tested.

The first version of StoryBlocks was designed in collaboration with Sesame Workshop and it aimed to bring a new level of interactivity into children's educational media and stories while promoting narrative development, social-emotional development, and empathy through storytelling. StoryBlocks was based on Problem Stories[6], an early childhood classroom practice that supports children's socio-emotional, language, and literacy development.

In the first design of StoryBlocks, children transitioned between an animated narrative that set up a social conflict, and an interactive comic-style composition that allowed children to construct their own solutions, and presented alternative solutions to engage children in critical thinking and reflection. To complete their stories, children dragged characters onto the screen, changed the characters' emotions, inserted items into their story, and used speech bubbles and text boxes to insert text. When they dragged a speech bubble onto the screen and clicked on it, a keyboard appeared for them to enter in any text they would like. The text could be read in either of the three characters' voices, or the voice of the narrator. Children could personalize their scenes to say anything they would like.

While the original version of StoryBlocks transitioned from an animated story, a second version of StoryBlocks was implemented in the classroom, during writing workshops, and with the Boston Public Library's storytime. Rather than creating a new, animated script, we used children's story books, such as *Horace and Morris but Mostly Dolores*[7], and read the book up until the conflict. We then let the children use StoryBlocks to create their solutions. In this way, the first two frames of StoryBlocks were pre-populated to reflect the children's story book, and then the children used the last two frames and shared their solutions with each other. For

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reflection and discussion, the researcher or librarian facilitated reflection, shared the ending of the story from the book, and then guided a discussion about the solutions.

The physical book-digital app hybrid methodology proved to be more engaging than when we had children watch the animation, and it allowed us to change up the story without having to write a whole new script and engage in lengthy animation production. However, there were still some limitations to the current version of StoryBlocks. Although incorporating the children's book stories allowed us to be more versatile, it was still a heavy lift to change the first two screens and design items that fit with the story (such as the cheese flag in *Horace and Morris but Mostly Dolores*). Another big limitation in the design of StoryBlocks was made clear to me while reading an article by Ageliki Nicolopoulou[8] on designing an interpretive and sociocultural approach to understanding children's storytelling. Her dynamic, integrative framework seemed to require multiple data points, multiple stories. The second version of StoryBlocks required a lot of adult scaffolding to implement, and while that was not an issue for the one-off workshops and classroom visits, it would not have been sufficient to engage children long enough for sustained play over multiple sessions. Without a longitudinal view, we would not have been able to collect enough data to really see the development of children's narratives. Lastly, while the Problem Stories practice followed a constructionist framework, there were a lot of aspects to children's narratives that were lost by allowing them to only complete the story, not tell their own story. Although opening up the functionality of StoryBlocks to follow more of a child-directed process would create more complexity in the analysis of stories, it would also provide more insight into children's minds, voice, and meanings. What stories did children want to tell?

There were many changes that needed to be made to the StoryBlocks design in order to make it more engaging, allow for more diversity of stories and child agency, and make it more self-sustaining in a home environment. The third version of StoryBlocks was inspired by Vivian Paley's Storytelling and Story Acting Curriculum[9]. Paley's storytelling and play practice documents the development of children's narratives, places an appropriate amount of responsibility on an adult, allows for an incredible amount of child agency and voice, supports the development of a community of peers, is extremely motivating and fun for children, and has clear implications for children's learning and development[10][11][12]. As mentioned previously, I have always wanted to incorporate more of the open format of Storytelling and Story Acting Curriculum. I believe that being able to have both fully child-generated stories as well as semi-structured stories could be really helpful for creating sustained engagement as well as guiding support. The goal of StoryBlocks has always been to integrate it into our Coaching System, for the purpose of supporting family involvement in playful learning activities, and so it was clear that StoryBlocks would need a big makeover in order to make it sustainable not just for

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[8] Nicolopoulou, A. (2011). Children's storytelling: Toward an interpretive and sociocultural approach. *Storyworlds: A Journal of Narrative Studies, 3,* 25-48.

[9] Paley, V. G. (1986). On listening to what the children say. *Harvard educational review*, *56*(2), 122-132.

[10] Su, M. (2010). Play and self-regulation depicted in picture books. (Doctoral Dissertation).

[11] Nicolopoulou, A., Barbosa de Sa, A., Ilgaz, H., & Brockmeyer, C. (2009). Using the transformative power of play to educate hearts and minds: From Vygotsky to Vivian Paley and beyond. Mind, Culture, and Activity, 17(1), 42-58.

[12] Cremin, T., Flewitt, R., & Mardell, B. (Eds.). (2016). *Storytelling in Early Childhood: Enriching Language, Literacy and Classroom Culture*. Taylor & Francis.

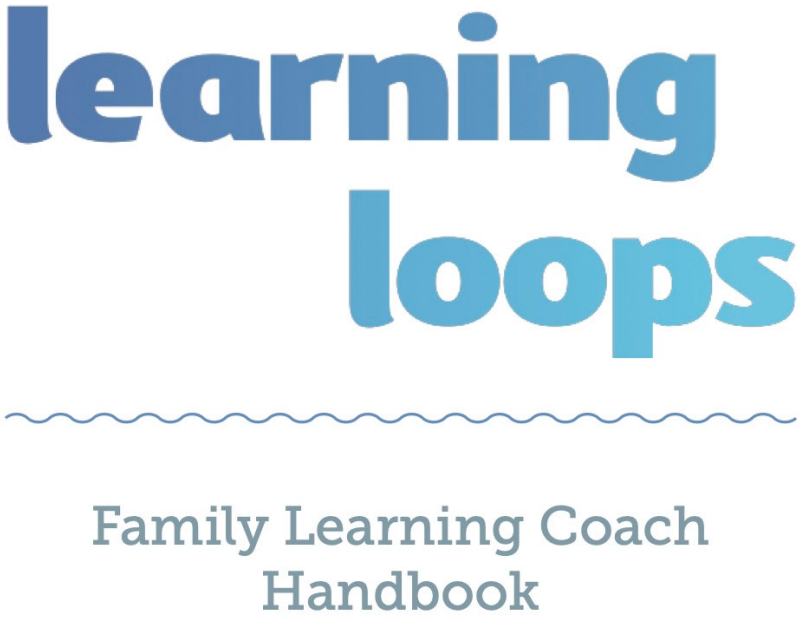
children, but for coaches and parents to know how to support children's stories and co-engage with them.

The major challenge to opening up StoryBlocks became how to provide enough visual elements (e.g., backgrounds, characters, items) to children in order to support their creation of any kind of story. More specifically, how could we help children exercise their narrative freedom without engaging in endless scrolling to find certain items or backgrounds? The answer came from work by my colleague, Sneha Makini, who developed and tested the app PictureBlocks[13]. One of the main interactions of PictureBlocks was transitioning a child's typed word that they spelled into its corresponding image so that children could bring that image into their canvas to create full pictures. Sneha co-designed and developed the version of the StoryBlocks app that was used for the Learning Loops pilot. This included reusing her work on PictureBlocks to build many of the features of StoryBlocks, such as the beloved search feature which made the app more open-ended. The integration of PictureBlocks into the StoryBlocks app not only broadened the possibilities of children's stories, but it also encouraged children to use literacy and writing in order to incorporate visual elements. The search feature fundamentally changed the design of StoryBlocks so that it could support children's personally-generated stories.

[13] Makini, S. P. (2018). PictureBlocks: constructing and deconstructing picture-driven literacy development (Master's Thesis, Massachusetts Institute of Technology).

Appendix B: Excerpts from the Coach Handbook

The Coach Handbook for the Learning Loops Spring 2019 pilot was over 120 pages. Therefore, this appendix only provides a preview of the Coach Handbook through selected excerpts. This handbook was written by myself and edited by Sarah Ballinger.



Welcome Coaches!

Welcome Family Learning Coaches! Coaches are an integral part of the Learning Loops program. Thank you for dedicating your time to work closely with children and families, support children's playful learning and narrative development, and help change the way families interact with technology to empower them to engage in the learning process.

What is the coaching handbook?

This Coach Handbook is a guidebook full of resources about how to be a Family Learning Coach. There are five sections: 1) The Learning Loops Approach, in which we introduce the guiding principles of our approach and describe our early learning app, StoryBlocks; 2) Family Learning Coach, in which we define the roles and responsibilities of a Coach; 3) Using the Coach Console to Analyze Stories and Communicate with Families, in which we offer examples to guide coaches about how to use the Coach Console; 4) Supporting a Network of Coaches, in which we provide details about the tools and processes for supporting fellow Coaches and Coach Coordinators; and 5) Facilitating In-Person Workshops, in which you will find all the necessary resources to prepare for and lead the workshops.

The Coach Handbook contains examples and activities that we will use during the Coach Training, and that you can reference throughout your time as a Family Learning Coach. This is your copy to mark up and we hope it proves to be a helpful resource. We value your opinion and encourage you to share any feedback on how we can improve this Handbook, the training, and your coaching experience.

Thank you for being a Family Learning Coach, and we look forward to working with you!

Sincerely,
The Learning Loops Team

Table of Contents

Goals and Roles of a Coach

Important Notes

As you think about your role as a coach, remember that you are representing Learning Loops. The Learning Loops appraoch follows a play-based, constructionist approach to learning, and you should try to use this lense when interacting with the children and families. You can go back to the Guiding Principles of Learning Loops section on page 4 for a more in-depth explanation.

What is the goal of a Family Learning Coach?

Family Learning Coach aim to promote children's literacy skills and narrative development through play and support family engagement in children's learning process. In order to be successful, the Coach must form a positive and trusting relationship with the family, have background knowledge of children's language and literacy development, and believe in a "constructionist" and playful definition of learning.

What is the role of a Family Learning Coach?

When supporting children and caregivers using StoryBlocks, the Family Learning Coach primarily (1) supports the family in understanding and contextualizing their children's learning process through storytelling in order to empower parents to co-engage with their children, and (2) directly supports children's narrative development by using the data from children's personally generated stories to provide feedback and scaffold the storytelling process.

Responsibilities of a Family Learning Coach

In order to be a successful Family Learning Coach and add value for the children and caregivers participating in Learning Loops, Coaches are responsible for the following:

1 Building positive, trusting relationship with families

The relationship between the family and Coach extends beyond the digital space. Communicating about personal experiences and home environments to better contextualize play and compose tailored updates requires a level of intimacy that can only grow from taking great care in building a trusting relationship.

2 Maintaining positive, responsive communication with families

Communication is key to a successful coach-in-the-loop system. Families will feel more invested in the program when they have a strong relationship with their Coaches and regularly communicate back and forth. Make sure to always be responsive when families communicate with you.

3 Using the Coach Console to analyze play, interact with children, and compose and send updates and activities to caregivers

The Coach Console is a tool designed to augment the analytic capabilities of Coaches by helping them analyze play, compose updates to families, suggest new Story Starters to children to expand their sphere of exploration, and provide feedback to scaffold their narrative development. This tool brings a new level of visibility into children's learning process through play and allows Coaches to better promote children's literacy and narrative development.

4 Fostering community-building between families at the in-person workshops

Learning Loops aims to carve out a brave space for families to grow their community and connect with other families in their cohort. The workshops promote Coach-family and family-family connections and expose families to storytelling activities that will help support and empower them.

5 Connecting with Coach Coordinators and supporting fellow Coaches

Learning Loops prioritizes creating human networks, so it is important that we help Coaches connect with one another to build a trusting and supportive community. Our team provides platforms for Coaches to connect and share knowledge with each other. Coaches will also be supported by Coach Coordinators (members of the Learning Loops team) who will check-in with Coaches regularly, offer support, and solicit your feedback with the goal of improving our Coach tools and resources.

Coach Commitment Checklist

Coach Time Commitment

Once you complete our one-day Family Learning Coach training, we ask that you commit a **total of about 3 hours per week to serve up to 6 families at a time**. Below is a complete list of the coach commitments throughout the program. If you have any questions or concerns about the commitment or these activities, do not hesitate to contact your Coach Coordinator.

Before Pilot:

- ☐ Attend 1-Day Family Learning Coach training
- ☐ Complete 15-minute online Coach pre-survey

During Study:

- ☐ Attend 4, 15-minute online Coach-Coordinator Check-ins
  - ☐ Check-in 1: Week 0 (before workshop 1)
  - ☐ Check-in 2: Week 2
  - ☐ Check-in 3: Week 4
  - ☐ Check-in 4: Week 6
- ☐ Use Coach Console to:
  - ☐ Analyze play, annotate stories, and send updates to caregiver up to three times per week
  - ☐ Send Story Stickies, Story Starter, and caregiver-child activity up to three times per week
  - ☐ Respond to caregiver messages as soon as possible (frequency varies week to week)
- ☐ Facilitate 3, 1-hour in-person workshops with families
  - ☐ Workshop 1: Meet and Greet (week 0)
  - ☐ Workshop 2: Family Check-in and Play (week 4)
  - ☐ Workshop 3: StoryBlocks Book Party Celebration (week 8)

After Pilot:

- ☐ Complete 15-minute online Coach post-survey
- ☐ Coach certification ceremony

Coach Weekly Checklist

Coaches must check the Coach Console at least 3 times per week to look for new play from children or messages from caregivers. **We recommend that Coaches check the Coach Console every morning that an update is due so all the play in a given session is analyzed between updates.** The following is a weekly checklist that can help Coaches keep track of their weekly responsibilities. This list is broken up into two sections: what to do if a child has played with the app and what to do if a child has not played with the app.

- ☐ **3 times per week:** Login to Console, check Caregiver Messages and Child's Play.

If child has played:

- ☐ ***3 times per week*** **-** Analyze each story within a session since last update, and:
  - ☐ View **Overview of Progress**
  - ☐ View **Story Stats** for each story within the session
  - ☐ Write **Story Annotations** for each story within the session
- ☐ ***3 times per week*** **-** Interact with the caregiver through updates by:
  - ☐ Choose one story to write a caregiver update about and **categorize update**
  - ☐ **Compose Update** about play to send to caregiver as text message
    - ☐ ***At least once per week*** **-** create a related **caregiver-child activity** to send along with caregiver update (each update does not need to have an activity, just once per week).
- ☐ ***At least once (1-3 times) per week*** **-** Interact with the child by:
  - ☐ Choose a story within session to send a **Story Sticky** to child in order to provide feedback on story or ask questions.
  - ☐ Send a **Story Starter** to child to co-create stories or inspire new play.

If child has not played:

- ☐ ***Once per week*** **-** Send a **Lack of Activity (LOA) update** if child has not played for 7 consecutive days.
  - ☐ Include a **caregiver-child activity** in the LOA
  - ☐ Send a **Story Starter** to the child to inspire new play.
- ☐ Call or text caregiver to check-in if two LOAs have been sent in a row (child has not played for 14 consecutive days).

Interacting with the Child

Quick Tips for Interacting

- Your interactions with children should focus on acknowledging their voice and inspiring their play in ways that scaffolds their learning.
- *Story Starters* are Coach-suggested beginnings of stories that are sent to the child as a way to prompt new play, expose children to different stories or elements of storytelling, and co-engage in the storytelling process. Story Starters can be created by Coaches and sent to children at any time. They are a great way to inspire play if a child has not played with StoryBlocks in a while.
- *Story Stickies* are the comments, questions, or feedback that Coaches attach directly to children's stories. This Post-it-like feature allows children to view and respond to Coach comments or feedback by editing their stories to address any comments. This is a wonderful way for Coaches to provide rapid feedback on children's stories, express what they liked in the story, or ask questions that help children develop their stories.

What is the Interact feature?

Story Starters and Story Stickies are the conduits for Coach-child interactions. Therefore, it is important for the Coach to take advantage of these features to directly support the achievement of the child-directed goal, communicate about stories, and provide feedback that inspires the child to use StoryBlocks in creative ways to reinforce what they have learned and guide them towards new ways of playing.

Children need to have an interested observer when they tell stories, someone who can acknowledge and encourage their voice, ask questions, and engage in play with them. Similarly, Coaches want to have meaningful interactions with children about their stories. Story Starters and Story Stickies provide opportunities for interactions between Coaches and children and for Coaches to scaffold children's learning within their stories.

Story Starters

What are Story Starters?

Story Starters are the Coach-suggested start of a story that is sent to the child to finish or adapt. These are meant as ways to inspire the child's new play, expose children to different types of stories or elements of storytelling not yet explored, and to co-engage with children's storytelling by co-authoring stories. While Story Stickies are tied to specific stories, Story Starters can be created and sent any time and are a great way to inspire play if a child has not played with StoryBlocks in a while.

Story Starters allow Coaches and children to have more back-and-forth interactions in a playful way. Since all the frames in StoryBlocks are open, children can create any story they would like. However, some children have a fear of the blank page and need some support generating ideas for stories or benefit from being exposed to different types of stories to inspire their storytelling. Story Starters are an important feature of the Learning Loops system that enable Coaches co-engage in children's storytelling and provide scaffolding.

When creating Story Starters, Coaches use the same features that children use within StoryBlocks. These Story Starters should be personalized for each child and Coaches can use children's past play, their interests, or suggested activities as inspiration for the Story Starters.

What can I do with Story Starters?

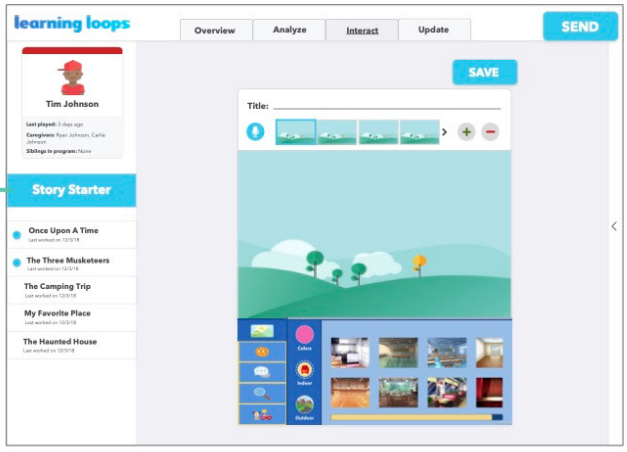
- Create stories centered on a problem or topic that the child cares about to understand how they might solve an issue or to encourage them to make a story with a problem or high point.
- Ask children questions by starting a story that gets them to communicate something. For example, if a child has a big basketball game, send a Story Starter that asks them to detail how their big game went in story form.
- Re-engage a child who has not played with Story Blocks or who needs inspiration for stories. You can use Story Starters to expose them to new topics or recreate their favorite stories in their own words.
- Co-author stories or play narrative games by sending frames back-and-forth to create a full story together!
- Get creative with your Story Starters and inspire new forms of storytelling and play. Make sure they are personalized for each individual child.

When do I send Story Starters?

Story Starters should be sent at least once a week, up to three times per week. If the child really enjoys them, you can send more, but don't overwhelm the child. The child does not have to complete Story Starters sent to them.

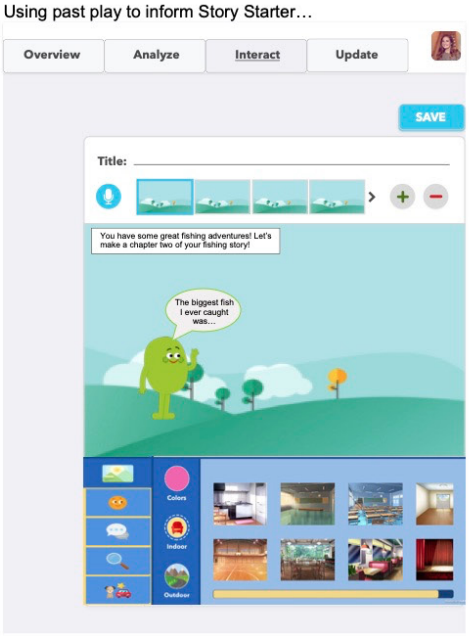
How do I create and send Story Starters?

Story Starters cabn be created by selecting a child, clicking on the Interact tab, and then clicking the blue "Story Starter" button on the left. Coaches can create scenes much like children do in StoryBlocks, and then click "send" to send the story to the child's device.

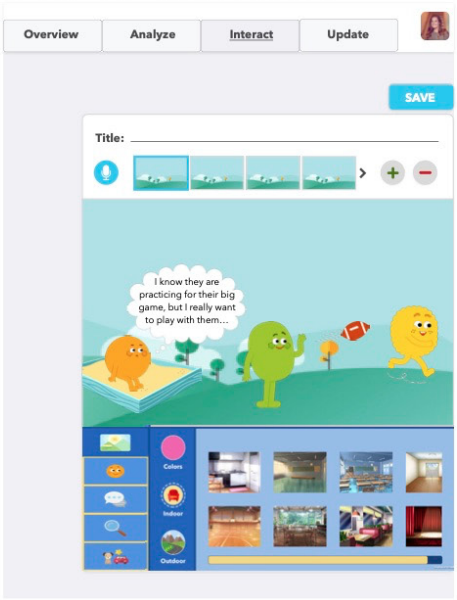


What are examples of Story Starters?

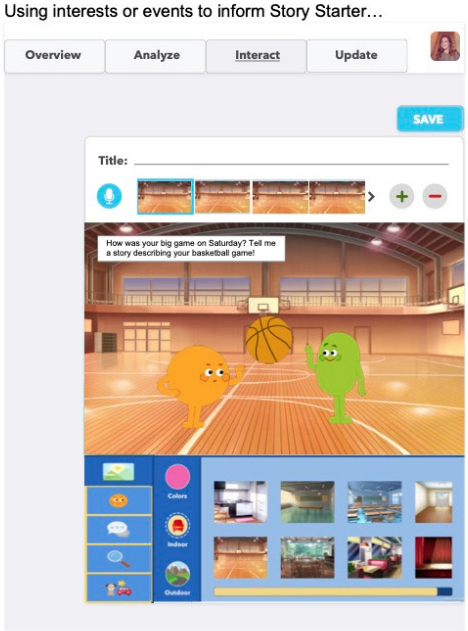
Using past play to inform Story Starter…



Sending a Problem story as the Story Starter…



Using interests or events to inform Story Starter…



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Story Stickies

What are Story Stickies?

Story Stickies are the Post-it-style feature that allows Coaches to share comments, questions, and feedback with children that the coach attaches directly to a child's story. Coaches can type in their comments or record their voice and paste the sticky on a frame of the story which is then sent directly to the child's device. The child can respond by editing their story to address the Coach's Story Sticky.

Story Stickies do not have to be sent for every story a child makes. Coaches should try to send a Story Sticky about once a week (or more, depending on how much the child plays) so as to not overwhelm the child. Make sure stickies are useful and not just empty praise or criticism. If you like a child's story, be specific about what you like about it. If the child can improve an element of his/her story, try asking a clarification question or offering examples of ways s/he can improve it in his/her own style.

Story Annotations for each story can be viewed by the Coaches in the notes panel to help inform the Story Stickies. Story Stickies allow Coaches to play the role of an interested observer (by showing interest in their stories and what they have to say increases children's trust and inspires them to share their voice through storytelling), as well as provide scaffolding through timely feedback.

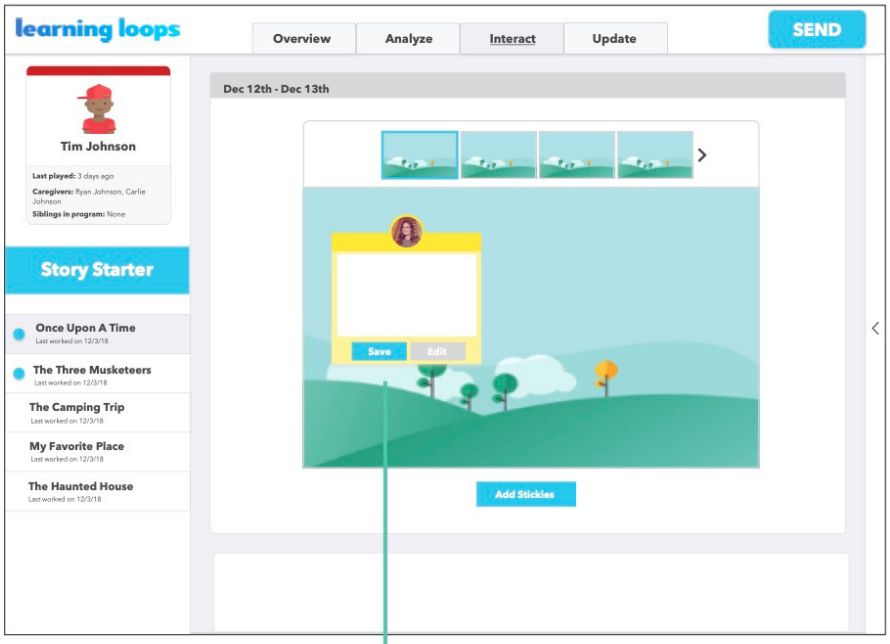
What can I do with Story Stickies?

- Use notes from your Story Annotations to provide scaffolding on children's stories, ask clarifying questions, or give positive feedback.
- Ask questions that encourage children to think critically about their stories. While children will not always edit their stories in response to your feedback, Story Stickies help inspire thoughts, ideas, and reflections for children within and beyond their individual stories.
- Employ methods like distance prompting to connect elements in children's stories to their everyday lives, or ask them to connect their stories to their personal experiences and tap into their emotions about the experience.
- Support narrative growth in children through providing feedback to improve their stories in ways that empower the child and align with their individual story goals.
- Address gaps or incohesiveness within stories by asking clarifying questions that help them provide more detail to convey meaning.
- Send Story Stickies to help children with the editing process and produce final stories that will be included in a book at the end of the program.

When do I send Story Stickies?

Story Stickies should be sent at least once per week (depending on amount of the child's play). You do not need to comment on every story, but should pick one to three stories to comment on per week and you may insert multiple stickies in a single story. If you do not have any feedback on a story, it is okay to write a personal note or send nothing at all. Sending too many Story Stickies (more than three in a week) can overwhelm the child and discourage them from play. If children have not created many stories, then you may focus more on sending Story Starters than Story Stickies.

How do I create and send Story Stickies?

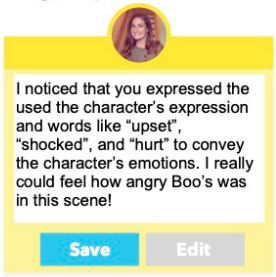


Story Stickies are associated with specific stories within a story session. After completing the Story Annotations, click the Interact tab and attach Story Stickies to different frames to give feedback, ask questions, offer details about what was done well in the story, or prompt reflection. Once stickies are written, click Save. When you send your update, the Story Sticky will be sent to the child's device.

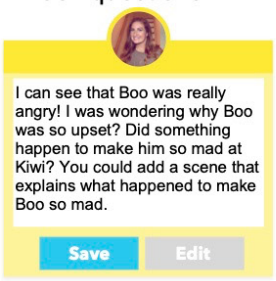
What are examples of Story Stickies?

Story Stickies can…

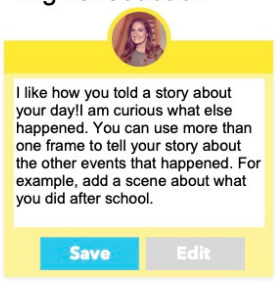
…give praise



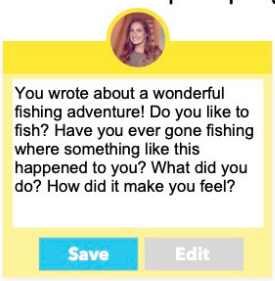
…ask questions



…give feedback

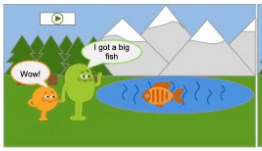


…use distance prompting



ACTIVITY: Give feedback with Story Stickies!

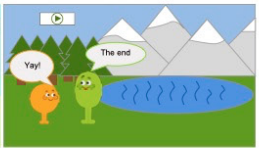
Instructions: Use the example story below (and your previous Stats and Annotations) to write 4 different kinds of Story Stickies.



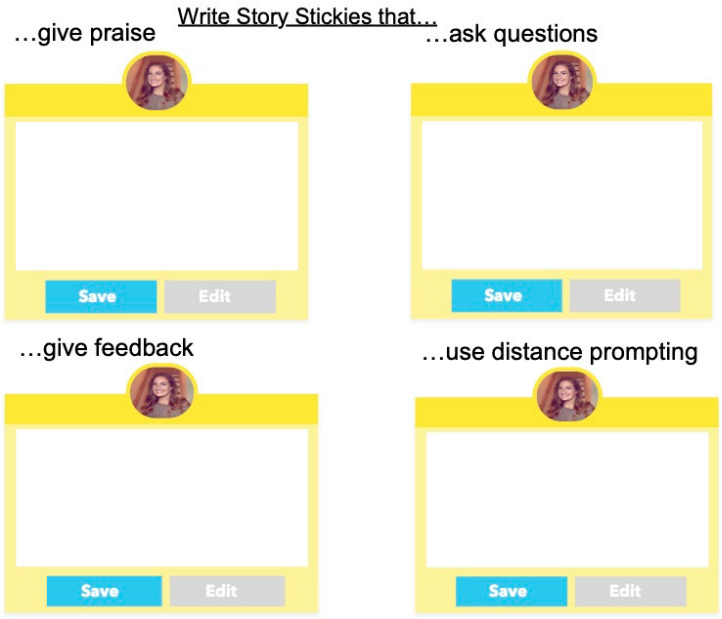
Audio: "One time daddy took me fishing and caught me a great barracuda."

Audio: "And then he realized he couldn't put his thumb in its mouth because it had super sharp teeth. Yeah!"

Audio: "And then he cooked it for dinner and then we had it."



Audio: "And then that's all!"



Important Reminders for Interacting

- Based on the child's play, create and send Story Starters that recognizes their interests, provide extra scaffolding, or expose them to a new type of story or narrative skill.
  - Make sure Story Starters are related to the child's play, interests, and skill level.
- When sending Story Stickies, use language that acknowledges the child's effort and aligns with the child's storytelling goal.
  - If giving praise, be specific about what you liked about the story. Don't just say "good job!".
  - If you see consistent or common mistakes, gently nudge the child without telling them they are wrong. Model the correction in your response or ask a question to get them thinking in new ways.
  - Switch up the type of feedback you give. Use techniques such as distance prompting to encourage the child to reflect on stories and give you more insight into the story's meaning.
  - Story Stickies are a great way to interact directly with the child. Make sure to gauge how many to send to each child, as this may differ child to child.

Goals and Roles of Coach as Facilitator

Goals of a Coach Facilitator for the workshops

The Learning Loops team believes that in-person human connections are critical for building a strong relationships between Coaches and families. This is why the program includes three, one-hour in-person workshops at which Coaches and families will meet, share information, engage in best practices for storytelling, and build a supportive community. The Coach Facilitator will provide a brave space for families to meet, connect, play and support one another.

What are my Main Objectives as a Coach Facilitator?

1. Build trust and relationships with your families.
2. Serve as a connector between families.
3. Facilitate hands-on learning for families by:
    a. introducing concepts,
    b. modeling examples,
    c. observing and guiding through questions, and
    d. listening while encouraging reflection and sharing.
4. Cultivate a brave, supportive, and playful space by:
    a. encouraging playful exploration and experimentation,
    b. surfacing families' interests,
    c. asking questions and listening openly,
    d. empathizing with families, and
    e. honoring each person's unique perspective and voice.

Coach Facilitators will lead three workshops with thier families. This section is organized by workshop and includes the purpose of, structure (before, during, after) for, and checklist of the materials for each workshop.

Workshop #1: Meet and Greet

Purpose of Workshop #1

1. Meet with each family to start building a relationship and learn about their interests.
2. Connect families one another to foster a community of storytellers.
3. Empower families to explore playing with StoryBlocks and begin to build confidence in co-engaging in the storytelling and learning process.

Before Workshop #1

To prepare for Workshop #1, revisit the Coach training exercise focused on building your public narrative (in appendices). Practice the public narrative that you will share with families to introduce yourself at the workshop.

Your Coach Coordinator will check in with you the day before your workshop to answer any questions you may have and help you prepare.

On the day of the workshop, make sure to arrive early to set up for the workshop with your Coach Coordinator. Make sure to bring all of the materials included in the checklist in blue, below. Your Coach Coordinator will provide the items listed in black.

Workshop #1 Checklist

Presentation Materials:
- ☐ Computer and projector
- ☐ Overview of Coach Role slide
- ☐ Coach Public Narrative Story

Facilitation Forms and Materials:
- ☐ Benefits of Storytelling info sheet
- ☐ Getting to know your families prompt sheet
- ☐ Clipboard with paper
- ☐ Notebook for notes
- ☐ Coach Handbook

StoryBlocks Activity Materials:
- ☐ (5) iPads with StoryBlocks
- ☐ iPad chargers

Introduction Activity Materials:
- ☐ 3x5 index cards
- ☐ Scrap paper
- ☐ Colored markers

Workshop Materials:
- ☐ Name tags
- ☐ Sharpie markers
- ☐ Pens and pencils

Food and Beverages:
- ☐ Food (pizza, salad, snacks)
- ☐ Beverages (water bottles, soda)
- ☐ Plates, utensils, cups, napkins
- ☐ Trash bags

During Workshop #1

You will facilitate the workshop with support from your Coach Coordinator.

Workshop #1 Agenda

Part 0: Optional Meet & Eat Period (15 minutes prior to start of workshop)

- Food will be available and children and caregivers can arrive, get name tags, and mingle to be ready to start on time.

Part 1: Eat (15 minutes)

- Get settled - Collect name tags and food
- Introductions - About Me, About Us (share to group) or 3 words to describe you and 3 to describe your child/caregiver
- Coach Introduction - Share public narrative-like story and why you are a coach. Provide a 1-minute overview of role of a coach.

Part 2: Meet & Make (40 minutes)

Coach meets with caregivers:

- Share info sheet on the benefits of storytelling for learning and development
- Ask caregivers share an activity they like doing with their child. Relate it to StoryBlocks and give an example of a suggested activity connecting both StoryBlocks and the favorite activity.
- Ask caregivers about their interests and ways they like to interact with their children to better get to know them
- Address any questions or concerns from caregivers.

Coach Coordinators meet with children:

- Share book with the children and talk with them about ways to use StoryBlocks.
- Children create stories in StoryBlocks.

After Coach meets with caregivers, Coach meets individually with each child:

- Ask the child about his/her interests and plays StoryBlocks with him/her.

Part 3: Share (15 minutes)

- Ask children and caregivers share their StoryBlocks stories and discuss why they made this story (What did they learn? What was easy, hard, etc.?).
- Thank the families and remind them that they will keep in touch via text message. Tell families about date/time and main purpose of next workshop.

After Workshop #1

Upon completion of Workshop #1, you should check-in with your Coach Coordinators to debrief on how the workshop went, discuss any concerns or questions, and share feedback.

Make sure to take all of the forms and information from the workshop activities home so you can reference them later when analyzing stories, composing updates and activities, sending Story Starters, and communicating with families.

Workshop Resources

The workshop resources can be found in the appendix of this handbook. For workshop #1, please use the following resources:

1. Public Narrative Activity (adapted from Marshall Ganz)
2. Getting to Know Your Families Prompt Sheet

Appendices

Getting to Know Your Families Prompt Sheet

Instructions: During Workshop #1, use this list of questions to get to know your families. These questions will help you understand your families' interests and allow them to better get to know you. Focus on asking open-ended questions and take turns answering each question. Use the next pages to write down your notes.

Getting to Know You Questions:

General:

- How has your day been so far? OR Describe your day in three words. Why did you choose these words?
- What is one thing that you are [excited for / curious about / concerned about / would like to know more about] the Learning Loops program or StoryBlocks app?
- Describe yourself in three words.
- Describe each other in three words (children and caregivers).
- What are three things that you think of when you hear the word "play"?

Experiences:

- What is something that you enjoy doing or you've done that you are proud of?
- Name one book that you've enjoyed reading. What did you enjoy about it?
- Think of an object in your life (from now or in the past) that you relate to or associate with your learning experience (sometimes referred to as "evocative objects"). What is it and how does it relate to your learning experience?

Favorites:

- What is your favorite book to read as a family?
- What is your favorite movie/TV show to watch as a family?
- What is your favorite thing to do outside of work or school?
- Discuss other favorites: animals, athletes/sports, foods, toys, games, academic subjects — anything that is age-appropriate and sparks interest.

Favorites:

- What are two things you are looking forward to in the coming week/month/year?
- If you could meet any character in real life, who would you like to meet and why?
- Ask "what if" questions. For example:
    - What if you could take a trip anywhere? Where would you go? Why?
    - What if you could do any job in the world? What job would you choose? Why?
    - What if you could be any type of animal? What animal would you be? Why?

Getting to Know Your Families Record Sheet

Instructions: Use this page to jot down key interests or pieces of information that are shared with you. Keep this sheet and use this information to inform the updates and activities you send to caregivers and the Story Starters and Story Stickies you send to children.

GENERAL

CAREGIVERS:	*CHILDREN:*

EXPERIENCES

CAREGIVERS:	*CHILDREN:*

Appendix C: *StoryBlocks Tales* Excerpts

StoryBlocks Tales was a book created at the end of the Learning Loops spring 2019 pilot study that featured one story authored and selected by each of the participating children. Coaches contributed by writing a profile about each child, and children were given the book at the end of the pilot celebration to take home with them. The following excerpts were chosen from a chapter of *StoryBlocks Tales*. The coach picture was altered and all names were changed to protect the privacy of our participants.

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TABLE OF CONTENTS

CHAPTER 1: COACH SARAH

CHAPTER 2: COACH MELANIE

CHAPTER 3: COACH NATALIE

CHAPTER 4: COACH KEYLA

CHAPTER 5: COACH CORA

CHAPTER 1: COACH SARAH

Sarah is a Speech Language Pathology graduate student at Northeastern University.

Her favorite story is *Eat, Pray, Love* and as a child she loved *Junie B Jones.*

When she was younger, she always wanted to be a teacher.

DROWNING

"Amelia loves to share stories with the theme of friendship. The characters always help each other through challenges, solve problems together, and celebrate their success together at the end!"
-Coach Sarah

9


1
3
4
5
How was your day today? Wait did you hear anything?
I did not hear anything
Help!!!!!!!!
A boy in danger!


1
2
4
5
Oh my god!!!! My boy!!!!!!!!!
I am drowning
I am coming!!

10


1
2
3
5
Yay you are saved!!!!!
Thank you so much for saving my baby !!!! .
You are wellcome !


3
4
6
7
Yay
Thank you!
Yey thank you!
you are very welcome!!!!!

11

THE END!

12

CHAPTER 2: COACH MELANIE

Melanie is a Speech Language Pathology graduate student at Northeastern University.

Her favorite stories were about Disney Princesses when she was a child.

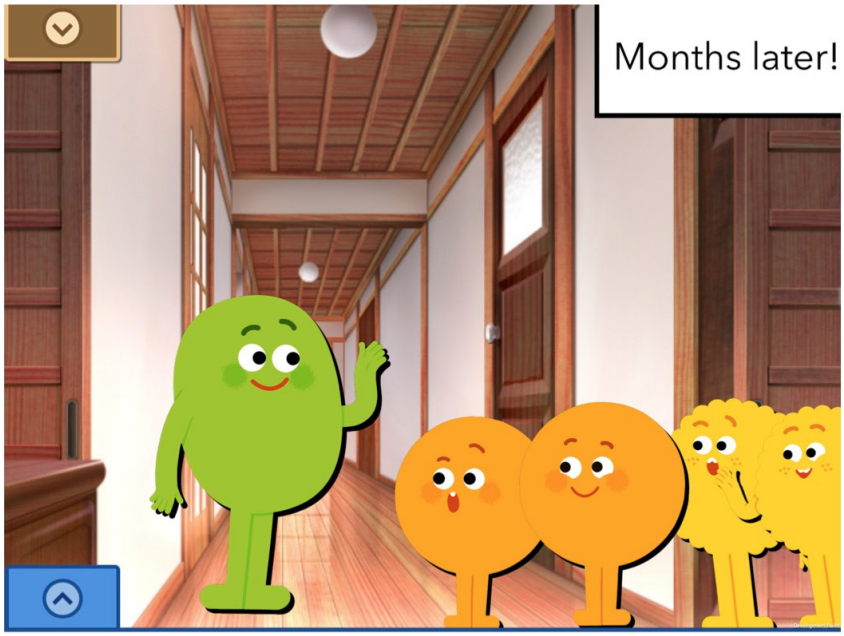
When she was younger, she always wanted to be a teacher.

21

TARANTULA TAKEOVER

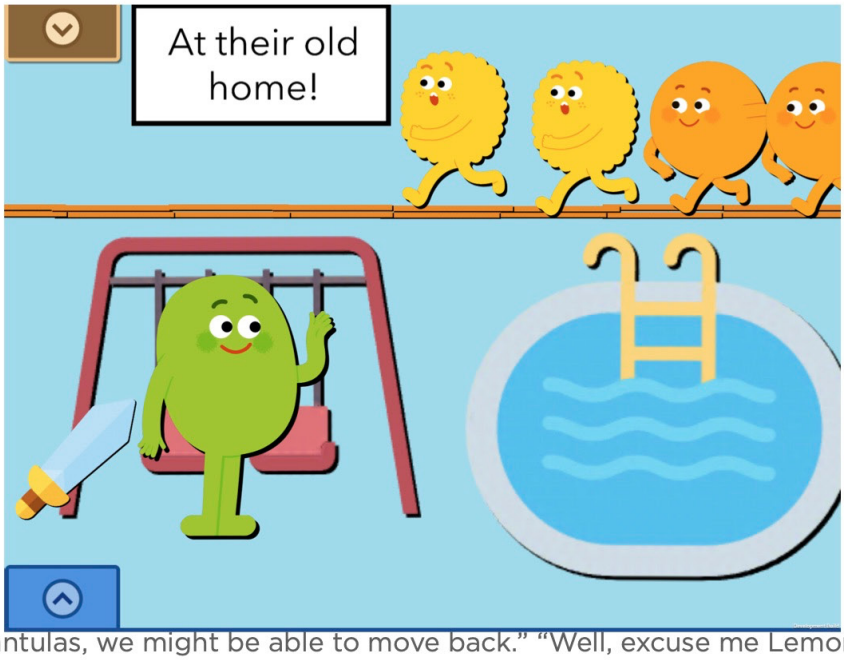
SASHA

"Sasha is a kind girl who creates very detailed stories about family and friends, such as a 'Tarantula takeover' and exploring a 'Colossal Cave!'"
-Coach Melanie

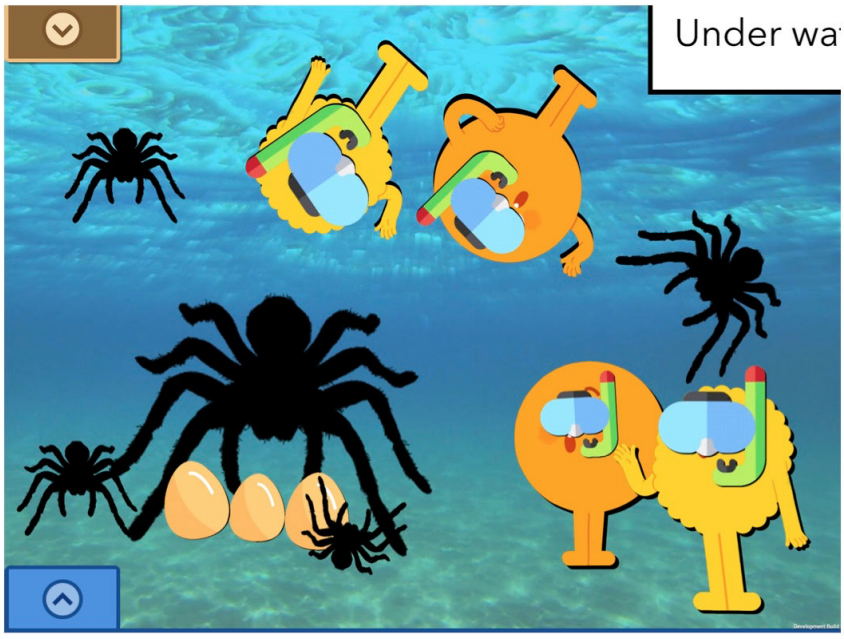


"Want to go back to our old house to see if the tarantulas are still there? I got some news that they're working on it and we might be able to go back." "Oh really? we get to go back?" "I don't know if we'll be able to live there, but we can take a trip and see how its doing." "Great! I'm so happy!"

22



"The tarantulas, we might be able to move back." "Well, excuse me Lemon..." "Uh!" "Woah, I don't feel anything, let's get inside the pool!" "Okay, let us get in too!" "Yeah, let's look! I got my goggle in my backpack! C'mon guys, let's get our snorkels and goggles and look in there!"



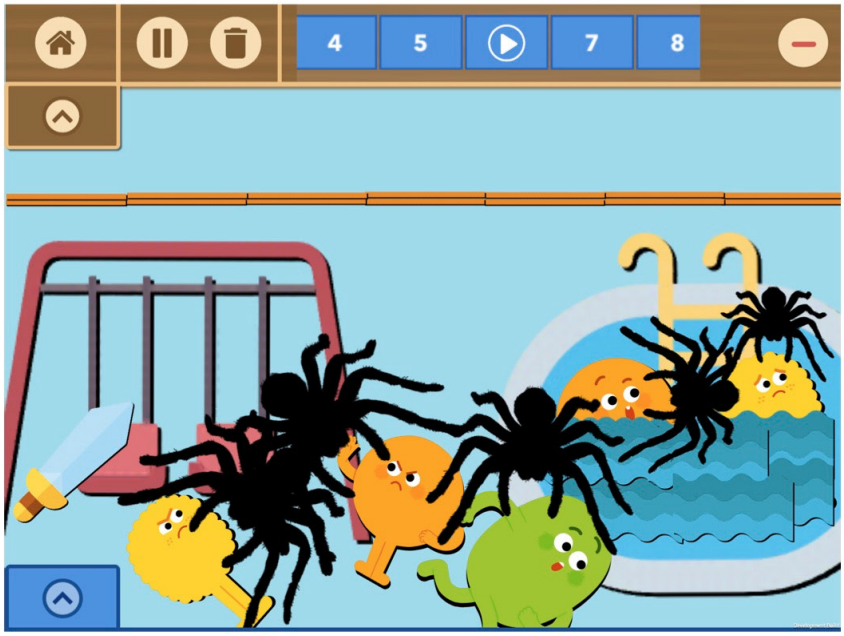
"AHHHHH! TARANTUALS!!!" "AHH! They're laying eggs guys!" "We definitely can't live here! C'mon, let's go!!!"

23

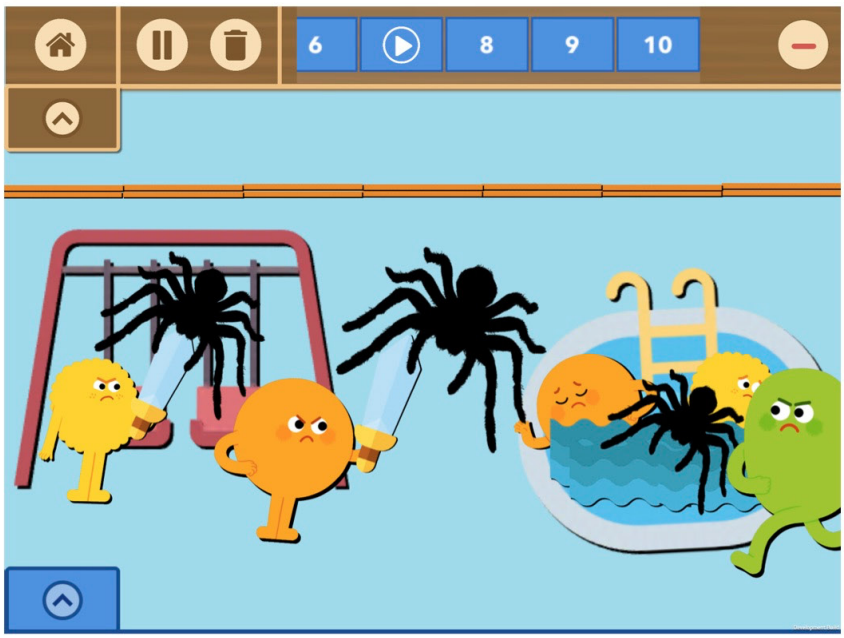
"Ahh, tarantulas! Guys, I don't think its safe here, I'm pretty scared, c'mon let's go! There are tarantulas everywhere, all over the kitchen too!" "Okay, mom, we have to get into the car NOW!"

"AHHHH! They're grabbing me!" "Mom, NO! The tarantula is about to jump on you!" "Lem, no!" "Mom!" "Kids!" "No, watch out!!!" "AHHH!"

24



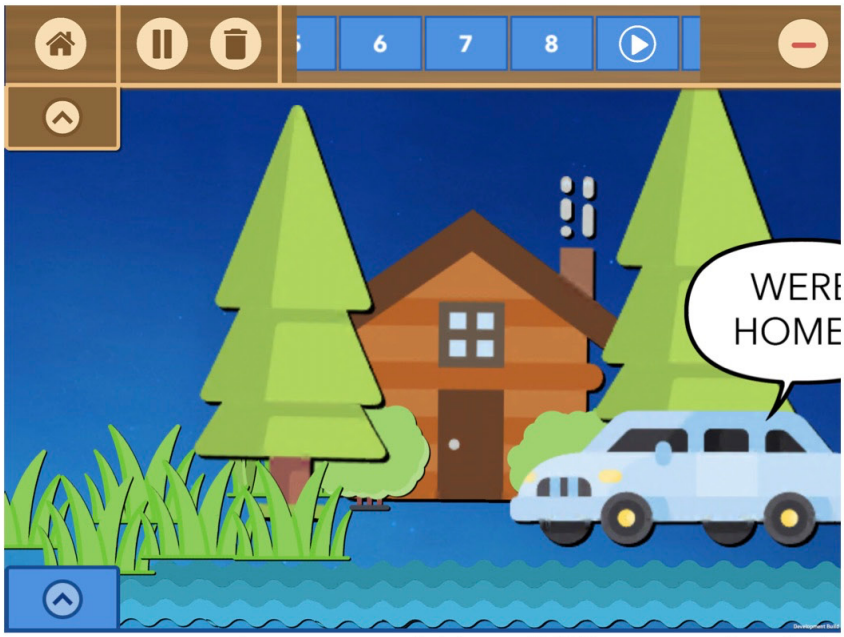
"Mom, the tarantulas are going to throw me in the water! Oh no! They're pushing me closer to the pool! Please, help!" (splash, splash, cough). "Mom, please, HELP!!!"



(splash) "Mom, we're drowning, HELP!" "That's it! I hate these stupid tarantulas! We have to do something! Oh, look at these swords we left here, we have to fight them off so we can grab them before they drown.. but there's not enough time!" "Mom, grab them while we fight off the tarantulas so they don't drown!" (splash, splash).

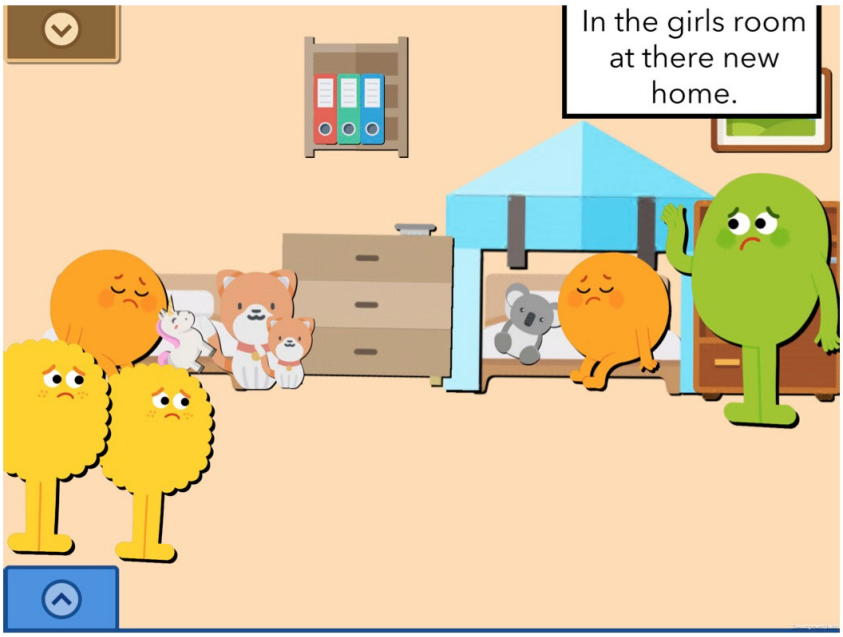
25

"Alright kids, the tarantula infestation is too bad for anybody to stay here, we have to go." "Okay mom, but I'm really going to miss this old house." "I'm sorry nobody can stay here, its too.." (hisssssss) "...get into the car kids. NOW!"



"We're home guys, we need to get out of this car!" "Okay, mom, I really hope there are no tarantulas in here!" "Yeah, me too, that would be terrible!"

26



THE END!

27

CHAPTER 3: COACH NATALIE

Natalie is an experiential learning advocate, storyteller, and art teacher who loves to bridge science and art.

Her favorite story book is *Harold and the Purple Crayon* because she loves to draw and use her imagination!

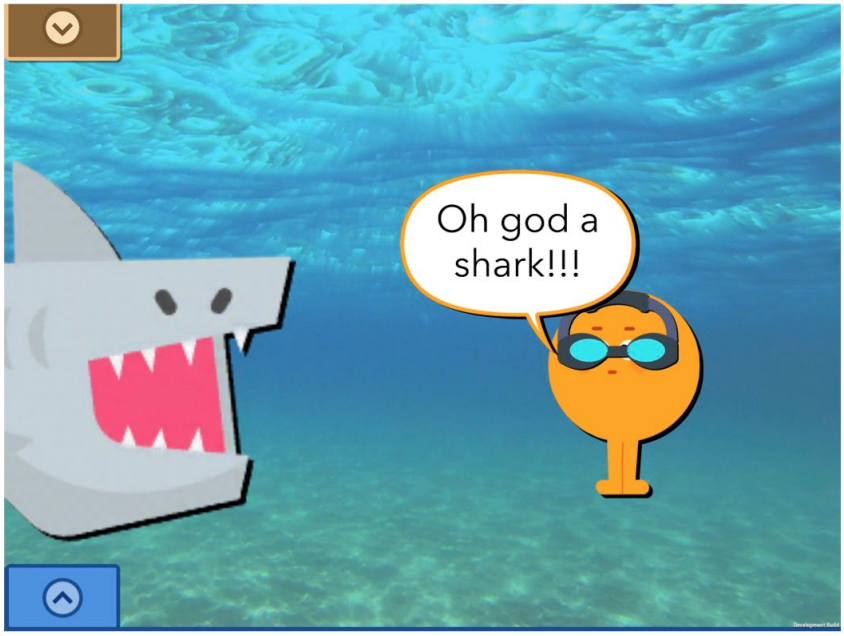
When she was younger, she always wanted to be a veterinarian because she loves animals.

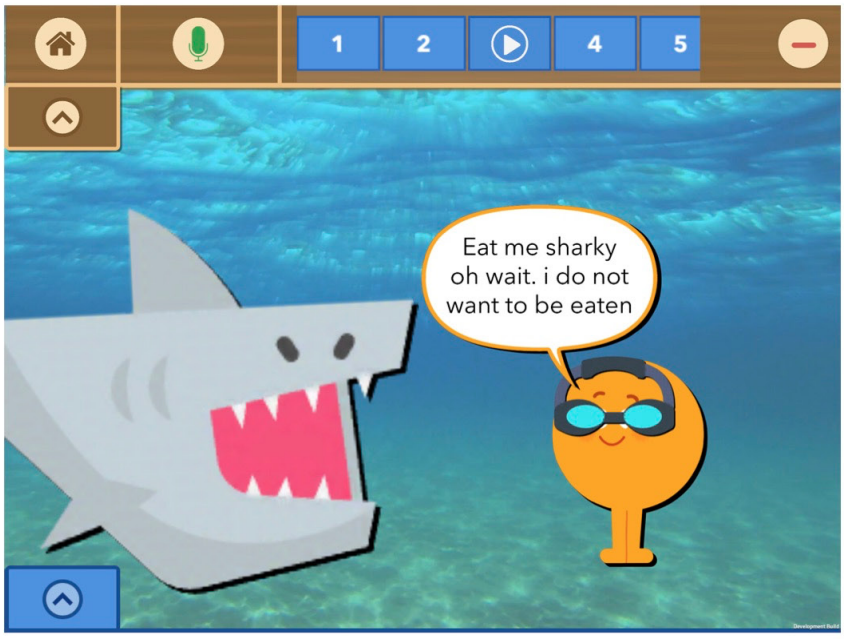
BOO AND SHARK

ROGER

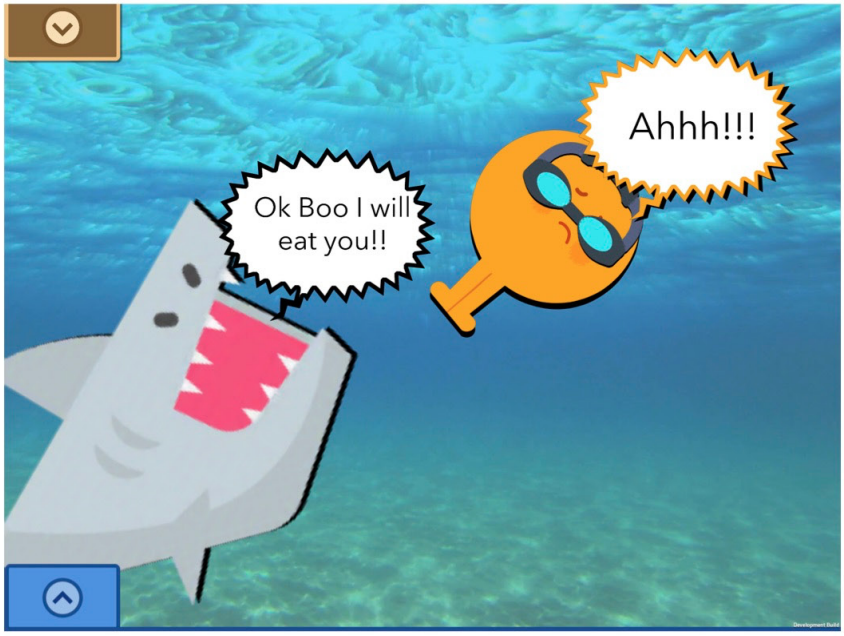
"Roger loves to write adventure stories about everything from sharks to outer space! He creates interesting challenges in his stories that always leave you on the edge of your seat!"
-Coach Natalie

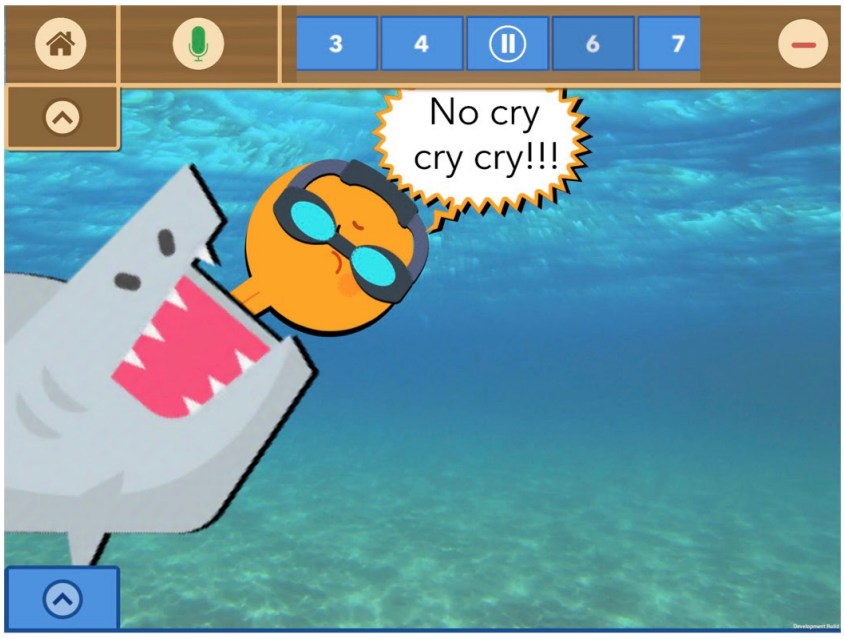
60


Oh god a shark!!!


1
2
4
5
Eat me sharky oh wait. i do not want to be eaten

61





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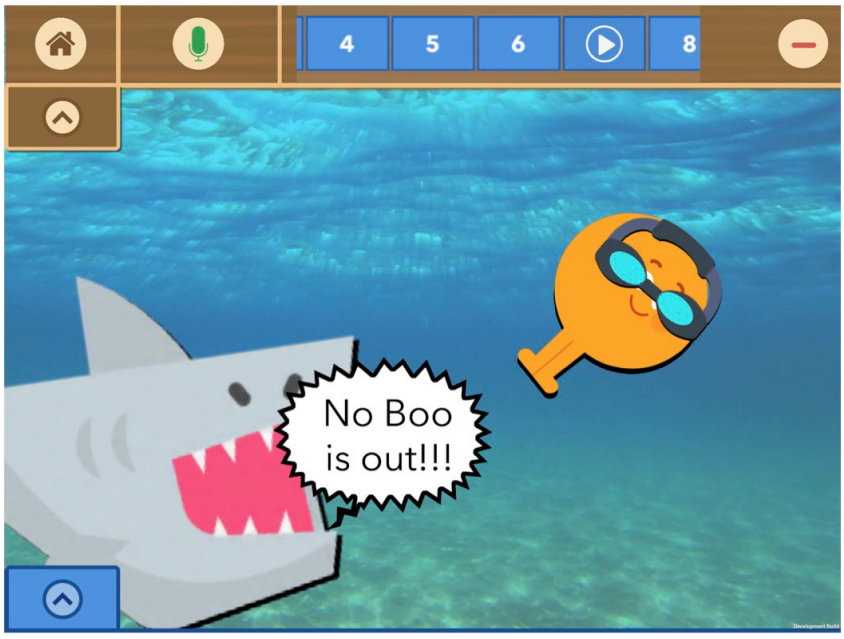

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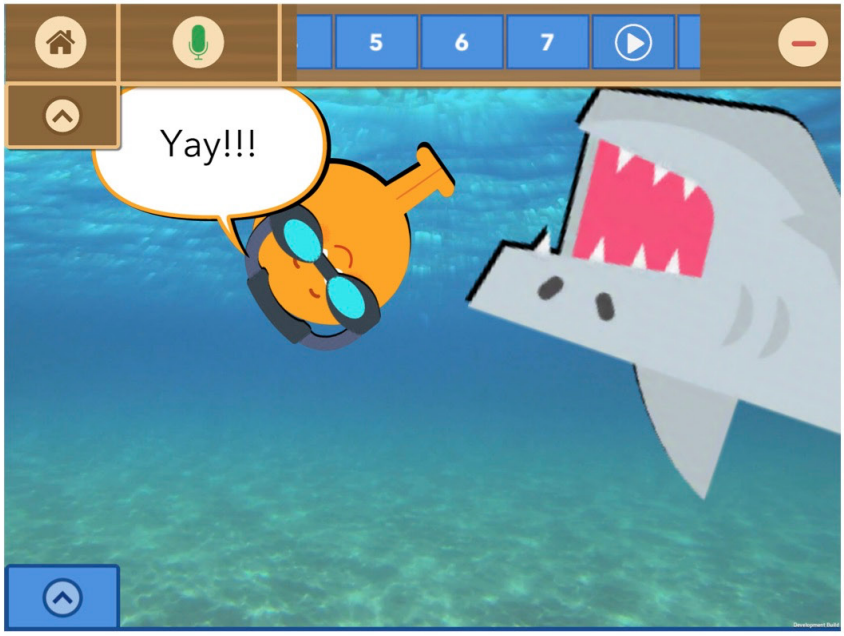

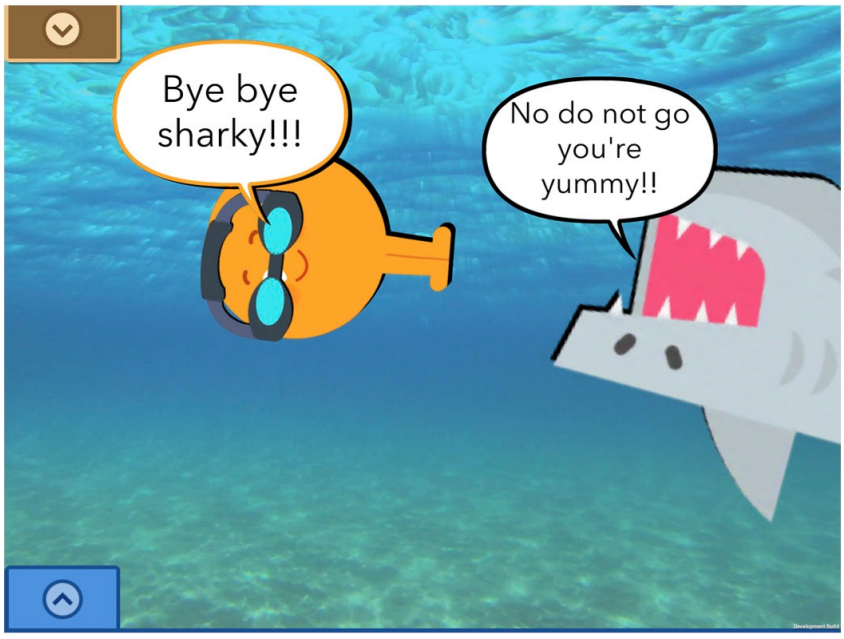

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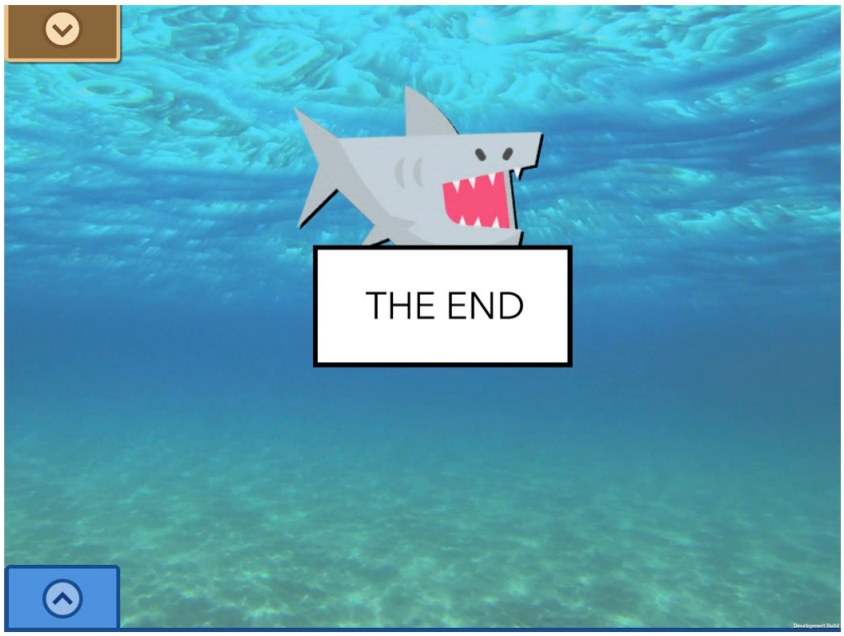


THE END!

65

CHAPTER 4: COACH KEYLA

Keyla is an English teacher and a recent graduate of the Harvard Graduate School of Education's Literacy Coaching track.

Her favorite story book is *Harry Potter*.

When she was younger, she always wanted to be a ballerina or a lawyer.

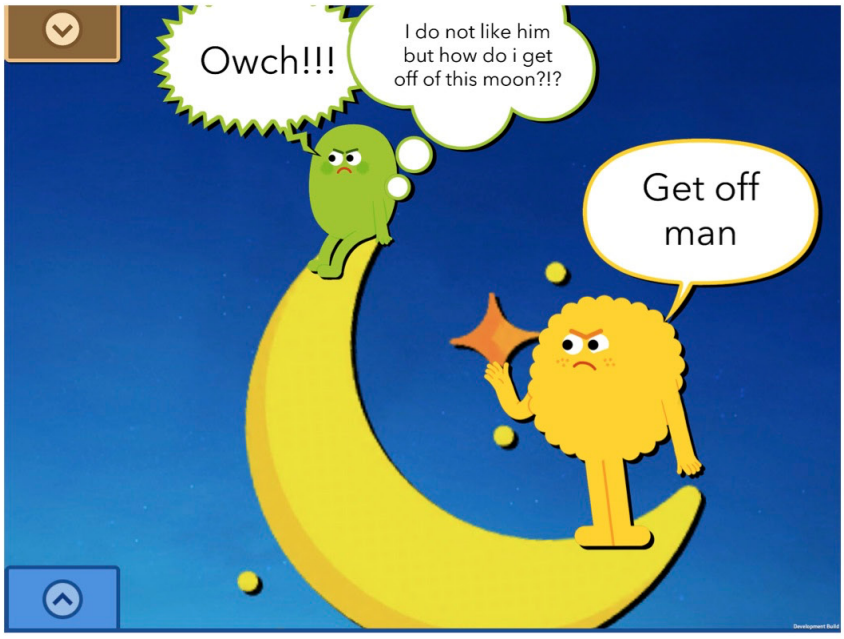
A CHOOOOOO

ILLAN

"Illan is creative with a hilarious sense of humor! As an author, his stories often include unusual characters, clever use of props, and lots of detail!"
-Coach Keyla

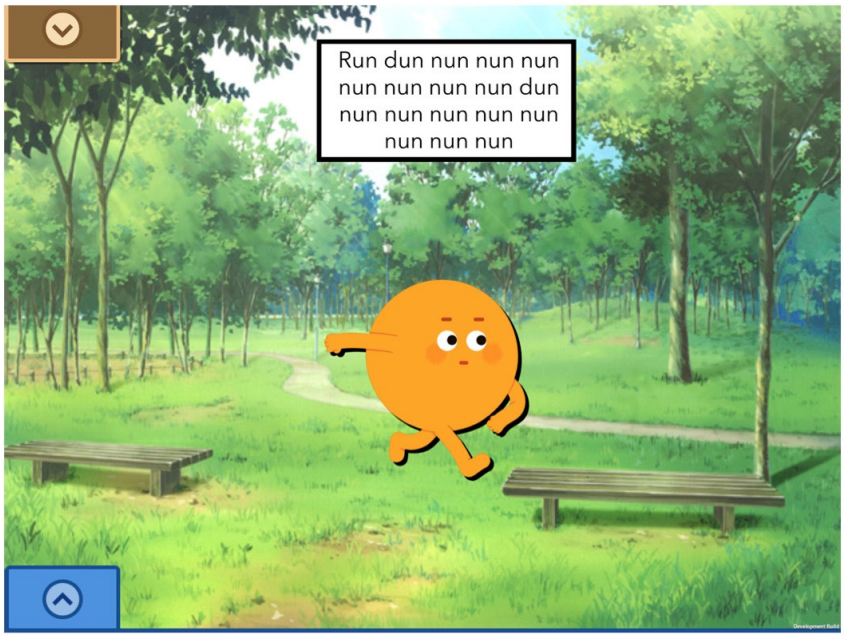
73


Hey i said bless you!!!
a chooooo!!!!!!!!
Sorry . A choooo!!! I did not a chooo!!! Mean to! A choooo!!!!!!!

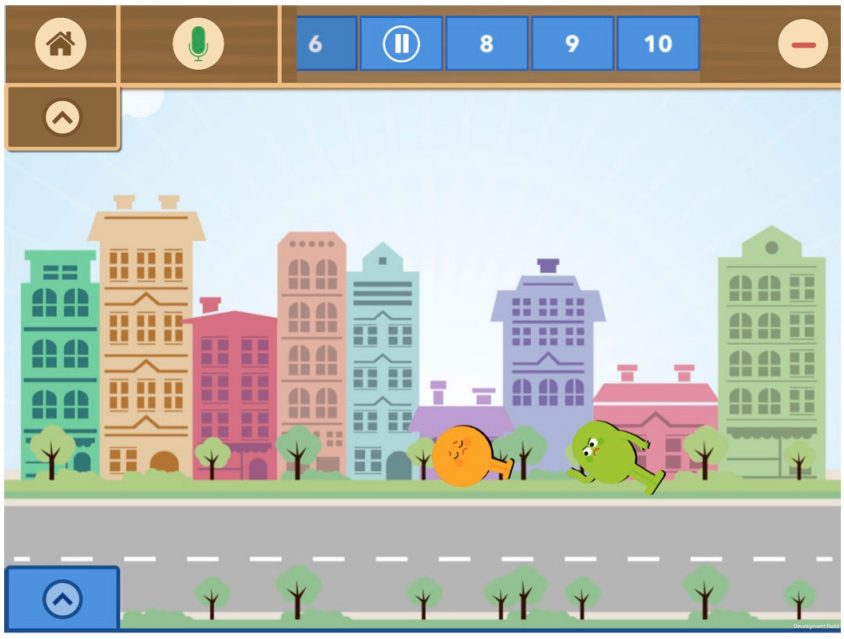

Owch!!!
I do not like him but how do i get off of this moon?!?
Get off man

74


1
2
3
5
Uuuuuummmm...


Run dun nun nun nun
nun nun nun nun dun
nun nun nun nun nun
nun nun nun

75



76


wow!
Guess what happened up there. I seen a alien and he push me off the moon and who knew Lem was a alien!like wow!


Guess what i see. An alien space ship!!
Ohh no! This is not good!

77

THE END!

78

CHAPTER5: COACH CORA

Cora is a recent graduate of the Harvard Graduate School of Education's Literacy Coaching track.

Her favorite story book from childhood was *The Talking Eggs* by Robert San Souci.

When she was younger, she always wanted to be a paleontologist when she grew up.

LIFE IN 2019

SAMANTHA

"Samantha brings passion and drama into every story she creates, with emotion-packed plots that explore deeper themes, from friendship to accepting oneself."
-Coach Cora

99


i hate donald trump and his wfe because they dont like immigrants


buy me a ,latte
Ok i'll buy it

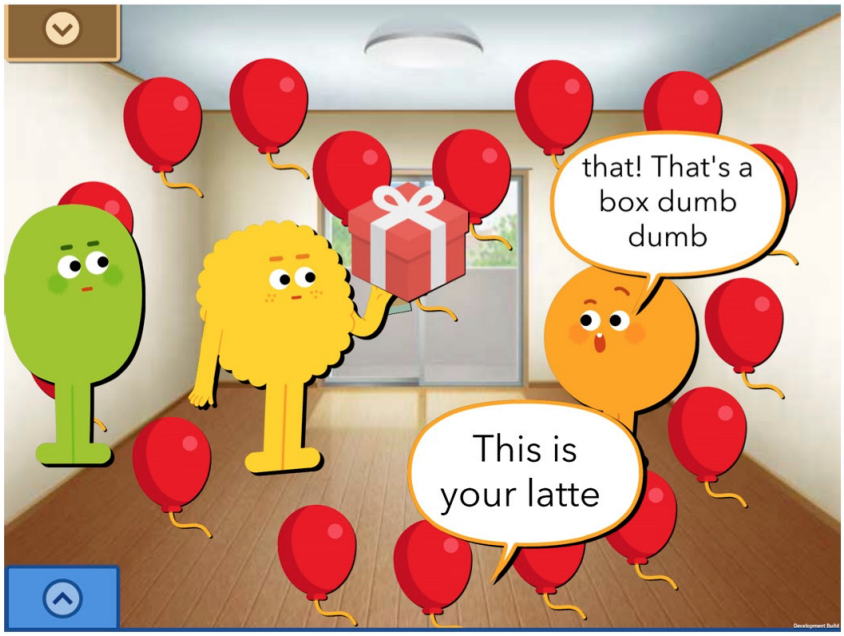
100


Shh dont
make a sound
....SHOOT


2
3
4
6
goin too
japan
This is so
cool kiwi

101

102



THE END!

103