GeoStories

International Storytelling For Children

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Introduction

Ever sit a child down in front of a computer and ask them to write you a story? They'll stare at the computer and complain that it's no fun. Alternatively, watch a child play with toys. As they play, they'll start telling the most fantastic stories about their blocks or dolls.

Research shows (Cassel, 2001, Bederson, 2009, and Jarvis, 2008) that children need an outlet to express themselves on a platform larger than just those they encounter in their daily lives. They want a way to tell their stories to children worldwide, and, in turn, read stories of children from other cultures. In addition to giving them a creative outlet, this would give them a chance to learn about different children and especially different cultures.

New mobile device models, such as iPhone, G1, and Blackberry, have high levels of functionality, allowing users to check email, surf the internet, or use a host of applications. These mobile devices provide infinite new possibilities for children to express themselves. In the first place, mobile technologies enable sharing to occur during play. Consider this scenario – a child goes on a family vacation to the beach. He creates a sand castle and eats his favorite dinner, chicken tenders, at the local restaurant. While it may seem trivial, recording the story cannot wait until the end of the vacation when access to a family or library computer returns. It has to happen immediately with pictures and other audio-visual content. It also has to be fun (and easy) enough to smoothly integrate into play, rather than being an extra homework-like component. Mobile devices provide the portability, user interactions, audio-visual tools, and "fun-factor" necessary to solve this problem for the first time.

We investigated these issues at a series of design sessions at the Human Computer Interaction Laboratory at the University of Maryland. During the sessions, an intergenerational design team consisting of eight children and a handful of researchers discussed what types of stories children might want to tell and how they wanted to express them. Afterwards we explored ways the iPhone and other mobile devices might be used to better facilitate story telling. These results were compiled into the GeoStories prototype discussed within.

Storytelling

For as long as we can remember, man has told stories. Originally a way to pass down history, storytelling has become an essential part of human communication and development. No longer just an oral tradition, our stories take many forms from books, many of them now interactive, to the things we watch on TV or the internet.

Researchers agree that storytelling plays an essential part in children's development. For children, storytelling most often occurs in what Cassell (2001) terms "fantasy play." "[T]he children's language and actions are both the process and the product of their fantasy play…. Children demonstrate in this language a sense of possibility… Through their language and their actions they create the world in which they are playing" (Cassell, 2001, p. 170-171). Fantasy play is the primary way children communicate their stories and thus is the focus of our discussion.

Fantasy play is essential in child development because it is an important way they communicate their feelings and their creativity. "Storytelling of all sorts is the primary form through which we understand and impose order on our experience" (Cassel, 2001, p. 170). Children's stories, no matter how seemingly simple, can tell us quite a lot about the children themselves. Further, on a cultural level, stories are the way we explore our beliefs. By distancing ourselves from reality, we are able to explore difficult thoughts with a sense of immunity (Cassel, 2001). Storytelling is also the way children learn about their culture (Cassel, 2001) (Decortis, 2002) making it an ideal medium for expanding cultural awareness.

Figure 1 - Sharing Stories Using the GeoStories Prototype

Beyond just culturally, storytelling is essential in cognitive, social, and emotional development. Stories are important ways for children to exercise their imaginations. During a design session for another storytelling application (Druin, 2005), one child offered that "With tv and movies you don't get to imagine what things look like". During our sessions, we found that children distinguish between true, make-believe, and semi-reality stories, although all three seem to exercise their imaginations. Stories devised during fantasy play are a collaborative effort "where children share out the character roles, and take turns being the narrator…. Thus, in storytelling we experiment with, construct and express our identities" (Cassell, 2001, p. 171.). Stories are an important way for children to express themselves while reflecting their feelings about the world around them (Decortis, 2002). Further, a child's stories will naturally increase in complexity over their development, from simple stories to ones with various characters, a narrator, and a plot. Through story-writing, children practice language skills as well as character and plot development (Cassell, 2001, p. 171). While children's stories may seem exceedingly simple, they are an important part of childhood development.

Story-telling is often most effective when practiced as a part of fantasy play. A few days after one of our storytelling sessions, in which several children had trouble coming up with topics, we gave them a pile of blocks and let them see what they could make with them. Within a few minutes, they were telling us fabulous stories about their creations. We believe that having a connection to physical reality is extremely important. "[C]hildren have an early emotional engagement to physical objects…" (Cassell, 2001, p. 173). Using items from the physical world can help children to better connect their stories with reality (Decortis, 2002, p. 418). Further, it has been shown that leaving a tangible public record of the story itself is important. This is part of the theory of constructionism that states that "children learn as they build or construct a public artifact" (Fails, 2007, p. 181). Through building the artifact, in this case a shared story, children learn creativity, language, and social skills.

Previous Research

While several projects have focused on harnessing technology to enhance storytelling, we believe that the advent of new mobile technologies warrants further research. Early technological storytelling tools merely allowed the creation of stories on a computer as they would be on paper. The typical story for a child would be a picture and some text (Decortis, 2002). They did not really empower children to express themselves or create imaginative stories any more than paper and crayons (Cassell, 2001). Technology opens up many opportunities to better support story creation.

One of the first projects to investigate these possibilities was the KidPad project spearheaded at the University of New Mexico (Druin, 1997) (Benford, 2000). To develop KidPad, researchers paired up with local school children to recreate Pad++ into a storytelling tool for children. The resulting application, KidPad, used zooming to create nonlinear stories. The children could link a location on one image to a new zoomed image representing the next part of the story. Thus they would tell nonlinear stories by linking zoomed images. The study found that the children wanted to draw with a touch screen, record sound to enhance their stories, get spelling help from dictionaries, create animations, and zoom through more than just images (different worlds, time, etc) (Druin, 1997).

The study continued to enhance collaborative tools in KidPad and Klump (a modeling tool to help generate story ideas by stretching virtual clay) (Benford, 2000). During this study, researchers redesigned KidPad and Klump to give enhanced functionality when two children used the same tool simultaneously. For example, when two children drew simultaneously with different colors, KidPad would create a new color, otherwise inaccessible, by mixing them. This model did not force collaboration it but rather gave users added benefits if they chose to work together.

Instead of facilitating collaborative storytelling through software applications as in KidPad and Klump, StoryMat supports it via a play mat that records a child's movements with a toy and voices (Cassell, 2001). The story can be played back later with a shadow of the toy and a recording of the child's voice. The authors found that there was a need for technologies that could support creativity in open-ended ways. The mat supported open-ended creation by giving children the freedom to move around as they created the stories. StoryMat essentially enables collaboration between one or two children and the mat itself. They found that the mat could be a participant in a collaboration to successfully promote more creative vibrant stories.

Another study looked to harness the power of technology to help support exploration for inner-city children in London (Williams, 2005). The researchers were concerned that the loss of outdoor play in and urban environment could cause problems for children. In particular, they were concerned that "a persons 'sense of place' – that feeling of knowing a place, of being at home there, which is derived from accumulated experiences and memories will be eroded" (Williams, 2005, p. 820). The solution they devised was a soundscape program. The application allowed the children to explore a park area and add sounds to various locations. As the children wandered the park, it showed them where they were on their devices and also where they had recorded sounds. The sounds could be spoken audio, sung audio, or recordings from their favorite songs. The children could then share their soundscapes with friends and family. The

researchers found that the soundscapes were exciting to the children who wanted to extend them further throughout their environment, creating their own personal space. The children also wanted more information to be stored in their soundscapes, such as safety features that identified dangerous areas or told their parents where they were.

More recently, Jerry Fails, a graduate student at the University of Maryland, has been working on different methods to use multiple cell phones to collaboratively tell stories (Fails, 2007). In his preliminary research, children were brought to Fort McHenry and provided with personal digital assistants (PDAs) to record their experiences. All of the PDAs were linked to one story so if one child made a change another would see that change. Despite the built-in sharing, the children still came together to show each other what they had added. His research focuses on how to enhance this collaborative experience, while minimizing the difficulties of limited screen space. In order to achieve this he proposes enabling mobile devices to "sync" when brought together. This would mean sharing screen space across multiple devices to present more information and encouraging collaboration.

Concurrently to this research, Bederson, Druin, and Quinn (2009) were also working on providing access to the International Digital Children's Library (ICDL) (Druin, 2001) on cellular phones. According to Bederson, story books are unique because both text and image are equally important and need to be viewed concurrently (2009). This was a challenge on mobile devices where such a medium has not been common. However, they found that using mobile devices was the best way fulfill their goal of "increase[ing] cultural understanding among the world's children through broad access to children's books from different cultures" (Bederson, 2009, 2). This research continued with sessions to create a storytelling application integrated with the ICDL stories (Druin, 2009). In this interface, stories can be modified or appended by the users. The system specifically targets children and older adults. This research is ongoing but some findings were closely related to this research and will be relayed through out the discussion.

Technology Review

The proposed research- to enable children worldwide to share their stories with the features described herein – is new to the IPhone community. With over 1 million IPhone applications sold worldwide (Burrows, 2009), only a few applications support storytelling and even fewer for children. The iStory application is one such application, in theory designed for both adults and children (Steil, 2009). The application allows users to create interactive stories online, defining transition choices and resulting plot lines for readers. Readers can then explore the stories online. The ideas seem promising, and have gotten some good reviews from users, but do not adequately support the child population we wish to investigate. In particular, the stories are entirely textual, an interface not suitable to children.

Applications such as Whrrl (Grove, 2009) come far closer to multimedia-based storytelling. Whrrl integrates with Facebook to provide users with location-based storytelling services. Users can share stories with their friends and collaborate on them but only when they are in the same location. This type of storytelling is closer to our goals but for an older audience. Most children in our target age group do not have Facebook and most likely will not for several years to come. We also go further than this application to allow sharing beyond "friend" circles in order to give

cultural exposure. Finally, this application does not support the story starters or audio recording described within.

Other applications record audio content but not in a story context. Applications like SpeakEasy (http://www.zarboo.com/speakeasy.html) and iTalk Recorder (http://www.griffintechnology.com/products/italk) can record audio clips such as singing or a lecture but they do not integrate them in any way with an actual story. Overall, no IPhone application adequately supports spontaneous storytelling by children.

Methods

Participatory design sessions were conducted with a group of eight children, ages 7-11, at the Human Computer Interaction Laboratory (HCIL) at the University of Maryland. During these sessions we gathered qualitative data on which to base our design. The group of children, referred to as Kids Team, meets twice a week with a team of designers in order help design new technology with a variety of partners. They go through a two week summer camp to get comfortable with their role as design partners. Contrary to the more common use of children as testers, these children experience all of the design roles specified by Druin (2002), especially design partners and design informants. In these roles, they are actively involved in the technology's development from conception to completion as they were on this project.

During the first session with the children we used low tech materials commonly referred to as "bags of stuff" or "big pieces of paper" to get ideas of what types of stories the children would tell and how they would tell them (see Figure 2). After that, we used computers and a high-tech prototype. During all sessions we used contextual inquiry to observe the children's behavior. During contextual inquiry, one observes how children work with the storytelling technologies, be it traditional pen and paper, computer, or prototype (Benford, 2000). We were also particularly interested in the content of the stories and types of collaboration.

Figure 2 - Big Piece of Paper Story

Design Experience

The HCIL has a long history of research in using mobile devices with children, occasion in conjunction with older adults (Fails, 2007) (Franckel, 2009)(Druin, 2009)(Bederson, 2009).

However, this particular line of study – using mobile devices to tell children's stories internationally – began with an exploratory design session during the children's training camp in the summer of 2009. During this session, researchers and children partnered with UNICEF representatives to brainstorm ideas of how children worldwide could share their stories. While UNICEF was unable to continue participation, the design session was enough to demonstrate that more research was warranted.

One of the UNICEF representatives, Jonathan Jarvis, recorded the final observations from the Kids Team session. He observed that such a story-telling environment needed to have a sense of community, be easily accessible, and emphasize the story environment. The children felt that "no one else was telling stories, and that was discouraging to the storyteller" (Jarvis, 2009). They wanted a sense of a storytelling community where everyone was able to read everyone else's stories. Sharing the stories gave the children ideas for their own stories. Interestingly, the children had strong associations on where the stories were told. These "story places" were the places the children wanted to tell their stories. They included things like campfires, tents, television studios, caves, and giant story-recording kiosks (see Figure 3). From this session we concluded that the technology had to support collaboration and sharing as well as a clear association between the stories and the places where they were written.

Figure 3 - Story Places Prototype Sketch

Thanksgiving Stories

Our next design session with the children was shortly after Thanksgiving so we asked them to tell us about their Thanksgiving this year or their favorite things to do on Thanksgiving in past years. We gave them low-tech materials such as markers, crayons, foam pieces, and yarn as well as large pieces of paper in order to tell their stories. The goal of this session was to get an idea of what details were important and how they presented their stories.

Not surprisingly, the children used a lot of pictures and visual content. One child chose to draw out her entire story as one giant picture. More interestingly was the way the stories were laid out on the paper. Only one of the children opted to arrange their story like a book – left to right and mostly text. The rest drew out non-linear stories that traveled around the page, generally not in regular patterns. One boy was really excited about his story and wrote it around the page in interlocking swirls of text with images interspersed (see Figure 4). The iPhone is ideal for this type of functionality because it is sensitive to turning gestures.

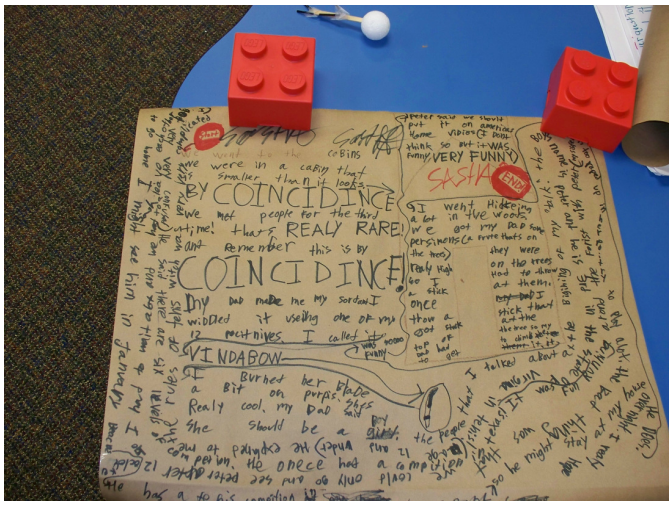

Figure 4 - Swirls of Writing in a Thanksgiving Story

Power Point Stories

While we got several ideas from the Thanksgiving stories session, we decided that more research was needed on the content and format of the stories. This resulted in another brainstorming session. Again working independently, the children were each given a desktop computer and instructed to create a true story in Power Point. Before the session, we gave the children the option to bring in objects they wanted to include in the stories. In addition to the objects (which we photographed), we allowed them to look online for images, take pictures in the lab, draw, or type text.

Figure 5 – Pokemon Story Title Page

The hardest part for the children was getting ideas for their stories. Interestingly, the children who had brought in objects had only a small advantage in this regard. One boy who brought in a toy plane wrote a story of his trip to Florida. Another girl brought in Pokemon cards so her story was about how the game was played (see Figure 5). The others based their stories on the things that were around them. One boy had a particularly difficult time coming up with ideas, eventually settling on a time he and a friend (also in Kids Team that day) went hiking. Another wore her favorite belt the day of the session. Her story was about fashion so she pulled a lot of pictures of models off the internet and photographed herself with her belt (see Figure 6). Another wrote about their pet cat. Yet another wrote about the things she likes such as cars and dogs. She had a lot of trouble typing so one of the researchers helped her.

The last girl has a passion for singing. She had created a website online with her songs and some pictures of her singing. She immediately started copying the audio files and pictures into her story. She wrote about her songs a little but more important was the singing itself. Her audio story led rise to an important revelation in this session – audio could be used both as a storytelling medium as well as inspiration.

While writing the stories, we observed the children's behavior for future analysis. Just like in the Thanksgiving stories, layout was quite important to many of the children. Even more important though were backgrounds. Three out of the seven children went straight to the backgrounds in PowerPoint before even starting their stories. Another went back and added one later. It seems that some of the children actually got ideas from the backgrounds themselves. Backgrounds could also be a type of story starter GeoStories could use.

Figure 6 – A photo for a fashion story

Several of the children wrote most of their stories and then took a break to see the others' work before continuing. The children needed a break as well as a chance to get new ideas. The GeoStories application we create needs to enable these behaviors by allowing for intermittent creation. We knew we would need to have story starters but this showed us that story ideas that could be activated mid-story were appropriate.

At the end of the session, we asked the kids to tell us the most difficult aspects of writing their stories and what could be done to make it easier. The children agreed almost immediately that typing was the hardest part. Thinking coming up with a topic or deciding how to write it was a close second. They also agreed that they would rather audio record their stories. Often, as it was in this session, we find that the children are so bogged down by typing that it severely limits the scope of their stories. Most of the children are avid computer users and will not give up control to a researcher, even if they do not enjoy typing. Occasionally, a researcher will take over typing in order to allow the children the freedom to focus on their creation rather than the letters on the keyboard. In our mobile application, children will not necessarily have people to take over, nor should they have to. They need to have the freedom and control to be able to create their stories themselves.

The children also addressed the concept of story ideas as opposed to story starters. They defined these story ideas as being questions that the storytelling application would ask as the user went through their story, not just at the beginning as we had earlier assumed. In the middle of this discussion, the children started playing the round-robin storytelling game. One child would add a sentence to the story and then the next would say the next sentence. This gave rise to a similar idea for creating the storytelling community. Perhaps our application could support collaborative stories such that one child would create the first page, another the next, etc. This would encourage exciting new creativity while also giving children exposure to the community.

Finally, during our discussion several children likened their storytelling to being a pen pal. Several of the children had pen pals and all of them said they would be interested in having one. When asked what they would ask a pen pal, they came up with a series of cultural questions such do they take an English class, what their school day was like, what their favorite things to do were, and if they were bilingual. Their curiosity reinforced our suspicions that the children have

a natural interest in children from other cultures. They wanted to read stories from both children they knew and did not know.

Several aspects of the session seemed to warrant further research. Using audio seemed quite a powerful tool for the children. The audio could be used as both story ideas and as a medium for storytelling. The children clearly wanted story bridges – things that could connect their stories to the physical world around them. We knew that the mobile technologies were capable of making that connection but the real question was how. We surmised that audio might possibly be that connection. For the two sessions up to this point, the children had worked individually. The tag-team storytelling that occurred spontaneously in our discussion made it clear that collaboration was an important aspect of the storytelling experience.

Audio Stories

During the first Power Point storytelling session, the children brought up the concept of sound – both spoken and sung- as a possible way to prompt stories as well as tell them. In order to investigate this concept further, we presented the children with 17 sound effects pulled from a variety of places. We played sounds of a seashore, a school yard, moaning with chains rattling, a cackle and howl, a swamp, an airplane, a bell machine, a car honk, bees, a monster, a crowd, rain pattering on the roof, a dog barking, an airplane stewardess, quote from Wall-E, sheep, bathtub filling up, door squeaking, and a vacuum cleaner. As you can see, the sounds were extremely varied. We played all of the children the sounds without identifying them and asked them to vote on their favorites to use as story starters. The three favorites were the Wall-E quote, the stewardess, and the ocean. The Wall-E quote and the stewardess (which happened to also be from Wall-E but no one made that connection) were the only two clips with actual words in them.

As we were playing the sounds, the children got really excited. They started trying to guess what the sounds were. Interestingly, they all had different ideas about what the sounds represented. One boy thought a clip sounded like an airplane but said he'd rather have it be a chainsaw. Another boy said he could make up a story from all of the sounds. It quickly became clear that the favorite sounds had clear associations for the children, albeit not always the same association. Each child chose their own personal favorite sounds which included the chainsaw/airplane, beach, Wall-E, creaking door, zombie, stewardess, and witch sounds. Whereas often children will all choose the same "popular" item in a group, they all picked their own favorite. One girl said that they liked the beach sound because they liked the adventure implied in it.

The children then made Power Point stories based off their favorite songs. This time, we equipped each group with a headset to record audio. While they were given a choice to work alone or with a partner, all of the children immediately paired off, indicating to us that collaboration was really important to them, not to mention more fun! Particularly interesting, the top voted sounds were not the sounds they chose to tell a story about. Only two of the top voted sounds (only one spoken) were used in stories, one of which (the stewardess spoken sound) only in conjunction with another sound effect. The sounds they chose seemed to be the most exciting for them, be it an implied adventure or a scary story.

Figure 7 – Recording a story about an airplane crash

This was by far the most interesting session thus far for the children. They were so excited about their stories that they constantly called us over to hear what they had recorded. At the end of the session, everyone complained that they wanted to keep working on their stories. Sound definitely proved to be far more exciting and stimulating a story starter than the physical items from home.

All of that enthusiasm created some very creative stories. Two girls recorded their individual stories of their trips to the beach. One pair, a boy and a girl, created a story about a witch. They were the only group to draw out their characters. Two other girls created a story together about two zombie friends at the beach who found a zombie dog. As they recorded, they added in sound effects. They liked using pictures of themselves pretending in the story. During the middle of their story, the both got up and started pretending to be zombies, dressing one girl in a scarf like a mummy (see Figure 8). This supports our claim that storytelling should be a part of play, not a separate process. While the computers did support this activity, the mobile devices will blend far more seamlessly into play, better enabling and even encouraging it. Finally, two boys recorded a story about an airplane combining two of the sounds they heard earlier. During their story, they used sound effects and different voices to give the illusion of excitement and suspense. Interestingly, this story was the only one without pictures.

Figure 8 - Playing the Zombies in their story

Most groups relied on audio as the primary form of storytelling rather than typing. They added pictures, backgrounds, and a title page that was often the only page with text. Only one pair used limited text and another drew their own pictures. As for the audio story starters, none of the groups had trouble getting started on their ideas. If anything was a problem, it was that the partners had too many different ideas on what to write about.

One issue the children did encounter was the difficulty of recording sound. Since Power Point cannot record audio, the children used the audio recording tool built into Windows XP. This meant dealing with sound files and importing them into Power Point, a task most children did not

know how to do. In addition, they often messed up on the recording and needed to edit out a section of the file. With the audio recording tool they were not able to do that.

Prototype Test

For the final session, I created a simple high-fidelity prototype for the iPhone. The prototype allowed the children to create a story with a title page and as many pages as they wanted (see Figure 9). The title page has a title, an automated author byline, and two buttons for playing and changing the story starters. Each page could have a picture from the camera or from the user's picture collection, a title, and some audio. The stories were saved in a list for the children to review.

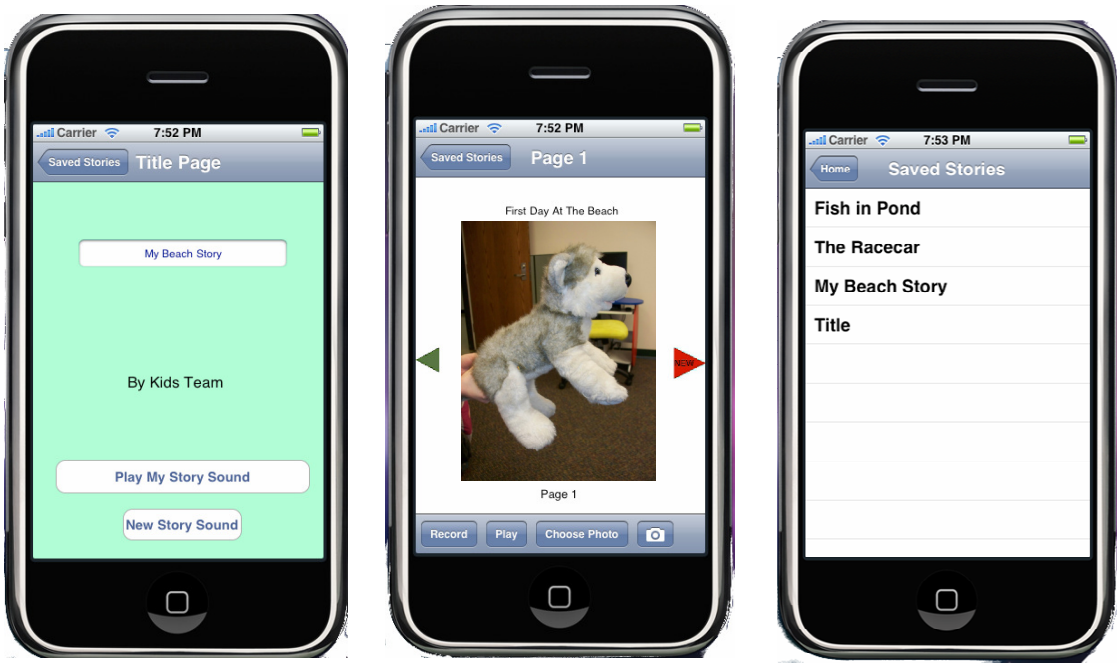

Figure 9 - Prototype Screen Shots

The children were split up into three groups – two pairs and one group of three. The children were given a very brief overview of the software and let explore on their own. The actual story content was left up to the children.

The children really enjoyed the simple interface and successfully created interesting stories. Only one group actually tried the story starter sounds (perhaps because they were not explicitly introduced and did not stand out well), yet all of the groups quickly found topics. Perhaps the very nature of being mobile in a playroom helped generate ideas. One group told a story with themselves as the main characters. They took pictures of themselves acting out the parts, of course with a good bit of humor, and recorded the story content using special voices. Another group wrote a story about "Bod the tiger," a character they drew out and then photographed (see Figure 11). They recorded sound effects and the dialog. The last group wrote about their toys – a stuffed tiger and a balloon (see Figure 10). Since they all wanted to record at once, they took turns making pages. This added a little extra element of fun to their story since no one knew what would happen next.

All of the groups were really proud of their stories and eager to share them with their peers. The other children were really curious about the others' stories and seemed to enjoy hearing them. Several of the groups, replayed their favorite parts for everyone to hear. A few of the children even got up and started acting out the action. When talking about her page where the tiger does Kung Fu, one girl got up and demonstrated it. All of the stories were silly fictional ones, albeit told in very different ways.

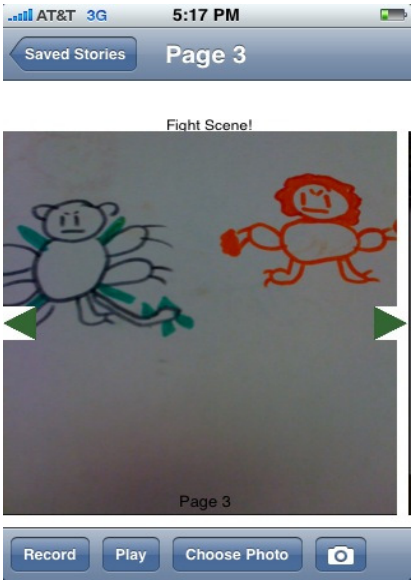

Figure 11 – Bod the Tiger

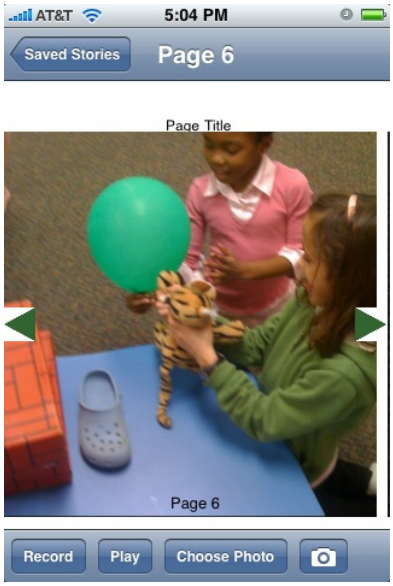

Figure 10 - Tiger and Balloon Story

By making the prototype with limited functionality, we were able to focus on specific aspects of the story creation process and get valuable insight. The title page proved important to the children who had all included one in their Power Point stories. They were more disappointed by the auto-generated byline (used this to simulate one of the proposed security features) that they would have liked to have filled in themselves. Interestingly, only one group tried the audio story starter button but quickly gave up finding it too difficult to find the sound they were looking for. It seems that the story starter functionality should be in a separate page that makes it easier to locate textual or audio ideas to help the child get started.

As it turned out, the simple page interface worked well on the mobile device, leaving the focus on storytelling and not navigating a lot of tiny buttons. While a storytelling application should still incorporate features like drawing, this simple interface allowed the children to do most of what they desired. Most groups really only wanted one image and one sound per page. They were disappointed by the "title" text or more specifically lack of a "caption" text field. While the children's Power Points had titles on all of the pages rather than captions, on the mobile devices everyone wanted captions, not titles. Some groups used the title field as a type of caption and then used the audio to add more detail or sound effects.

From several sessions with the children using iPhones (both for this study and others) (Bederson, 2009) (Druin, 2009), we found that the dragging and pinching gestures on the iPhone are not intuitive for all adults, yet the children discover them almost immediately. The same was true for this application – the children quickly navigated between pages with a drag gesture. Dragging from the title page to the first story page was an issue because there was no visual clue (the story pages had arrow images).

The design decision to leave the length of the stories arbitrary proved successful. Per Decortis, "The child should be free to construct a story, with no restrictions on length" (2002, p. 419). All of the children's stories were of different lengths with very distinct endings. Adding too few or

too many pages would have resulted in loss of control to the children, truncating their work or leaving them with empty pages.

Overall, the prototype testing session was a success. Our suspicions about the ability of mobile devices to provide an easy storytelling interface were confirmed. Further, it was clear that the devices enabled a good bit of flexibility in story content and freedom of movement that the computers could not enable. The audio interface was far better received than other storytelling applications the children had been shown in the past.

Research Findings

Our design sessions investigated two fundamental problems with storytelling software: sense of tangibility of the story and the environment and providing enough inspiration to spur creativity while not stunting the child's own ideas. To these problems we looked to four main solutions: mobility, geographic positioning, collaboration, and audio. Combined for the purposes of storytelling software, these four can allow children to seamlessly transition between storytelling and play, making the two one in the same. Further, they can give children the illusion of realism, of being a part of their stories, other children's stories, and a storytelling community.

Mobility

In recent years usability of mobile devices has skyrocketed, not only in the United States but world-wide. Mobile devices can connect areas of the world that are not yet reachable by landlines with those that have every privilege. Currently, a whooping 4.1 billion people have cell phone service, connecting half of the world via cell phone (Costa, 2009). According to Costa, "Globally, the mobile phone is now the primary communication tool. This shift has a stunning impact on developing nations, the wireless industry, and even the Internet itself" (2009). In Costa's paper "One Cell Phone Per Child", he challenges the notion that programs like One Laptop Per Child (www.laptop.org) that provide cheap laptops to developing countries. Instead, he argues that mobile devices are more appropriate and already widely available.

The advent of mobile devices, particularly such functionality-rich ones as Blackberry, IPhone, or G1, creates infinite possibilities for storytelling applications. Mobility itself gives flexibility to the storyteller, a fact that is important in both inspiration and artifact creation. "Mobile devices empower children to create content or digital artifacts in situ, where they are in the context of the object or situation for which they are creating a representation" (Fails, 2007, p. 161). Children need this type of flexibility to create spontaneously (Decortis, 2002). Returning to our base scenario – a child at the beach making a sandcastle – story creation cannot wait until returning home. In order for the child to capture their inspiration, the sandcastle, they need to be able to create the story immediately (Fails, 2007). Further, they might want to share the environment around them, pictures of the sandcastle and friends or the sounds of the ocean. The excitement will not last so the story should be able to capture it immediately.

Mobile devices add to the sense of tangibility that earlier solutions sought but could not quite grasp. Children need to relate their stories to some aspect of reality, be it an object, a place (see Geographic Positioning), or a sound (see Audio). During a session for Bederson's story-editing application, after writing most of a story, two girls suddenly complained that they were bored

(2009). When asked why, they admitted that they had enjoyed telling the story of the tiger and balloon on the GeoStories prototype because they had the stuffed animal. They described, "It's more fun to have an actual object in your hand because you actually have a figure to work with. Because you can actually touch it." The cell phones allowed them to play with their toys, in this case a stuffed tiger, while creating a story. This tangible interface (tiger) combined with the virtual interface (cell phone) made story creation far more interesting.

Until recently, the best solution to this problem was to embed technology into the environment. Unfortunately, this requires the forethought to place the devices, not to mention expensive technology. Mobile devices allow the same types of tangibility to occur without requiring any additional technology or any foresight. Only these types of devices can achieve the true mobility embedded technology simulates (Fails, 2007, p. 182).

Geographic Positioning

Geographic positioning has often been considered too dangerous to use with children. However, every year more security developments, plus more experience with online networking applications like Ganz's Webkins (www.webkinz.com), make it easier, and safer, for children to play online. Geographic positioning has plenty of excellent benefits for children's storytelling applications. The notion of a location adds a sense of tangibility for children that other methods cannot. As we found in Kids Team sessions, children have a strong connection between events and where they occur. The children emphasized the story creation location in their summer session with UNICEF (Jarvis, 2009). During our discussion "When a child invents a story, there is a natural interaction with the local environment and the use of various means of expression" (Decortis, 2002, p. 416). Pairing the story-creation place with the location where the story was created emphasizes the story's connection with the place where it was created.

Children have a vibrant curiosity about the world around them. During the author's earlier research in intergenerational blogging, the children "were really curious about all the places the older adult had been and their blog reflected their questions" (Franckel, 2008, p. 3). During our discussion with the children about stories, they revealed that they associated storytelling with having a pen pal. Their primary questions for a pen pal were cultural. By adding geographic information to the stories, the children can search for stories from far-away places as well as nearby. While in their own home they can learn about someone from China. Using the same application, they can find another child who took the same trip to the beach a week earlier.

Geo-tagging stories has more potential that even our limited application. Various organizations could use such a system to give information to children. For example, parks and museums are always looking for ways to keep children engaged on learning in a fun way. They could post stories from various places inside a museum or inside a park to tell children about them. Children could also contribute their own stories to create a rich library of information.

Security is a major issue that was not specifically addressed with this paper. Whenever sharing information to an online community, it is a good idea to have security mechanism to block unwanted readers. With children, this concern is even stronger. However, one proposal was to use parents or grandparents as potential filters for content. Only allow stories that are approved by parents to be shared. Parents should be given instructions on what to allow or not allow. For

instance, names should not be any more than first names, possibly changed. In order to prevent a specific child to be tracked based on clustering of stories, stories would not have user information (even a login name) attached at all. Better yet, stories would be given random login names giving the impression of multiple posters. Children themselves do not seem to have any issue with having GPS data to their work. In the London-based soundscape research, the children suggested using the technology for security purposes (Williams, 2005). The children seemingly welcomed being tracked in order to allow their parents to know where they were or at least to be able to alert other users of dangerous places. This area of research is an area we hope to continue in the future, but was not the main focus in this particular study.

Collaboration and a Storytelling Community

Figure 12 - Sharing Stories on IPhone Prototype

Developing a storytelling community was important from the first session with the kids when they said they felt like no one else was telling stories (Jarvis, 2009). The children expressed a need to be a part of a larger community. We found that, to create a community, storytelling applications need two attributes: easy access to other children's stories based on a set of meaningful criteria and mechanisms for collaboration.

This first attribute – giving children access to other stories – is perhaps easier but no less important. For the soundscape project, children were able to hear other children's sounds as they moved around the park (Williams, 2005). When given the chance to show their soundscapes to parents and friends it was clear that the soundscapes were really intended for peers. The children enjoyed hearing the other sounds as much as they enjoyed creating their own. Sometimes they would adopt other children's sounds as their own – creating a mixed soundscape. Sharing not only creates a storytelling community but also a forum for mixing and exchanging ideas.

The geographic positioning of stories will further strengthen the sense of community by giving readers something in common (or something starkly different) from the story's author. Readers can opt to hear stories that were told near them. This enhances the story for the reader as they can experience the place where the story was written as they read the story.

The second attribute – mechanisms for collaboration – has been a popular area of study for many years. Collaborative play has a far more complex structure as the children build off one another (Cassell, 2001). During the Kids Team sessions, the children naturally gravitated towards

collaboration, even when they were not given the option of working together. During the individual stories, the children shared their stories with each other and gave each other ideas. When partnering was an option, no one chose to work alone. Finally, during our discussion of storytelling, the children spontaneously began telling a story, each one contributing a little, like the round-robin storytelling game. Similar types of collaborative behavior were observed in earlier storytelling research. Fails (2007) equipped each child with their own wireless device on which they were able to see everyone else's changes, yet they still came together to share and discuss what they had added. When using Pad++, often one child would begin the story and another would add the next part on another part of the surface (Druin, 1997). The GeoStories software needs to not only enable, but encourage, these types of behaviors.

Benford (2000) differentiated encouraging versus enforcing collaboration, where encouraging provided incentive to collaborate and enforcing mandated it with strict turn-taking behavior. In order to encourage collaboration, KidPad and Klump enabled those who collaborated to use more features, such as more colors.

Storytelling applications need both a community and a collaboration mechanism. The geographic positioning will help to develop a community atmosphere as well the audio clips. In order to further the feeling of community and collaboration, our designs included a suggestion component for children to suggest story ideas for other children. The resulting story should be sent back to the author of the suggestion so a partnership relationship can be forged. Further, there should be at least one story at a time that can be a community effort. This story can be started with a sound, or some other type of prompt, and then users can take turns working on the rest of the story. This type of activity would increase intrigue while giving users exposure to one-another.

Audio

One of the major insights to come out of this research was the potential of audio to enhance the storytelling experience. We found that the children responded extremely well to audio clips used as story starters. The sounds that were most popular were the ones that had clear associations for the children, albeit not always the same ones. This type of story starter inspired more creativity than pictures or other people's stories (Druin, 2009), or an item from home.

Sound also proved a powerful tool for telling the stories themselves. Traditional storytelling technologies rely on text-based approaches. However, for children, expression is often easier using other multimedia-type mediums such as images or audio. For them it is often difficult to express their thoughts in words, but with speaking they have little issue. From the prototype test, we did find that eliminating words entirely limited the children. Instead, they like to describe the scene using both audio and words, but for the purposes of our focus, it the children did not need more than one text box or audio recording per page.

The soundscape project found a similar magnetism for sound. The children enjoyed recording themselves, sometimes choosing to record themselves singing rather than using the professional sound track (Williams, 2005). Similarly, Decortis found that "The children's experience has been enriched in terms of both quality and quantity, with the possibility to record and use sound and movement in their narrative creations" (2002, p. 427). Design sessions for the ICDL

storytelling application found similar results – children enjoy recording themselves and hearing it played back (Druin, 2009). It seems children naturally enjoy using sound to express themselves and sound inspires more creativity than traditional means.

Conclusions

Mobile devices have created many opportunities for storytelling. As demonstrated, mobile phones can finally achieve a new level of flexibility for children, allowing them to create stories seamlessly during play. This is the only way for children to channel the energy, creativity, and fun so apparent during playtime into their stories. Rather than taking away from play, storytelling should enhance it. Mobile devices can achieve this if equipped with the right software.

Telling stories gives children an outlet for their creativity as well as exposes them to new ideas. From our design sessions with Kids Team, four major areas– mobility, geographic positioning, collaboration/community, and audio – are particularly important to storytelling software. These four characteristics help children to have a stronger connection with their stories and the storytelling community. Audio provides a more powerful story starter than traditional methods. Children prefer telling their stories with audio over telling them with traditional methods. However, they do still need text, images, and other multimedia. Geographic positioning adds an extra dimension of tangibility to stories by placing reader and storyteller at the same place. Alternatively, geography can give the reader a sense of place in the story, while assuaging their curiosity about a foreign culture. Collaboration and a sense of community are as important to children as they are to childhood development experts. Children want to work together, and it happens that their stories are far more complex and educational when they do. Storytelling applications should foster these communities by giving users a way to collaborate assuming that co-present communication may be rare with such a tool. This is especially important in our tool that focuses on international storytelling.

Cell phones, particularly high-functional models such as IPhone, G1, and Blackberry, naturally optimize all of these characteristics. Obviously, cell phones' primary function is to handle audio data. Newer phones can record audio for later use. Most new phones are also equipped with GPS for a variety of new location based services such as maps. These GPS features have been used for geo-blogging but not for children's storytelling. While mobile phones do not inherently encourage a sense of community, as demonstrated, they can use a variety of techniques to enhance cohesion among members. Besides enabling co-present collaboration (Fails, 2007), cell phones are so widely used in the modern world that they can reach many populations that cannot be reached by computers or telephones (Costa, 2009) (Bederson, 2009).

Mobile technology has not yet been used to its full benefit, especially for children. Some worry that mobile technology is too dangerous or inaccessible to children. However, as demonstrated, harnessing the features of mobile phones can have powerful implications for children's applications that cannot be achieved otherwise. Half the world is accessible by mobile phone and that number is only growing. Security is a concern but a great many strides have been made in this direction, to the point where benefits can overcome many the risks. Mobile technology holds a lot of promise for children, warranting further research in this area.

References

Bederson B. B., Quinn A., Druin, A. (2009). Designing the Reading Experience for Scanned Multi-Lingual Picture Books on Mobile Phones. *In Proceeding of the Joint Conference on Digital Libraries (JCDL 2009,* (in press).

Benford, S., Bederson, B. B., Åkesson, K., Bayon, V., Druin, A., Hansson, P., Hourcade, J. P., Ingram, R., Neale, H., O'Malley, C., Simsarian, K. T., Stanton, D., Sundblad, Y., & Taxén, G. (2000). Designing Storytelling Technologies to Encouraging Collaboration Between Young Children. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (The Hague, The Netherlands, April 01 - 06, 2000). CHI '00. ACM, New York, NY, 556-563. doi:http://doi.acm.org/10.1145/332040.332502

Cassell, J. & Ryokai, K. (2001). Making Space for Voice: Technologies to Support Children's Fantasy and Storytelling.*Personal Ubiquitous Comput.* 5, 3 (Jan. 2001), 169-190. doi:http://dx.doi.org/10.1007/PL00000018

Burrows, P. (2009). Apple Sells Its Billionth App. *Business Week*. Retrieved May 7, 2009, from http://www.businessweek.com/technology/ByteOfTheApple/blog/archives/2009/04/apple_sells_its.html

Costa, D. (April 2, 2009). One Cell Phone Per Child. *PCMag.com*. Retrieved April 8, 2009, from http://www.pcmag.com/article2/0,2817,2344283,00.asp

Decortis, F. & Rizzo, A. (2002). New Active Tools for Supporting Narrative Structures. *Personal Ubiquitous Comput.* 6, 5-6 (Jan. 2002), 416-429. doi:http://dx.doi.org/10.1007/s007790200046

Druin, A. (2002). The role of children in the design of new technology. *Behaviour and Information Technology, 21*(1), 1-25.

Druin, A., Bederson, B. B., Hourcade, J .P., Sherman, L., Revelle, G., Platner, M., Weng, S. (2001). Designing a Digital Library for Young Children : An Intergenerational Partnership. In Proceedings o*f Joint Conference on Digital Libraries (JCDL 2001)* ACM Press, 398-405.

Druin, A., Bederson B. B., & Quinn A. (2009). Designing Intergenerational Mobile Storytelling. (in press).

Druin, A., Stewart, J., Proft, D., Bederson, B., & Hollan, J. (1997). KidPad: A Design Collaboration Between Children, Technologists, and Educators. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Atlanta, Georgia, United States, March 22 - 27, 1997). S. Pemberton, Ed. CHI '97. ACM, New York, NY, 463-470. doi:http://doi.acm.org/10.1145/258549.258866

Fails, J. A. (2007). Mobile collaboration for young children. *Proceedings of the 6th international Conference on interaction Design and Children* (Aalborg, Denmark, June 06 - 08, 2007). IDC '07. ACM, New York, NY, 181-184. doi:http://doi.acm.org/10.1145/1297277.1297324

Franckel, Sonia (2008). Designing an Intergenerational Blog. *Computer Science Department: Undergraduate Education Office at the University of Maryland, Computer Science Department*. Retrieved May 8, 2009, from http://undergrad.cs.umd.edu/files/research/Franckel.pdf

Jarvis, J. (2008). Human Computer Interaction Lab. *Interangible*. Retrieved Jan 5, 2009, from http://www.johnnj.net/interangible/archives/175

Steil, T. (2009). *iStory*. Retrieved May 7, 2009, from http://istoryweb.appspot.com/

Van Grove, J. (March 13, 2009). Whrrl Brings Collective Location-Based Storytelling to Your iPhone. *Mashable: The Social Media Guide.* Retrieved May 7, 2009, from http://mashable.com/2009/03/13/whrrl-iPhone/

Williams, M., Jones, O., Fleuriot, C., & Wood, L. (2005). Children and emerging wireless technologies: investigating the potential for spatial practice. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Portland, Oregon, USA, April 02 - 07, 2005). CHI '05. ACM, New York, NY, 819-828. doi:http://doi.acm.org/10.1145/1054972.1055088