

Visible Language

the journal of
visual communication
research

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Before there was reading there was seeing.

People navigate the world and probe life's meaning through visible language. *Visible Language* has been concerned with ideas that help define the unique role and properties of visual communication. A basic premise of the journal has been that visual design is a means of communication that must be defined and explored on its own terms. This journal is devoted to enhancing people's experience through the advancement of research and practice of visual communication.

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Design Features of Learning Apps for Mobile Gamification:

Graphic Designers Use Co-design to Prompt Young Children to Speak

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Abstract

This study sought to understand the design features of learning apps required for mobile gamification learning applications. In our study, 10 parents, two speech pathologists, and two childcare workers iteratively co-designed an app that is meant to assist parents to prompt young children with speech difficulties to speak. The co-designed app, Koko the Talking Koala, drew on current knowledge of mobile gamification theory. We identified six key design features of learning apps for app design, and propose that the following be included when designing apps: 1) include life-related scenarios in the storyline and the narrative; 2) use animation to prompt engagement, maintain attention, and invite participation; 3) use clear navigational instructions; 4) use rhymes and repetition with audio rewards; 5) focus on parent-child interaction; and 6) use visual elements to express emotion.

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Keywords

*co-design
graphic design
mobile gamification learning
speech learning
design method(s)*

1 Introduction

This study sought to understand the design features of learning apps required for mobile gamification learning applications. We present a case study trialing co-design in graphic design through a mobile gamification learning application (hereafter referred to as “app”) and aiming to help parents to prompt their young children with speech difficulties to speak. Although there is a growing interest in designing for young children’s speech development by using advances in technology, there are few studies that examine these issues using a co-design method with parents, speech pathologists, and childcare workers developing a design outcome for speech development.

Current speech learning practices require face-to-face sessions with speech pathologists using paper-based speech learning materials. As technology advances, there is a growing interest in mobile gamification in young children’s speech learning. Moreover, there is a high demand for speech therapy services in Australia and a lack of professional speech pathologists available (Parliament of Australia, 2014). Consequently, there is a gap where graphic design could assist in the development of mobile gamification learning, as this would support automated learning intervention.

Co-design was chosen as a method to involve parents and caregivers as the end-users in the design process. So, instead of designing *for* end users, this study is about designing *with* the parents and caregivers as end users of the app. Co-design presented an opportunity for us as designers to engage with the end users in designing a mobile gamification learning app that not only worked visually, but also has educational and functional values. Arguably, visual images are meaningless if the audience cannot comprehend their meaning (Strauss & Zender, 2017).

In our study, parents, speech pathologists, and childcare workers co-designed an app that is meant to assist parents to prompt young children with speech difficulties to speak. An iterative co-design method was used with 10 parents, two speech pathologists, and two childcare workers, who met in three co-design sessions. A design outcome was iteratively co-designed with all end users and a final technology-based speech learning app design prototype was agreed upon. Co-design practices increased our understanding of mobile gamification in this study by focusing on the needs and preferences of parents and childcare workers as the caregivers, while incorporating their creative ideas and the expert insights from the speech pathologists into the iterative co-design process.

2 Graphic Design and Co-design

Graphic designers use problem-driven design strategies to produce a design solution to address communication issues in the community. Some of these strategies can be termed “creative intuition” to deliver visual communication messages (Forlizzi & Lebbon, 2002). This, and lack of concrete knowledge about the end user, could lead to an unwitting exclusion of the end user in the process of creating a design solution (Wragg & Barnes, 2016). Consequently, there is no such thing as a guarantee that graphic designers are able to communicate their messages precisely to their end user.

Further barriers faced by graphic designers include the diversity of end users, which has contributed to the need for designers to find other approaches when involving the end users they are designing for (Forlizzi & Lebbon, 2002). This has led to graphic designers selecting methods with the highest probability of messages being interpreted correctly by the end users. Co-design has been found to encourage the end user’s creative insight in the design process to inspire and assist designers in creating design outcomes (Hanington & Martin, 2012; Wilson et al., 2015).

Designers have been criticized for seeing themselves as the sole experts behind the design outcome. Critics believe that designers tend to disregard nondesigners’ input into the design (Frascara, Meurer, van Toorn, & Winkler, 1997). However, in a study of a multidisciplinary practice addressing commercial, public, and nonprofit fields, graphic design has adjusted to innovative and social changes by using the co-design process (Cabim, 2015). In co-design, designers create *with* end users to deliver appropriate solutions to them.

Co-design is a broad umbrella term that refers to design processes that seek to combine the views, inputs, and skills of people with many perspectives to address a specific problem (Mitchell et al., 2016). In the process, co-design involves multiple collaborators. These collaborators work together in the design process to produce design outcomes.

2.1 Co-design in Mobile Gamification Learning

Young children today spend a lot of time playing and interacting with touchscreen devices. Children can incorporate the knowledge they have gained from playing activities into learning concepts in everyday life (Hitron et al., 2019). Some studies, including the one by Thieme et al. (2017) have shown that technology provides an opportunity

for collaborative learning for children as they grow up in the digital age. Others have suggested that children at early ages have the ability to solve problems on touchscreen devices and subsequently apply their learning during interactions with physical objects. As a result, these children demonstrated significant improvement at solving tasks given during the practices (Huber et al., 2016).

Previous studies have incorporated co-design in mobile gamification learning for young children. Co-design methods have been used in at least one previous study evaluating an educational game aimed at supporting the learning of both visually impaired and sighted children (Metatla et al., 2020). According to Pedell et al. (2014), co-design includes participatory activities such as “workshops, storytelling, performance techniques, games and human-centred iterative prototyping” to improve communication and engagement with end users in technology development (p. 1). A gap in published knowledge exists, leading to an opportunity for the case study presented in this paper: using co-design to develop a mobile gamification learning app that aims to assist parents to prompt their young children with speech difficulties to speak.

2.2 Designing for Young Children

Designing for children is completely different from designing for adults, particularly because the physical and mental aspects of children are in a constant state of development (Rice, 2012). Moreover, children from different age groups have different preferences for informative images (Klohn & Black, 2018). Those who design for children arguably should be familiar with the way children think and act.

When designing technologies that are meant to help parents communicate with their young children, designers often rely on assumptions about how parents interact with their children as to how they learn, play, and communicate together. However, these assumptions may not be correct (Skovbjerg et al., 2016). In order to develop quality design proposals, knowledge of how parents would like to best interact with their young children needs to be gained. Designers also need to understand how technology can assist in their children’s education and communication development.

In the age range of 18 months to 3 years, children are most likely to be influenced by their family members—specifically their parents or caregivers—in their needs and preferences. Many co-design studies involving children actually include the adults who are the primary caregivers or educators at school, particularly when investigating supportive educational technology (Metatla et al., 2019). The research presented in this paper is focused on co-designing with parents of young children.

2.3 Mobile Gamification Design

Nowadays children interact with touchscreen devices on a daily basis (Lauricella et al., 2015) and numerous “educational” mobile applications are marketed to them and their parents (Shuler, 2012). Children use mobile devices to watch videos, to play games, to read, to communicate with others, and increasingly, to learn. Technology devices are being used at home and school for both educational and entertainment purposes. Educational applications abound in the touchscreen app marketplace and the majority are marketed toward children and teenagers (Shuler, 2012). In a study of a visual tool to support people with communication disabilities, Noël (2015) combined verbal information with pictorial information and movement. The lessons in this research are applied in the present study, where we aim to create a communication tool for young children with speech difficulties. This process by which words and pictures are represented to construct knowledge is known as multimedia learning (Mayer, 2005).

The use of mobile gamification learning can be seen using virtual reality (VR) technology within the design process as a tool for communication design practice (Laing & Apperley, 2020). Mobile gamification learning is no longer new as previous research has investigated its approach and how it influences the learning motivation of young children in a mobile learning environment (Su & Cheng, 2015). Many recent studies have recognized the growing interest in using mobile gamification learning not only as an educational tool, but also as an approach to enhance young children’s learning (Blumberg & Blumberg, 2014; Kapp, 2012; Landers, 2014; Michael & Chen, 2005; Smith & Pellegrini, 2008).

Understanding how to design technology-based learning materials is important for designers. However, speech prompting materials are not commonly available in a technology form. Instead, current speech learning materials only exist in paper-based forms where they are used in therapy sessions with speech pathologists. Children with disabilities face challenges when interacting, communicating, or even playing with their non-disabled peers (Ringland, 2019). Fortunately, many researchers argue that technology can help bridge these gaps (Koushik et al., 2019). According to the most recent literature, playing with digital games shows positive influences on children’s skills such as speech and verbal communication learning, problem-solving skills, and social engagement (Mascio et al., 2013). This presents designers with an opportunity to develop mobile gamification learning that will help parents interact with their young children—especially in the area of speech learning materials.

3 Methods

The case study presented here initially aimed to develop an app to help parents who have young children between the ages of 18 months and 3 years old and were born Deaf; in particular, the app was meant to help parents prompt the children to speak. Through analysis of our pilot studies in co-design sessions with parents and designers, however, we found that speech delay was also commonly experienced by children who had their hearing intact. Hence, the case study context was broadened to include *all* young children, with or without disabilities. A co-design case study was the appropriate research method because it allowed design researchers to co-work with parents, childcare workers, and speech pathologists to trial the gamification learning application and develop a set of design features that meets the needs of the caregivers. Using the co-design method provided a platform for us, as graphic designers, to co-design a mobile gamification learning app with parents that did not just work visually and technically, but also had an educational learning value and function to prompt young children with speech difficulties to speak.

3.1 The Case Study

This study sought to understand the design features of learning apps required for mobile gamification learning applications. In our study, we explored the method of co-design in a graphic design setting. In our study, 10 parents, two speech pathologists, and two childcare workers iteratively co-designed an app to assist parents to prompt young children with speech difficulties to speak in three phases of co-design sessions.

Co-design involves working with end users as participants in the co-design process, to get their insights and creative ideas and to synthesize these ideas into the design process. This study presented a complex challenge, which is why the case study method was an appropriate choice as it allowed for a variety of activities and approaches to be undertaken, supporting a richer interpretation of the case context (Yin, 2015).

By using qualitative research, a set of rich data was collected that revealed a variety of insights from the parents' perspectives. A series of one-on-one co-design sessions provided a platform for parents to express their insights. Working with end users' experiences respected the creative insight of participants; it also inspired ideas and helped guide the design process through their responses to the design outcomes. We decided to co-design with the parents of young children, as the speech pathologists we consulted explained that learning to speak is a process that starts

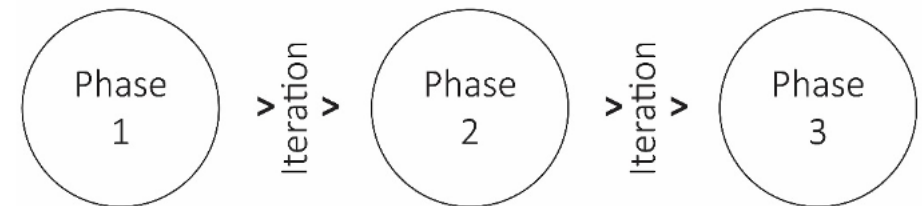
with parents. It was also important to begin the co-design process with the parents of young children, as the parents are the gatekeepers of any apps the children use. Parents are also the primary purchasers of the proposed end-product outcome, and are invested in their children's speech learning programs.

3.2 Procedures

The three phases of co-design sessions involved an iterative process of exploring design and review ideas (Figure 1). Iteration was made on the app in between each design phase.

Figure 1.

Diagram of iterative co-design process



The activities trialed in the co-design sessions were:

- Phase 1 – Design
- Phase 2 – Refinement
- Phase 3 – Review

The participants were involved in three co-design session settings of 30 minutes each. A "think aloud" technique was used in the co-design sessions to allow the participants to share their insights while trialing the app, to avoid missing any important comments. Each phase aimed to trial the app development, based on the creative ideas and insights from the previous phase. Here is a sample of the activities we used across all of the phases:

Activity 1 – Prototype trial

This took the form of a co-design session between us as co-design facilitators, a researcher who acted as a notetaker, and each participant, and aimed to establish directions for design iterations (Figure 2). The activity was audio recorded and photographed.

Figure 2. Prototype trial activity



Activity 2 – Reflection

The participants were asked the following questions related to the app, and the notetaker recorded the participants' responses (Figure 3):

1. Is the game engaging, fun and interactive?
2. While playing the game, I feel ____.
3. Describe a feature that you might want to be included in this prototype.
4. What age group do you think this game is suitable for?
5. What do you think about an iPad as the device, or any other device you would suggest?
6. Where would the children play the technology-based speech learning app?
7. What do you think about the content (design, color, type, storyline, user experience, and wordings)?

Figure 3. Reflection activity



Activity 3 – Word list

The participants were asked to write additional words they would like their children to learn in the app (Figure 4). All participants wrote their word suggestions on sticky notes and stuck them to the paper provided.

Figure 4. Word list activity



3.3 Participants

Over eight months, three phases of co-design sessions were held. The number of participants for every project differed depending on a criteria, including the complexity of the research question and the scope of the study (Morse, 2020). In this study, 10 parents, two speech pathologists, and two childcare workers participated in the co-design sessions (Table 1). The first co-design phase involved five parents and one childcare worker. The second co-design phase involved four parents and one childcare worker. The third co-design phase involved one parent and two speech pathologists. All co-design sessions were held in a one-on-one setting of 30 minutes each.

TABLE 1.

Participants in the co-design session

Participants	Phase 1	Phase 2	Phase 3
Parents	5	4	1
Child-care workers	1	1	-
Speech pathologists	-	-	2

In total there were 10 different parents across the three phases of co-design, and two childcare workers; one childcare worker participated in phase 1, and another in phase 2. We have assigned each parent a number: Parents 1–5 in participated in phase 1, Parents 6–9 in phase 2, and Parent 10 in phase 3. We have assigned the childcare worker in phase 1 the label of “Childcare worker 1,” and the worker in phase 2 the label of “Childcare worker 2.”

3.4 Data Sources

The data sources used in this research included audio recording transcription, semi-structured interview transcription, participant reflection surveys, observational drawings, and photographs. The data collected were analyzed chronologically under activity headings into a large case study report which was then categorized into themes to develop the key design features. The case study analysis began with the question, “How can graphic designers use co-design to develop a mobile gamification learning to prompt young children with speech difficulties to speak?” Overall, we aimed to understand which design features of learning apps were required for mobile gamification learning applications. In the following section, we present the findings from the co-design sessions.

3.5 Koko the Talking Koala final prototype app design

After the first two phases of our co-design sessions, we designed a prototype app using Adobe Illustrator program to be used and tested in evaluation co-design sessions in phase 3. The prototype for the Koko the Talking Koala app prototype was conceived and built with our participants as a stimulus; the app’s goal was to help parents prompt children with speech difficulties to speak. It is a storyline-based app with a Koko, a baby koala, as the main character. Koko’s story is that he got lost and went on a journey to find his Mummy (mother koala). The storyline for the app appears on the following pages.

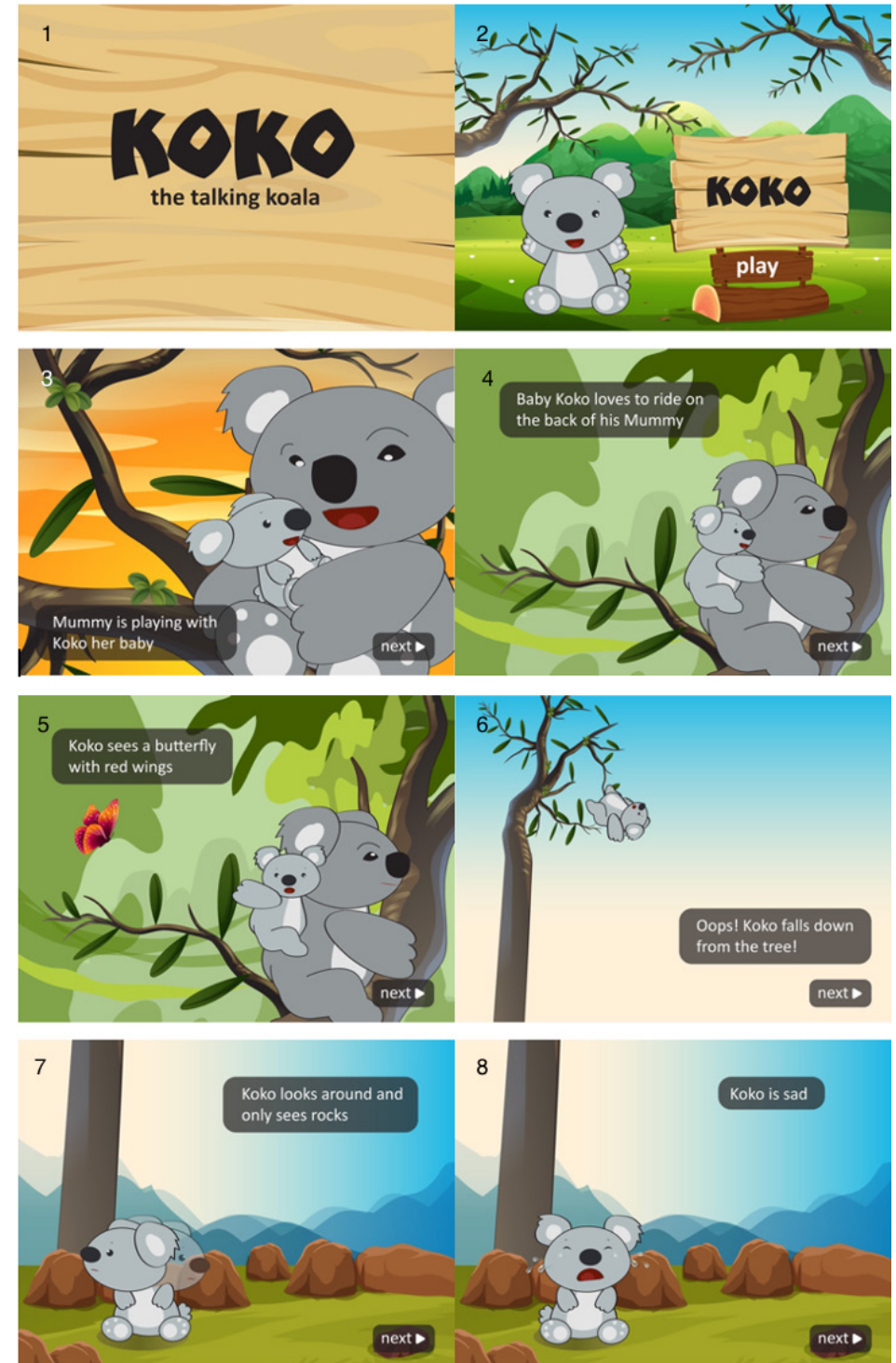
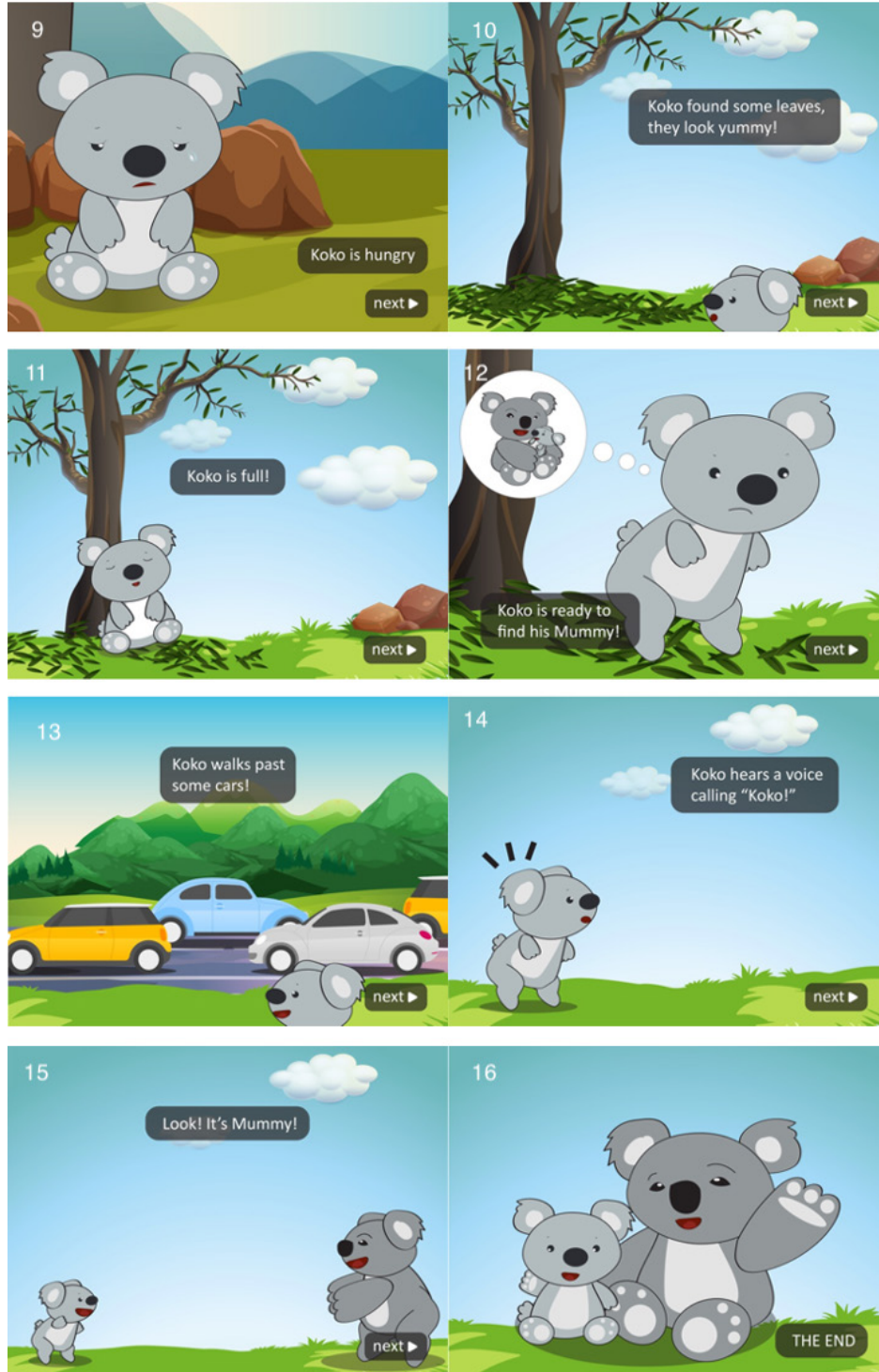


Figure 5.

Koko the Talking Koala app prototype design and storyline (facing page & following page)



4 Findings

This study sought to understand the design features of learning apps required in the development of a mobile gamification learning app. The findings uncovered six key elements that we believe are required when creating a mobile gamification learning app.

4.1 Include Life-Related Scenarios in the Storyline and the Narrative

The designers proposed the storyline of Koko the koala based on the suggestions of the parents and the speech therapists. Overall, the participants enjoyed the storyline and thought that the children would relate to the story. One participant claimed that the sentiments and feelings that developed from relating to the story led to engagement not only between the child and the app, but also between parent and child while interacting together. One parent explained:

I like the fact that you're using a sort of parent and child scenario. I think they'll immediately relate to that quite well. They'll understand what's going on; it's very clear in the picture that they're engaging with each other, playing together. Cool.
(Parent 7)

This response indicated to us that we as developers made an appropriate choice with our storyline. Eight participants discussed the use of the storyline to draw in the parent and child together as the end users. Using a storyline as a basis for the app was thought to be a useful platform for delivering messages of encouragement for children. Childcare worker 1 said, "[The storyline] has a sense of encouragement like, it encourages you to keep looking if you miss someone or get lost."

There were constructive suggestions about additional storyline ideas that could be added to the app. The participants felt it was appropriate to see that the storyline had real-life "homely" settings. One parent commented:

I suggest real settings. Like situations that they would have experienced at home, like kitchen tools would be good. But teddy bears, picnic, trains, bath, bath time. Yeah, that's what they do, park, activities. Park activities and, and I think engaging with other children like, what do children play? What do they do? They go on the swings.
(Parent 8)

All of the participants agreed that the app was more like an interactive storybook rather than an interactive game. This finding was significant, as we understood the parents and childcare workers indicated they wanted an interactive storybook. The story and narrative were clearly important for our end users in mobile gamification learning.

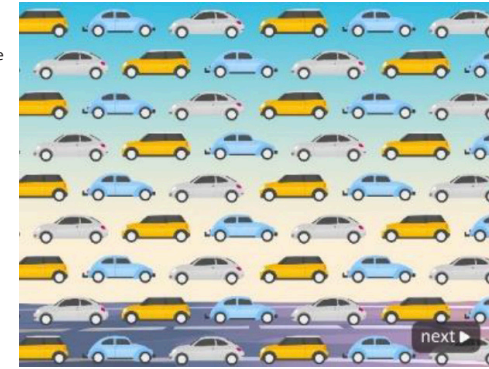
4.2 Use Animation to Prompt Engagement, Maintain Attention, and Invite Participation

The app was developed as a storybook on screen as a prototype, without animation, because creating the coding for animation was outside the scope of this research. There had been discussions about animation and movement of the graphics in mobile gamification learning during the sessions. The participants voiced that the benefits of the animation were to increase engagement, maintain attention, and invite the participation of the end users. We generated discussion and shared ideas about the technology interface and animation that could be added to the app for further development. All the participants wished to see the illustrations animated; two comments to this effect were made in the co-design sessions. Parent 4 said, *"I wanted the cars to move (in panel 13). In all three times, I wanted movement. So that saying would make something happen."* As another perspective, Childcare worker 1 said, *"It would be good moving, like make it animated."*

Animation that led to participation was related to the interaction element, where rewards were displayed on the screen as a response to the end users' efforts. The animation and movement on-screen created a new level of interaction and engagement between the end users and the app. When the participants interacted with the app, they expressed a desire to see the screen respond as if it was a technology-based interactive storybook.

Figure 6.

Rewards screen on the prototype



4.3 Use Clear Navigational Instructions

During phase 1 of the iterative co-design sessions, we were immediately met with negative feedback about the navigation instructions within the app. There was confusion about whether something was going to happen, or if users were going to be told to do something. Two participants stated that they were waiting to see whether there was something they needed to do, because they did not know what to click (Figure 7). For example, Parent 5 said, *"I was a bit confused then to know what to do or click on, what do I touch and there wasn't really anything obvious at the moment."* And Parent 4 said, *"I'm waiting for it to say something and it's not saying anything."*

Figure 7.

Participants navigating through the app



Two participants kept forgetting to speak out the word and said that they needed a little prompt that came up saying something like, “Say ‘lost’ now,” or “Say ‘help.’” However, this instruction contradicted what they were taught in speech therapy sessions, where telling someone to say something directly and asking questions could be counterproductive. A recollection of one of the participants, whose child experienced speech delay and went to speech therapy, was that she was discouraged from telling her child to say something directly because it put pressure on the child: “So, even when there’s a question like, ‘What’s that?’ I have a feeling my son would not feel like he is supposed to answer” (Parent 2).

To avoid pressuring the child with a direct question or instruction, the speech pathologist suggested an indirect prompt instead. A simple example was singing a happy birthday song with a child; when the song came to “hip hip...,” pausing after the “hip hip” would prompt the child to be more inclined to fill in the gap and say “hooray!” by themselves, without the need for obvious prompting.

Informed by the feedback from phase 1 of the co-design sessions, we made changes to the app. The refined app was then trialed in phase 2 of the iterative co-design sessions. During this phase, all the participants navigated through the app smoothly without any confusion. This showed that co-designing with the parents was useful in counteracting navigational instruction problems.

4.4 Use Rhymes and Repetition with Audio Rewards

At the beginning of the iterative co-design sessions, we played background music in the room while the participants trialed the app to represent the background music playing within the app. One of the participants then asked that the music be turned off because it distracted him: “Oh, sorry can I lose the music in the background?” (Parent 3). Afterwards, we turned off the background music for the rest of the sessions with the other participants, and none of them complained about the lack of music—nor did they request to have the background music back on. Hence, we decided the background music was unnecessary and distracting, and could be removed from the app. This decision was supported by the speech pathologists during the expert review. The speech pathologists argued that background music caused unnecessary noise and distractions in the speech learning process. However, they strongly encouraged the use of other sound effects as a reward in mobile gamification learning. This argument was supported by childcare workers who participated in the co-design sessions. For example:

— *I saw those young children like music, they like the sound of everything but they like the repetitive sound mostly. They like to repeat*

the sounds of anything they hear, from [engines] to animals, and even us teachers, they respond and sometimes copy how you talk.
(Childcare worker 1)

With the insight of using sound as a reward came the discovery of the importance of the rhyming of speech in the app. Four of the parents loved the ending of the story in the prototype app where the text reads “snug as a bug in a rug with a hug.”

— *“He is now snug as a bug in a rug with a hug.” That’s really good because of the rhyming. The words, I think more of those repeated ones, and I think more of the rhyming.*
(Parent 7)

Also, young children were used to repeating what their parents were doing or saying. They had the sense to complete the sentence when they were prompted to do it, like repeating the last word.

— *You could actually leave that gap in the “hip hip hooray” and that would... if you’ve told the child to sing along then hopefully they’d be more inclined to fill the gaps.*
(Parent 2)

— *I’m just thinking, when they read a little storybook, that’s what they do, they repeat the last word. They memorize things, repeating little things like that.*
(Parent 8)

From these responses, it was clear to us that parents wanted to see more rhymes like this throughout the story. They believed that young children learned faster through repeated words and rhyming, specifically in mobile gamification learning.

4.5 Focus on Parent-Child Interaction

The app encouraged interaction—not only between young children and the app but also between young children and their parents, as they were interacting with the app together. We sought to develop an interaction between children and technology without abandoning the interaction between parents and children. Communication is not a solo activity; rather, it happens between two people. One of the speech pathologists remarked that the app needed to prompt a conversation between parents and their children (Speech Pathologist 2, Figure 7). Parents and speech pathologists remarked that it was important for the parents to model the responses required by the app first with their children, and then the children could be left alone to follow the prompts and speak to the app.

— *I would probably sit with her, but I don’t think everyone is going*

to be able to do it. I could run through it once with her and then leave it with her. So, I've modelled it and then I could put her on the couch with it.

(Parent 10)

Figure 8.

Co-design session with speech pathologists



The idea of having a human–computer interaction element in the app was based on discussions we had with the parents in the co-design sessions. We repeatedly heard about the current speech therapy process, in which interaction happened between a child and a speech pathologist. Parents were also encouraged by speech pathologists to interact with their children in the speech learning process at home. For example, one parent commented: *“She taught us some games that were designed to just make him talk, and she taught me how to develop games too, so we would develop our own games at home”* (Parent 2).

Half of the participants who came to the co-design sessions in phase 1 and phase 2 had children who had experienced speech delays when they were young. Half of those participants brought their young children to speech pathologists for speech therapy, while the other half did not. One of the participants said that interaction with peers was a major milestone that improved her son's speech learning. When young children experienced speech delays, they needed to catch up with their peers in their own speech ability. It was found that interaction with peers was a key element in prompting young children to speak. In a situation where two-way communication occurred between peers, responses were exchanged and there was a reaction to every action or words spoken. For example, one parent exclaimed, *“Especially with premature children or speech delayed, they do like always catch up, and I think the biggest one is being socialized and being in a kind of education center, that makes a huge difference”* (Parent 7).

All the participants argued that the term “interactive” meant engagement between end users and technology, and how responsive the technology was to the action made by the human or the child.

Several participants came up with the idea of giving a reward for every word spoken by the end users while interacting with the app to give the sense of responsiveness and achievement. Two parents commented on this topic. Parent 3 said, *“All that sort of thing, so it really gives them that whole sense of accruing something and that yeah, that they're not just learning for learning's sake.”* And Parent 8 said, *“What happens if they get it right? like 'da da!!' something like that. A nice sound would be nice, I like that, and they say 'correct!', 'well done!' So yeah... my son likes it.”*

Eight participants requested “rewards” delivered through both visual and sound responses. Some of the examples of visual rewards that were suggested were starbursts, fireworks, trophies, balloons, confetti, streamers, items flying all around the screen, and highlighted or glowing objects. A nice sound effect was also suggested as positive. It was clear to us that the focus on child–parent communication was important to our participants.

4.6 Use Visual Elements to Express Emotion

Pictures in current paper-based speech learning practice are sometimes poorly drawn, and are not always drawn by designers. One of the participants remembered that the speech learning activities that she and her son had experienced had a lot of pictures, rather than words, since her son was not at the age when he could read yet:

Some of the pictures were really badly drawn and incredibly poorly designed. We didn't even end up using it that much. There seemed to be a real lack of [good quality drawing].

(Parent 2).

The app trialed in our co-design sessions was described as “professional” by the participants. Its vibrant colors and illustrations provided a visual presentation that was suitable for young children between the ages of 18 months and 3 years, and that was appreciated by the parents. In fact, one parent commented: *“I think that it was really beautifully presented. I think that the visuals are great for this age”* (Parent 2).

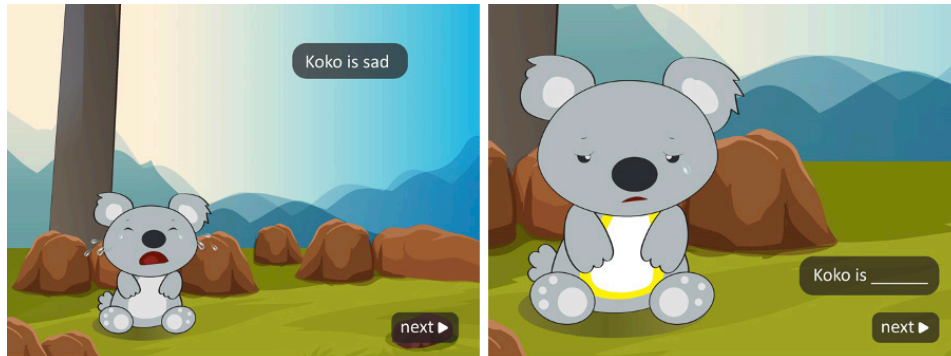
The overall visual appearance of the app also related to the illustrations of the character's pose and expressions. Poor design could lead to wrong impressions of the storyline, and this could cause confusion. For example, one parent pointed out the following about Koko: *“He looks sad rather than hungry, could you maybe make him rub his tummy?”* (Parent 7).

Overall, the participants' comments on the app's visual elements were positive. The images were judged not to be overly complex, nor did they create distractions on the screen. One parent's

comment typifies the satisfaction the parents felt with the prototype design: *"I think it's good because the pictures reflect what is being said, and are simple, not too complicated. I'm quite impressed that the facial expression of the koala matches the feelings"* (Parent 6) (see Figure 9).

Figure 9.

The facial expression of the koala matches the feeling.



It is interesting to note that although we as graphic designers put a lot of effort into the visual elements of mobile gamification learning apps, participants instead focus more on the functional aspects of the design. Mobile gamification learning is not only about the visual elements and how they appeal to end users; it is also importantly about usability and how the end user perceives the app.

5 Discussion and Conclusion

This study sought to understand the design features of learning apps required for mobile gamification learning applications, and used co-design to develop an app with the purpose of helping parents prompt young children who have speech difficulties to speak. Co-design as a method, which aims to design *with* rather than *for* people, has been used in various disciplines, such as architecture, business studies, community development, health care, product design, and systems design, but has not previously been used in the graphic design of a technology-based speech learning app. The documentation of the three phases of co-design sessions held during this study provides significant insights into how the designers, parents, childcare workers, and speech pathologists worked together to create a prototype that suited the parents' needs and preferences in mobile gamification learning for young children.

Co-design emerged from other design practices as a unique form of design that proposes that end users and designers share expertise and collaborate in the design process. In our research, the end users and us as the designers/researchers were equal in all phases of the co-design sessions held during the study. In our study, the co-design process reduced the tendency of the designers to design outcomes based on their assumptions, instinct, or intuition. The co-design process involved the end users in constructing the design, rather than merely being passive end users. This collaboration depended on the reliability of parents as representatives of their young children in the co-design process. Having parents who were the main caregivers and decision-makers for their young children enhanced the credibility of deeming them end users in participating directly in the co-design process to develop the technology-based speech learning app prototype. In our future research, we aim to observe young children between the ages of 18 months and 3 years as they interact with our prototype app.

In our study, we iteratively co-designed an app to assist parents to prompt their young children with speech difficulties to speak. Our study uses the current knowledge of co-design practices by identifying six key design features of learning apps for mobile gamification learning. The designers, the parents, childcare workers and speech therapists iteratively designed an app specifically to assist parents to prompt young children with speech difficulties to speak. The key design features of learning apps identified for mobile gamification learning app are to: 1) include life-related scenarios in the storyline and the narrative; 2) use animation to prompt engagement, maintain attention, and invite participation; 3) use clear navigational instructions; 4) use rhymes and repetition with audio rewards; 5) focus on parent-child interaction; and 6) use visual elements to express emotion.

This study highlights the answers to the research questions that were set at the beginning: what are the design features of learning apps required for mobile gamification learning applications. We acknowledge that there are still issues to be understood about how our proposed technology-based speech learning app will work in the actual market. We are currently investigating the further development of the app prototype with the help of a multidisciplinary team of experts, including a children's story writer and an app developer. Furthermore, we are aiming to market the technology-based speech learning app to help speech pathologists across Australia meet the needs of speech therapy for young children, with an ambitious goal of extending the technology-based speech learning app to reach a global audience and be translated into other languages. The results of this study significantly support the benefits of co-design in developing mobile gamification learning.

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