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Empowering Families, Engaging Readers: The Design and Evaluation of a Bilingual
Storybook App

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Education

by

Dandan Yang

Dissertation Committee:
Professor Mark Warschauer, Co-Chair
Professor Penelope Collins, Co-Chair
Professor Judith Kroll

2022

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- Kim, Y.-S. G., Yang, D., Reyes, M., & Connor, C. (2021). Writing instruction improves students' writing skills differentially depending on focal instruction and children: A meta-analysis for primary grade students. *Educational Research Review*, 34, 100408. <https://doi.org/10.1016/j.edurev.2021.100408>
- Yang, D., Zargar, E., Adams, A. M., Day, S. L., & Connor, C. M. D. (2020). Using interactive e-book user log variables to track reading processes and predict digital learning outcomes. *Assessment for Effective Intervention*, 46(4), 292–303. <https://doi.org/10.1177/1534508420941935>
- Connor, C. M., Kim, Y.-suk G., & Yang, D. (2020). Personalizing Literacy Instruction for Diverse Learners and Children with Severe Literacy Difficulties. In J. A. Washington, P. D. McCardle, & D. L. Compton (Eds.), *Dyslexia: Revisiting etiology, diagnosis, treatment, and policy* (pp. 113–125). essay, Paul H. Brookes Publishing Co.
- Rosner, F., Yang, D., Rao, A., Samuelsen, S. (2022) Gas Turbine Price Projection for n-th Plant Equipment Cost. *The Engineering Economist*.
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Selected Conference Presentations

*The undergraduate and graduate students who I mentored are marked with **

- *Zhao, J., *Sha, H., *Xu, S., *Xia, C., *Yang, K., *Zeng, H., Yang, D., Collins, P. E-book Discussion Prompts' Impact on Children's Learning During Shared Reading in an EFL Setting, paper accepted to present at the Society for the Scientific Study of Reading Conference 2022, Newport, CA.
- *Zhao, P., *Du, C., *Zheng, Z., *Wang, Y., *Bai, H., Yang, D., Collins, P., Warschauer, M. (2022) Investigating the Association Between E-book Interactive Features and Story

- Comprehension During Bilingual Shared Reading. Paper accepted to present at American Educational Research Association 2022 annual meeting, San Diego, CA. (I served as primary researcher and mentor)
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ABSTRACT OF THE DISSERTATION

Empowering Families, Engaging Readers: The Design and Evaluation of a Bilingual
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Doctor of Philosophy in Education

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Professor Mark Warschauer, Co-Chair

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With authentic English input and multimedia features, English storybook apps have the potential to be used as an effective learning tool for parent-child shared reading practice in families in English as a second or foreign language settings. This cost-effective educational technology may be particularly beneficial for those children from low socio-economic backgrounds in developing countries and language minority families in English speaking countries. However, most of the commercialized English storybook apps on the market are not designed to support parent-child joint engagement, especially for parents with limited English proficiency. Lack of theoretical and empirical evidence can be found to inform app designers and researchers on what design features should be included to facilitate dialogic reading and second language acquisition for this learner population. To this end, this dissertation fills in these research gaps by: 1) designing an interactive English-Chinese storybook app for young children and parents whose first language is Chinese to practice

dialogic reading and learn English at home; 2) conducting an evaluation study to examine the learning effectiveness of the innovation and how it interacts with the child and parent characteristics; and 3) conducting a randomized controlled trial to examine whether and to what extent the embedded discussion prompts impact children's learning and exploring how parents and children responded to these prompts. Using contextual inquiry and participatory design techniques, we identified demands and design challenges of English storybook apps for this learner population and developed an interactive multimedia storybook system with five design features which can effectively facilitate parent-child joint engagement and children's learning. We found that embedding bilingual discussion prompts in the storybook app significantly promoted children's story comprehension and retelling. Our qualitative analysis of parent-child interactions revealed that the discussion prompts with feedback allow parents to practice dialogic reading strategies and provide scaffolding to their children naturally and effectively without explicit training. With parents translating and elaborating the story, children received more comprehensible input, thus enhancing their comprehension. The design of the questioning avatar further established children's parasocial relationship with the story character and boosted their motivation. Together, this dissertation contributes to the fields of educational technology, language and literacy, human-computer-interaction by shedding light on the design, affordances, and educational effectiveness of interactive bilingual storybooks for children and their parents from linguistically diverse backgrounds.

1. Introduction

Touchscreen devices and literacy apps have become ubiquitous in children's home life. In the most recent report from the Common Sense Census (Rideout, 2020), 75% of children aged 0-8 in the United States lived in homes with tablets. A nationally representative survey in 2014 (Rideout, 2014) also shows that 62% of children had access to e-readers or literacy apps on tablets. Half of those children read digitally regularly. The increased screen time and the proliferation of storybook apps with various design features have dramatically changed the landscape of children's literacy development and may also have altered the nature of parent-child joint reading (Kucirkova, 2019).

Although storybook apps can support young children's language and literacy development, interactive multimedia features may impede children's learning (Furenes et al., 2021; Reich et al., 2016; Takacs et al., 2015a). Storybook apps often have interactive features, such as games and animations, to make the reading experience more entertaining for young learners. However, these features may distract children from story-relevant information and impede comprehension and learning (Furenes et al., 2021; Reich et al., 2016; Willoughby et al., 2015). Further, most storybook apps include audio narration to enable children to use them independently, without parental engagement (Munzer et al., 2019). With limited attentional skills, young children may easily get distracted by the interactive features in the e-book without parents' guidance.

Indeed, parents could play an important role in the development of children's language and literacy skills in their first language (L1), particularly during parent-child

shared reading. When parents read stories with their children, they can ask story-related questions, elaborate new vocabulary, scaffold to enhance comprehension, and encourage the child to ask questions. Many studies have shown that all these verbal and social interactions are key to promote children's language skills, comprehension, vocabulary skills and print knowledge in their L1 (Arnold & Whitehurst, 1994; Blewitt et al., 2009; Chow et al., 2008; Lever & Sénéchal, 2011; Pillinger & Wood, 2014; Robb, 2010; Strouse & Troseth, 2014; Twait et al., 2019).

Although the benefits of parent-child shared reading to children's L1 development have been well established, not much attention has been paid to shared reading in the second language (L2) or bilingual settings. In fact, more than half the world's population is multilingual and read in more than one language (Bialystok et al., 2012; McBride, 2015). Multilingualism is viewed as a means to expand economic opportunity and personal enrichment (Collins & Ho, 2020). In countries where English is a foreign language (EFL), this view has driven policies to promote English education (Collins & Ho, 2020) and parental demand for English literacy materials such as e-books (Jin et al., 2014). However, parents with limited English proficiency may experience additional challenges in EFL settings while reading an English book with their children due to the language barriers. Although there are many commercial English e-book apps available on the market, few of them are designed for parent-child shared reading to promote second language learning or bilingual literacy. If the literacy apps are not designed to create a space for parent-child joint engagement, parents may not fully utilize this valuable family time to promote

children's deep cognitive engagement and improve children's social-emotional skills and parent-child bonds (Doyle & Bramwell, 2006).

These gaps in the literature motivate me to design an e-book app that may benefit children's second language learning while fostering parent-child shared reading using multimedia. An evaluation study is conducted to examine the learning effectiveness of the innovation and how it interacts with the child and parent characteristics. Considering the potential of e-book discussion prompts in facilitating dialogic reading, another aim of the dissertation is to examine and understand the role of bilingual e-book discussion prompts in parent-child shared digital reading in an EFL context.

2. Literature Review

2.1. The Design of Story E-books

Electronic books on mobile devices and tablets are becoming increasingly prevalent in both L1 and L2 language learning environments for young children. Over 15 years ago, e-book was described as a text converted into digital form, a book in a computer file format, or an electronic file of words and images (Rao, 2003) or a computer file which contains the text of a printed book read on a personal computer, a personal digital assistant, a laptop computer, or an electronic device designed specifically for reading e-books (Heider & Jalongo, 2014). Even though these definitions are still valid in describing the very basic functions that e-books have nowadays, the technological enhancements and diverse interactive features that are widely incorporated in e-books are oversimplified. Since the first CD-ROM storybook, *Just Grandma and Me*, was created in the mid 90s (Ito, 2012), electronic books became increasingly engaging and interesting for children to read due to the more interactive design features embedded by educators and programmers. In response to the proliferation of various kinds of e-books and reading applications on the market, educational researchers have devoted many efforts in understanding this digitized reading and learning experiences among children in the past few decades.

In general, digital storybooks vary greatly regarding their visual and auditory design and the degree of interactivity: they range from static and non-interactive which are purely scanned versions of printed books, to highly interactive, which usually include animation, games, hotspots and other multimedia features (Abdelhadi, 2020). Many studies have examined the independent use of e-books by children and how design variation leads to

different learning outcomes including story comprehension, letter word knowledge and vocabulary (Karemaker et al., 2017; Walsh & Blewitt, 2006; Xu et al., 2021).

On the one hand, a large body of research has shown that well-designed e-books can foster vocabulary and literacy development for children in different age groups (Korat, 2009; Korat & Shamir, 2007, 2008; Lewin, 2000). According to a meta-analysis examining the effects of technology enhances story books for children's literacy development (Takacs et al., 2015b), a small but significant benefit of technology existed for story comprehension and vocabulary learning compared to traditional story reading. The advantages of e-books were also corroborated by other studies. An experimental study (Smeets & Bus, 2012) examining the effect of an e-book interactive vocabulary feature on children's word learning found that children who read digital books with a computer-based assistant that posed extratextual vocabulary questions significantly outperformed the control group in expressive vocabulary assessment. Similarly, Cochran and Bull found that e-books could enhance students' learning motivation, better keep their attention, and thus improve learning achievement (Cochran & Bull, 1991). It was also mentioned in another study (Moody, 2010) that digital reading materials were widely used in classrooms in order to support children's engagement while reading storybooks and foster their emergent literacy development.

On the other hand, there are still contradictory research findings on the impact of the various design features embedded in e-books on reading and learning outcomes (e.g. Reich et al., 2016; Takacs et al., 2015a; Xu et al., 2021). In a study (Karemaker et al., 2017) examining added e-book features including an interactive avatar and dictionary, children in

the plain e-book group performed as well on all measures as children in the enhanced features groups. The meta-analysis from Takacs (Takacs et al., 2015a) examined the effects of technology enhanced story books for young children's literacy development. Besides the main effect of e-book in general, their results also indicated that multimedia features embedded in e-books were beneficial to children's digital learning while interactive features were found to be distracting and detrimental. This study took an important step in quantifying the benefits and pitfalls of the technology enhanced e-books. However, several limitations exist when interpreting the results. First of all, some studies included in this meta-analysis were outdated (as early as 1980). E-book technologies have been evolving with a tremendous speed. From CD-ROM to touch-screen Apps, children can have completely different user experiences. Thus, conclusions from e-books four decades ago cannot be assumed to be generalizable to e-books nowadays. Second, the study only focused on reading e-books in readers' native languages, and e-books in second language or bilingual learning context are not analyzed. Third, how the authors categorized interactive features is unjustified. Based on the results of the moderation analysis, the author concluded that all interactive features are detrimental to children's digital reading. But this category includes design features with great diversity such as games and dictionaries. Although games and dictionaries are both interactive, they are still quite different in their purpose, functionality and nature.

The contradictory findings on the educational effectiveness of digital books and the design features may be attributed to the design, particularly whether the embedded design features are congruent to the story line. For example, Takacs et al. (2015) cautioned that

interactive features, such as games and dictionaries, were found to be distracting and detrimental to children's learning. These interactive design features may impede children's learning because they are not related to the story content and may be considered incongruent design features (de Jong & Bus, 2003). Incongruent e-book design features are considered to be "bells and whistles," as they distract children's attention from the main storyline and create unnecessary cognitive load to young children as well. Based on the empirical studies in recent years, researchers have established general agreement on the exclusion of incongruent interactivity in e-book design; however, due to the differences in theoretical and methodological approaches, it is difficult for researchers to systematically examine the benefits and limits of each design feature given the variance in child characteristics, e-book content and design.

Overall, these studies shed light on desirable e-book properties that could help children read or learn independently. Yet these insights may not be directly applied to develop e-books intended to also support parent-child interactions, as the user-system interactions will inevitably be different and more complicated when the role of parents is considered.

2.2. Dialogic reading

Considerable evidence shows that home literacy environment makes unique contributions to children's development of oral language and vocabulary skills, school readiness and later academic success for both monolingual and bilingual children (Burgess et al., 2002; Griffin & Morrison, 1997; Payne et al., 1994; Weigel et al., 2006). Home literacy environment encompasses many aspects such as parents' educational attainment, how

often parents read to their children, the availability and quality of the reading materials (Anna D. Johnson et al., 2008; Davis-Kean, 2005; Kiuru et al., 2013; Leseman & Jong, 1998; Sénéchal & Lefevre, 2002).

Shared reading, the practice whereby parents read books together with their children, is an effective home literacy practice that is beneficial for children's literacy and language development (Crain-Thoreson & Dale, 1992; Lonigan et al., 1999). Although shared reading may take many forms, dialogic reading is an evidence-based approach that uses strategic and structured prompts to promote children's verbalization, participation, and comprehension (Chow et al., 2008; Lever & Sénéchal, 2011; Pillinger & Wood, 2014). During the dialogic reading process, parents can transform their children from passive listeners to active learners and storytellers(Whitehurst et al., 1988) by asking story-related questions, elaborating on new vocabulary, and scaffolding for comprehension, encouraging children to ask their own questions. These verbal interactions promote children's cognitive skills (Twait et al., 2019), narrative skills and language development(Arnold & Whitehurst, 1994; Lever & Sénéchal, 2011), vocabulary learning(Blewitt et al., 2009; Strouse & Troseth, 2014), and story comprehension(Robb, 2010).

Two commonly used dialogic reading principles are "PEER" and "CROWD", initially developed by Whitehurst and colleagues (Lonigan & Whitehurst, 1998; Payne et al., 1994). "CROWD" refers to the five types of prompts that parents can practice, including completion prompts, recall prompts, open-ended prompts, wh-questions, and distancing prompts. The "PEER" steps can guide the reading through 1) discussion pages in the e-book or parent-initiated questions that prompts the reader with story-related "CROWD"

questions, 2) the e-book app or the adult evaluate the accuracy of the response and the adult may either praise the child or scaffold the child towards an acceptable answer, 3) the adult expand on the child's response using elaboration and/or follow-up questions, and 4) the adult repeat the prompt to allow the child to construct or recite a better response (Hargrave & Sénéchal, 2000; Lonigan & Whitehurst, 1998; Towson et al., 2017; Whitehurst et al., 1994)

The use of the "PEER" and "CROWD" strategies in parent-child shared-reading practices is believed to enhance meaningful discussion about the story and promote children's literacy and language learning (Whitehurst et al., 1988). For example, Coyne and his colleagues implemented a story book intervention on kindergarten children where trained teachers incorporate multiple shared reading strategies during the instruction including scaffolded discussion, linking story themes to children's personal experiences and facilitating story recalls(Coyne et al., 2004). Their results show that the treatment group demonstrated greater gains in receptive vocabulary than the control group, which suggests that shared reading using evidence-based strategies can facilitate vocabulary learning. Asking story related questions is also proved by some studies to be an effective approach in engaging children and boost vocabulary and comprehension outcomes. In an experiment conducted by Walsh and Blewitt, 35 three-year-old children were randomly assigned into one of the three groups: vocabulary eliciting questions, non-eliciting questions and control with no question(Walsh & Blewitt, 2006). Trained research assistants read three stories repeatedly with or without questions across four reading sessions. Their results indicate that story reading with questions is more effective than

story reading without questions in children's word comprehension gains and the types of questions asked do not yield any difference in children's learning outcomes. Similar results have been found in other studies that children's vocabulary and comprehension show greater gains when reading stories with trained adults using some conversation and book-reading strategies (Wasik et al., 2006; Whitehurst et al., 1988; Zevenbergen & Whitehurst, 2003).

2.3. Dialogic reading using e-books

E-books in general show promise in facilitating children's engagement (Richter & Courage, 2017) and promoting emergent literacy skills (Shamir & Korat, 2007), phonological awareness (Chera & Wood, 2003), and comprehension and vocabulary skills (Smeets & Bus, 2015). Many storybook apps include multimedia and interactive features such as audio narration, sound effects, animation, and interactive games (de Jong & Bus, 2003; Guernsey et al., 2012; Korat & Shamir, 2004). Many of these features are designed to engage children and support their independent use of the app without parental involvement. For example, the audio narration and multimedia features enable pre-literate children to make sense of new vocabulary and "read" independently (Kucirkova & Littleton, 2016).

However, studies point to the benefits of parental engagement in children's reading of e-books (Dore et al., 2018; Stuckelman et al., 2021; Troseth et al., 2020a). The additional benefits of providing high-quality social interactions and sustaining children's attention make parents irreplaceable in children's home literacy practices for printed or digital storybooks. While reading a story, parents can initiate meaningful conversations about the

content, connect the story to children's life experiences (Dore et al., 2018), ask and answer questions, and reward children's positive behaviors. These social interactions are crucial for maximizing learning opportunities in the practice of home literacy. Moreover, it may be challenging for young children to maintain focus while reading e-books with multimedia and interactive features, as they are still in the critical developmental stage of building cognitive and attentional skills (Kent et al., 2014). When children get distracted, parents may draw their attention back to reading by pointing to the illustrations, asking an interesting question, or activating hotspots. In addition to the cognitive and attentional challenges, a recent study from Xu and colleagues (Xu et al., 2019) indicates that children also experience difficulties navigating e-books when reading independently; they struggle to determine and use the appropriate motion and timing for page-turning. These challenges are amplified for children under four years old and those who lack experience using digital devices.

Despite the established benefits of parental engagement in children's story-reading practices (Lever & Sénéchal, 2011), existing e-books may not support or enrich such interactions. For example, Munzer and colleagues (Munzer et al., 2019) found that parents and their toddlers have fewer high-quality interactions when reading e-books compared with reading printed books. Such high-quality interactions include asking story-related questions and commenting about the storyline, which literacy experts believe to be important learning moments for children (Troseth et al., 2020a). These findings suggest that although storybooks have been widely adapted for digital use by children, their design may hinder parent-child joint media engagement.

2.4. E-books for English Language Learning

Despite the demand for English literacy materials across the world (Jin et al., 2014), e-books have overwhelmingly been designed for English-speaking audiences. However, e-book features that are beneficial to native speakers may not be generalizable to those who learn English as a second language (L2). Many studies discussing the benefits and pitfalls of the design features are based on Paivio's Dual Coding Theory (Takacs et al., 2015a). In the Dual Coding Theory, information is processed through two equal representational channels: verbal and non-verbal (Paivio, 1991). This theory has been used as one supporting piece of evidence to explain the positive findings of the effectiveness of technology enhanced e-book with multimedia features such as animated pictures, music, and sound effects (Takacs et al., 2015a). However, regarding e-books in L2 learning, Boers (Boers et al., 2017) pointed out that the role of multimedia support in the acquisition of new words is different for L1 and L2 learners because L1 learners already have the mental connection between the pictures and the words. In particular, the benefits of multimedia assistance in vocabulary learning are not necessarily a reflection of how visual cues can promote words' concreteness or imageability and it is highly likely that those words are already represented in memory as concrete and imageable for L1 learners. On the contrary, for L2 learners, such connection between a shown picture and a word in mind does not exist, thus the superiority of multimedia featured e-books over simple text cannot be justified for second language learners just based on the Dual Coding Theories without experimental validation.

Millions of children in non-English speaking countries such as China and Japan are learning English as a second language. Their parents are looking for well-designed digital storybooks to enable them to read the stories with their children while developing their children's English language skills. Particularly, parents in this context may experience great challenges while reading English story books with their children due to their limited English proficiency, low self-efficacy in English, and the linguistic differences between the home language and English (Chow et al., 2010). Given the complexities of reading and learning in a second language, practicing parent-child shared reading of an English storybook without the assistance of multimedia technology may be a difficult task for non-English speaking parents. However, there is a dearth of research on designing and applying multimedia storybooks to compensate for the linguistic disadvantages of non-English speaking parents and facilitate the strategic joint-reading of English storybooks. Designers, educators, and policymakers need such evidence and information to guide innovations, design, and policymaking regarding educational technologies in English education in EFL countries.

2.5. Dialogic reading in a second language

Recent studies have extended the benefit of shared book reading to children's literacy development from monolingual to second language settings. A recent meta-analysis examining 54 studies of shared reading for English learners conducted in the United States found an overall significant positive effect on English learners' oral language and literacy-focused measures (Fitton et al., 2018). However, this meta-analysis included only studies conducted in the United States, a developed English-speaking country. In non-

English-speaking countries, particularly developing countries, children may not have access to rich English-language environments and educational resources for English language practices (Yu & Ruan, 2012). Also, most studies included in the meta-analysis were interventions implemented by researchers and service providers, with only 10 out of the 54 studies addressing shared reading with family members. The dynamics and effectiveness may differ when trained researchers versus parents implement shared-reading interventions. Therefore, we cannot assume that the positive findings of shared-reading interventions in this meta-analysis can be generalized to the parent-child shared-reading practices in EFL settings.

A study conducted by Chow and colleagues (Chow et al., 2010) revealed that although dialogic reading can facilitate English reading skills in Chinese children, second language dialogic reading in EFL settings tends to be less effective than dialogic reading in monolingual settings in enhancing oral vocabulary skills. Researchers suggest that there may be some differences in the nature and function of dialogic reading in acquiring the first language versus the second language, especially for parent-child shared reading in EFL settings (Chow et al., 2010). Parents whose first language is not English may experience challenges when reading an English story with their children. These challenges may result from parents' limited English proficiency, low English self-efficacy, and the linguistic differences between the first and second languages. These potential difficulties may be more salient for parents from lower educational and socioeconomic backgrounds and impact how children benefit from home literacy practices.

2.6. The English Education and Story E-books in China

English is the most widely used language in global economics, education, and politics (Chang, 2006), and it is a mandatory subject in K-12 education in mainland China (Guo, 2012; Hu, 2005). The current English curriculum in China focuses on reading and writing, with little support for children to use English in daily communication (Cheung & Ng, 2003). Further, teacher preparation and curriculum development have yet to meet the demand for authentic, engaging, and effective English language education in public schools (Hu, 2005). Many lower- and middle-class families lack access to costly English language resources and experiences for their children, such as private tutoring, bilingual schools, or afterschool programs (Butler, 2015). The discrepancy in socioeconomic status (SES) and access to English education resources partially contribute to the widening gaps in students' English proficiency, educational level, employment opportunities, and social inequality (Butler, 2015).

While educators focus on English education reforms in the school setting, home literacy is largely ignored as an educational resource. The previous sections of the literature review suggested that shared storybook reading facilitates children's English language development and further predicts later academic performance. This cost-effective home literacy practice promises to be an effective English education resource to supplement English classes offered in schools.

As a widely used learning tool for home literacy practice, English story book Apps have gained great popularity in Apple stores and Android markets in China during the past several years. For example, Palfish Grade Reading, as one of the most popular English story

book apps, has accumulated over 150 million downloads from various Android markets by April 2020 (data source: www.qimai.cn). Other commercial English story book apps also achieved great success in the Chinese market such as iHuman Books, Zebra English, KaDa Stories, Wawayaya. Most of these English story Apps provide English stories, vocabulary games, and English online classes for children who learn English as a second language in China. Although all these apps focus on promoting children's English early literacy development, there is a diversity in their design features and affordances:

(1) **English narration.** Almost all story Apps reviewed have English narration. Some are auto played with/without pause buttons and some require clicking on the audio buttons.

(2) **Bilingual support.** Various degrees of bilingual support of the English story apps can be observed and they fall into one of the three conditions. a) no bilingual support: some English story Apps only have English narration and English text on the screen without any Chinese subtitles or dictionaries. b) Chinese translation for the story text upon request. For example, in Zebra English, English texts are shown on the page, and readers can click on the "translation" button at the right bottom corner if they want to view the Chinese translation. What's worth noting is that English text will disappear when a Chinese translation is displayed on the screen. c) English-Chinese dictionary for the vocabulary with hyperlink: every word in the story has a hyperlink to a dictionary page with pronunciations and Chinese translation (e.g. Palfish Grade Reading).

(3) **Vocabulary games.** Some Apps (e.g. iHuman Books) also offer simple interactive vocabulary games as supplementary resources to strengthen the new words learned in the stories.

(4) **Social and gamification features.** Some apps also have social (recommending a book to friends in Wawayaya) and gamification features (e.g. reader ranking in Wawayaya and rewarding system in Palfish Grade Reading) to motivate the users to read more and increase user online time.

Although there are a variety of story reading apps in the market, and they evolve various design features, not all the features (e.g. interactive games) have scientific evidence to prove their educational effectiveness (such as the interactive vocabulary games). More importantly, most of the English story Apps are not designed to support dialogic reading practice for parents who have limited English proficiency and their children in foreign language learning settings.

First, most of the English “story books” offered to children aged 2-6 who just begin to learn English are vocabulary-oriented instead of story-oriented. Most of them are not real stories, but rather simple sentences, or even pure alphabets and vocabulary. They function more like English vocabulary lessons and games instead of story books. For example, the first book in iHuman Books only has three words: “sun”, “moon”, and “star” and there is no plot to connect them into a real story. The purpose of reading in this case is not to understand an interesting story, but to learn and memorize certain English vocabulary. With the focus on alphabets and vocabulary, it is hard for parents to maintain children’s attention and practice dialogic reading. As quoted in one of the evaluation

articles: “We paid for the Palfish Grade Reading, But every day, my kid just ran away after having him read the first English vocabulary” (<https://zhuanlan.zhihu.com/p/64364128>). With the strong focus on English language learning, children cannot not read stories that are developmentally appropriate for their age and thus it is difficult for children to enjoy reading.

Second, even though some of the apps provide Chinese translation or dictionaries, they never show up on the same page as the English text. Also, not all apps provide L1 support and this might be frustrating for those parents who do not speak English. Finally, most of the Apps only have hyperlinks on the words and there are no interactive hotspots on the pictures, which means that children might lose some learning opportunities and language exposure.

2.7. Design Methodologies and Techniques for Children

As children have been increasingly recognized as stakeholders of some technologies, researchers have been developing new methodologies and techniques to meet the technological needs of children during the design process. In recent years, methods such as contextual inquiries and participatory design have been used to develop new technologies for children. These methodologies recognize children's critical role during the design process and thus consider them essential design partners. For example, when creating an inclusive letter writing app, Martens and his colleagues adopted co-creation and cooperative inquiry involving children as co-designers who participated in prototyping, testing, and providing feedback (Martens et al., 2018). In an e-book design study, Colombo and Landoni (Colombo & Landoni, 2013) built partnerships with children and worked

together to create low-tech and high-tech prototypes of e-books. Similarly, Wang and Chiu (H. F. Wang & Chiu, 2020) used children's learning outcomes as a key factor in deciding the best representational style for designing e-books.

On the other hand, parents who engage in children's technology use at home are not often seen as active design partners when developing e-books. Yet, understanding the context for shared reading by including parents as stakeholders can allow e-books to be tailored to support quality family time (Vezzoli et al., 2020). The use of cultural probes and contextual interviews with parents can characterize parents' role in shared reading practices with their children and identify potential tensions and opportunities for e-book shared reading design research.

2.8. Theories that Guide the E-book Development and Study Design

Sociocultural theory. Long and Vygotsky both conceptualized language development as social processes in a way that social interaction and negotiation of meaning between participants promote second language comprehension and ultimately facilitate language development (Long, 1980; Ortega, 2014). A critical concept needs to be reviewed here, known as Zone of Proximal Development (ZPD), in order to understand in what circumstances language learning occurs. ZPD is defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance, or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). In this technology and information era, social interactions have been endowed with new possibilities (Connor et al., 2020; Gatlin-Nash et al., 2021; Kim et al., 2021). Compared with printed story books, e-

books with multimedia and interactive features provided a novel way for children to develop literacy skills or learn a new language through digital reading and interacting with the device. Multimedia interactive features embedded in e-books such as pictures and sounds enable children to get scaffolding when they come across the vocabulary that are beyond their current word knowledge, thus they are provided with opportunities to experience ZPD and we hypothesize that learning opportunities will be further maximized in the three-way interaction among parent, child, and the e-book system.

The Cognitive Theory of Multimedia Learning. The cognitive theory of multimedia learning (CTML) is structured based on three principles. First, there are two channels for human beings to process information - visual/pictorial and auditory/verbal, which is known as the dual coding theory. Second, cognitive resources, including working memory, attentional skills, task switching and inhibitory control are necessary during this process and the cognitive capacities are always limited. Third, active learning requires a coordination of a series of cognitive processes during learning. Guided by the three principles, CTML proposed that there are five cognitive processes in multimedia learning: “selecting relevant words from the presented text or narration, selecting relevant images from the presented illustrations, organizing the selected words into a coherent verbal representation, organizing selected images into a coherent pictorial representation, and integrating the pictorial and verbal representation and prior knowledge” (Mayer, 2005, p. 31). Multimedia instructions that are designed in alignment with human being’s cognitive processes are more likely to lead to more meaningful and effective learning outcomes. CMTL along with several other relevant constructs such as the cognitive load (Sweller,

2005), and the dual coding theory (Paivio, 1986) suggest that language learning opportunities and digital learning outcomes can only be maximized if the design features of the e-books match readers' cognitive level.

3. The Development of the Storybook App

3.1. Study aims

The gaps in the literature motivate us to design an e-book app that may benefit children's second language learning while fostering parent-child shared reading using multimedia. We chose China as the design context because China has the largest English language learner population (Bolton & Graddol, 2012). Our goal was to understand the challenges and expectations from Chinese families during English storybook reading practice and design a multimedia interactive storybook that incorporates the linguistic, social, and learning demands of this learner population.

3.2. Design process

The proposed e-book innovation was aimed to promote children's English-Chinese bilingual language skills for young English language learners in China while facilitating joint engagement for parents who have limited to no English proficiency. Recognizing the crucial roles stakeholders may play in the design process and the valuable information they may provide, we incorporated some key principles and techniques from participatory design (Kuhn & Muller, 1993) and cooperative inquiry (Druin, 1999) into our design process. Due to the COVID-19 pandemic, direct, in-person interaction between children and the research team was not possible. As an alternate approach, most communications were conducted through video conferencing with the assistance of the parents. Parents as reading partners play a crucial role in children's reading, socializing and learning, thus we consider parents as equally important stakeholders in the design process.

Our intergenerational co-design was informed by the following techniques: multidisciplinary research partnership with users, contextual inquiry, low-tech prototyping, iterative high-tech prototyping, and triangulation of design ideas via interviews and observation. Our design team included not only doctoral students and professors who specialize in education, child development and educational technology, but also research assistants, illustrators, and student programmers. We also recruited children, parents and educational practitioners as design partners. The iterative design process included the following stages: contextual inquiry, low-tech prototyping with stakeholders, high-tech prototyping, and prototype testing through evaluation study.

E-book Design and Evaluation

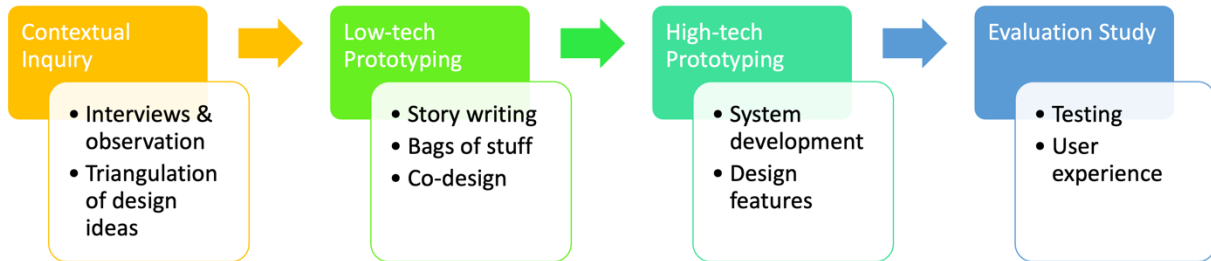


Figure 1: E-book Design and Evaluation Process

3.3. Participants

During the contextual inquiry and low-tech prototyping stages, we recruited six participants from middle-class families (three children and their mothers) in a medium-sized city in China with experience reading English stories on tablets. The parent participants were mothers (aged 30 to 34) and their children (2 boys, 1 girl) between four and five years old. Two of the mothers had bachelor's degrees, and one had an associate degree.

This study was approved by the Institutional Review Board through the University of California Irvine. Children who met the following criteria were considered for recruitment: (1) 3-7 years of age; (2) first language is Chinese; (3) do not have severe disabilities which might hinder them from reading the e-book; and (4) have web accessible touch-screen tablets or computers at home. The inclusion criteria for parents were as follows: (1) Chinese native speakers and (2) do not have other physical disabilities which might hinder them from reading the e-book.

Using a snowball sampling approach, the lead researcher and research assistants of the project reached out to potential participants through social media platforms. A Study Information Sheet in both English and Chinese was sent to the potential participants for careful review. The lead researcher and the research assistants answered all questions that parents and children had. After obtaining verbal consent from both the parents and the children, they were officially recruited for the experiment.

3.4. Contextual Inquiry

We used contextual inquiry (Beyer & Holtzblatt, 1999) to understand the Chinese families' digital English literacy practices with their young children and identify user needs and design challenges for this specific context. Our qualitative data gathering aimed to give insight into Chinese parents' experiences with commercial storybook apps and the development of an e-book that provides a better English learning experience for parents and children in the EFL context. Due to the COVID-19 pandemic, we performed the study remotely, administering semi-structured interviews and surveys and observing shared e-book reading via Zoom.

Several themes emerged from the interviews and observational data. On the one hand, English storybook apps were widely used in Chinese families, and shared reading was considered a popular and cost-effective home literacy activity. Children also preferred reading electronic storybooks using touchscreen tablets compared to printed books. One child reported, "I like reading the stories on my iPad because it's cool and interesting."

On the other hand, participants noted several limitations of the current commercial storybook apps in the app stores in China. First, parents' limited English proficiency prevented them from engaging in story reading in English or initiating discussion with their child. One parent mentioned, "When he (the child) is reading the English storybooks, the app reads out loud for him in English, so I don't even know whether I understand the story correctly or what else to talk about. I feel like the only way I can contribute is to maintain his attention to the story." Second, two parents indicated that for the books that are specifically designed for EFL children, the story plots are often too simple and

unengaging. “Although my child is almost five years old, because of his low English proficiency, the app always provides us with stories that are too simplistic and uninteresting.” They reported that the story learning sessions in some apps focused too much on building new vocabulary without interesting, developmentally appropriate stories, resulting in children quickly losing interest. One parent said, “My kid thinks that the English stories are boring, and he just runs away after hearing the first few new words.” Third, parents observed that the embedded English-Chinese dictionaries often did not include sample sentences and developmentally appropriate explanations for the children.

Taken together, although commercial English storybook apps have gained popularity among Chinese families, some of the design features were not well suited to their learning and social needs. Parents called for improving the e-book design features to facilitate shared reading and joint engagement for this specific learner population. We identified two design challenges for this proposed innovation: 1) involving parents with limited English skills in the shared English story reading process; 2) ensuring that the story content and the dictionary are developmentally appropriate and engaging for the young learners with varying ages and English proficiency levels.

3.5. Story Writing

With the contextual information and the design challenges in mind, the research team started the e-book design by writing a story with an engaging plot, interesting characters, and developmentally and culturally appropriate themes for children in our target population. The text of the story was more difficult compared with most of the English stories in commercial apps for young children in China, for the following two

reasons: 1) During the contextual inquiry, parents reported that compared with the Chinese stories they read, the English stories in the commercial e-book apps are oversimplified, so their children quickly lose interest reading the English e-book stories. 2) This e-book will be designed for parent-child shared reading so parents can scaffold story comprehension, thereby allowing children to comprehend more complex stories.

The Story of an Orange Oakleaf was then drafted in English and translated into Chinese. It tells the story of an oakleaf butterfly who gets frustrated with his dry-leaf-looking wings. With his mother's encouragement, he successfully saves his butterfly friends from an evil bird using his oakleaf color as camouflage.

The story has a total of 451 English words. The Automated Readability Index (Senter & Smith, 1967) and Flesch-Kincaid Grade Level (Flesch, 2007) showed the story's text readability is "easy" and can be read independently by English-speaking children at the lower elementary level. However, when reading with parents who can scaffold comprehension, children can comprehend more challenging texts. Thus, this story may be also considered appropriate for children at the kindergarten level when engaging in shared reading with their parents.



Figure 2: The cover of the story book.

3.6. Low-tech Prototyping

Using the story draft, we conducted low-tech prototyping with the six participants to explore the story visualization and design features. Low-tech prototyping or “mock-ups” were used to enable stakeholders to express and visualize their ideas and expectations for the e-book. Bags of Stuff is a prototyping technique where children and adults use art supplies such as paper and crayons to create “mock-ups” of the innovation (Guha et al., 2013).

Due to the pandemic, the lead researcher provided instructions to the parents through Zoom before the design workshop. During each workshop, the lead researcher narrated the story and asked the parents and children to co-design two e-book pages (Please see Figure 3 for a digital storybook page co-designed by a child and her mother). More specifically, families drew what they thought the storybook should look like. They also presented what they would like the e-book to do, and experiences they would like to have while reading. After the presentation, the lead researcher discussed the design pieces as a group to clarify the design features and gain an understanding of the user needs and rationale behind the design.



Figure 3. Parent and Child Co-design of a Story Page.

To empower children in the design process, we told them they were the “designer” and their parents were “assistants and consultants.” Based on the artwork and their presentations, children’s main demands were identified: 1) children want to have fun reading while learning English. 2) children want to interact with the story characters beyond listening to the story narration, as one child said, “I want to know what the bad bird says to the butterflies”. 3) Children want to learn more English words by touching the objects. Parents’ wishes were also identified: 1) The English Chinese dictionary must be engaging and self-explanatory to the children; 2) The e-book design must be attractive enough to maintain children’s attention, but not distract from the story; 3) One parent stressed the importance of Chinese translation; 4) Parents appreciated the use of some discussion questions while reading.

Based on the data and the discussion within the research team, several design features were identified to improve the shared reading experiences: English narration, customized English dictionary, character statements, and discussion prompts. Different illustrations and UI design styles were initially proposed and presented to the participating families using Microsoft PowerPoint slides. A final version was selected based on the feedback from the participants and the research team.

3.7. High-tech Prototyping

We developed a high-tech prototype for a bilingual interactive storybook, based on the insights acquired through low-tech prototyping. The e-book was a web-based multitier system that used React as the basic framework, and HTML and JavaScript as the main

programming languages. The e-book HTML5 files were developed using Adobe Captivate 2019. Several multimedia and interactive features were embedded in the story:

(1) **English narration.**

Each story page is designed with automatic English narration for the story texts shown on that page. Children and parents do not have to click on any button to play the audio; it will be automatically played as users turn to each page. The audio narration will play once and if readers want to listen again, they can click the replay button located on the upper right corner of the screen. The audio files are human voice recordings from an English native speaker reading the story. Similar to the story pages, English texts on customized dictionaries, hotspot prompts and discussion pages will be read out loud in English as well. The narrations are English only and there will not be Chinese audio input throughout the story. We did not include background music due to the mixed research findings on the effect of background music on children's reading comprehension (Kiger, 1989; Thompson et al., 2012).

(2) **Multimedia dictionary.**

A dictionary window will pop up if users touch words/phrases with hyperlinks in the text or some key items on the illustration (e.g. the gift, the fence). The multimedia dictionary window contains four elements: a child-friendly example sentence of the target vocabulary, translation for both the target word and the sentence in Chinese, English narration of the target word/phrase and the sentence, and an animated/static picture as visual assistance for understanding. A sample dictionary window of the key word "gift" is demonstrated below. Users can activate the dictionary window by clicking on "gift" in the

text or clicking the gift box on the picture. To close the dictionary window, users simply need to click the cross at the upper right corner of the window.



Figure 4. Demonstration of a character statement hotspot and dictionary hotspot.

(3) **Character statement hotspots.**

On each story page, we also designed character statement hotspots where users can click on the items/characters and listen to some story-related statements by the characters. For example, in Figure X, Little Oak opened the cage and set his butterfly friends free. On this page, if the user clicks on Little Oak, a statement window will pop up with Little Oak saying “I’m here to save you guys! You are free!”. If the user clicks on the red butterfly, it says “You saved us with your camouflage! I am so amazed!” Similarly, the yellow butterfly says “You are my hero Little Oak!”. Unlike the dictionary windows, the statement window will automatically disappear when the audio narration is finished.



Figure 5. Demonstration of a character statement hotspots.

(4) **Discussion prompts.**

Following the "CROWD" dialogic reading principle (Zevenbergen & Whitehurst, 2003), we designed four types of discussion prompts in our storybook asked by the avatar Little Oak, who was the main character of the story. The four types are (1) Recall prompts where children are prompted to recall the story plot (e.g., "What did Mama just say to Little Oak?"); (2) Open-ended prompts which encourage the child to interpret or respond to the story or illustrations in their own words (e.g., "What colors are the wings of the butterflies in this picture?"); (3) Wh- questions which start with why, what, where, when, how (e.g., "Why are those butterflies so popular?"); and (4) Distancing prompts that encourage children to relate the story to their own experiences or emotions (e.g., "Have you seen a snake before?", "Do you like them?", "Why?").

We provided multiple-choice answer options with visual cues (see Figure 6.) to half of the discussion prompts for the following reasons: a) it would be less challenging for the children to make a response given that the children who participated in the study were at a young age and most of them have limited English proficiency; b) adding multiple-choice answers to the prompts allowed us to design individualized feedback pop-ups for each discussion prompt to model the "prompt – evaluate – feedback" sequence and thus facilitate the parents to practice the "PEER" strategy. Specifically, individualized feedback was provided in a pop-up window by Little Oak after the parent or child selected an answer by touching the screen. For example, if the user selected a correct answer, Little Oak would appear saying: "Congratulations! That is correct! Everyone likes colorful butterflies because

they are as beautiful as a rainbow!" or if the wrong answer was selected, he would say "Uh-oh, that doesn't seem to be the right answer. Try again!"

For discussion prompts that related to children's own experiences or descriptive prompts that rely on children's observation and interpretation, we only provided an example answer from Little Oak's perspective (see Figure 7.). For example, the final discussion prompt asked, "Has mommy/daddy ever had tears of joy?" The answer provided by Mama Oak was "Mama Oak had tears of joy when Little Oak won the singing competition in the garden."

There were a total of 20 discussion prompt pages in both reading sessions (10 in each session). The discussion prompts in the second reading session were more challenging than those in the first reading session. All the discussion prompt pages had automatic audio narration in English and written text in English and Chinese for parents' reference. The discussion prompts were automatically played as the users were reading the story but they could stop the narration and skip the discussion page by clicking on the "next" button.



Figure 6. Demonstration of a multiple-choice discussion prompt page with feedback.



Figure 7. Demonstration of an open-ended discussion prompt page with feedback.

(5) **Bilingual support.**

In order to better engage non-English-speaking parents in this dialogic reading process with their children, we provide L1 (first language) support on every page. By reading the Chinese translation of the story, statement windows and dictionary windows, we hypothesize that parents can provide some scaffolding to the child about the new vocabulary and the story. We also hypothesize that with the bilingual support, parents can have more meaningful conversations with the children on discussion pages, which might be beneficial for children's story comprehension, word learning and language development.

3.8. Prototype testing

To test the usability of the storybook system, parents read the story on a touch screen tablet with their children twice at home. Three of the 10 families were assigned to read the story without the Chinese translation and the remaining seven families read the bilingual version. The two shared-reading sessions were video recorded by the parents using a second mobile device. After the second shared-reading session, the research assistants conducted interviews with both parents and children on their user experiences and perceptions.

User experience from observations and interviews revealed the following findings. First, most parents and children had a satisfactory experience reading the storybook with their children. The sole technical issue reported by some parents was that the page loading time was too long, interfering with user experiences. Second, parents believed that the parent-child shared storybook reading was more effective and beneficial to their children's

learning compared with children reading storybooks alone. Third, the character statement hotspots were the most popular feature among children. Finally, some parents did not have sufficient English proficiency and confidence to read the story in English. A parent who read the English-only version of the story said: “I am not very motivated to teach my kid (during shared reading). One major reason is that I do not have confidence in my English skills There were a lot of words that I did not know, such as oakleaf butterfly and lizard. When I was in college ten years ago, I passed the College English Test 6 and my English pronunciation was beyond the average of my peers, but now in order to teach each word, I will have to search each word on Baidu (a Chinese search engine). A lot of words in the story look familiar but I just could not remember what they mean.” Thus, the L1 support was confirmed as a necessary feature for promoting parental involvement and optimizing the learning opportunities for the children.

Based on the user experience, feedback and suggestions of the users, we refined and improved the high-tech prototype in the following ways: a) we adopted bilingual support as a standard feature for our e-books, providing Chinese translation on all English text to support parents with limited English proficiency; b) we added more character statement hotspots; and c) to reduce the lags in page loading time, we further optimized the website by upgrading the bandwidth and minimizing the e-book html file sizes.

In addition to the interactive features, the system also allows researchers to track the user activities by recording clickstream data in the user logs. Five types of activities are tracked in the log data: clicks on the page turning buttons, clicks on the replay buttons,

answers to the discussion questions, clicks on the character statement hotspots, and clicks on the vocabulary dictionary hotspots.

p2_quote_button_littleoak	quotes		2020-10-04 13:31:28
p1_quote_button_oakleaf	quotes		2020-10-04 15:10:56
p1_quote_button_blackbird	quotes		2020-10-04 15:11:53
p1_quote_button_blackbird	quotes		2020-10-04 15:11:54
p1_quote_button_flower	quotes		2020-10-04 15:12:15
p1_quote_button_flower	quotes		2020-10-04 15:12:16
p1_quote_button_ladybug	quotes		2020-10-04 15:12:29
p1_nextButton	next_button		2020-10-04 15:12:39
p1_nextButton	next_button		2020-10-04 15:12:40
p2_replayButton	replay_button		2020-10-04 15:12:59
p2_cocoon	vocabulary		2020-10-04 15:13:29
p2_cocoon	vocabulary		2020-10-04 15:13:30
p2_takes a deep stretch	vocabulary		2020-10-04 15:13:38
p2_takes a deep stretch	vocabulary		2020-10-04 15:13:41
p2_butterfly	vocabulary		2020-10-04 15:13:42
p2_quote_button_littleoak	quotes		2020-10-04 15:13:51
p2_nextButton	next_button		2020-10-04 15:14:01
p3_backButton	back_button		2020-10-04 15:14:10
p2_replayButton	replay_button		2020-10-04 15:16:03
p2_nextButton	next_button		2020-10-04 15:16:33
p3_disappointed	vocabulary		2020-10-04 15:19:08
p3_water	vocabulary		2020-10-04 15:19:38
p3_quote_button_oakleaf	quotes		2020-10-04 15:19:48
p3_quote_button_oakleaf	quotes		2020-10-04 15:19:54
p3_disappointed	vocabulary		2020-10-04 15:20:06
p3_dry	vocabulary		2020-10-04 15:20:06
p2_butterfly	vocabulary		2020-10-04 15:20:22
p2_replayButton	replay_button		2020-10-04 15:20:44

Figure 8. Demonstration of the user log data for one of the participants.

4. Evaluation Study and Parent-child Interaction

4.1. Research questions

We conducted an evaluation study to examine how much story-related English vocabulary the children gained from reading the story using the designed e-book app twice with their parents who have none to limited English proficiency. Following the experiment, we also investigated the self-reported user experiences and perceptions from both the parents and the children, and examined how children and parents' characteristics interact with the learning. The following research questions guided our study design:

1. What is the English vocabulary learning effectiveness of the designed e-book app?
2. How do children's characteristics (age, gender, English vocabulary baseline skills) and parents' English proficiency level interact with children's English vocabulary learning outcomes during the e-book shared reading?
3. What are parents' and children's perceptions and experiences of the e-book design features?

4.2. Methods

4.2.1. Participants

To evaluate the refined prototype, we recruited another 83 parent-child pairs for a total of 166 participants. Children who met the following criteria were considered for recruitment: 3-7 years of age; first language is Chinese; have web accessible touch-screen tablets or laptops at home. Using a snowball sampling approach, the lead researcher contacted potential participants through social media platforms. The average age of the

children was 5.11 years old. All children were born and raised in China. All parents were native Chinese speakers with a wide range of English proficiency level, education level and socioeconomic status. Detailed demographic information of the participants is in Table 1.

Table 1. Parent and Child Demographics for the Evaluation Study.

<i>Children</i>		N	%
Age		Mean=5.11	SD=1.20
Female		34	39.8%
English Skill	None	36	43.4%
	Beginner	19	22.9%
	Intermediate	14	16.9%
	Advanced	14	16.9%
<i>Parents</i>			
Age		Mean=34.00	SD=4.49
Female		79	95.2%
Degree	Associate's	12	14.5%
	Bachelor's	40	48.2%
	Master's	24	28.9%
	Doctorate's	7	8.4%
Monthly Household Income (CNY)	<10000	12	14.5%
	10001-20000	40	48.2%
	20001-30000	24	28.9%
	>30000	7	8.4%
	None	5	6.0%
English Skill	Beginner	43	51.8%
	Intermediate	22	25.5%
	Advanced	13	15.7%

Note: National monthly household income in the city is ¥7305 on average, as reported by China's national bureau of statistics (Jan 2021).

4.2.2. Procedures

Prior to the shared reading sessions, all child participants completed an English Story Vocabulary Test with trained research assistants via Zoom. Meanwhile, parents completed a questionnaire about their demographics and home literacy practices. After completing the pre-study measures, parents were assigned a username and a password to log in to their account on the e-book website. Parents and children then read the story twice on their own touch-screen tablets within a period of two to three days, video recording the reading sessions through Zoom meetings. Demonstrations of parents reading the e-book with their children are presented below in Figure 9 and Figure 10. Within 24 hours of completing the second reading session, the child participants completed the English Story Vocabulary Test with trained research assistants via Zoom. Following the post-test, we conducted semi-structured interviews with the parents and children. Trained bilingual research assistants conducted open coding, axial coding, and selective coding (Muller & Kogan, 2010) to identify topics of interest, gain insights into their experiences and perceptions of the system.



Figure 9. Demonstration of a mother reading the e-book with her daughter.



Figure 10. Demonstration of a father reading the e-book with his daughter.

4.2.3. Measure

The English Story Vocabulary Test was administered to assess children's story-related vocabulary knowledge before and after the reading sessions. This test contained two subtests: Story Receptive Vocabulary and Story Expressive Vocabulary. In the Story Receptive Vocabulary subtest, 25 English words from the story were read to the children, who selected which of four pictures displayed on the screen best depicted the target word. In the Expressive Vocabulary subtest, the children were asked to name in English 25 story-related words, shown one by one. Each item was worth one point, yielding a maximum possible score of 25 for both subtests and a total score of 50. The overall reliability of this test yielded a Cronbach's alpha of .97.

4.3. Results

4.3.1. English Vocabulary Learning Effectiveness

We examined the learning effectiveness of our e-book through descriptive analysis and paired t-tests. Children showed significant gains in Receptive Vocabulary, $t(82) = 12.60, p < .001$, Cohen's $d = 1.38$, and Expressive Vocabulary, $t(82) = 9.98, p < .001$, Cohen's $d = 1.09$. from pretest (Receptive Vocabulary Subtest: $M = 10.28, SD = 7.61$; Expressive Vocabulary: $M = 13.39, SD = 7.78$) to post-test (Receptive Vocabulary Subtest: $M = 10.28, SD = 7.61$; Expressive Vocabulary: $M = 13.39, SD = 7.78$). Thus, parent-child joint reading of our e-book led to moderate to large gains in storybook vocabulary.

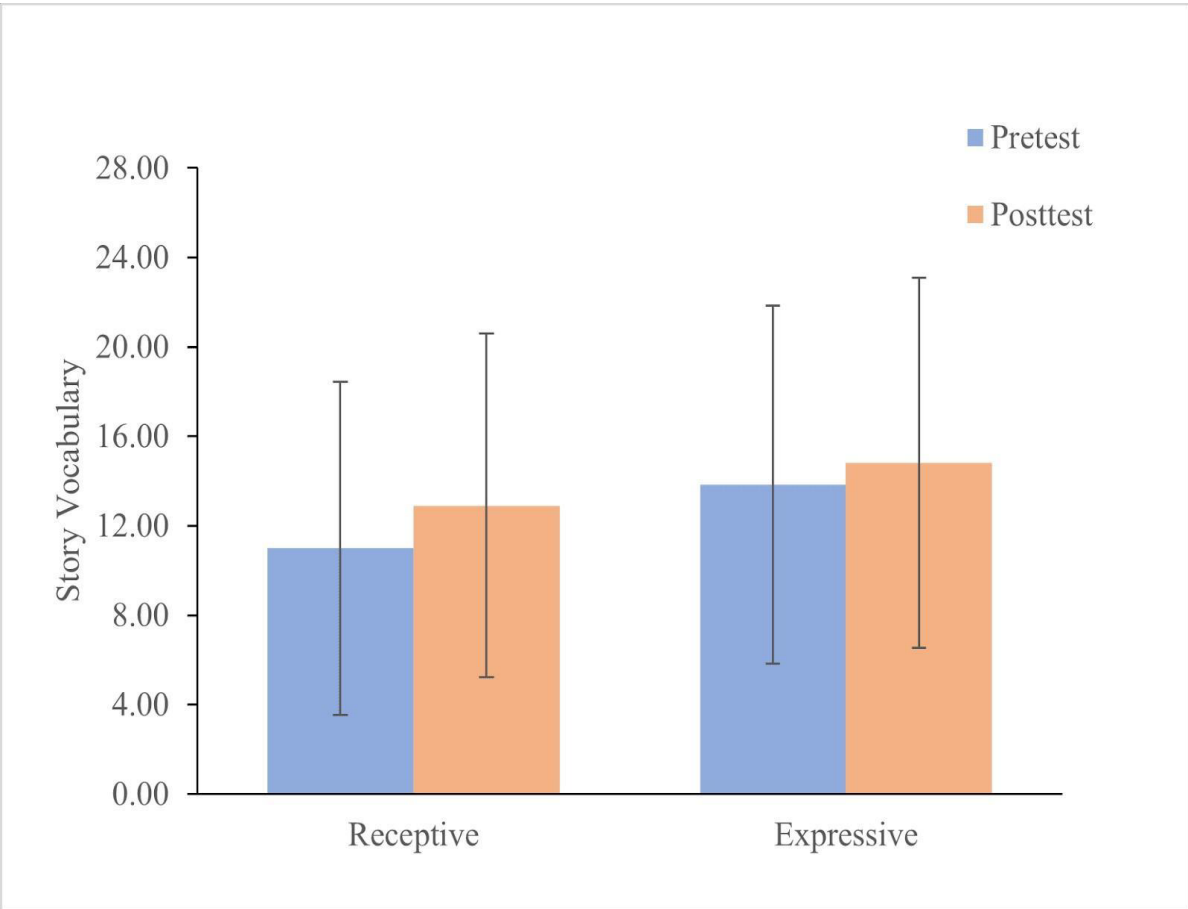


Figure 11. Story Receptive and Expressive Vocabulary Pre- and Post-test scores.

4.3.2. Child characteristics and Vocabulary Learning Outcome

We calculated a regression analysis to examine how children's initial English vocabulary knowledge and demographic characteristics, such as age, gender, and their parents' English proficiency contribute to their growth in story vocabulary knowledge. After auto-regressing the English vocabulary gain on children's baseline vocabulary scores ($b = 0.34, p < .001$), we found that the baseline vocabulary scores had a quadratic relation with story vocabulary gain ($b = -.01, p < .001$). Details of the regression model can be found in Table 2. Figure 12 shows that children with midrange vocabulary knowledge showed the greatest gains in story vocabulary knowledge, while at the extreme ends of the scale showed the least gains. This quadratic relationship suggests that children with little initial vocabulary knowledge have more limited word learning benefits from the e-book, while children with larger vocabularies at pretest experienced ceiling effects in word learning. None of the demographic control variables contributed to growth in story vocabulary knowledge.

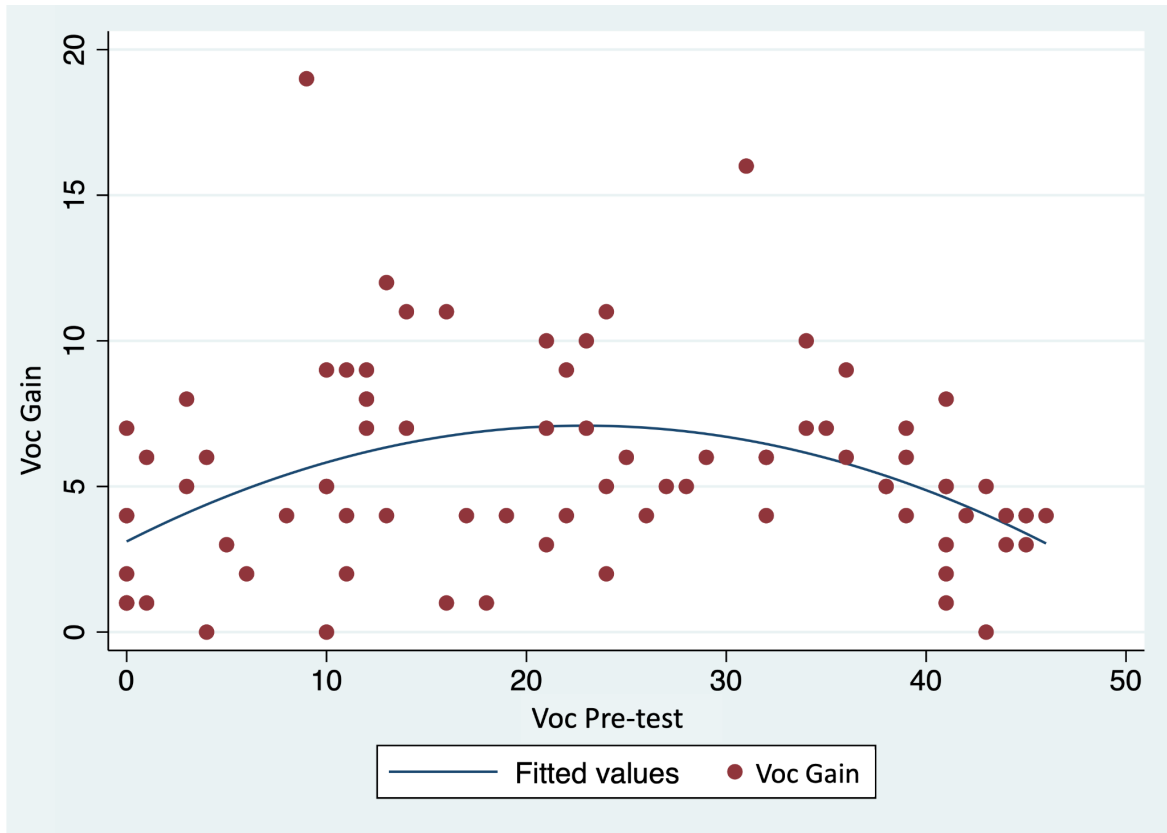


Figure 12. Children’s English story vocabulary gains as a function of initial vocabulary knowledge

Table 2. Regression Table on the English Story Vocabulary Gains.

	b	SE	T value	P Value
Vocabulary Pretest	0.34	0.09	3.57	0.001
Vocab Pretest 2	-0.01	0.002	-3.82	0.000
Child Age	0.17	0.36	0.48	0.63
Child Gender	0.1	0.74	0.13	0.89
Parent English	0.11	0.45	0.24	0.81
Constant	2.2	1.91	1.15	0.26

4.3.3. User Experience

In the interviews, 94% of the children reported they enjoyed reading this e-book, because of the interactive features, interesting story plot and beautiful illustrations. Similarly, 92% of the parents considered our e-book as an effective English learning tool and enjoyed this parent-child reading activity. The user experiences and perceptions about the five e-book design features are described below.

Story Narration.

Most parents (92%) and children (82%) liked the English story narration. Specifically, parents appreciated the narrator's authentic English pronunciation and its expressive prosody. Importantly, some parents mentioned that the narration maintained their children's attention, providing them with an authentic and appealing story reading experience. The narration provided children with prosodic cues to parse the oral language and support comprehension (Rahbar et al., 2020), and model English pronunciation. Children were also attracted by the dramatic voices of the story characters: "I like that the black bird has a husky and scary voice and the Little Oak sounds cute." However, it was less attractive to children who lacked sufficient English proficiency to comprehend the English narration and needed parental support.

Multimedia Dictionary.

Ninety-two percent of the parents and 88% of the children reported that they liked the customized multimedia dictionaries. Parents found these dictionaries successfully combined education with recreation, noting, "It is fun and at the same time, helps reinforce

vocabulary learning”. Yet parents who clicked on the dictionary too frequently believed it overloaded their children cognitively.

Many children were attracted to the dictionaries by the illustrations and sample sentences. They observed, “It teaches me how to apply these words into sentences,” and “The fun pictures enabled me to have a deeper impression on the new words.”. Children were empowered with the agency provided by the hotspots embedded in the illustrations and superscripts, reporting, “When I don’t understand something, I would simply click on it.” The dictionaries were also appealing to children because of the animations and because the customized learning materials reflected their real-life experiences. “I like the dictionaries because the animation comes from my favorite cartoon,” another child offered.

Character Statement.

Character statement hotspots were children’s (90%) and parents’ (96%) favorite design feature. Touching the characters on the screen and listening to their dialogue in the moment allowed children to simulate verbal interaction with the characters in the story. According to the children: “... I can talk to them and make friends with them”, “I can read their mind and learn what they would say at that moment”, “It’s just so much fun to speak with them.” During these interactions, children established recognition and emotional attachment with the main character. For example, one child commented he liked Little Oak because he is a hero and can protect him. For most parents, the entertaining and interactive nature of the character statement played a critical role in sustaining children’s interest and attention while reading: “It’s great in that it brought the story to life”, “My child listens to the story more carefully with these character statements.” Yet, they

recognized the importance of e-book reading as a joint exercise, as “Children might be too occupied with the character statements to learn from the core story plot reading alone.”

Discussion Prompts.

Almost all the children (82%) and parents (98%) liked the discussion prompts. Indeed, the discussion prompts were the favorite feature for several children: “I love it the most. It helps my brain run really fast!”; “I love this the most because I feel so excited when I get the questions right.” Another common reason why children liked the discussion prompt the opportunity to engage more with the story’s main character, Little Oak, who was the prompt’s avatar: “I love it when the Little Oak raises a question because I could learn more about him,”; “I like it just because the Little Oak is there.” However, a few children were less interested in the discussion prompts because they interrupted the reading flow. The discussion prompts were parents’ favorite feature because they encouraged children to understand the story more deeply and engage with the e-book: “It triggers him to think logically,”; “The feedback is like a reward that makes her happy.”

Bilingual Support.

We obtained feedback on bilingual support from parents because our young children did not yet have the reading skills to read the Chinese translations. Most (90%) of the parents appreciated the bilingual support feature, as it enabled them to use a separate English-Chinese dictionary to check unfamiliar English vocabulary. The Chinese translation boosted their confidence in explaining the story to their children. “It’s the best! I love the Chinese translation because I have limited English skills. I would not know what to do without it,” said one parent. The parent of a seven-year-old child recommended that

bilingual support be an optional feature because older children who can read Chinese may read the story in Chinese and ignore the English content.

4.4. Discussion

4.4.1. English Vocabulary Learning Outcomes

Parent-child shared reading has been considered an enjoyable home literacy practice that is beneficial for children's word learning and comprehension skills (Mol et al., 2008). This study sought to develop a bilingual English-Chinese touchscreen e-book app as a learning tool for children in Chinese-speaking settings to develop English language skills while supporting parent-child joint engagement. Although shared reading was found to be less effective in promoting vocabulary growth in second language settings when print books were used (Chow et al., 2010), we found children learned on average 4.76 new English vocabulary through shared reading with our e-book. These gains are consistent with the 2-5 word gain reported for older, monolingual children in a recent meta-analysis (Flack et al., 2018). Our participants' vocabulary gains are particularly noteworthy, as older children are more proficient in acquiring new vocabulary (Bion et al., 2013). Thus, the findings suggest that e-books with features such as multimedia bilingual dictionaries and discussion prompts can create engaging and meaningful shared reading opportunities that promote young children's second language learning.

4.4.2. How Child and Parent Characteristics Interact with English Vocabulary Learning

Shared reading, where parents scaffold their children's text comprehension when reading together, can enable children to read more difficult texts that contain richer

vocabulary, and more sophisticated themes(Stahl, 2012). However, shared reading may be less beneficial when children in EFL settings read English stories with their non-English-speaking parents(Chow et al., 2010). Our findings show that a well-designed multimedia interactive e-book can compensate for EFL parents' limited English proficiency and provide effective digital learning experiences for young English learners with comparatively more challenging texts. The supportive multimedia features in the app enabled non-English-speaking parents to read and learn English together with their children, while the children enjoyed English stories with higher conceptual density that is more developmentally appropriate.

In this technology mediated shared language learning environment, the only factor that interacted with vocabulary learning was children's English vocabulary baseline skills. The quadratic relationship between English baseline skills and vocabulary learning outcome may be that children who have preliminary English skills are overwhelmed by the new alphabet, vocabulary, and syntactic structures of the story. Thus, they may lack sufficient English skills for new vocabulary acquisition than those children with preliminary English skills. Similarly, while children with more advanced English skills might enjoy the e-book, they learned fewer new words because the vocabulary was already familiar. This pattern is consistent with the view that children learn most when books or e-books are at their instructional level (Betts, 1946; Halladay, 2012), or Zone of Proximal Development (Vygotsky, 1978). An implication of this is that children's English proficiency should be weighted more than age in algorithms for recommending storybooks and designing storybook apps for EFL contexts.

4.4.3. How E-book Design Features Support Learning

Our e-book incorporated five multimedia features to better meet the learning and social needs of young English learners and their parents. We identified three ways of how the design features of the e-book system facilitate learning during the parent-child shared reading in EFL settings.

Providing support for parents' limited English proficiency and parent-child interaction

Parents' limited proficiency in English is a primary challenge for parent-child shared reading of English stories in EFL settings. Without sufficient English knowledge, many parents lack confidence in their comprehension of the stories and reading aloud in English, thereby limiting the benefits of shared reading (Chow et al., 2010). We found that the English audio narration and discussion prompt in English and Chinese provided parents with enough bilingual support to actively engage in the shared reading of this e-book.

Although audio narration may not be beneficial for parent-child shared reading in their native language (Dore et al., 2018), we found in EFL settings, parents appreciated the English narration because it exposed their children to an authentic model of oral English. Moreover, parents believed the discussion prompts enabled them to contribute to their children's English learning, as the prompts sparked meaningful discussions and enabled them to evaluate and reinforce their children's comprehension. These supportive features enabled parents and children to code-switch between Chinese and English while shared reading (Cummins, 1991), enhancing the learning experience by reducing the constraints of limited English proficiency. This finding implies that when designing storybook apps for

multilingual families, it is important to embed design features such as audio narration and bilingual support that facilitate parental engagement and joint learning experiences.

Contributing to the establishment of the parasocial relationship with story characters

Studies show that children learn more effectively from media characters whom they develop strong parasocial relationships with (Brunick et al., 2016; Calvert et al., 2014). Three factors are suggested by recent research that contribute to the formation of bond between media and children: attachment, character personification, and social realism (Bond & Calvert, 2014). Yet, this line of research has mainly focused on mainstream media such as TV shows; the design of story characters to promote parasocial relationships during shared digital reading activities is rarely discussed.

In the current study, we found that well-designed storybook apps with interactive multimedia features are beneficial for building emotional attachment with the story character by contributing to attachment, character personification and social realism. For example, the discussion prompts with immediate feedback provided a unique space for the children to learn more about the character and develop a closer relationship by connecting their own real-life experiences through joint interactions. This real-world relevance may foster children's sense of social realism and hence establish an emotional bond with the media character (Troseth et al., 2006). Moreover, the character statement hotspots expose children to the in-the-moment dialogues, facial expressions and person-like emotions such as frustration, sadness, and happiness. The human-like needs and emotional capabilities of Little Oak, together with his brave actions and unique camouflage ability, facilitated character personification, trust (Bernath & Feshbach, 1995) and attachment (Bond &

Calvert, 2014), which are believed to be key to the formation of parasocial relationships. These findings provided critical implications for storybook app designers and researchers that some interactive features such as character statement and discussion prompts with feedback should be incorporated into the story-based learning system as an effective approach to develop parasocial relationships between children and the story characters and promote engagement.

Maximizing comprehensibility and language exposure

Maximizing text comprehensibility and L2 language exposure is key to successful vocabulary learning and comprehension in English language learning instructions (al Zoubi, 2018; Chaudron, 1985). In the current study, we found two design features, customized multimedia dictionaries and character statement hotspots, beneficial for this particular learner population.

Unlike the dictionaries in many commercialized storybook apps which do not offer customized content or visual support to young children, our multimedia dictionary incorporated evidence-based principles for vocabulary instruction (Beck et al., 2013), such as providing comprehensible input through developmentally appropriate definitions, translations to Chinese, and the use of sample sentences to contextualize word meanings. The inclusion of age-appropriate animations and sample sentences not only facilitated meaning making of the unfamiliar vocabulary, but also helped sustain and redirect children's attention to the story. We also found that well-designed character statement hotspots can be engaging, as children activated hotspots many times. The repeated exposure to oral language supports language acquisition (Waring & Nation, 2004). Indeed,

after listening to the character statements repeatedly, some children incorporated the character statement sentences into their story retellings, mimicking the narrator's prosody. Therefore, when designing storybook apps for multilingual contexts, developers might consider the importance of incorporating age-appropriate and engaging multimedia features such as customized multimedia dictionaries in digital storybook apps to maximize language learning opportunities for bilingual children.

4.4.4. Challenges and tensions during design

Tensions and challenges were also identified during the participatory e-book design. One challenge was the divergent demands and expectations held by parents and their children about the storybook reading activity. Most parents considered storybook apps as an important source of English language input and the shared reading experiences as a key opportunity to improve their children's English skills. Thus, from the parents' perspective, "learning English" served as a primary goal for the e-book design and reading. Guided by this strong educational purpose, during reading, some parents tended to frequently request that the children activate the hotspots on vocabulary, listen to the English words/sentences and repeat afterwards as practice. In contrast, children simply wanted to enjoy the story and have fun with the technology. Through the interviews with children, we found that being asked to repeat the English words or sentences that they struggled to pronounce diminished their user experiences and motivation for joint reading. One girl stated, "I prefer to read the story myself because my mom always asked me to read the English words that I don't know." Further, we observed that children showed greater interest in the hotspots in the illustrations where "animals can talk to them" rather than the vocabulary

hotspots preferred by their parents. Thus, to balance the power between the two stakeholders and boost children's motivation, we decreased the dictionary hyperlinks in the English text and instead focused more on the story characters. In future participatory design with multiple stakeholders including children, tensions between the stakeholders should be recognized and the power should be balanced between children and adults.

Another challenge during the design process was incorporating the wide range of demands and baseline language skills from the parents and children. Due to the variance in the socioeconomic status, parents' education level and uneven distribution of English language resources, children showed a wide range of baseline English skills. To design an e-book system which can meet the demands of children with no English proficiency to fluent English skills is of great difficulty. Our participatory design study suggests that involving parents as a mediator in this e-book learning process allows flexibility in the e-book use for children with various learning demands. A well-designed digital storybook with features to support parent-child engagement can empower parents with flexibility and agency to provide individualized reading experiences, social interactions, and authentic bilingual language input for their children. Our study highlights the importance of parents as mediators to individualize the learning experience to their children's needs and suggests recommendations for how e-books should be designed to support such parent-child joint engagement.

4.5. Limitations and Future Directions

Some limitations need to be considered when interpreting the findings. First, the evaluation study was not a randomized controlled trial, which means that other factors may have contributed to the vocabulary gain from post- to pre-tests such as English exposure to target words outside of the experiment. However, given that the participants were living in China and the experiment was finished within a short period of time, the exposure to the target words in English should be minimal. Second, due to the constraints during COVID-19, the contextual inquiry and design was conducted virtually with 6 participants, although the data collected through virtual interviews, observations and Zoom meetings were sufficient to inform design. Future research can consider a more systematic and comprehensive review and evaluation of the commercial storybook apps on the market to provide evidence for the teacher and parents in selecting bilingual storybook apps and to inform designers and educators in future e-book design for the EFL and bilingual setting. Another future direction is to explore empowering the avatar with bilingual conversational agents and the applicability of the character statement feature in other technologies such as augmented reality.

5. Randomized Controlled Trial on Discussion Prompts

5.1. Study aims and Research Questions

Whereas e-book multimedia and interactive features such as audio narration, animation, or interactive games are unlikely to support and may hinder parental engagement, discussion prompts may have the potential to facilitate parent-child dialogic reading (Strouse et al., 2013). Embedding discussion pages in the e-book allows the app to prompt story-related questions for the readers, create space for parent-child joint engagement, and stimulate meaningful discussions about the story and vocabulary. Moreover, reading e-books with discussion prompts may improve parents' dialogic reading techniques, especially for parents from low socioeconomic backgrounds. For example, in an e-book experiment conducted by Troseth and colleagues (Troseth et al., 2020b), parent-child pairs from low socioeconomic families read a narrated e-book twice with or without questions. In the enhanced e-book condition, an avatar asked questions, which were more straightforward in the first reading and more challenging in the second reading. They found that parents with the enhanced e-books spoke more than three times more with their children, with a greater breadth of vocabulary than parents using the unmodified e-book. Despite the differences in parent-child interactions, children who used the enhanced e-books did not have better learning outcomes than those who used the unmodified e-books.

Although the literature illustrates the potential benefits of embedding discussion questions in e-books to facilitate dialogic reading, it is unclear how this design feature impacts parent-child shared reading in an EFL context. By prompting children and parents

with bilingual story-related questions with audio and visual cues, evaluating children's responses, and providing contingent feedback, the technology-enhanced e-book may facilitate dialogic reading and improve children's digital learning outcomes. To the best of our knowledge, no studies have investigated the applicability and effectiveness of bilingual discussion prompts in facilitating dialogic reading in EFL settings. Thus, the current study aims to examine and understand the role of bilingual e-book discussion prompts in parent-child shared digital reading in an EFL context.

The following research questions guided the study design and implementation:

1. What is the impact of embedded bilingual discussion prompts with immediate feedback on children's story comprehension, prompted story retelling, and English vocabulary learning?
2. To what extent are the user activities on the discussion pages (including the number of close-ended discussion questions attempted to answer, the number of questions answered correctly at the first trial, and time spent on discussion pages) correlated with children's story comprehension, prompted story retelling, and English vocabulary scores for the children in the treatment group?
3. What are the main ways that parents respond to discussion prompts, and how do they appear to affect children's learning?
4. What are parents' and children's self-reported experiences and perceptions of the embedded discussion prompts in the bilingual e-book?

5.2. Methods

This chapter focuses on one design feature—bilingual discussion prompts, and its impact on children's learning. This experimental study used both quantitative and qualitative analysis. We conducted a randomized controlled trial to answer the first research question and examined how bilingual discussion prompts impact children's story comprehension, story retelling, and story vocabulary learning outcomes after two shared-reading sessions. We conducted a correlational analysis using the clickstream data to answer the second research question. Variables gleaned from the clickstream data included the number of multiple-choice questions that users attempted to answer, the number of questions answered correctly at the first trial, and time spent on discussion pages (including close-ended and open-ended questions). For the third research question, we randomly selected 20 videos of the reading sessions from the treatment group and explored the parent-child interactions on discussion pages. Using bottom-up qualitative analysis, we aimed to identify verbal responses and user behaviors that reflect how discussion prompts may or may not facilitate learning. To answer the last research question, we examined the self-reported experiences and perceptions about the e-book and the embedded discussion prompts based on the data collected through parent questionnaires and interviews with both parents and children after the two reading sessions. Details of the methods and an introduction of the e-book with the discussion prompt feature are provided below.

5.2.1. An introduction of the interactive storybook

The first author wrote the e-book "The Story of an Orange Oakleaf." It is a story of an oakleaf butterfly who dislikes its dry-leaf-like wings but eventually learns to appreciate them as their dry-leaf appearance plays a crucial role in saving its butterfly friends from an evil bird. This storybook was hosted on a website with several multimedia and interactive features, including English narration, multimedia dictionaries, bilingual support, and character statement hotspots where users could click on the items/characters and listen to some story-related statements by the characters. The only difference between the e-books for the treatment and the control groups was that the bilingual discussion prompts with feedback were embedded in the e-books for the treatment group. While the control group's e-books did not include discussion prompts, all other multimedia and interactive features matched the treatment group's. For a detailed description about the discussion prompts, please refer to section 3.7.

5.2.2. Study design and procedures

To examine the impact of the discussion prompts on children's learning outcomes, we conducted a randomized controlled trial with 107 young English learners and their parents whose first language is Chinese. Initially, we recruited 130 families, but due to the difficulties with remote data collection, internet issues, device issues, and parents' tight schedules, 107 families completed the full set of procedures. During the experiment, children and their parents were randomly assigned into either (1) the treatment group where parents read the e-book embedded with discussion prompts with their children twice or (2) the control group where parents read the e-book without discussion prompts

with their children twice. We intentionally assigned more children to the treatment group (1.5 times control). The two reading sessions took place in children's homes on two scheduled consecutive days.

Children were administered three post-tests following the two reading sessions: English Story Vocabulary Test - Receptive and Expressive Vocabulary Subtests, Story Comprehension Test, and Story Retelling Test. All assessments were administered through Zoom. Parent-child interactions during the two reading sessions were also videotaped by parents using another mobile device. Following the post-tests, parents completed a questionnaire, and we conducted semi-structured interviews with the parents and children to gain information about their perceptions and experiences with the discussion prompts.

5.2.3. Participants

Children who met the following criteria were considered for recruitment: (1) 3-7 years of age; (2) first language is Chinese; (3) do not have severe learning disabilities, cognitive disabilities, or developmental delay reported by the teacher; (4) do not have other physical disabilities which might hinder them from reading the e-book (e.g., hearing impairment); and (5) have web-accessible touchscreen tablets or computers at home. Inclusion criteria for parents were: (1) Chinese native speakers and (2) do not have other physical disabilities which might hinder them from reading the e-book (hearing impairment). Using a snowball sampling approach, the lead researcher and research assistants reached out to potential participants through social media platforms. We sent the Study Information Sheet in English and Chinese to the parents for careful review. The lead researcher and the research assistants addressed all the parents' and children's

questions. Of the 107 parent-child pairs that completed the study, 103 lived in China and 4 lived in the United States.

5.2.4. Measures

English Story Vocabulary Test was administered to assess the amount of story-related vocabulary children mastered after the two reading sessions. This test contained two subtests: Story Receptive Vocabulary and Story Expressive Vocabulary, and each subtest consisted of 25 items (50 in total). In the Receptive Vocabulary subtest, children heard one English word or phrase from the story and selected which four pictures displayed on the screen best illustrate that term. The test instructions were in Chinese. In the Expressive Vocabulary subtest, children were shown four big pictures consisting of 25 story-related items (5-8 items on each picture). Test administrators used their mouse to point to an image illustrating each target word and asked the children to name it in English. Children scored one point for each item correctly named in English and a score of zero for incorrect responses and no responses. This test yielded a Cronbach Alpha of .97.

Story Comprehension Test. After the two shared-reading sessions, children were given a comprehension test to evaluate their understanding of the story. The comprehension test consisted of seven sets of questions. Three of the question sets included a simple closed-ended question followed by a follow-up open-ended question (e.g., “Did Little Oak use his camouflage when saving his friends? How did he do it?”) and the other four included only one open-ended question in each question set (e.g., “Why did everyone say that Little Oak is a real hero?”). Close-ended questions asked simple questions such as yes or no questions and children received scores of 1 for correct

responses and 0 for incorrect answers and nonresponses. Open-ended questions were wh-questions that required a longer response and were scored on a scale of 0-3, with 0 representing nonresponses or completely incorrect answers and 3 representing thorough and correct answers. Answers received a score of 1 if the child mentioned an on-topic word or a phrase, but the answer was generally incorrect or irrelevant. Responses received scores of 2 if they were partially correct. Story comprehension questions were read aloud in English and Chinese, and children answered in their preferred language. The maximum score for this test was 24. All the answers were doubled-scored with an inter-rater reliability of over 90%. This test had a Cronbach Alpha of .85.

Story Retelling Test. After the two shared reading sessions, children were also administered a cued Story Retelling Test. Because of their young age, children were shown key illustrations as recall prompts to retell the story. We used the following instructions: "Hi, I just missed the story of Orange Oakleaf! Can you tell me what happened to Little Oak? You can refer to the following illustrations to remind you of what happened." When children stopped in the middle of the retelling, the test administrator prompted them with, "and then?" or "and next?" Due to the limited English proficiency of most participants in the experiment, we asked the children to retell the story in Chinese. To score the retelling post-test, we transcribed children's verbal responses into text and scored the critical idea units in the story (Capotosto & Kim, 2016). The first author and a trained research assistant scored the test, and the inter-rater reliability was 95% among the group.

5.2.5. Parent-child interactions on the discussion pages

Parents recorded the shared reading sessions and shared the videos with the research team after finishing the experiment. We randomly selected 20 video recordings from the group who read with the discussion prompts to answer the second research question. Trained research assistants transcribed the verbal interaction scenarios on the discussion pages using the CLAN program (MacWhinney, 2017). These 20 videos yielded 200 verbal interaction scenarios and 2,699 utterances on discussion pages. The following qualitative data coding and analysis were both inductive and theory driven. We remained open to the unplanned themes and categories of how our participants respond to the discussion prompts and were informed by the dialogic reading and second language acquisition theories on what specific behaviors or conversations benefit children's learning. The first and second authors coded the parent-child behaviors and conversations on discussion pages in three steps.

First, we conducted open coding and memoing to explore, reflect and identify the content and topics of parent-child verbal and nonverbal interactions from all discussion scenarios. To ensure all possible topics can be identified, this step was solely driven by data where the two researchers read the transcripts repetitively, coded the data individually, and discussed together without having any presumptions from the theories. Some initial topics were identified for each scenario, for example, the parent is correcting the children's misunderstanding of the previous story plot, or the parent is encouraging the child to repeat the word in English.

Second, axial coding was conducted to look for patterns across various participants and discussion prompts. While identifying the themes that represent the most defensible interpretations of the data, we also referred to studies on dialogic reading (e.g., the CROWD & PEER strategies) and English language acquisition as theoretical guidance. The two main theories on second language acquisition were Vygotsky's (Vygotsky, 1978) social constructivism and Krashen's (Krashen, 1981) Theory of Second Language Acquisition.

The final step was selective coding where we centralize and superordinate the codes into core categories. In this step, several main themes of parent-child interactions and the learning opportunities emerged, including parents naturally practicing dialogic reading strategies and providing scaffolding, children receiving comprehensible input, and children becoming active learners. Aside from the themes aligned with literacy and language learning theories, we also noticed that some discussion prompts did not yield any discussion (e.g., the question was skipped, or the child was distracted from a discussion).

5.2.6. User experiences of the discussion prompts

The perceptions and user experience of the discussion prompts for both parents and children were examined using the parent questionnaire and the semi-structured interview data. The interview was conducted after the post-test. Trained research assistants asked all children, "How do you like this e-book?" and children in the treatment group, "How do you like the questions asked by Little Oak?" Similarly, all parents were asked, "How do you like this e-book?" and parents in the treatment group were asked, "How do you like the discussion prompts in the e-book?" After parents' and children's initial responses, follow-up questions were asked to gain more detailed information. After the interview, trained

research assistants transcribed parents' and children's responses into printed text. We quantitatively analyzed answers for the yes or no question, and we qualitatively coded the rest of the data to identify topics of interest and gain insights into parents' and children's experiences and perceptions of the discussion prompts feature.

5.3. Results

RQ1: What is the impact of discussion prompts with immediate feedback embedded in the story on children's story comprehension, prompted story retelling, and English vocabulary learning?

Table 1 summarizes children's outcomes in treatment and control groups. To avoid experiment-wise Type I Error, we conducted a multivariate analysis of variance (MANOVA) before proceeding to t-tests, and our findings imply a significant impact on the three variables in the treatment condition ($F(4, 102) = 7.74, p < .001$). A series of Bonferroni-adjusted t-tests showed that children who read the e-book with discussion prompts demonstrated significantly better comprehension ($t(105) = 5.42, p < .001$) and retelling ($t(83) = 3.36, p = .001$) than children in the control group. The effect sizes (measured with Cohen's d) for story comprehension and story retelling were 1.07 and .66 respectively. However, there was no significant difference between the two groups' performance on English story vocabulary ($t(105) = .62, p = .54$). Similarly, there were no significant differences on the receptive vocabulary subtest ($t(105) = 0.03, p = .98$) or expressive vocabulary subtest ($t(105) = 1.14, p = .87$).

Table 3. T-test results on children's learning outcomes.

	Treatment Group (n=64)		Control Group (n=43)		t-test
	Mean	SD	Mean	SD	
Story Comprehension	19.39	3.18	14.59	5.93	5.42***
Story Retelling	15.09	4.97	11.67	5.44	3.36**
Story Receptive Vocabulary	13.83	7.33	13.79	7.41	0.03(ns)
Story Expressive Vocabulary	15.11	7.56	13.4	7.68	1.14(ns)

*Note: * p<.05, ** p<.01, ***p<.001.*

RQ2: To what extent are the number of close-ended discussion questions answered and the number of questions answered correctly on the first trial correlated with children's story comprehension, prompted story retelling, and English vocabulary post-test scores for the children in the treatment group?

The correlations of the user log data for the 11 close-ended discussion questions with learning outcomes for children in the treatment group are summarized in Table 2 in the Appendix. We found that the number of close-ended questions attempted was positively correlated with children's story comprehension post-test scores ($r = .28, p = .02$). That is, children who attempted to answer more of the close-ended discussion prompts tended to show better story comprehension at post-test. Moreover, the number of questions that were answered correctly at the first trial was positively correlated with children's story retelling ($r = .26, p = .04$) and story receptive vocabulary scores ($r = .34, p = .01$). In contrast, the time spent on discussion pages was not significantly correlated with children's learning outcomes ($r = .14$ for story comprehension, $r = -.07$ for retelling, $r = -.23$ for expressive vocabulary, and $r = -.17$ for receptive vocabulary). Note that these results should be interpreted with caution because they are correlational and cannot yield causal inferences.

Table 4. Correlation table for the clickstream variables and children's learning outcomes for the treatment group.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) NDA	1.00						
(2) NDC	0.64***	1.00					
(3) TDP	0.02	-0.16	1.00				
(4) Story Comprehension	0.28*	0.17	0.14	1.00			
(5) Story Retelling	0.15	0.26*	-0.07	0.49***	1.00		
(6) Expressive Vocabulary	0.17	0.24	-0.23	0.18	0.27*	1.00	
(7) Receptive Vocabulary	0.21	0.34**	-0.17	0.07	0.24	0.88***	1.00

Notes: 1. * $p < .05$, ** $p < .01$, *** $p < .001$. 2. Variables: (1): Number of close-ended discussion questions attempted to answer, (2) Number of close-ended discussion questions answered correctly at the first trial, (3) Time spent on the discussion pages, (4) Story comprehension scores, (5) Story retelling scores, (6) Story Expressive Vocabulary, (7) Story Receptive Vocabulary

RQ3: What are the main ways that parents respond to discussion prompts, and how do they appear to affect children's learning?

Based on the qualitative analysis of the 200 verbal interaction scenarios of the discussion prompts, we identified four main themes which yielded 12 types of parent-child responses. For a table listing examples of all the themes, please see Table 5.

First, we found that the discussion prompts provide unique opportunities for the children to receive more comprehensible input (Krashen, 1981), which is key to second language acquisition. By translating the English story into Chinese and reviewing the story and vocabulary, parents, facilitated by the e-book app, ensured that their children receive natural communicative input that is appropriate for the current stage of their linguistic competence while still being able to enjoy the story. This theme is reflected by the following types of responses: (1) Translation (75%) with the L1 support, parents were able to translate the discussion questions, English vocabulary, new phrases, and story plot into Chinese, which facilitated children's story comprehension. (2) Vocabulary review (13.5%) The discussion questions enabled parents to detect unfamiliar English vocabulary and review the key English vocabulary words with the child. (3) Story plot review (6%) Parents review or retell the story when the child forgot or misunderstood the previous story plot.

Example 1: a mother translating the English discussion prompt into Chinese for their child.

Narrator: Can you name a few other animals who use camouflage to protect themselves?

Mother: 你还记不记得用自己颜色保护自己的动物? (Do you remember any animal that uses their own color to protect themselves?)

Example 2: A mother reviewing the story plot with the child.

Mother: 小枯叶蝶在水里看起来像什么? (What does Little Oak look like in the water?)

Narrator: "good job, Little Oak realizes that he looks like a dry leaf and gets very disappointed".

Mother: 小枯叶蝶意识到自己是一片, 长得像枯叶的时候非常的开心还是难过?

(Little Oak realizes that he looks like a dry leaf, was he happy or sad looking like a dry leaf?)

Child: 开心. (Happy.)

Mother: 开心, 开心? (Happy, happy?)

Second, we found that with the discussion prompts, followed by the customized feedback on discussion pages, parents naturally practice dialogic reading strategies to facilitate and scaffold their children's learning (Towson et al., 2017). Just as social constructivism emphasizes, learning happens in the Zone of Proximal Development and can be fostered through interactive and dialogical pedagogical practices (Vygotsky, 1978). This kind of scaffolding is achieved by the following types of responses: (1) Follow-up questions (57.5%) asked by the parent to encourage the child to elaborate or provide more responses to the original prompt; (2) Scaffold/correction (26.5%), when the parent scaffolds the child towards the right answer for the discussion questions or corrects any of their story-related misunderstandings; (3) Elaboration (13.5%), when parents expanded the discussion of the

story plot or vocabulary by explaining, describing, and connecting; (4) Distancing discussion (10%) in which the parent or child makes a personal connection with the story content.

Example 1: when the e-book provides a discussion prompt for the child to answer, the mother translates the question without the child seeking assistance and asks a follow-up question that the child is capable of answering.

Mother: 你之前见过蛇吗? (Have you seen a snake before?)

Child: 我没见过没见过. (I have never seen it before.)

Mother: 在动物园也没见过吗? (Haven't seen it in the zoo?)

Child: 对, 没见过一条蛇也没见过. (Yes, never seen a snake before.)

Mother: 哦, 你喜欢他们吗? (Do you like them?)

Child: 不喜欢不喜欢. (No, Don't like them.)

Mother: 为什么? (Why?)

Child: 他们会咬人. (Because they bite.)

Example 2: When the child provides a wrong answer to a discussion question, the mother scaffolded the child.

Mother: "What does Little Oak look like in the water"?

Mother: 他看起来, 在水里看起来像什么呀? (What does it look like in the water?)

Child: 像朵花. (Like a flower)

Mother: 啊, 像朵花? (like a flower?)

Mother: 你要看翅膀. (You need to look at the wings.)

Mother: 就是他刚刚在前面我们那一页, 他在那个水里边看到自己的倒影对吧? (On the page before, Little Oak saw its own reflection in the water, right?)

Mother: 然后他觉得自己像什么? (And what did he think he looked like?)

Child: 枯叶蝶. (Oakleaf butterfly.)

Mother: 啊枯叶蝶, 他看起来像什么? (Oakleaf butterfly, but what does he look like?)

Child: 枯叶. (A dry leaf.)

Mother: 枯叶, 对了. (A dry leaf, yes.)

Third, we found that with the facilitation of the discussion prompts, parents create a positive learning climate that encourages children to become active storytellers instead of passive listeners. By responding positively to children's participation (20.5%), such as a thumbs-up or verbal praise when they respond during the discussion, parents lowered the Affective Filter, particularly boosting children's self-confidence and reducing anxiety (Krashen, 1981). Meanwhile, encouraging the child to repeat and talk in English (18%) increases the quantity and quality of the language output, which is crucial to second language acquisition (Swain, 2005). An example of a mother encouraging their child to answer the discussion prompt using an English phrase:

Mother: 用英语说谢谢你怎么说? (How do you say "thank you" in English?)

Child: "Thank you".

Narrator: "If I were one of the butterflies, I would say to Little Oak thank you very much for coming here and saving us".

Mother: "Thank you very much for coming".

Child: "Thank you thank you thank you".

Besides the above-mentioned parent-child responses that benefit learning, we also found that in a small number of scenarios, no parent-child verbal interactions were stimulated by the discussion prompts. Given the significance of social and dialogical interactions in bilingual literacy practices, we cannot conclude that learning is facilitated in these circumstances. These included (1) no child response (9.5%), in which the child did not respond despite the parent's attempt to engage verbally with their child; (2) distraction (2.5%) reflected instances when the child was disengaged, such as clicking the cursor randomly or making off-topic comments; and (3) skipped questions (7.5%) reflected instances when the discussion questions were cut-off due to technical problems or the reader's clicks/misclicks to skip the problem.

Example: When the mother tries to engage the child in a discussion, the child did not respond to the questions.

Mother: "Why are the butterflies so popular"?

Mother: 为什么他们这么受欢迎呢? (Why are they so popular?)

child point to the e-book

Mother: Because...

Mother: 你不用点你就说就可以了. (You don't have to click, just say it.)

Narrator: because they are very colorful and beautiful.

Mother: "because they are very colorful and beautiful".

Mother: 他们非常的五彩斑斓非常美丽. (Because they are colorful and beautiful.)

Mother: "Because they are colorful and beautiful".

Table 5. Parent-child interactions on discussion pages.

Theme	Type	Frequency	Description	Example
Maximize Comprehensible Input	Translation	150	Translates English story content into Chinese	Narrator: Can you name a few other animals who use camouflage to protect themselves? Mother: 你还记不记得用自己颜色保护自己的动物? (Do you remember any animal that uses their own color to protect themselves?)
	Vocabulary review	27	Reviews vocabulary words from the story	Mother: "He looks like a flower", flower 是什么知道吗? (Do you know what "flower" means?) Child: Flower 就是一个彩虹. ("Flower" means a rainbow.) Mother: 不是, 是一朵花. (No, it is a flower.) Child: 是花. (It is a flower)
	Story plot review	12	Goes over the story plot by story retelling or question asking	Mother: 小枯叶蝶在水里看起来像什么? (What does Little Oak look like in the water?)

				<p>Narrator: "good job, Little Oak realizes that he looks like a dry leaf and gets very disappointed".</p> <p>Mother: 小枯叶蝶意识到自己是一片,长得像枯叶的时候非常的开心还是难过? (Little Oak realizes that he looks like a dry leaf, was he happy or sad looking like a dry leaf?)</p> <p>Child: 开心. (Happy.)</p> <p>Mother: 开心, 开心? (Happy, happy?)</p> <p>Child: 不. (No.)</p> <p>Mother: 刚刚它在水里面看到自己的样子的的时候是怎么样的? (When he saw himself in the water just now, how did he feel?)</p> <p>Child: 它, 非常难过. (He was sad.)</p>
	Follow-up questions	115	Uses follow-up questions to encourage child response	<p>Narrator: What did mama say to Little Oak?</p> <p>Mother: 枯叶蝶对妈妈, 枯叶蝶妈妈对小枯叶蝶说了什么? (What did mama say to Little Oak?)</p>

				<p>Child: 我们的翅膀后来会变成最好的礼物. (Our wings will become the best gift.)</p> <p>Mother: 是谁给他的礼物? (From whom?)</p> <p>Child: 大自然 (From the nature.)</p>
<p>Practice Dialogic Reading Strategies</p>	<p>Scaffold/ correction</p>	<p>53</p>	<p>Facilitates the child towards the right answer for the discussion question or correct a misunderstanding</p>	<p>Mother: "What does Little Oak look like in the water"?</p> <p>Mother: 他看起来, 在水里看起来像什么呀? (What does it look like in the water?)</p> <p>Child: 像朵花. (Like a flower)</p> <p>Mother: 啊, 像朵花? (like a flower?)</p> <p>Mother: 你要看翅膀. (You need to look at the wings.)</p> <p>Mother: 就是他刚刚在前面我们那一页, 他在那个水里边看到自己的倒影对吧? (On the page before, Little Oak saw its own reflection in the water, right?)</p> <p>Mother: 然后他觉得自己像什么? (And what did he think he looked like?)</p>

				<p>Child: 枯叶蝶. (Oakleaf butterfly.)</p> <p>Mother: 啊枯叶蝶, 他看起来像什么? (Oakleaf butterfly, but what does he look like?)</p> <p>Child: 枯叶. (A dry leaf.)</p> <p>Mother: 枯叶, 对了. (A dry leaf, yes.)</p>
	Elaboration	27	The parent or child expands on a story plot or vocabulary	<p>Mother: 你找一下这图里你找出来其他动物吗? (Can you find any other animals in this picture?)</p> <p>Mother: 这个是一个什么呀? (What is this one?)</p> <p>Child: Squirrel.</p> <p>Mother: Squirrel 啊, 这个是 owl, 猫头鹰你看哪里是 squirrel 啊. (Squirrel? This is an owl; how did you see a squirrel?)</p> <p>Mother: 你看他是不是融为一体了这根树, 他作成树的那个样子让敌人以为他是树, 他是不是就是 “camouflage to protect” himself. (See how it was disguised as the tree, the way he</p>

				became the tree made its enemies think he was a tree, he just used camouflage to protect himself.)
	Distancing discussion	20	The parent or child makes a personal connection with the story content	<p>Mother: 你之前见过蛇吗? (Have you seen a snake before?)</p> <p>Mother: 你喜欢他们吗, 为什么? (Do you like them? Why?)</p> <p>Mother: 昨天提问的不一样啊, 你见过蛇吗? (This question is different from yesterday, have you seen a snake before?)</p> <p>Child: 我没见过没见过. (I have never seen it before.)</p> <p>Mother: 在动物园也没见过吗? (Haven't seen it in the zoo?)</p> <p>Child: 对, 没见过 一条蛇也没见过. (Yes, never seen a snake before.)</p> <p>Mother: 哦, 你喜欢他们吗? (Do you like them?)</p> <p>Child: 不喜欢不喜欢. (No, Don't like them.)</p>

				<p>Mother: 为什么? (Why?)</p> <p>Child: 他们会咬人. (Because they bite.)</p> <p>Mother: 非常什么? (What?)</p> <p>Child: 会咬人. (They bite.)</p> <p>Mother: 会咬人 (They bite.)</p> <p>Child: 比如说毒蜥蜴或什么的. (Like a poisonous lizard or something.)</p> <p>Mother: 嗯. (Ok.)</p> <p>Child: 毒蜥蜴会咬人. (Poisonous lizards can bite.)</p>
Promote Positive and Collaborative Learning	Positive reaction	41	Praises the child for their responses or positive behaviors	<p>Mother: 为什么蝴蝶那么受欢迎呢? (Why are the butterflies so popular?)</p> <p>Child: 因为他们漂亮. (Because they are beautiful.)</p> <p>Mother: Colorful, right?</p> <p>Mother: 又漂亮 beautiful. (And beautiful.)</p> <p>Mother: 对, you are right! (Yes, you are right!)</p>

	English talk	36	Encourages the child to repeat English phrases, answer questions or talk in English	<p>Mother: 用英语说谢谢你怎么说? (How do you say "thank you" in English?)</p> <p>Child: "Thank you".</p> <p>Narrator: "If I were one of the butterflies, I would say to little oak thank you very much for coming here and saving us".</p> <p>Mother: "Thank you very much for coming".</p> <p>Child: "Thank you thank you thank you".</p>
No parent-child verbal interactions	No child response	19	The parent tries to have verbal interaction with the child but receives no verbal response	<p>Mother: "Why are the butterflies so popular"?</p> <p>Mother: 为什么他们这么受欢迎呢? (Why are they so popular?)</p> <p><i>*child point to the e-book*</i></p> <p>Mother: Because...</p> <p>Mother: 你不用点你就说就可以了. (You don't have to click, just say it.)</p> <p>Narrator: because they are very colorful and beautiful.</p>

				<p>Mother: "because they are very colorful and beautiful".</p> <p>Mother: 他们非常的五彩斑斓非常美丽. (Because they are colorful and beautiful.)</p> <p>Mother: "Because they are colorful and beautiful".</p>
	Distraction	5	<p>The child is not paying attention (clicks randomly, makes off-topic comments, does not participate/ answer)</p>	<p>Mother: "Why does the blackbird".</p> <p>Mother: No.</p> <p>Child: 这个. (This.)</p> <p>Mother: 啧. (Tsk.)</p> <p>Child: 这个. (This.)</p> <p>Mother:你能不能听我解释完啊. (Can't you listen to me explain.)</p> <p>Child: 这个是不是? (Is it this one?)</p> <p>Mother: 嗯. (Hm.)</p> <p>Child: 是不是啊? (Is it?)</p> <p>Child: 嗯? (Hm?)</p>

	Skip discussion pages	15	The question gets cut-off due to technical problems or the readers clicks/misclicks to skip the problem	Mother: Do you have the "tears of joy"? <i>*The participants did not answer this question due to technical problem*</i>
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RQ4: What are parents' and children's self-reported experiences and perceptions of the embedded discussion prompts in the bilingual e-book?

We examined the self-reported experiences and perceptions of the e-book, and the discussion prompts feature. The interview data revealed that for the whole sample, 93% of the children and 92% of parents enjoyed reading the e-book story and whether the e-book has discussion prompts did not impact how users liked the e-book. The discussion prompt feature was well received, as 82% of the children and 98% of the parents liked it. Several children reported the discussion prompt was their favorite feature: "I love it the most. It helps my brain run really fast!"; "I love this the most because I feel so excited when I get the questions right." Another frequently mentioned reason for liking the discussion prompt was the appearance of our questioning avatar as the main character, Little Oak: "I love it when the little oak raises a question because I could learn more about him"; "I like the questions because the little oak is there." However, a few children showed less interest in or disliked this feature because the questions interrupted the reading flow or were too hard to answer. As one child commented, "I always had to pause the story reading for those questions."

The discussion prompts were parents' favorite feature among all the design features because they felt that the questions enabled their children to understand the story better and engage with the e-book. Typical comments were "It triggers him to think logically," and "The feedback is like a reward that makes her happy."

5.4. Discussion

Previous research showed that as a commonly used family literacy practice in monolingual contexts, parent-child shared reading may be less effective in English as second or foreign language contexts (Chow et al., 2010). Indeed, reading an English story to a child could be very challenging for non-English speaking parents, especially those who are less educated and from low socioeconomic backgrounds. Multimedia features in digital storybook apps may provide new opportunities to this conundrum by facilitating parent engagement in the second language reading process. This study examined one e-book design feature: discussion prompts with bilingual support and their impact on children's learning in EFL settings.

The results from our randomized controlled trial showed that the discussion prompts with bilingual support in the e-book promoted greater story comprehension and retelling among EFL children. These results not only complement the findings from Troseth et al. (Troseth et al., 2020b)—interactive e-book with a questioning avatar successfully enriched parent-child talk for low socioeconomic families—but also provide a critical piece of evidence that well-designed discussion prompts can effectively promote literacy outcomes even when parents have limited English proficiency. The comprehensive analysis of the user activities on e-book discussion pages, parent-child interactions, and user experiences reveals the following ways that bilingual discussion prompts may facilitate children's learning.

First, discussion prompts allow parents to effectively practice C-R-O-W-D and P-E-E-R dialogic reading strategies with their children. Qualitative analysis indicated that bilingual discussion prompts, coupled with the immediate feedback, helped parents use

dialogic reading strategies, such as elaborating story content, reviewing vocabulary, and connecting the story with previous experiences (Arnold & Whitehurst, 1994; Hargrave & Sénéchal, 2000; Troseth et al., 2020b), without explicit training in these strategies. These dialogic reading scenarios provided unique scaffolding opportunities through the Zone of Proximal Development that is crucial to children's learning (Vygotsky, 1978). Moreover, parents who responded to their children with encouragement and praise may have enhanced the reading experience to be more engaging and enjoyable and boosted children's learning motivation.

Second, discussion prompts allow parents to provide comprehensible input (Krashen, 1981) to the children via translation and vocabulary review. When exploring parent-child verbal interactions on discussion pages, we noticed that parents engage in translanguaging practices. Parents repeated the discussion questions in English and translated, elaborated, and scaffolded them in Chinese because they assumed their children needed extra assistance to overcome the language barrier. This bilingual scaffolding may have provided additional learning opportunities and bolstered children's comprehension and memorization. Given that this observation was from the qualitative analysis of the verbal transcript, further investigation of parent-child verbal interactions and how these interactions are associated with children's learning outcomes is required.

Third, the individualized feedback followed by the discussion questions provided extra learning opportunities for the children. Correlation analysis revealed that, generally, the more multiple-choice questions parents and children attempted to answer, the better children comprehended the story. Indeed, by making selections on the multiple-choice questions, children received customized audio feedback from the e-book to either further

elaborate the story or correct misunderstandings. The findings from the current study added one more piece of evidence to support the benefits of individualized interactions during digital storybook reading to children's learning (Xu et al., 2021; Yang et al., 2021).

Fourth, the questioning avatar of the discussion prompts promoted children's parasocial relationships with the story character and boosted motivation. Studies show that children learn more effectively from media characters with whom they develop strong parasocial relationships (Brunick et al., 2016; Calvert et al., 2014). The most popular e-book element, according to the study participants, was the questioning avatar, Little Oak—the story's main character. One child stated that he enjoyed the discussion session because it enabled him to know more about Little Oak. The discussion prompts with immediate feedback provided a unique space for the children to learn more about the character and develop a closer relationship by connecting their real-life experiences through joint interactions. This real-world relevance may foster children's sense of social realism, hence establishing an emotional bond with the media character (Bond & Calvert, 2014; Troseth et al., 2006). These findings provided critical implications for storybook app designers and researchers that some interactive features, such as discussion prompts with feedback, are effective and should be incorporated into the story-based learning system to develop parasocial relationships between children and the story characters and promote engagement. Another direction for future research is to empower the avatar with a bilingual conversational agent, providing more learning opportunities for children.

As for the vocabulary learning outcomes, we noticed that discussion prompts provided additional learning opportunities for children to review English vocabulary with their parents. Like Troseth et al. (Troseth et al., 2020), no significant effect of discussion

prompts on learning English vocabulary was found. However, the non-significant finding of the discussion prompts in enhancing English word learning may reflect the nature of the prompts we used, which focused on overall story comprehension rather than story-related vocabulary. Therefore, future research should examine if discussion prompts focusing on story vocabulary promote children's second language vocabulary development.

We observed that the readers did not utilize the discussion prompts adequately on a few discussion pages. For example, instead of encouraging the child to answer the questions posed by Little Oak, several parents answered the questions for their children, or they skipped the discussion pages and continued with the story. These behaviors could be attributed to a variety of factors, e.g., not being unaware of the potential benefits discussion prompts may provide for the children, or as indicated by the interview, children finding the questions too challenging to answer or thinking that the questions interrupted their reading flow. Future studies might explore how to improve and customize this design feature to meet the needs of different user populations.

Conclusions

6.1. Limitations and future directions

Some limitations need to be considered when interpreting the findings. First, the evaluation study was not a randomized controlled trial, which means that other factors may have contributed to the vocabulary gain from post- to pre-tests such as English exposure to target words outside of the experiment. However, given that the participants were living in China and the experiment was finished within a short period of time, the exposure to the target words in English should be minimal. Second, due to COVID-19, the contextual inquiry and design was conducted virtually with 6 participants, although the data collected through virtual interviews, observations and Zoom meetings were sufficient to inform design. Future research can consider a more comprehensive review and evaluation of the commercial storybook apps on the market to provide evidence for the teacher and parents in selecting bilingual storybook apps and to inform designers and educators in future bilingual e-book design. Another future direction is to explore empowering the avatar with bilingual conversational agents and the applicability of the character statement feature in other technologies such as augmented reality.

Several limitations need to be considered when interpreting the findings. First, the findings on parent-child responses were based on qualitative analysis; thus, we cannot draw causal inferences about the extent to which the discussion prompts impact parent-child interaction and the use of dialogic reading strategies. Second, though user-experience interviews were conducted right after the reading sessions, cases of inefficient use of discussion prompts were not identified until later, after we had the opportunity to

transcribe the parent-child interactions. For that reason, we may have missed some details in these interviews. Future user experience studies should examine the reasons behind such user behaviors to improve the e-book discussion prompt feature.

6.2. Conclusions

The benefits of parent-child shared reading on children's language and literacy development in L1 have been well established by a large body of literature. However, it has not drawn much attention from researchers on how to support shared reading practices in English as a second/foreign language settings. In this information technology era, hundreds of English storybook apps are available on the market, yet the educational value for most of them are unvalidated and more importantly, most of them are not designed to support the kind of parent-child interactions, that are believed to be key to children's learning. In fact, many families with young English learners in EFL/ESL settings lack developmentally appropriate and engaging English storybook apps during parent-child shared reading activities. To fill these gaps in the literature, the current dissertation is aimed to design and evaluate a multimedia interactive storybook app specifically for this learner population.

During the contextual inquiry and the participatory design process, the research team and I found that although many commercial English storybook apps are accessible in the digital market for second language acquisition purpose, the design and quality of those apps have yet to meet the social and learning needs of parent-child shared reading in this context. Through participatory design, we identified and adapted five e-book features which may better support children's contextualized learning and meaning making of the unfamiliar vocabulary and the story content while promoting parent-child joint media

engagement. These design features are: English story narration, customized multimedia dictionary hotspots, character statement hotspots, discussion prompts with feedback, and the translation in L1. We further interviewed parent and child users to gain deeper insights into children's learning experiences as well as users' perceptions about the five e-book features, which provided critical implications to app designers for future e-book design for this learner population.

Our evaluation study showed that children significantly improved their story-related English vocabulary after two reading sessions using the designed storybook. We also found that children's baseline English skills has a quadratic relation with vocabulary learning outcomes, while age, gender, and parents' English level do not play a role in the technology mediated learning process. Five e-book design features, such as customized multimedia dictionaries and discussion prompts with feedback, we found to enable parents with limited English proficiency to provide scaffolding and better engage with children's learning. We further found that the interactive features maximized English language exposure and comprehensibility of the story, while creating opportunities for children to develop parasocial relationships with the story characters. These findings not only established exciting potential for technology enhanced e-books as an effective educational tool to promote bilingual home literacy practice for linguistically diverse families, but also provided key implications for designers to inform future e-book app design.

In the fifth chapter, we examined the role of e-book discussion prompts with bilingual support in parent-child shared reading in an English as a foreign language setting. The randomized controlled trial showed that embedding bilingual discussion prompts in the storybook app significantly promoted children's story comprehension and retelling.

Our qualitative analysis revealed that the discussion prompts with customized feedback allow parents to practice C-R-O-W-D and P-E-E-R dialogic reading strategies and provide scaffolding to their children naturally and effectively without explicit training. With parents translating and elaborating the story, children received more comprehensible input, thus enhancing their comprehension.

Moreover, the findings from the qualitative analysis show that the questioning avatar further established children's parasocial relationship with the story character and boosted their motivation. These findings provided critical implications for storybook app designers and researchers that some interactive features, such as discussion prompts with feedback, are effective and should be incorporated into the story-based learning system to develop parasocial relationships between children and the story characters and promote engagement.

Training parents and education practitioners on effective bilingual literacy practices may be costly and time-consuming. This dissertation shed light on the exciting potential of well-designed English storybook apps powered by interactive discussion prompts as an effective learning aid in English language acquisition and bilingual education. This simple and low-cost instructional technology has the potential to minimize the achievement gap and educational inequity, particularly for children from low-income households in English as a second or foreign language settings.

References

- Abdelhadi, S. M. (2020). Responses to hotspots during parent–child shared reading of eBook. *International Journal of Child-Computer Interaction*, 23–24.
<https://doi.org/10.1016/j.ijcci.2019.100164>
- al Zoubi, S. (2018). *The Impact of Exposure to English Language on Language Acquisition*. www.jallr.com
- Anna D. Johnson, Anne Martin, Jeanne Brooks-Gunn, & Stephen A. Petrill. (2008). Order in the House! Associations among Household Chaos, the Home Literacy Environment, Maternal Reading Ability, and Children’s Early Reading. *Merrill-Palmer Quarterly*, 54(4), 445–472. <https://doi.org/10.1353/mpq.0.0009>
- Arnold, D. S., & Whitehurst, G. J. (1994). Accelerating language development through picture book reading: A summary of dialogic reading and its effect. In *Bridges to literacy: Children, families, and schools*. (pp. 103–128). Blackwell Publishing.
- Beck, I., McKeown, M. G., & Kucan, L. (2013). *Bringing words to life: Robust vocabulary instruction*. Guilford Press.
- Bernath, M. S., & Feshbach, N. D. (1995). Children’s trust: Theory, assessment, development, and research directions. *Applied and Preventive Psychology*, 4(1), 1–19. [https://doi.org/10.1016/S0962-1849\(05\)80048-4](https://doi.org/10.1016/S0962-1849(05)80048-4)
- Betts, E. A. (1946). Foundations of reading instruction, with emphasis on differentiated guidance. In *Foundations of reading instruction, with emphasis on differentiated guidance*. American Book Co.
- Beyer, H., & Holtzblatt, K. (1999). Contextual design. *Interactions*, 6(1), 32–42.

- Bialystok, E., Craik, F. I. M., & Luk, G. (2012). Bilingualism: consequences for mind and brain. *Trends in Cognitive Sciences*, *16*(4), 240–250.
<https://doi.org/10.1016/J.TICS.2012.03.001>
- Bion, R. A. H., Borovsky, A., & Fernald, A. (2013). Fast mapping, slow learning: Disambiguation of novel word–object mappings in relation to vocabulary learning at 18, 24, and 30 months. *Cognition*, *126*(1), 39–53.
<https://doi.org/10.1016/J.COGNITION.2012.08.008>
- Blewitt, P., Rump, K. M., Shealy, S. E., & Cook, S. A. (2009). Shared Book Reading: When and How Questions Affect Young Children’s Word Learning. *Journal of Educational Psychology*, *101*(2), 294–304. <https://doi.org/10.1037/a0013844>
- Boers, F., Warren, P., Grimshaw, G., & Siyanova-Chanturia, A. (2017). On the benefits of multimodal annotations for vocabulary uptake from reading. *Computer Assisted Language Learning*, *30*(7), 709–725.
<https://doi.org/10.1080/09588221.2017.1356335>
- Bolton, K., & Graddol, D. (2012). English in China today: The current popularity of English in China is unprecedented, and has been fuelled by the recent political and social development of Chinese society. *English Today*, *28*(3), 3–9.
<https://doi.org/10.1017/S0266078412000223>
- Bond, B. J., & Calvert, S. L. (2014). A model and measure of us parents’ perceptions of young children’s parasocial relationships. *Journal of Children and Media*, *8*(3), 286–304. <https://doi.org/10.1080/17482798.2014.890948>
- Brunick, K. L., Putnam, M. M., McGarry, L. E., Richards, M. N., & Calvert, S. L. (2016). Children’s future parasocial relationships with media characters: The age of

- intelligent characters. *Journal of Children and Media*, 10(2), 181–190.
<https://doi.org/10.1080/17482798.2015.1127839>
- Burgess, S. R., Hecht, S. A., & Lonigan, C. J. (2002). Relations of the home literacy environment (HLE) to the development of reading-related abilities: A one-year longitudinal study. *Reading Research Quarterly*, 37(4), 408–426.
<https://doi.org/10.1598/rrq.37.4.4>
- Butler, Y. G. (2015). Parental factors in children’s motivation for learning English: a case in China. *Research Papers in Education*, 30(2), 164–191.
<https://doi.org/10.1080/02671522.2014.891643>
- Calvert, S. L. , Richards, M. N. , Jordon, A. , & Romer, D. (2014). Children’s parasocial relationships. In *Media and the well-being of children and adolescents* (pp. 187–200).
- Capotosto, L., & Kim, J. S. (2016). Literacy discussions in low-income families: The effect of parent questions on fourth graders’ retellings. *First Language*, 36(1), 50–70. <https://doi.org/10.1177/0142723715626071>
- Chang, J. (2006). Globalization and English in Chinese higher education. *World Englishes*, 25(4), 513–525.
- Chaudron, C. (1985). Comprehension, comprehensibility, and learning in the second language classroom. *Studies in Second Language Acquisition*, 7(2), 216–232.
<https://doi.org/10.1017/S0272263100005386>
- Chen, Q., Rosner, F., Rao, A., Samuelsen, S., Bonnema, M., Jayaraman, A., & Alptekin, G. (2020). Simulation of elevated temperature combined water gas shift and solid

- sorbent CO₂ capture for pre-combustion applications using computational fluid dynamics. *Applied Energy*, 267. <https://doi.org/10.1016/j.apenergy.2020.114878>
- Chen, Q., Rosner, F., Rao, A., Samuelsen, S., Jayaraman, A., & Alptekin, G. (2019). Simulation of elevated temperature solid sorbent CO₂ capture for pre-combustion applications using computational fluid dynamics. *Applied Energy*, 237, 314–325. <https://doi.org/10.1016/j.apenergy.2019.01.042>
- Chera, P., & Wood, C. (2003). Animated multimedia 'talking books' can promote phonological awareness in children beginning to read. *Learning and Instruction*, 13(1), 33–52. [https://doi.org/10.1016/S0959-4752\(01\)00035-4](https://doi.org/10.1016/S0959-4752(01)00035-4)
- Cheung, H., & Ng, L. K. (2003). Chinese reading development in some major Chinese societies: An introduction. *Reading Development in Chinese Children*, 3(17).
- Chow, B. W. Y., McBride-Chang, C., & Cheung, H. (2010). Parent-child reading in English as a second language: Effects on language and literacy development of Chinese kindergarteners. *Journal of Research in Reading*, 33(3), 284–301. <https://doi.org/10.1111/j.1467-9817.2009.01414.x>
- Chow, B. W. Y., McBride-Chang, C., Cheung, H., & Chow, C. S. L. (2008). Dialogic Reading and Morphology Training in Chinese Children: Effects on Language and Literacy. *Developmental Psychology*, 44(1), 233–244. <https://doi.org/10.1037/0012-1649.44.1.233>
- Cochran, P. S., & Bull, G. L. (1991). Integrating word processing into language intervention. *Topics in Language Disorders*, 11(2), 31–49. <https://doi.org/10.1097/00011363-199111020-00005>

- Collins, P., & Ho, T. T. (2020). Bilingualism and Biliteracy. In *Oxford Research Encyclopedia of Education*.
- Colombo, L., & Landoni, M. (2013). Low-tech and high-tech prototyping for eBook co-design with children. In *Proceedings of the 12th International Conference on Interaction Design and Children*, 289–292.
- Connor, C. M., Kim, Y. S. G., & Yang, D. (2020). Personalizing literacy instruction for diverse learners and children with severe literacy difficulties. In *Dyslexia: Revisiting etiology, diagnosis, treatment, and policy*.
- Coyne, M. D., Simmons, D. C., Kame'enui, E. J., & Stoolmiller, M. (2004). Teaching Vocabulary During Shared Storybook Readings: An Examination of Differential Effects. *Exceptionality*, 12(3), 145–162.
https://doi.org/10.1207/s15327035ex1203_3
- Crain-Thoreson, C., & Dale, P. S. (1992). Do Early Talkers Become Early Readers? Linguistic Precocity, Preschool Language, and Emergent Literacy. *Developmental Psychology*, 28(3), 421–429. <https://doi.org/10.1037/0012-1649.28.3.421>
- Cummins, J. (1991). Interdependence of first-and second-language proficiency in bilingual children. *Language Processing in Bilingual Children*, 70–89.
- Davis-Kean, P. E. (2005). The influence of parent education and family income on child achievement: The indirect role of parental expectations and the home environment. *Journal of Family Psychology*, 19(2), 294–304.
<https://doi.org/10.1037/0893-3200.19.2.294>
- de Jong, M. T., & Bus, A. G. (2003). *How well suited are electronic books to supporting literacy?*

- Dore, R. A., Hassinger-Das, B., Brezack, N., Valladares, T. L., Paller, A., Vu, L., Golinkoff, R. M., & Hirsh-Pasek, K. (2018). The parent advantage in fostering children's e-book comprehension. *Early Childhood Research Quarterly, 44*, 24–33.
<https://doi.org/10.1016/J.ECRESQ.2018.02.002>
- Doyle, B. G., & Bramwell, W. (2006). Promoting Emergent Literacy and Social-Emotional Learning Through Dialogic Reading. *The Reading Teacher, 59*(6), 554–564. <https://doi.org/10.1598/rt.59.6.5>
- Druin, A. (1999). *Cooperative Inquiry: Developing New Technologies for Children with Children*.
- Fitton, L., McIlraith, A. L., & Wood, C. L. (2018). Shared Book Reading Interventions With English Learners: A Meta-Analysis. *Review of Educational Research, 88*(5), 712–751. <https://doi.org/10.3102/0034654318790909>
- Flack, Z. M., Field, A. P., & Horst, J. S. (2018). The effects of shared storybook reading on word learning: A meta-analysis. *Developmental Psychology, 54*(7), 1334–1346.
- Flesch, R. (2007). Flesch-Kincaid readability test. *Retrieved October, 26*(3).
- Furenes, M. I., Kucirkova, N., & Bus, A. G. (2021). A Comparison of Children's Reading on Paper Versus Screen: A Meta-Analysis. *Review of Educational Research, 91*(4), 483–517. <https://doi.org/10.3102/0034654321998074>
- Gatlin-Nash, B., Hwang, J. K., Tani, N. E., Zargar, E., Wood, T. S., Yang, D., & Connor, M. C. (2021). Using assessment to improve the accuracy of teachers' perceptions of students' academic competence. *The Elementary School Journal, 121*(4), 609–634.

- Griffin, E. A., & Morrison, F. J. (1997). The unique contribution of home literacy environment to differences in early literacy skills. *Early Child Development and Care*, 127(1), 233–243. <https://doi.org/10.1080/0300443971270119>
- Guernsey, L., Levine, M., Chiong, C., & Severns, M. (2012). Pioneering literacy in the digital wild west: Empowering parents and educators. *New York: New America Foundation \& Joan Ganz Cooney Center*.
- Guha, M. L., Druin, A., & Fails, J. A. (2013). Cooperative Inquiry revisited: Reflections of the past and guidelines for the future of intergenerational co-design. *International Journal of Child-Computer Interaction*, 1(1), 14–23. <https://doi.org/10.1016/J.IJCCI.2012.08.003>
- Guo, Y. (2012). Teaching English for Economic Competiveness: Emerging Issues and Challenges in English Education in China. *Comparative and International Education*, 41(2).
- Halladay, J. L. (2012). Revisiting key assumptions of the reading level framework. *Reading Teacher*, 66(1), 53–62. <https://doi.org/10.1002/TRTR.01093>
- Hargrave, A. C., & Sénéchal, M. (2000). A book reading intervention with preschool children who have limited vocabularies: the benefits of regular reading and dialogic reading. *Early Childhood Research Quarterly*, 15(1), 75–90. [https://doi.org/10.1016/S0885-2006\(99\)00038-1](https://doi.org/10.1016/S0885-2006(99)00038-1)
- Heider, K. L., & Jalongo, M. R. (2014). *Young Children and Families in the Information Age: Applications of Technology in Early Childhood*. Springer Netherlands. <https://books.google.com/books?id=78-5BQAAQBAJ>

- Hu, G. (2005). English language education in China: Policies, progress, and problems. *Language Policy*, 4(1), 5–24.
- Ito, M. (2012). *Engineering Play: A Cultural History of Children's Software*. MIT Press.
https://books.google.com/books?id=iVRN2dzy_zUC
- Jin, L., Jiang, C., Zhang, J., Yuan, Y., Liang, X., & Xie, Q. (2014). *Motivations and expectations of English language learning among primary school children and parents in China*. www.britishcouncil.org
- Karemaker, A., Jelley, F., Clancy, C., & Sylva, K. (2017). The effects on children's literacy skills of reading e-books with different features: Are 'bells and whistles' over-rated? *International Journal of Child-Computer Interaction*, 12, 30–36.
<https://doi.org/10.1016/J.IJCCI.2017.01.004>
- Kent, S., Wanzek, J., Petscher, Y., al Otaiba, S., & Kim, Y. S. (2014). Writing fluency and quality in kindergarten and first grade: The role of attention, reading, transcription, and oral language. *Reading and Writing*, 27(7), 1163–1188.
<https://doi.org/10.1007/s11145-013-9480-1>
- Kiger, D. M. (1989). Effects of music information load on a reading comprehension task. *O Perceptual and Motor Skills*, 69(2), 531–534.
- Kim, Y. S. G., Yang, D., Reyes, M., & Connor, C. (2021). Writing instruction improves students' writing skills differentially depending on focal instruction and children: A meta-analysis for primary grade students. In *Educational Research Review* (Vol. 34). Elsevier Ltd. <https://doi.org/10.1016/j.edurev.2021.100408>
- Kiuru, N., Lerkkanen, M. K., Niemi, P., Poskiparta, E., Ahonen, T., Poikkeus, A. M., & Nurmi, J. E. (2013). The role of reading disability risk and environmental

- protective factors in students' reading fluency in grade 4. *Reading Research Quarterly*, 48(4), 349–368. <https://doi.org/10.1002/rrq.53>
- Korat, O. (2009). The effects of CD-ROM storybook reading on Israeli children's early literacy as a function of age group and repeated reading. *Education and Information Technologies*, 14(1), 39–53. <https://doi.org/10.1007/s10639-008-9063-y>
- Korat, O., & Shamir, A. (2004). Do Hebrew electronic books differ from Dutch electronic books? A replication of a Dutch content analysis. *Journal of Computer Assisted Learning*, 20(4), 257–268.
- Korat, O., & Shamir, A. (2007). Electronic books versus adult readers: Effects on children's emergent literacy as a function of social class. *Journal of Computer Assisted Learning*, 23(3), 248–259. <https://doi.org/10.1111/j.1365-2729.2006.00213.x>
- Korat, O., & Shamir, A. (2008). The educational electronic book as a tool for supporting children's emergent literacy in low versus middle SES groups. *Computers & Education*, 50(1), 110–124. <https://doi.org/10.1016/J.COMPEDU.2006.04.002>
- Krashen, S. D. (1981). Bilingual education and second language acquisition theory. *Schooling and Language Minority Students: A Theoretical Framework*, 51–79.
- Kucirkova, N. (2019). Children's Reading With Digital Books: Past Moving Quickly to the Future. *Child Development Perspectives*, 13(4), 208–214. <https://doi.org/10.1111/cdep.12339>
- Kucirkova, N., & Littleton, K. (2016). *The digital reading habits of children Shared reading Practices in Early Childhood Education and families for Language learning*

and Literature experiences (SPrELL) View project Dynamic, Real-time, On-demand, Personalisation at Scale (DROPS) View project The digital reading habits of children A National survey of parents' perceptions of and practices in relation to children's reading for pleasure with print and digital books.

<https://www.researchgate.net/publication/299563417>

Kuhn, S., & Muller, M. J. (1993). Participatory design. *Communications of the ACM*, 36(6), 24–29.

Leseman, P. P. M., & Jong, P. F. (1998). Home Literacy: Opportunity, Instruction, Cooperation and Social-Emotional Quality Predicting Early Reading Achievement. *Reading Research Quarterly*, 33(3), 294–318. <https://doi.org/10.1598/rrq.33.3.3>

Lever, R., & Sénéchal, M. (2011). Discussing stories: On how a dialogic reading intervention improves kindergartners' oral narrative construction. *Journal of Experimental Child Psychology*, 108(1), 1–24. <https://doi.org/10.1016/J.JECP.2010.07.002>

Lewin, C. (2000). Exploring the effects of talking book software in UK primary classrooms. In *Journal of Research in Reading* (Vol. 23, Issue 2).

Long, M. H. (1980). *Input, interaction, and second language acquisition*. University of California, Los Angeles.

Lonigan, C. J., Anthony, J. L., Bloomfield, B. G., Dyer, S. M., & Samwel, C. S. (1999). Effects of Two Shared-Reading Interventions on Emergent Literacy Skills of At-Risk Preschoolers. In *Journal of Early Intervention* (Vol. 22, Issue 4).

Lonigan, C. J., & Whitehurst, G. J. (1998). Relative efficacy of parent and teacher involvement in a shared-reading intervention for preschool children from low-

- income backgrounds. *Early Childhood Research Quarterly*, 13(2), 263–290.
[https://doi.org/10.1016/S0885-2006\(99\)80038-6](https://doi.org/10.1016/S0885-2006(99)80038-6)
- MacWhinney, B. (2017). *MacWhinney, B. (2017). Tools for analyzing talk part 2: The CLAN program.*
- Martens, M., Rinnert, G. C., & Andersen, C. (2018). Child-centered design: Developing an inclusive letter writing app. *Frontiers in Psychology*, 9(DEC).
<https://doi.org/10.3389/fpsyg.2018.02277>
- Mayer, R. E. (2005). Cognitive theory of multimedia learning. *The Cambridge Handbook of Multimedia Learning*, 3184.
- McBride, C. (2015). *CHILDREN'S LITERACY DEVELOPMENT* (2nd Edition). Routledge.
www.psypress.com/books/series/DEVP,
- Mol, S. E., Bus, A. G., de Jong, M. T., & Smeets, D. J. H. (2008). Added value of dialogic parent-child book readings: A meta-analysis. *Early Education and Development*, 19(1), 7–26. <https://doi.org/10.1080/10409280701838603>
- Moody, A. K. (2010). Using Electronic Books in the Classroom to Enhance Emergent Literacy Skills in Young Children. *Journal of Literacy and Technology*, 22(4).
- Munzer, T. G., Miller, A. L., Weeks, H. M., Kaciroti, N., & Radesky, J. (2019). Differences in parent-toddler interactions with electronic versus print books. *Pediatrics*, 143(4). <https://doi.org/10.1542/peds.2018-2012>
- Ortega, L. (2014). *Understanding second language acquisition*. Routledge.
- Paivio, A. (1986). *Mental representations: A dual coding approach*. Oxford University Press.

- Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology, 45*(3), 255.
- Payne, A. C., Whitehurst, G. J., & Angell, A. L. (1994). The Role of Home Literacy Environment in the Development of Language Ability in Preschool Children from Low-income Families. *Early Childhood Research Quarterly, 9*(3-4), 427-440.
- Pillinger, C., & Wood, C. (2014). Pilot study evaluating the impact of dialogic reading and shared reading at transition to primary school: early literacy skills and parental attitudes. *Literacy, 48*(3), 155-163.
- Rahbar, S., Ahangari, S., & Saeidi, M. (2020). Raising the learners' awareness of prosodic features in pronunciation and its impact on listening comprehension: Insights from noticing hypothesis. *Foreign Language Research Journal, 10*(2), 260-271.
- Rao, S. S. (2003). Electronic books: A review and evaluation. *Library Hi Tech, 21*(1), 85-93. <https://doi.org/10.1108/07378830310467427>
- Reich, S. M., Yau, J. C., & Warschauer, M. (2016). Tablet-Based eBooks for Young Children: What Does the Research Say? *Journal of Developmental & Behavioral Pediatrics, 37*(7), 585-591. www.jdbp.org
- Richter, A., & Courage, M. L. (2017). Comparing electronic and paper storybooks for preschoolers: Attention, engagement, and recall. *Journal of Applied Developmental Psychology, 48*, 92-102. <https://doi.org/10.1016/J.APPDEV.2017.01.002>
- Rideout, V. (2014). *Learning at home: families' educational media use in america*.
- Rideout, V. (2020). *The Common Sense census: Media use by kids age zero to eight*.

- Robb, B. M. (2010). *New ways of reading: The impact of an interactive book on young children's story comprehension and parent-child dialogic reading behaviors* [Doctoral Dissertation, University of California Riverside].
<https://escholarship.org/uc/item/5xm8n8xk>
- Rosner, F. (2018). *Techno-Economic Analysis of IGCCs Employing Novel Warm Gas Carbon Dioxide Separation and Carbon Capture Enhancements for High-Methane Syngas* MASTER OF SCIENCE in Mechanical and Aerospace Engineering. University of California Irvine.
- Rosner F. (2021a). *Design and Thermo-Economic Analyses of Solid Oxide Fuel Cell-Gas Turbine Hybrid Systems with Water Recovery*. UNIVERSITY OF CALIFORNIA IRVINE.
- Rosner F. (2021b). *Economics of Cell Design and Thermal Management in Solid Oxide Fuel Cells under SOFC-GT Hybrid Operating Conditions: Part II, Pressure Dependency*.
- Rosner, F., Chen, Q., Rao, A., & Samuelsen, S. (2019). Thermo-economic analyses of concepts for increasing carbon capture in high-methane syngas integrated gasification combined cycle power plants. *Energy Conversion and Management*, 199. <https://doi.org/10.1016/j.enconman.2019.112020>
- Rosner, F., Chen, Q., Rao, A., & Samuelsen, S. (2020). Thermo-economic analyses of isothermal water gas shift reactor integrations into IGCC power plant. *Applied Energy*, 277. <https://doi.org/10.1016/j.apenergy.2020.115500>
- Rosner, F., Chen, Q., Rao, A., Samuelsen, S., Jayaraman, A., & Alptekin, G. (2019a). Thermo-economic analyses of IGCC power plants employing warm gas CO₂

- separation technology. *Energy*, 185, 541–553.
<https://doi.org/10.1016/j.energy.2019.07.047>
- Rosner, F., Chen, Q., Rao, A., Samuelsen, S., Jayaraman, A., & Alptekin, G. (2019b). Process and economic data for the thermo-economic analyses of IGCC power plants employing warm gas CO₂ separation technology. *Data in Brief*, 27.
<https://doi.org/10.1016/j.dib.2019.104716>
- Rosner, F., Rao, A., & Samuelsen, S. (2020a). Water gas shift reactor modelling and new dimensionless number for thermal management/design of isothermal reactors. *Applied Thermal Engineering*, 173.
<https://doi.org/10.1016/j.applthermaleng.2020.115033>
- Rosner, F., Rao, A., & Samuelsen, S. (2020b). Economics of cell design and thermal management in solid oxide fuel cells under SOFC-GT hybrid operating conditions. *Energy Conversion and Management*, 220.
<https://doi.org/10.1016/j.enconman.2020.112952>
- Rosner, F., Rao, A., & Samuelsen, S. (2021). Thermo-economic analyses of solid oxide fuel cell-gas turbine hybrids considering thermal cell gradients. *Journal of Power Sources*, 507. <https://doi.org/10.1016/j.jpowsour.2021.230271>
- Rosner F, S. S. (2022). Thermo-Economic Analysis of a Solid Oxide Fuel Cell-Gas Turbine Hybrid with Commercial Off-the-shelf Gas Turbine. *Applied Energy*.
- Rosner, F., Yang, D., Rao, A., & Samuelsen, S. (2022). Technical note: Gas turbine price projection for n-th plant equipment cost. *Engineering Economist*.
<https://doi.org/10.1080/0013791X.2022.2048330>

- Sénéchal, M., & Lefevre, J.-A. (2002). Parental Involvement in the Development of Children's Reading Skill: A Five-Year Longitudinal Study. *Child Development*, 73(2), 445–460.
- Senter, R. J., & Smith, E. A. (1967). *Automated readability index*.
- Shamir, A., & Korat, O. (2007). Developing an educational E-book for fostering kindergarten children's emergent literacy. *Computers in the Schools*, 24(1–2), 125–143. https://doi.org/10.1300/J025v24n01_09
- Smeets, D. J. H., & Bus, A. G. (2012). Interactive electronic storybooks for kindergartners to promote vocabulary growth. *Journal of Experimental Child Psychology*, 112(1), 36–55. <https://doi.org/10.1016/J.JECP.2011.12.003>
- Smeets, D. J. H., & Bus, A. G. (2015). The interactive animated e-book as a word learning device for kindergartners. *Applied Psycholinguistics*, 36(4), 899–920. <https://doi.org/10.1017/S0142716413000556>
- Stahl, D. (2012). Complex text or frustration-level text: Using shared reading to bridge the difference. *The Reading Teacher*, 66(1), 47–51.
- Strouse, G. A., O'Doherty, K., & Troseth, G. L. (2013). Effective coviewing: Preschoolers' learning from video after a dialogic questioning intervention. *Developmental Psychology*, 49(12), 2368.
- Strouse, G. A., & Troseth, G. L. (2014). Supporting toddlers' transfer of word learning from video. *Cognitive Development*, 30(1), 47–64. <https://doi.org/10.1016/J.COGDEV.2014.01.002>

- Stuckelman, Z. D., Strouse, G. A., & Troseth, G. L. (2021). Value Added: Digital Modeling of Dialogic Questioning Promotes Positive Parenting During Shared Reading. *Journal of Family Psychology*. <https://doi.org/10.1037/fam0000932>
- Swain, M. (2005). The output hypothesis: Theory and research. In *In Handbook of research in second language teaching and learning* (pp. 495–508).
- Sweller, J. (2005). Implications of cognitive load theory for multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 19–30). Cambridge University Press. .
- Takacs, Z. K., Swart, E. K., & Bus, A. G. (2015a). Benefits and Pitfalls of Multimedia and Interactive Features in Technology-Enhanced Storybooks: A Meta-Analysis. *Review of Educational Research*, *85*(4), 698–739. <https://doi.org/10.3102/0034654314566989>
- Takacs, Z. K., Swart, E. K., & Bus, A. G. (2015b). Benefits and Pitfalls of Multimedia and Interactive Features in Technology-Enhanced Storybooks: A Meta-Analysis. *Review of Educational Research*, *85*(4), 698–739. <https://doi.org/10.3102/0034654314566989>
- Thompson, B., Thompson, W. F., Schellenberg, E. G., & Letnic, A. K. (2012). Fast and loud background music disrupts reading comprehension. *Psychology of Music*, *40*(6), 700–708. <https://doi.org/10.1177/0305735611400173>
- Towson, J. A., Fettig, A., Fleury, V. P., & Abarca, D. L. (2017). Dialogic Reading in Early Childhood Settings: A Summary of the Evidence Base. *Topics in Early Childhood Special Education*, *37*(3), 132–146. <https://doi.org/10.1177/0271121417724875>

- Troseth, G. L., Saylor, M. M., & Archer, A. H. (2006). Young Children's Use of Video as a Source of Socially Relevant Information. *Child Development, 77*(3), 786–799.
- Troseth, G. L., Strouse, G. A., Flores, I., Stuckelman, Z. D., & Russo Johnson, C. (2020a). An enhanced eBook facilitates parent–child talk during shared reading by families of low socioeconomic status. *Early Childhood Research Quarterly, 50*, 45–58.
<https://doi.org/10.1016/J.ECRESQ.2019.02.009>
- Troseth, G. L., Strouse, G. A., Flores, I., Stuckelman, Z. D., & Russo Johnson, C. (2020b). An enhanced eBook facilitates parent–child talk during shared reading by families of low socioeconomic status. *Early Childhood Research Quarterly, 50*, 45–58.
<https://doi.org/10.1016/J.ECRESQ.2019.02.009>
- Twait, E., Farah, R., Shamir, N., & Horowitz-Kraus, T. (2019). Dialogic reading vs screen exposure intervention is related to increased cognitive control in preschool-age children. *Acta Paediatrica, International Journal of Paediatrics, 108*(11), 1993–2000. <https://doi.org/10.1111/apa.14841>
- Vezzoli, Y., Kalantari, S., Kucirkova, N., & Vasalou, A. (2020, April 21). Exploring the Design Space for Parent-Child Reading. *Conference on Human Factors in Computing Systems - Proceedings*. <https://doi.org/10.1145/3313831.3376696>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Walsh, B. A., & Blewitt, P. (2006). The effect of questioning style during storybook reading on novel vocabulary acquisition of preschoolers. In *Early Childhood Education Journal* (Vol. 33, Issue 4, pp. 273–278).
<https://doi.org/10.1007/s10643-005-0052-0>

- Wang, B., Rosner, F., Rao, A., Zhao, L., & Samuelsen, S. (2021). Method for determining the change in gas turbine firing temperature. *Journal of Engineering for Gas Turbines and Power*, 143(9). <https://doi.org/10.1115/1.4050859>
- Wang, H. F., & Chiu, M. C. (2020). Ebook presentation styles and their impact on the learning of children. *Proceedings of the Interaction Design and Children Conference, IDC 2020*, 438–443. <https://doi.org/10.1145/3392063.3394425>
- Waring, R., & Nation, I. S. (2004). Second language reading and incidental vocabulary learning. *Angles on the English Speaking World*, 4, 97–110.
- Wasik, B. A., Bond, M. A., & Hindman, A. (2006). The effects of a language and literacy intervention on head start children and teachers. In *Journal of Educational Psychology* (Vol. 98, Issue 1, pp. 63–74). <https://doi.org/10.1037/0022-0663.98.1.63>
- Weigel, D. J., Martin, S. S., & Bennett, K. K. (2006). Contributions of the home literacy environment to preschool-aged children's emerging literacy and language skills. *Early Child Development and Care*, 176(3–4), 357–378. <https://doi.org/10.1080/03004430500063747>
- Whitehurst, G. J., Epstein, J. N., Angell, A. L., Payne, A. C., Crone, D. A., & Fischel, J. E. (1994). Outcomes of an emergent literacy intervention in Head Start. *Journal of Educational Psychology*, 86(4), 542.
- Whitehurst, G. J., Falco, F. L., Lonigan, C. J., Fischel, J. E., DeBaryshe, B. D., Valdez-Menchaca, M. C., & Caulfield, M. (1988). Accelerating language development through picture book reading. *Developmental Psychology*, 24(4), 552.

- Willoughby, D., Evans, M. A., & Nowak, S. (2015). Do ABC eBooks boost engagement and learning in preschoolers? An experimental study comparing eBooks with paper ABC and storybook controls. *Computers & Education, 82*, 107–117.
<https://doi.org/10.1016/J.COMPEDU.2014.11.008>
- Xu, Y., Yau, J. C., & Reich, S. M. (2019). The added challenge of digital reading: Exploring young children's page turning behaviors. *Proceedings of the 18th ACM International Conference on Interaction Design and Children, IDC 2019*, 432–438.
<https://doi.org/10.1145/3311927.3323121>
- Xu, Y., Yau, J. C., & Reich, S. M. (2021). Press, swipe and read: Do interactive features facilitate engagement and learning with e-Books? *Journal of Computer Assisted Learning, 37*(1), 212–225. <https://doi.org/10.1111/jcal.12480>
- Yang, D., Zargar, E., Adams, A. M., Day, S. L., & Connor, C. M. D. (2021). Using Interactive E-Book User Log Variables to Track Reading Processes and Predict Digital Learning Outcomes. *Assessment for Effective Intervention, 46*(4), 292–303.
<https://doi.org/10.1177/1534508420941935>
- Yu, Z., & Ruan, J. (2012). Early childhood English education in China. *In Perspectives on Teaching and Learning English Literacy in China*, 51–65.
- Zevenbergen, A. A., & Whitehurst, G. J. (2003). Dialogic reading: A shared picture book reading intervention for preschoolers. In *On reading books to children: Parents and teachers* (pp. 177–200).

Appendix A. Parent Questionnaire

姓名: name	年龄: age
您是孩子的: father or mother	最高学历: education
职业: occupation	配偶最高学历: spouse education
	家庭月收入: family income

1. 您的英语水平如何? What is your English proficiency level?
 - a. 一点不会
 - b. 会基本对话
 - c. 四级水平
 - d. 流利对话
2. 您配偶的英语水平如何? What is your spouse's English proficiency level?
 - a. 一点不会
 - b. 会基本对话
 - c. 四级水平
 - d. 流利对话
3. 您觉得幼儿英语学习重要么? What is your perception about children's English education?

- a. 太小了没必要学英语
 - b. 可以学一点
 - c. 还行，如果学校开设英语课程会支持
 - d. 很重要，希望可以帮助有额外的英语资源让孩子学英语
4. 您给孩子报过英语补习班或者英语家教么？如果有的话孩子学了多久？

Has your child attended any English programs/English tutors? If so, how long?

5. 您觉得家长在孩子英语学习的过程中可以起到什么作用？有什么局限？

How do you help your children to learn English? Is your English proficiency a limitation?

6. 您平时给孩子读故事书吗？您会给孩子读英文故事书吗？为什么？

Do you read story books to your children? Do you read English story books to your children?

Appendix B. List of items tested in the Story Vocabulary pre and post





test:

black bird/黑鸟	cocoon/蛹/茧	take a stretch/伸懒腰, 懒腰	oakleaf butterfly/枯叶蝶
turn his head/转头	friend/朋友/小伙伴	sad/伤心/悲伤/难过	dance/跳舞
colorful/五颜六色/多彩	cry/哭	decoration/装饰	help/帮/帮助/帮忙
scary/吓人/恐怖/令人害怕	happy/高兴, 开心	camouflage/伪装/掩盖/保护色	guard/警卫/守卫
taking a nap/睡觉/小憩	noise/噪音	wake up/起床/叫醒	fly/飞
sleep/睡/睡觉	cage/笼子	party/派对	free/放飞/自由
tears of joy/高兴的眼泪	butterfly/蝴蝶	rainbow 彩虹	red/红
orange/橘色/橙子/橙色	yellow/黄	green/绿	blue/蓝
purple/紫	hero/英雄	squirrel/松鼠	ladybug/瓢虫
flower/花	bunny/rabbit/兔子	gift/present/礼物	lizard/蜥蜴/变色龙
snake/蛇	frog/青蛙	map/地图	house/房子/家
tree/树	garden/花园	fence/栏杆/栅栏	dry leaf/leaf/叶子/枯叶
bird/鸟	water/水		


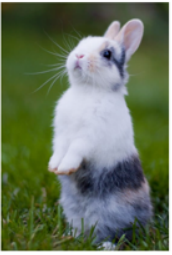

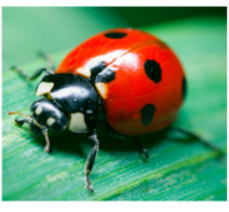
Appendix C. Receptive Story Vocabulary Test Sample Item

Demonstration

8. Which of the following is **dance**?

1. 	2. 	3. 	4. 
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15. **camouflage**

1. 	2. 	3. 	4. 
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Appendix D. Demonstration of some story illustration and text.



Little Oak comes out of his cocoon and takes a deep stretch, “Now I am a beautiful butterfly!”

小枯叶蝶从蚕蛹里钻出来伸了个大大的懒腰：“我现在是一只美丽的蝴蝶啦！”



But when he sees himself in the water, he gets very disappointed, “Oh, is that me? Like a dry leaf?”

当他看到水里的自己时，他非常失望：“哦，那个就是我吗？像一片枯叶？”



Mama Oak comforts him, "Don't cry, my baby. One day, you will know that our oakleaf color is the best gift from the nature."

妈妈安慰他说：“孩子，别哭。有一天，你会知道我们枯叶一样的颜色是大自然给我们的最好的礼物。”

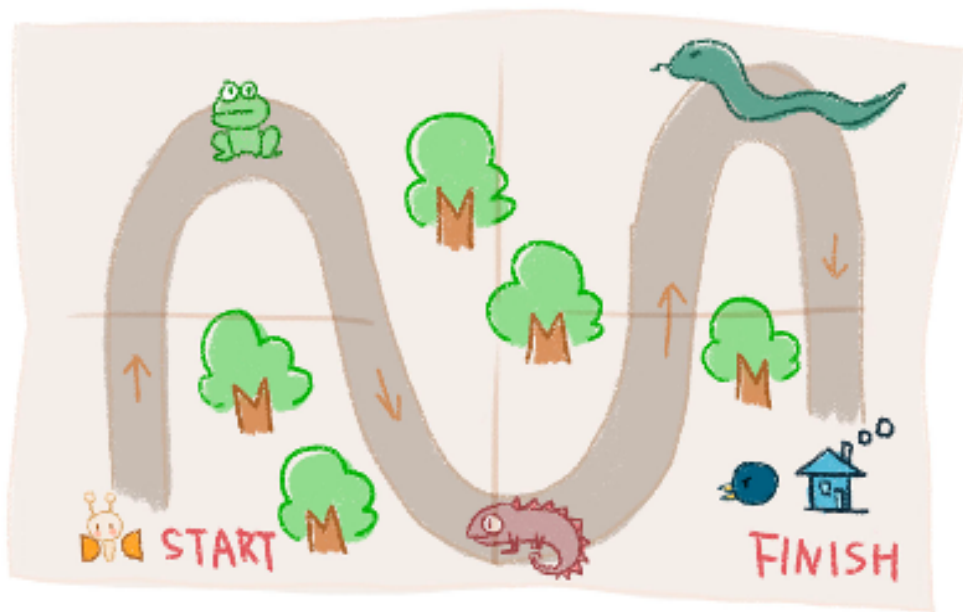


Little Oak is happy that the black birds does not see him, but he is also sad that he is all alone. Little Oak decides to save his friends!

Mama Oak says, “Go ahead, my baby! Remember to use our oak color camouflage to stay safe!”

小枯叶蝶决定去拯救他的小伙伴们！

妈妈说：“去吧我的孩子！记得用我们枯叶翅膀做伪装来保证安全！”



In order to get to the bird house and save his friends, Little Oak needs to pass several guards: a frog, a lizard, a snake and the black bird.

为了到大鸟家解救小伙伴，枯叶蝶需要经过几道关卡。守卫们是一只青蛙，一只蜥蜴，一条蛇和那只大黑鸟。



Later, there is a big party for our Little Oak in the garden!

Everyone cheers “Thank you, Little Oak! You save us with your camouflage! You are a real hero!”

Hearing this, Little Oak begins to cry again. But this time, they are the tears of joy.

后来，大家为了小枯叶蝶在花园里开派对！

蝴蝶们欢呼说：“谢谢你枯叶蝶！你用你的伪装救了我们！你是个真正的英雄！”