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An Investigation into the Effects of Electronic Storybooks on Language and Literacy Outcomes

MARILENA SAVVA

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DURHAM UNIVERSITY

AN INVESTIGATION INTO THE EFFECTS OF ELECTRONIC STORYBOOKS ON LANGUAGE AND LITERACY OUTCOMES

A Thesis presented for the degree of

Doctor of Philosophy

School of Education, Durham University

By

Marilena Savva

2023

Table of Contents

List of Tables

List of Figures

List of Appendices

Abstract

The array of availability of diverse digital reading applications, the mixed results emerging from small-scale experimental studies, as well as the long-standing tradition and range of known positive developmental outcomes gained from adult-child storybook reading warrant an investigation into electronic storybooks (e-books). In doing so, the thesis looks to provide the reader with both a meta-analysis and an experimental study of e-book and print book reading for young children. To achieve this, the thesis comprises of two studies, which complement each other.

Study 1 comprises of a meta-analysis of examining the effects of e-books on language and literacy outcomes for young children. The overall purpose of the meta-analysis was to examine the impact of e-book reading on language and literacy development of young children when compared to traditional reading of print books with or without adult scaffolding in a structured and controlled environment. The meta-analysis included 29 experimental studies published between 2008 and 2021 with a target population of 3–8-year-olds. Analyses indicated a small positive effect for e-books when compared to print books on language and literacy development (g = 0.25; 95% CI = [0.09, 0.42]). A moderate positive effect was found for vocabulary learning (g = 0.40; 95% CI = [0.10, 0.69]), especially in relation to expressive vocabulary (g = 0.54; 95% CI = [0.08, 1.00]). In addition, a significant positive correlation was found between multimedia e-books and the development of code-related skills (g = 0.63, 95% CI = [0.28, 0.99]). However, no significant differences were found between e-book and print book reading in relation to story comprehension. Overall, findings showed that digital features combined with adult scaffolding produced significant positive effects when compared to traditional print book reading with adult support. The findings have practical ramifications, since they can help researchers and educators identify which digital features have the greatest influence on improving children's language and literacy skills when engaging with e-books.

Study 2 collected data from sixty children between the ages of 3 and 7 years old over the school year 2020-2021. The children attended a private English school in Cyprus where English was taught as a main language, but it was considered an additional language for the participants. The purpose of the second study was to employ the findings from the first study and apply them to a particular demographic, namely children who learn English as an

additional language, in order to assess the impact of e-books in contrast to print books on the learning outcomes of this specific group of learners. The intervention took place at their school, where two print books and two e-books were compared using two different teaching styles – an interactive style and a performance style. The children listened to each story twice. The statistical analyses were conducted using the IBM SPSS Statistics 28 software; particularly, repeated measures ANOVA analyses were conducted. The results of the study indicated that children who are acquiring English as an additional language may enhance their vocabulary and comprehension skills by engaging in storybook reading with the support of interactive adult scaffolding. Specifically, the findings demonstrated a significant statistical difference in expressive vocabulary between the interactive teaching style and the performance teaching style, with the interactive teaching style yielding higher mean scores ($F(1, 58) = 5.014$, $p=0.02$, $\eta_p^2=0.08$). Additionally, it was observed that the interactive teaching style yielded greater mean scores compared to the performance teaching style ($F(1, 56)=4.15$, $p=0.04$, $\eta_p^2=0.06$) in story comprehension outcomes (although the results were deemed non-significant after the Bonferroni adjustment). In terms of e-books versus print books, there was no interaction effect for receptive vocabulary ($F(1, 58) = 0.177$, $p=0.67$, $\eta_p^2=0.00$) and expressive vocabulary ($F(1, 58) = 2.490$, $p =0.12$, $\eta_p^2=0.04$), which shows that everyone improved from pre-test to post-test regardless of condition. While analysing the results retrieved from book medium analyses, post-scores revealed a statistically significant result for explicit story comprehension ($p=0.04$, $\eta_p^2=0.07$), favouring the print condition (before Bonferroni correction).

Together, the two studies indicate that e-books can support language and literacy outcomes. Multimedia features incorporated in e-books are found to benefit children more than interactive features, which seem to distract children from the storyline and as a result from their development. This thesis also highlights the importance of adult scaffolding during storytelling sessions, since it benefits children more than independently listening to an e-book. Adult support during e-book reading can support both typical developing learners, as well as children learning English as an additional language. Findings indicated that the utilisation of interactive adult scaffolding is beneficial for children who are learning English as an additional language. This approach involves engaging children in discussions about the story while they are reading, as opposed to the performance teaching style, which involves skilful storytelling with minimal interruptions in the text. Overall, multimedia e-books with adult support have the potential to support young children in both vocabulary

and story comprehension, regardless of their native language.

Statement of Declaration

I declare that this work is my own. Material in this thesis has been published.

Statement of Copyright

The copyright of this thesis rests with the author. No quotation from it should be published without the author's prior written consent and information derived from it should be acknowledged.

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I wish to use this space to take the opportunity to say thank you for all the people who have helped me to complete my doctoral study.

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Introduction

There is ample evidence that storybook reading is one of the most important sources of language and literacy development during nursery, preschool and primary school years (Bus et al., 1995; Hindman et al., 2014; Mol & Bus, 2011). However, in a world in which media dominates our daily lives, young children spend a lot of time with on-screen activities (e.g., playing online games, watching cartoons) at the expense of reading print books. "Modern" classrooms are elevating by following the social norm as schools have integrated the use of tablets into their curriculum by downloading various educational and non-educational applications as well as e-books (Apple, 2013). In addition, the unexpected arrival of the COVID-19 pandemic has necessitated significant changes in school institutions throughout the world. It has resulted in the closing of schools and the reform of teaching and learning practices, with technology being used more today than ever before. This development holds great promise and makes it imperative to determine how much the use of this software affects young children's language and emergent literacy levels. How well can an e-book develop children's language, story comprehension and other early literacy skills depends on the quality and how well e-books have been designed to specifically meet the children's developmental needs (Shamir & Korat, 2006).

Since 2010, research on e-books has expanded substantially. E-books are digital storybooks that are easily accessible via mobile applications and other electronic devices (e.g., Kindle, tablet) and include various digital components. Most of the e-books aimed at young children are equipped with interactive and multimedia features, e.g., oral reading, background music and sounds, hotspots activating animation, on-demand word definitions, and other functions that may support or hinder language and literacy development. Based on research over the last decade, well-designed e-books for young children, and especially for those who lag behind, can serve as a good support for young children's language (vocabulary learning and story comprehension) and literacy development (phonological awareness, print awareness, word reading and writing, alphabet knowledge). To date, there have been conflicting findings with some studies finding that e-books may hinder learning (e.g., Estefani & Queiroz, 2018; Gong & Levy, 2009) while others demonstrate that they may help (Bus et al., 2015; Shamir et al., 2012). In addition, the fast development of technology and software has reduced the generalisability of findings between generations. Thus, it is crucial to assess and evaluate this book medium that children use today and how well their included features

can increase children's language and literacy development.

Study 1 aims at analysing the efficacy of e-books in facilitating young children's language and literacy development when compared to more traditional presentations of stories, such as narrating a story aloud or reading a print storybook, by performing a meta-analysis. The overall purpose of the meta-analysis is to examine the impact of e-book reading on language and literacy development of young children when compared to traditional reading of print books with or without adult scaffolding in a structured and controlled environment. When comparing print books and e-books as a medium, multimedia, and interactive features embedded in e-books may tax working memory compared to paper books, or conversely, paper books may necessitate significant more adult input for new learning to be acquired by young children. Several experimental studies have investigated the factors that influence children's learning via e-books and story applications (e.g., Bus et al., 2020; Hassinger-Das et al., 2020; Lawrence & Choe, 2021; Neumann, 2020b). As the e-books in question integrate a variety of characteristics, the variety of research published over the previous decade yields mixed results. Consequently, it is essential to review and evaluate the e-books used by young children and the extent to which the digital elements contained in e-books promote children's language and literacy development. To that end, the meta-analysis (Study 1) seeks to investigate the embedded features within e-books, which may resemble adult scaffolding, and to what extent these digital features can promote learning when compared to traditional reading of print books.

Furthermore, the purpose of this thesis is to gain a better understanding of adult scaffolding via the usage of various teaching styles while reading a print book and an e-book. Although positive correlations have been found between variation in the quality of adult scaffolding during shared reading and children's language development (e.g., Hindman et al., 2008; Hindman et al., 2014), further research is needed to examine the effectiveness of these scaffolding techniques in relation to young children's language and story comprehension development. The two scaffolding techniques proposed to be evaluated by this thesis (in Study 2) are the interactive teaching style and the performance teaching style. During the interactive teaching style adults initiate a discussion and ask questions before, during and after the storytelling session. Within a performance teaching style adults and learners engage in a brief conversation before the reading begins. During the story listening session, children remain silent in order to concentrate on listening to the story. At the end of the story, the

discussion continues, and children may ask any questions or initiate conversation. These two scaffolding techniques, as well as book mediums (e-book versus print book) are assessed in Study 2.

Book medium (e-book versus print book) as well as teaching style (interactive versus performance) are evaluated for children learning English as an additional language. It is essential to evaluate the effectiveness of e-books against print books with the assistance of adults by comparing the two aforementioned teaching styles for children whose native language is not English. In the past decade, the majority of research on the effectiveness of e-books has concentrated on first-language learners, whereas relatively few studies have included individuals learning English as an additional language. Therefore, the second study assessed these variables at a school-based intervention employing an e-book and a print book for the development of vocabulary and story comprehension in children learning English as an additional language. The participants were children (3-7 years) residing in Cyprus and attending an English private school. English was either the second, third or fourth language of the participants. The choice of school and country for this study was based on the author's home country and their school of employment.

Cyprus, the third largest island in the Mediterranean, is located in the north-eastern part of the Mediterranean Sea and encompasses a total land area of 9,251 square kilometres. Cyprus is a relatively newly formed sovereign state, established in 1960, and a member of the European Union since 2004. Despite the fact that the island has historically had a multilingual and multicultural profile, cultural variety has risen significantly since the late 1990s as a result of economic growth. According to the preliminary census results of the Statistical Service of Cyprus (2021, October 1), the population in the Government controlled areas of Cyprus on the 1st of October 2021 was 923,272. The total number of foreign nationals amounts to 193,300 and corresponds to 21% of the total population. Article 20 of the Constitution of Cyprus (1960, April 6) protects the right of every individual to receive instruction or education, and the right of any person or institution to provide it. This right is safeguarded for any person, irrespective whether Cypriot or foreigner, to the extent that they reside in the Republic. To this end, migrant students can enrol in public as well as private schools, even if their parents do not have the status of legal migrants. The language taught at public schools is Greek and they follow the Greek national curriculum. Private schools can adjust their curriculum and timetable according to the

educational system of another country. Therefore, many foreigners choose for their children to attend English schools and be taught primarily in English rather than in Greek. The English private school where the author works accepted pupils from a variety of socioeconomic backgrounds, and English language proficiency is not a criterion.

In addition to the broader contextual framework outlined above, this research also included a personal dimension. As a preschool teacher for the past ten years, it has been possible to professionally engage and reflect upon issues of effective language and literacy teaching in preschools with the use of technology. Incorporating non-traditional teaching approaches into my lessons has always piqued my interest, particularly when technology is involved. Therefore, the purpose of the thesis was to provide answers to critical questions that I, as an educator, had encountered when attempting to include technology in my teaching practice. Overall, this thesis is divided into two studies:

- Study 1: Meta-analysis examining the effects of electronic storybooks on language and literacy outcomes for children aged 3 to 8 years old.

- Study 2: The "perfect" e-book versus print book: A comparison of different types of media and reading styles for vocabulary and story comprehension for children learning English as an additional language.

Outline of the Thesis

The thesis is structured in six chapters. The introductory section describes the context of the study, as well as its aims and significance.

Chapters 1, 2 and 3 provide the theoretical foundation. Chapter 1 presents the background and recent research on electronic storybooks and traditional reading of print books for language and literacy development of young children. Chapter 2 examines adult scaffolding during print book reading and e-book reading and presents the two teaching styles used in Study 2. In Chapter 3, research on young children learning English as an additional language and storybooks (print and e-books) are presented, as well as the characteristics of children learning English as an additional language.

Chapter 4 present the meta-analysis (Study 1), which aimed at examining the impact of e-book reading on language and literacy development of young children when compared to traditional reading of print books with or without adult scaffolding in a structured and controlled environment. The chapter presents the research questions, inclusion and exclusion criteria and results of the meta-analysis.

Chapter 5 describes the experimental study (Study 2), including its research design, the research procedures followed throughout the intervention, and the presentation of the results.

Finally, Chapter 6 presents the research findings and the relationship between the findings of the two studies, their embodiment in prior research literature, as well as the lessons learned from the two studies. This chapter offers an insight into the contribution this study makes to the field.

Chapter 1: Traditional Print Books and Electronic Storybooks (E-books)

This chapter examines the background and benefits of reading traditional print books. In addition, after assessing the advantages for language and literacy development, the design and features of e-books that may aid or hinder children's growth are explored.

1.1 Introduction

The sale of e-books is a growing trend and its market share is steadily increasing (Korat & Falk, 2019). E-books can be instantly purchased online and they are available via apps, tablet or e-reader devices, and current digital sales are increasing across the board. In the present study, e-books are defined as a digital form of a print book and a number of terms are being used to refer to e-books, such as electronic storybooks, digital books, storybook apps, digital storybooks, e-readers. According to a report by the Association of American Publishers (AAP, 2021), e-book sales increased by 15.2% in the first eleven months of 2020, generating $1.0 billion United States dollars. Harper Collins has reported that in the first quarter of 2020, e-book sales were up 26% compared to the prior year (Kozlowski, 2020). The big genre sales within the digital division were children and general fiction e-books (Kozlowski, 2021). There are various formats available for the purchaser and consequently the ease of access has paved the way for the application of e-books within the early years' curriculum.

Since the advent of tablet computers and smartphone devices, young children tend to spend more and more of their time on on-screen activities (e.g., playing online games, watching online videos). During the COVID-19 pandemic, screen time has increased dramatically for everyone - including children, many of whom were receiving school instruction remotely (Hassinger-Das et al., 2020). Ofcom (2020) in the United Kingdom reported that 24% of 3–4-year-old children had their own tablet and 42% of 5-7 years old owned their own tablet or smartphone device. Ofcom's most recent investigation, conducted in 2023, reveals that 40% of children aged 3 to 4 and 61% of children aged 5 to 7 own a mobile device. According to the data, tablets and telephones are utilised by children aged 3-4 and 5-7 years for various online activities, such as watching videos or playing online games. Specifically, tablets emerged as the predominant device utilised by

children aged 3-4 years for accessing the internet (75%), engaging in gaming activities (50%), and viewing television content (excluding traditional television sets) (67%). Tablets were also the most popular devices among children aged 5-7 years, with 86% of this age group using them to access the internet, 67% to watch television programmes or films (excluding traditional television sets), and 67% to engage in gaming activities (Ofcom, 2023). These findings further amplify the concerns already expressed by several studies on the impact of digital media on children's learning and development. The driving force behind these concerns is that young children today have their own digital devices and are more likely to be using them on a daily basis, which may potentially result in the replacement of printed storybooks by digital versions. Thus, e-books are a ubiquitous part of our society and may have a direct and immediate effect on the rate of young children's language development and literacy acquisition.

1.2 Storybook Reading

Storybook reading is well-established in the literature, and it is regarded as a leading avenue for building early academic skills (Bus et al., 1995; Bus et al., 2000; Dickinson & Tabors, 2001; Gonzalez et al., 2014; Whitehurst & Lonigan, 2003). A large body of work supports the finding that storybook reading facilitates emergent literacy skills (Bus et al., 2000; Chomsky, 1979; Clark, 1978; Davidse et al., 2011; Durkin, 1966; Hindman et al., 2014; Hindman et al., 2012; Mol & Bus, 2011; National Research Council, 1998; Scarborough & Dobrich, 1994; Teale, 1987). The range of positive developmental outcomes gained from early exposure to books persist beyond early childhood and continue into adolescence and young adulthood (Mol & Bus, 2011; Rose et al., 2018). Early childhood education can provide children with opportunities to develop essential foundation skills in language and literacy that directly translate into later school success (Burchinal et al., 2002; McCardle et al., 2001). Storybooks are by far the most prevalent text genre that preschool teachers choose to read aloud in their classrooms (Gerde & Powell, 2009; Hindman et al., 2008; Stone & Twardosz, 2001). Preschool teachers consider reading aloud to be an important activity in their classrooms (Hindman & Wasik, 2008; Lonigan et al., 2000), and indeed reading aloud helps young children to develop the oral language and early literacy skills needed for later literacy success (e.g., Dickinson et al., 1992; Wasik et al., 2006). To achieve this, teachers employ extratextual discourse, which pertains to conversations that take place outside the realm of reading, as a method

to promote children's engagement, improve their language and literacy skills, and offer the necessary support for children to successfully tackle tasks that are slightly beyond their independent capabilities.

Storybook reading is a popular practice in preschool classrooms, and it can offer the reader/listener a number of educational benefits (Bus et al., 1995; Gonzalez et al., 2014). Early childhood education offers young children an opportunity to enhance their communication and language skills, including the development of grammar, phonology, vocabulary, and pragmatics. Storybook reading activates the development of emergent literacy skills (Bus & Van IJzendoorn, 1988; Inoue et al., 2018), such as concepts of print (e.g., Nevo & Vaknin-Nusbaum, 2018; Justice & Ezell, 2000, 2004), phonological awareness (Chow et al., 2008; Lefebvre et al., 2011), and alphabet knowledge (Aram, 2006). The enhancement of these concepts can be achieved by engaging in high-quality interactions between adults and children during storybook reading (Justice & Ezell, 2002). These interactions have been found to facilitate the development of various early language skills, including expressive and receptive vocabulary (Farrant & Zubrick, 2012; Flack et al., 2018; Lenhart et al., 2020), as well as decontextualised language (Beck & McKeown, 2001; Seven et al., 2020), which involves the use of unfamiliar words (Marulis & Neuman, 2010; Montag et al., 2015).

Research results on storybook reading with children from low socioeconomic status (SES) families were found to be equally beneficial as results found in medium and high SES families (Shahaeian et al., 2018; Wasik & Bond, 2001). Low SES children often enter the early years' classroom demonstrating a gap in their oral language production and weaker print and phonological awareness skills as compared to their middle-class peers (Dickinson & Snow, 1987; Justice & Ezell, 2002). For example, Lefebvre et al. (2011) studied low-income preschoolers' language and literacy development while undergoing a storybook-reading intervention programme. According to the findings, the experimental group outperformed the control group in phonological awareness. The results of the analysis were also compared with a group of higher-income preschoolers who did not receive the intervention. Children from low-income families in the experimental group outperformed their higher-income counterparts on phonological awareness, vocabulary, and print awareness scores. Neuman and Kaefer (2018) worked in a year-long storybook intervention with low-income children on their oral language vocabulary and content

knowledge. Results of their analysis showed that the young children learned significantly more words than the control group. These results indicate that storybook interventions have the potential to develop young children's language and literacy development regardless of their background.

1.3 Emergent Literacy

Literacy - the ability to read and write - is without a doubt the most important skill required for academic and personal success (Snow, 1983). Literacy skills emerge even before children begin formal school (Burgess et al., 2002). From birth till the beginning of formal education, crucial language and literacy development milestones are accomplished. In the first 5 years of life, children acquire the skills and knowledge about language that are developmental precursors to conventional forms of reading and writing (Whitehurst & Lonigan, 1998). This group of skills and knowledge, including language development, vocabulary, print awareness, a core of basic world knowledge, and motor skills necessary for writing, is referred to as emergent literacy.

Emergent literacy was introduced by Clay (1966) and then restated by Sulzby and Teale (1996):

"Emergent literacy is concerned with the earliest phases of literacy development, the period between birth and the time when children read and write conventionally. The term emergent literacy signals a belief that, in a literate society, young children – even 1- and 2-year-olds – are in the process of becoming literate" (p. 728).

This suggests that language and literacy development has its roots from the most basic biologically and socially based human activities (Dickinson & McCabe, 2001). Emergent literacy concerns all of the different ways that humans communicate – through reading, writing, speaking, and listening – in real life situations. When a child is engaged with a picture book or drawing on a tablet, they are becoming a reader and a writer, engaging in these activities at their own level of competence (Strouse & Ganea, 2017).

The Early Years Foundation Stage (Department for Education, 2021) (UK Curriculum) statutory framework specifies four areas of emergent literacy development children require before learning to read and include (a) communication and language, (b) phonological awareness, (c) print awareness and (d) alphabet knowledge. Communication and language

includes vocabulary, grammar, phonology, and comprehension. Phonological awareness "refers to the ability to generate and recognize rhyming words, to count syllables, to separate the beginning of a word from its ending, and to identify each of the phonemes in a word" (Yopp & Yopp, 2000, p.130). Poor phonological awareness skills are a strong predictor of future reading difficulties in pupils (Storch & Whitehurst, 2002) making explicit instruction of phonological skills essential (Ehri, 1989). Print awareness is knowledge of the form and function of print and the association between written and oral language units (Ehri & Sweet, 1991; Snow et al., 1998). The acquisition of print concepts throughout the preschool period enhances a child's capacity to connect written and oral language (Adams, 1990). Finally, alphabet knowledge refers to a child's ability to recognise letters as distinct units known as graphemes and to name those letters (Worden & Boettcher, 1990). The ability to identify letters is regarded as a reliable indicator of one's knowledge of letter sounds, a crucial skill in comprehending the relationship between graphemes and phonemes and subsequently decoding words (Ehri & Sweet, 1991). Thus, an early year's teacher has an important goal to fulfil by helping every child achieve its full potential and to promote literacy in these crucial years. A highly researched activity supporting literacy development is shared storybook reading due to its association with emergent literacy and language development (Bus et al., 1997).

Reading books aloud not only promotes good reading habits, but also listening and speaking abilities. Children who are frequently exposed to storybook reading are more likely to use complex sentences, have enhanced literal and comprehension skills, develop a deeper understanding of story concepts, increase letter and symbol recognition, and develop positive attitudes about reading (Silvern, 1985). Reading to young children can enhance their communication skills as they discuss the story and illustrations (Kaderavek & Justice, 2002). According to Huck et al. (1989), children who exhibit advanced linguistic skills are often those who have been exposed to a significant amount of reading. Language expert, Chomsky (1972), believed that the development of syntactic complexity and expansion of vocabulary in young children could be attributed to the adult-child reading experience. Thus, reading a print storybook with an adult is a vital practice for promoting language and literacy development. The following section contrasts studies on traditional print book reading versus electronic storybooks.

1.4 What is an E-book?

E-books appeared as early as 1967 when Andries van Dam, a technology professor at Brown University, developed hypertext on a computer (Anuradha & Usha, 2006). Although he conceptualised e-books so many years ago, the electronic storybook has made its appearance in the early year's classroom in the mid-1990s when educational researchers began exploring their value as computers became smaller and more affordable. Since then, the availability of e-books has grown rapidly, resulting in e-books that are available in many languages and contain a variety of multimedia and instructional features that can be tailored to individual needs. E-books are characterised as a form of electronic text that contains key features of traditional print books such as a main idea or theme and pages that turn, but e-books may also contain multimedia, interactive, animated features and follow up activities too (Zucker et al., 2009). This complicates things even more as today's children are being introduced to various forms of e-books more than ever before.

Storybooks delivered via digital devices have been referred to by a variety of terms (e.g., electronic storybooks, digital books, storybook apps, digital storybooks, e-readers) (Reich et al., 2016). In the present study, the term *e-book* will be used when referring to the abovementioned terms. E-books can be described as digital representations of books that possess similar characteristics to traditional printed books, such as "turning" pages, and digital features that can assist the reader, such as audio narration, word pronunciations, text highlighting, text-to speech options and gamification (Dore et al., 2018; Takacs et al., 2015; Yin & Hwang, 2018). E-books can incorporate a variety of digital features with little uniformity across currently available software (Korat & Falk, 2019; Papadakis et al., 2018). Innovative technological hypermedia, such as multimedia (e.g., animation, music and sound effects) and interactive features (e.g., games, hotspots, dictionary function) add complexity to the reading experience as e-books contain a variety of elements and functions that traditional reading on printed pages do not (Chen et al., 2022; Zhang et al., 2020). Thus, there is a need to research and evaluate the effectiveness of this educational medium, as it seems that the use of the e-book will continue to expand and make its way into the early year's classroom.

Young children today can listen to storybooks not only when an adult reads to them from a printed version, but they can also "read" by themselves using e-books appearing on a computer, a tablet, a smartphone, or some other electronic device (Korat & Falk, 2019).

As a result of the growing awareness and concern of parents and teachers for the educational quality of e-books, researchers in several countries have studied this issue (e.g., in The Netherlands: De Jong & Bus, 2003; Smeets & Bus, 2015; in the US: Ingram, 2020; Roskos et al., 2009; Schugar et al., 2013; in the UK: Karemaker et al., 2010; Kucirkova & Flewitt, 2020; Underwood & Underwood, 1998; and in Israel: Segal-Drori & Shabat, 2021; Shamir & Korat, 2015). Furthermore, it is imperative for curriculum planners, e-book designers, and software developers to consider the quality of e-books (Korat & Falk, 2019; Van Daal et al., 2019). The possible discrepancy between the objectives of e-book developers and the cognitive development of children is a matter of great significance. An aim of this thesis is to analyse experimental studies involving interventions with e-books in an effort to evaluate the specific features embedded in e-books that may simulate extraneous support (e.g., adult scaffolding) provided to children while listening/reading a story for language and literacy development via performing a meta-analysis (Study 1).

1.5 Learning with E-books – the Role of Digital Features

Investigating the quality of app and e-book content is a continuing concern of researchers as they argue that digital and media developers are prioritising marketing and digital sales rather than pursuing educational objectives and values (Hiniker et al., 2019). Commercial e-books available in app stores might be highly entertaining, but they may fall outside the scope of what researchers consider educational (Hirsh-Pasek et al., 2015). In order for children to learn, comprehend and develop their literacy and language skills while engaging with an e-book they have to show understanding that goes beyond words, focus on the content of the story, listen clearly to the dialogues, add their own perceptions and knowledge to foresee what will happen next, and preserve information they have already read as the story progresses (Newmann, 2020). The arguments regarding the design properties of e-books should be focused on the principles of Mayer's multimedia learning (Mayer, 2005), Paivio's dual coding theory (Paivio, 1986), and Sweller's cognitive load theory (Sweller, 1988; Sweller et al., 2011) and how words (printed or audible or both) and pictures (static or dynamic) should be presented to provide meaningful and effective learning.

Paivio's dual coding theory explains that the human mind simultaneously processes two types of information: visual information-images (nonverbal) and verbal information-

logogens (Paivio, 1986; Sadoski & Paivio, 2013), both of which are represented within the content of e-books (Wong & Neuman, 2019). Mayer's (2005) cognitive theory of multimedia learning argues that the combination of multimedia narrations and visuals facilitates the creation of verbal and visual mental representations, which are then further developed in working memory and can be combined with prior information to form new knowledge. Dual coding theory as applied in Takacs and Bus's (2016) study states that when two sources of information (such as narration and animation) are compatible, they "can be processed simultaneously without causing cognitive overload" (Takacs & Bus, 2016, p.2). In line with Mayer's (2005) multimedia learning theory, it appears that the incorporation of narrative text accompanied by illustrations is beneficial for young children, just as images are beneficial when applied to text. The multimodal features of e-books may facilitate simultaneous processing of verbal and nonverbal information, thereby enhancing story comprehension (Sadoski & Paivio, 2013). Reviews of apps for young children have shown that, in addition to static images, animated pictures, in particular, can be useful additions to stories (Van Daal & Sandvik, 2011; Zucker et al., 2009). Multimedia elements (e.g., extra images, animation) may be used to illustrate important events in a story or include details about the context of a word in e-books. For example, animation embedded in an e-book might better demonstrate the meaning of a verb than a static illustration.

The incorporation of engaging features (e.g., decorative illustrations) can improve student interest but may also adversely affect learning (Mayer, 2014). According to cognitive load theory (Sweller, 1988), the human cognitive system is limited and the amount of information that learners need to process affects learning new knowledge (Sweller et al., 2019). The auditory and visual channels have limited capacity in terms of working memory and too much information or unnecessary/distracting information might create a cognitive overload which interferes with learning (Sweller et al., 2011). Consequently, the limited capacity of young children's working memory and the various extraneous features embedded in e-books may lead to cognitive overload, and as a result this would interfere with children's understanding of the storyline and prevent them from absorbing important information related to the educational activity (Bus et al., 2015; Sweller, 2016). Thus, the design and the number of multimedia components in e-books are critical. In order to mitigate cognitive overload, the assessment of e-book features is crucial for determining their impact on language and literacy development. The presence of multimedia

components in e-books that are unrelated to the main educational objective can impede children's learning, as these components possess the capacity to divert attention or disrupt the learning process (Kelley & Kinney, 2017).

When comparing print books and e-books as a medium, multimedia and interactive features embedded in e-books might tax working memory compared to paper books or conversely paper books without any extra features that might require a lot more adult input in order for new learning to pass from working memory to long-term memory. Furthermore, both formats incorporate active learning, as e-books offer various interactive features, such as hotspots and dictionaries and paper books usually go hand-in-hand with adult scaffolding. Finally, the success of any implementation of these concepts would be determined by the cognitive load that the medium and story material place on young children with limited concentration span (Richter & Courage, 2017). Due to the apparent inconsistencies between these viewpoints, additional investigation is warranted to explore the discrepancies in the cognitive processing of e-books and traditional print books among young children.

E-books have a choice of facilities such as multimedia effects, hidden hotspots and built in dynamic visuals. Multimedia effects include starting and restarting the oral reading, printed text that brightens or changes colour or size while the text is narrated, music, sound effects and animation. Hotspots are devices embedded in various screen locations and are intended to provide supplementary information such as illustrations that activate animations, hotspots in text that activate the pronunciation of words or phrases, explanation of a word, an option that provides an overview of all screens, and games and songs that are more or less related to the story content (De Jong & Bus, 2003). Activating e-books that incorporate a built-in dictionary and highlighted text may provide young children with a valuable learning experience, including the acquisition of new words, as well as the development of word recognition and reading skills (Korat, 2010). Built-in dynamic visuals may also expand on the story's content beyond what appears in the original text and may aid in a better understanding of the narrative (Korat, 2010). Thus, the research suggests that quality, as it pertains to the combination of considerate and interactive multimedia features, is a factor that potentially influences literacy development. E-books are viable tools to support literacy development in early childhood, but also specific factors or conditions have the potential to impact outcomes positively or

negatively. Thus, there is a need to examine and evaluate the e-books that teachers use in the class to support children's emergent literacy.

Furthermore, a significant number of studies focusing on e-books have been conducted on the basis of altered e-books (Korat et al., 2013; Smeets & Bus, 2012). These were commercial e-books altered in order to correspond to the study's needs or e-books created by the authors to carry out their research on language and literacy (e.g., Silverman, 2013; Segers & Verhoeven, 2002; Korat, 2010; Shamir, 2009; Korat & Shamir, 2012, 2008, 2007; Shamir et al., 2012). For instance, the study conducted by Korat et al. (2014a) utilised an e-book created by the researchers. The e-book was developed by scanning the pages of the print book that served as the comparative condition. To test vocabulary acquisition in the context of e-book reading, they embedded a dictionary with dynamic and static visuals into the e-book. Thus, more research needs to be done in order to assess and evaluate commercially available e-books used by children to promote language and literacy.

In conclusion, factors found to impact children's learning from e-books and story apps have been explored in several experimental studies (e.g., Bus et al., 2020; Hassinger-Das et al., 2020; Lawrence & Choe, 2021; Neumann, 2020b). The array of studies published in the past decade offer mixed results as the e-books in question incorporate various and diverse features. To that end, the present thesis, within Study 1, investigates the embedded features within e-books, which may resemble adult scaffolding, and to what extent these digital features can promote learning when compared to traditional reading of print books. After evaluating the digital skills offered in e-books, the author moves on to the second study of the thesis by selecting e-books with digital features that are considered supportive based on the findings of the meta-analysis (Study 1), in order to evaluate its effectiveness in regard to story comprehension and vocabulary learning specifically in children learning English as an additional language.

1.6 Recognising the Overarching Aims of the Thesis

The above literature outlined the different areas that e-books may have an impact on, specifically literacy development, vocabulary enhancement, increase of attention span, and child engagement. The findings are considered encouraging; nonetheless, additional investigation is warranted due to the rapid evolution of electronic stories in the market,

including new features, new platforms and eventually quite novel reading experiences. Thus, the subject of e-books as well as the advantages they provide in education is a fertile and rich ground for further research and analysis. The numerous viewpoints and attitudes that are presented in this thesis are just a starting point. As seen in the literature, researchers agree that the enjoyment of e-books by the children may just be a novelty factor, but there are also several documented cases where e-books support literacy as well as further development of language. The added functionality as well as interactivity that is available in e-books may greatly benefit children (Machado, 2015).

It is clear that growth of literacy skills is typically a vital part of the overall development of a child. Literacy skills are the foundation for developing independence, doing well at school and socialising with others. However, before the children learn how to write and read, it is imperative that the children develop the building blocks for literacy, which are the ability to listen, speak, understand, observe as well as draw (Cole, 2008). Thus, reading books to young children is one of the most important activities for developing language and early literacy skills.

All the studies included in this literature review are small-scale experimental studies. Research regarding the effects of e-books may not be numerous but existing studies cover a range of participant variables such as age, gender, socioeconomic status and bilingualism. An array of experimental conditions have been investigated such as participants working in pairs, adult reading of a print book, adult mediation of an e-book, comparison of different e-books, and the use of various e-book functions, such as hot spots and on-screen dictionaries.

Digital storybooks, including those created for modern devices such as smartphones and tablets, include a variety of enhancements that are changing children's early experiences with books (Lantz et al., 2020). The literature review presented here indicates that additional enhancements can improve the comprehension and retention of story details by children as young as 3 years old. Research findings indicate that the utilisation of animated visuals has been shown to decrease the cognitive effort needed to associate nonverbal cues with story language. This reduction in cognitive load subsequently enhances the processes of vocabulary acquisition and comprehension of stories (Schnotz & Rasch, 2005). There is evidence that animated images may be particularly beneficial for young children and children with language-delays (Bus et al., 2015). However, the inclusion of extraneous

visualisations and/or a variety of digital features might impede the learning process by depleting the mental capacities dedicated to information processing. In particular, certain digital components incorporated within storybook applications may lack a deliberate design and purpose aimed at directing attention and facilitating learning towards specific words and topics. These attractive and exciting digital features may attract children's attention to certain visuals that may be irrelevant to the story. Consequently, there exists the possibility that these e-books could hinder rather than improve story comprehension and vocabulary acquisition. Moreover, Bus et al. (2015) have provided empirical support for the notion that music and auditory stimuli have the potential to cause interference and decrease performance, particularly among children who have language deficits. The primary objective of Study 1 is to assess the effectiveness of e-books and their associated digital components in promoting or hindering the learning process.

In conclusion, well-designed e-storybooks provide scaffolding which supports young children who are developing literacy skills. Although many hopes have been raised with reference to the potential of e-book reading by young children, their quality as language and early literacy support is controversial. There is a concern that many e-books found on the commercial market are targeted more towards amusement than promoting young children's learning (Korat & Segal-Drori, 2016). Consequently, further research is needed to examine and evaluate commercially accessible e-books utilised by children to develop language and literacy.

1.7 Summary

This chapter examined the usage of e-books by young children in terms of their language and literacy development, as well as the digital aspects featured in e-books. The digital features are further examined with a meta-analysis performed in Study 1 (Chapter 4). Furthermore, when a child utilises an e-book, additional aspects of this activity, such as adult scaffolding, may be deemed essential. Chapter 2 explores teacher scaffolding during storybook reading, which is explored in both Study 1 and Study 2 of this thesis.

Chapter 2: Teacher Scaffolding During Storybook Reading

This chapter includes an overview of teacher scaffolding during traditional storybook reading as well as research assessing scaffolding while children are listening to electronic books. Two scaffolding strategies, performance and interactive, are introduced in Chapter 2 and evaluated in Study 2 (Chapter 5).

2.1 Introduction

Young children today are exposed to tablets, telephones, computers, and television from the very first months of their birth. Information is presented not only as words printed on paper but as digital images, sounds, animations, and texts. Materials such as e-books and applications are being used at schools to further teachers' goals in language and literacy development. Teachers at times may need to utilise different teaching resources to support and enhance reading. Thus, schools can provide children with innovative ways to use this technology. A number of studies have shown that digital literacies have the potential to provide young children with valuable learning experiences that enhance their learning and development (Beschorner & Hutchison, 2013; Clarke & Abbott, 2016). Moreover, technology has been found to have a positive impact on developing children's early literacy skills (Crescenzi et al., 2014; Neumann, 2014) as well as children's acquisition of a second language (Pellerin, 2013). However, the types of strategies educators can use to scaffold children's learning and understanding of the story content of e-books and print books requires further examination.

2.2 Background

According to Holdaway (1979) the "shared book experience" strategy is an interactive "reading experience" where the adult reads the story to the child and following the stories plot or memorable character, they both discuss the book's plot or topic (Holdaway, 1979; Reid, 2016). In this study, shared book reading is described as verbal alternations between the reader (i.e., adult, teacher) and the children in order to encourage the children to engage in lengthy discussions, ultimately fostering the children's literacy and language development (Dickinson & Morse, 2019). Storybook reading is a regular activity in the

preschool classroom and has many benefits for early learning (Bus et al., 1995; Dickinson & Tabors, 2001; Gonzalez et al., 2014). The adult may ask questions about the story or vice versa and, as a result, the adult is increasing the child's vocabulary, sentence structure, syntax, and print concepts (Reid, 2016). Adult-child shared storybook reading has been shown to promote the language and literacy of children considered at risk for learning difficulties (Justice et al., 2005). Zucker et al. (2013) examined the frequency (repetitions) of shared reading sessions and features (teachers' extra-textual discussions) of reading experiences within the preschool classroom with respect to children's language and literacy outcomes. Participants were 28 preschool teachers and 178 children (at risk). The researchers found that the frequency of shared classroom reading was positively and significantly related to children's receptive vocabulary development, as was the inclusion of extra-textual conversations around the text. Similarly, Aram and Biron (2004) compared the effectiveness of a joint storybook reading intervention for literacy development by using 11 children's books. The children involved were aged 3–5 years from low socio-economic backgrounds in Israel (n=35, control=24). The children in the reading programme performed significantly better than a control group (no intervention) on measures of orthographic awareness (d=0.91), word writing (d=0.13), and listening comprehension (d=0.30).

Traditionally, shared book reading has functioned as a chance for social contact to assist children's emerging literacy skills (Dickinson & Smith, 1994), and the majority of this research has historically been conducted using traditional paperbound books. As the use of e-books increases, so does the amount of research examining book reading in an electronic format. Theories of collaborative book reading using an electronic medium are likewise grounded within sociocultural theory (Neumann & Neumann, 2014; Yelland & Masters, 2007). These theories propose that children may learn from e-books through scaffolding. The current thesis sought to better understand scaffolding with the use of different teaching styles while reading a print book and an e-book.

2.3 Scaffolding During Storybook Reading

There is an extensive body of research demonstrating the impact of storybook reading on language-related outcomes, including a number of meta-analyses that evaluated the effects of storybook reading with young children in early years classrooms (e.g., Blok, 1999; Mol et al., 2009; Noble et al., 2019). Blok (1999), for example, conducted a meta-analysis and

reviewed ten studies, published between 1968 and 1994, regarding the impact of reading to young children in schools. The dependent variables were divided into two categories: oral language and reading skills. The total effect size for the domains of oral language and reading was d = 0.63 and d = 0.41, respectively. Despite the fact that these impact sizes may appear optimistic, it is important to note that the number of included studies was relatively small, and the majority of the included studies were of poor quality, e.g., the studies did not utilise an experimental design and a common deficiency in the majority of the included studies was the lack of information on the reliability of the dependent variables. Mol et al. (2009) conducted a meta-analysis to determine the extent to which interactive storybook reading improves vocabulary and print knowledge. The authors examined 31 (quasi-experimental) studies (n=2,049 children) in which teachers were trained to encourage children's active participation before, during, and after shared book reading. The authors categorised their included studies into three groups (i.e., dialogic, interactive, and interactive with extra activities) but did not provide more information relating to the characteristics of these groups, although the dialogic and interactive teaching style have many similarities. The effect sizes for language-related outcomes ranged from small to moderate: d = 0.45 for receptive vocabulary, d = 0.62 for expressive vocabulary, and d = 0.39 for print knowledge. In addition to the meta-analyses reported above, Noble et al. (2019) examined studies conducted between 1980 and 2017 that focused on shared reading interventions for typically developing children aged 7 years or younger. While there is an impact of shared reading on language development, it is less than that found in prior meta-analyses (g = 0.19, p = 0.002) and is close to zero when control groups were active and not just following the daily school curriculum (g = 0.028, p = 0.703). These results indicate that the current evidence for the efficacy of shared reading treatments is substantially lower than previously recognised.

The existing body of literature related to storybook reading suggests that engaging in this activity is associated with a variety of positive developmental outcomes. Among the most important are advances in language (expressive, receptive) and in emergent literacy (e.g., print awareness, vocabulary acquisition, letter knowledge, phonological awareness) that are fundamental to learning to read, engagement in reading, and ultimately contributing to academic achievement in school (Bus et al., 1995; Fletcher & Reese, 2005; Mol & Bus, 2011; Mol et al., 2008; Whitehurst & Lonigan, 1998). The benefits derived from early exposure to books last beyond the early childhood and extend into the periods of

adolescence and young adulthood (Mol & Bus, 2011). Over the past several decades, numerous studies have shown preschoolers' exposure to shared reading is associated with their development of language and early literacy development (e.g., Bus et al., 1995; Hindman et al., 2012; Mol et al., 2008; Mol & Bus, 2011; Payne et al., 1994; Zucker et al., 2013). Many of these positive outcomes are mediated by the adult child interaction that occurs during reading (Bus et al., 1995; Fletcher & Reese, 2005). Adults' talk to children is more complex during storybook reading than it is in other contexts (Richter & Courage, 2017). The approach in which young children are read to correlates with the language skills they acquire from shared book reading (Zevenbergen & Whitehurst, 2003) compared to an adult reading a story to a child without actively engaging the child (Arnold & Whitehurst, 1994; Whitehurst et al., 1994). Although positive correlations have been found between variation in the quality of adult scaffolding during shared reading and children's language development (e.g., Hindman et al., 2008; Hindman et al., 2014), further research is needed to examine the effectiveness of these scaffolding techniques in relation to young children's language and story comprehension development. Hence, the second study presented in this thesis evaluated and compared two teaching styles of an adult reading a story to a group of young children.

Several factors have been reported to influence language and literacy development from storybooks, such as who reads the story (Hindman et al., 2008), the type of scaffolding style employed (Bus et al., 1995; Reese & Cox, 1999), the child's age (Hargrave & Sénéchal, 2000), and the number of times the story is read to the children (e.g., Sénéchal, 1997). During the storybook reading session, adult scaffolding may occur through the use of various approaches and techniques. Scaffolding can occur prior to reading a story, during the story, and after the story is finished. As a start, adults have the opportunity to begin a story in ways that promote and ensure children's engagement in the session prior to shared reading. A traditional approach is to begin the story by examining the front and back cover of the storybook and make predictions concerning the story plot (Hindman et al., 2012; van Kleeck, 2008; Zucker et al., 2013). The synchronisation of attention between adult and child towards an object (in this case the story) prior to reading a story is referred to as *joint attention* (Tomasello & Farrar, 1986). According to Hoel et al. (2020), in the context of shared reading, creating a frame of joint attention prior to the reading activity provides an opportunity to scaffold literacy acquisition and can play a crucial role in sustaining children's attention, which may aid in vocabulary acquisition and story comprehension. In

addition, joint attention can continue while reading the story with the use of "extratextual" talk during shared storybook reading (Hindman et al., 2014), as well as at the end of the story. During and after a storybook reading, teachers frequently engage in conversations concerning the story (Fisher et al., 2004; Hisrich & McCaffrey, 2021; McCaffrey & Hisrich, 2017).

An example of extratextual talk during a shared-reading intervention is the *dialogic reading* approach developed by Whitehurst et al. (1988) as a language intervention for young children. The adult/educator is trained to utilise particular strategies to engage children in story-related discussions that are intended to foster their language development (Zevenberg & Whitehurst, 2003). These include asking wh-questions (e.g., "what is that?") and open-ended inquiries (e.g., "what is going on on this page?") and proving feedback (e.g., by expanding on what the child has said and/or described). Interactive (or dialogic) reading, for example, entails using a series of strategies to facilitate an interaction or dialogue between an adult and a child about the story at hand (Noble et al., 2019; Whitehurst et al., 1988). This common activity promotes conversation (Hoffman & Paciga, 2014) and appears to be a particularly rich source of verbal interaction between the adult and the child (e.g., Gilkerson et al., 2017; Mol et al., 2008; Whitehurst et al., 1988).

There is a substantial body of correlational, experimental, and intervention research that provides evidence for the advantages of dialogic reading (e.g., Flack et al., 2018; Mol et al., 2008; Noble et al., 2019). The meta-analysis by Mol et al. (2008) was undertaken to investigate the additional benefits of an interactive shared book reading that prioritises active engagement by the child, as compared to non-interactive involvement. They included 16 studies that reported vocabulary as an outcome measure and whose (quasi-) experimental conditions included a dialogic reading intervention group and a reading-as-usual control group with parents and their children. For expressive vocabulary their results revealed a moderate effect size d=0.59, with a sample size of 322 participants, favouring the dialogic reading intervention group (95% CI = [0.44, 0.75]; SE = 0.08; p< .001). However, the researchers noted that the effect size significantly decreased in older children (aged 4 to 5 years; n=275; d= 0.14; SE = 0.07; 95% CI = [–0.10, 0.37]) or in those who were at risk for language and literacy difficulties (n=208; d=0.13; SE= 0.11; 95%CI = [–0.08, 0.35]). In general, the studies included in this meta-analysis have demonstrated that engaging in dialogic reading has the potential to influence the home literacy practises of

families with children between the ages of 2 and 3 years. However, it does not appear to have the same impact on families with children who are at a higher risk of experiencing academic difficulties. In another meta-analysis conducted by Flack et al. (2018), a total of 38 studies including 2,455 children were examined to explore the potential moderating effects of reading styles, story repetitions, and associated variables on children's word comprehension. The findings of their study demonstrated that the implementation of dialogic reading, such as the utilisation of gestures, offering definitions, or engaging children in questioning during shared storybook reading, had a notable impact on the acquisition of new vocabulary by children. The use of dialogic reading techniques yielded a statistically significant increase of 1.22 words in children's vocabulary acquisition compared to non-dialogic reading approaches ($p < .001$). Therefore, in the context of acquiring vocabulary through storybooks, the manner in which stories are read holds greater significance than who reads them. The most recent meta-analysis conducted within the scope of dialogic reading was the study by Dowdall et al. (2020), aimed at evaluating the effects of dialogic book-sharing interventions on the language development of young children (ages 1-6 years). Their meta-analysis included 20 studies and their results revealed that shared reading interventions with parents produced a small positive effect size for expressive (n=1.664; d=0.41; 95% CI = [0.20, 0.61]) and receptive vocabulary (d=0.26; 95% CI = [0.12, 0.40]) of children. This suggests that interactive book sharing may be effective in enhancing both receptive and expressive vocabulary skills; however, these results were compared to control conditions that did not involve book reading (i.e., no intervention). Similarly, the meta-analysis of Flack et al. (2018) did not include a control group. In general, the results from various meta-analyses yielded inconsistent findings. Mol et al. (2008) reported that the beneficial effects of storybook reading were less evident in studies involving older preschool children (4–5 years old). Conversely, Dowdall et al. (2020), Flack et al. (2018) and Noble et al. (2019) suggested that the effects of storybook reading do not appear to differ based on children's age. In general, the existing body of literature indicates that dialogic reading is a generally effective approach for fostering receptive and expressive vocabulary. Hence, it is essential to explore potential variances in outcomes when comparing different scaffolding techniques employed during shared storybook reading with young children. The purpose of Study 2 is to examine and contrast two different scaffolding strategies, namely interactive and performance teaching styles, with the aim of assessing their efficacy in facilitating language acquisition among young children.

Overall, research has shown that during adult-child storybook reading, teachers are more likely to engage children in discussions relating to the instruction of new vocabulary (Dickinson et al., 2014), and this is supported by sociocultural theory (Vygotsky, 1978). A recent study by Clemens and Kegel (2021) found that engaging in book reading serves as a highly effective activity of boosting language skills in toddlers as early as 9 months of age. Furthermore, the study revealed that this particular activity evokes a greater degree of language usage when compared to other common parent-infant activities with language-related goals. The content of the storybooks appears to offer a valuable resource for parents, educators, and young children, stimulating rich language from both adults and children (Sosa, 2016). Furthermore, storybook reading allows adults to personalise story material by linking the text to the children's prior experience, enabling them to elicit conversations revolved around their own personal experiences, which improves story comprehension (Hoffman & Paciga, 2014), language exposure and the development of narrative and conversation skills (e.g., Grolig et al., 2019; Morrow, 1988). Preschool teachers apply these interactive techniques while reading to young children, and although discussion and questioning during shared book reading have been proven to be beneficial to children's literacy and language development, the amount and type of discussion used by adults is found to vary widely. Despite the substantial research base on storybook reading, there are several remaining areas to be investigated. The amount and type of dialogue initiated by the teacher while reading, as well as the manner in which a teacher reads, are two crucial parts of shared book reading that have a significant effect on the outcomes for children (Teale, 2003).

2.4 Scaffolding and Literacy Development

Scaffolding involves education-oriented support, discussions, and interactions that occur between a teacher and a learner with the aim of facilitating learning. It is closely connected to Vygotsky's social constructivist view of learning and his concept of Zone of Proximal Development (ZPD, Vygotsky, 1978) as well as the constructivist learning theories of Bruner (1966), Dewey (1923), and Piaget (1973). Constructivism's central idea is that learning is constructed, and learners develop new knowledge by building on their prior knowledge and experiences. According to Vygotsky (1978), learning takes place within the ZPD, that is, an area in which cognitive development is still in progress. The ZPD

delineates the gap between a student's independent capabilities and the level of support required to accomplish a learning activity successfully. Students experience success in the ZPD, which is facilitated by the provision of instructional scaffolding, which is widely recommended as a highly effective and varied constructivist teaching strategy (Clack & Graves, 2005). By employing Vygotsky's theoretical framework, educators have the ability to provide instructional scaffolding by adapting the amount of assistance provided throughout a teaching session to align with the student's present level of performance (Verenikina, 2008). A constructivist approach fosters a collaborative learning environment in which teachers and students co-operate and share their knowledge (Nicaise & Barnes, 1996). During shared book reading, which is a student-centred activity, both the child and adult are active participants in the construction of a dialogue surrounding the storybook (Whitehurst et al., 1988). Research greatly supports adult guidance while reading/listening to a storybook and the importance of adult scaffolding during storytelling to develop young children's literacy skills (Homer et al., 2014; Korat et al., 2011; Moody et al., 2010; Rvachew et al., 2017).

Studies on scaffolding during storybook reading fall into two broad categories: descriptive studies (i.e., not experimental) focusing on how adults read storybooks to children (e.g., Hindman et al., 2012; Zucker et al., 2021) and experimental studies analysing reading styles to determine how adults may read most effectively with young children (e.g., Wasik et al., 2006; Strasser et al., 2013). Walsh and Hodge (2018) conducted a review assessing the questioning techniques of 20 experimental studies during shared book reading with young children. The studies were examined in terms of their focus, quality, and questioning techniques. The reported studies appeared to focus on the effect of questioning techniques on language and literacy development, while the majority of studies used a low level of cognitive demand questioning to scaffold children's learning. Indeed, findings from other studies (e.g., Dickinson & Keebler, 1989; Dickinson & Smith, 1994; Hindman et al., 2012; Zucker et al., 2010) suggest that early childhood educators typically pose simple questions that require a minimal amount of cognitive effort to respond and that elicit one-word responses (Beck & McKeown, 2001).

In addition, another challenge that arises in research is when to ask the questions and whether the questions themselves may divert the child from the storyline. Wasik et al. (2006) undertook a language and literacy intervention with 16 teachers and 207 children,

in which the teachers were trained to use certain discussion techniques during their storybook reading. The scaffolding techniques were based on the research of Dickinson and Smith (1994) and Snow (1983), which demonstrated the following: engaging and encouraging active listening, demonstrating rich language, and proving feedback. Wasik et al. (2006) found a correlation between the timing of questions and vocabulary development, with questions asked before and after reading having a stronger influence on receptive and expressive language skills than questions asked while reading. However, Strasser et al. (2013) in their study with 72 children showed that explaining new vocabulary and unfamiliar words during storytelling did not hinder children's story comprehension. Therefore, further investigation is required to determine whether or not this association exists. Although the importance of scaffolding during storybook reading has been established (Van de Pol et al., 2010; Zucker et al., 2020), one area that requires further consideration is how different reading styles influence children's vocabulary and story comprehension; thus, researchers contend that how educators read to children is as important (Flack et al., 2018; Morrow et al., 1990; Senechal, 1997; Teale, 2003). Therefore, it is essential to determine which teaching style is deemed more beneficial for the language and literacy development of young children, and specifically in the context of e-books.

2.5 Interactive and Performance Teaching Styles

Although shared storybook reading is a well-researched practice with young children, few studies have examined the scaffolding styles that teachers may use in combination with different types of media. The second study intends to examine the impact of e-books versus print books on children learning English as an additional language in terms of vocabulary and story comprehension. Study 2 also investigates the reading styles of teachers: the *interactive style* which engages children in discussion of the story as they read, and the *performance style* characterised by few interruptions during the storytelling session, accompanied by extended pre- and post-story discussion. The timing of discourse before, during, or after reading a storybook might be significant, especially for young children with limited language skills who may benefit from adult pauses while reading to scaffold learning (Gathercole & Baddeley, 2014; Reese & Cox, 1999).

The two teaching styles (a) interactive style and (b) performance style are described as follows in the literature: the *interactive reading style* is considered a common approach (e.g., Baker et al., 2020; Baker et al., 2015; Flack et al., 2018; Walch, 2016). It is a

technique in which the reader frequently stops the story to engage the audience in the reading process (Arnold & Whitehurst, 1994; Whitehurst et al., 1998). Reading that involves such intensive interaction with children has been demonstrated to be particularly beneficial for vocabulary acquisition (Whitehurst et al., 1994; for reviews see Flack et al., 2018; Mol et al., 2008; Noble et al., 2019). In interactive storybook reading, an adult reads aloud a story, explains its content and vocabulary, and includes open-ended questions in a process of feedback and validation (Nevo & Vaknin-Nusbaum, 2018). It has been established that children learn about their environment by active participation in retelling and discussing the storyline, characters, and the vocabulary involved in the story (Pollard-Durodola et al., 2016). This type of teaching style employs the support of adults to cater to the higher-level cognitive requirements of its young audience by drawing parallels between the story and the children's own experiences and emotions (Zeece, 2007). Consequently, it should not come as a surprise that reading aloud from books with questions and answers is a common and necessary part of preschool literacy intervention programmes designed to foster language and literacy development. When adults employ the *performance teaching style*, they emphasise significant words or expressions and change their voices, facial expressions, and body language to impersonate the characters in the story. However, there are few breaks in the text for questioning like there would be in an uninterrupted performance – instead, there are extended conversations before or after the reading (Dickinson, 2001; Dickinson & Smith, 1994).

Greene Brabham and Lynch-Brown (2002) conducted a study with 117 1st graders (6-7 years old) and 129 3rd graders (8-9 years old) that included three conditions with equivalent level and quantity of comments and questions: (1) minimal extratextual talk – just reading condition, (2) an after reading performance style, and (3) during reading interactive style. Teachers were trained and guided by a scripted strategy to use one of the styles when reading two informational storybooks to pupils. This experimental comparison of reading-aloud styles supports the hypothesis that vocally mediated, interactional, and performance reading-aloud styles are more impactful than an adult reading a story without discussion for vocabulary learning. Interactional reading facilitated vocabulary acquisition more than performance reading. Findings confirm that teacher scaffolding and student discussions significantly aid students' acquisition of vocabulary, as well as their ability to construct meaning from storybook reading. Sociolinguistic theory's emphasis on adults' roles in supporting children in constructing meaning from written texts, as well as the importance

of social interaction and scaffolding in language and literacy development and education, were validated by the significant effects of reading aloud styles with verbal mediation on vocabulary gains (Ninio & Bruner, 1978; Vygotsky, 1986). Morrow et al. (1990) summed up differences between just reading and socially mediated reading by explaining, "Reading to a child is not sufficient for maximum literacy growth. It is the talk about books that surrounds the reading that seems to be the key" (p. 268).

In another study by Van den Brook et al. (2011) in the Netherlands, 40 children aged 2-3 years and 42 3rd grade children aged 8-9 years old were randomly assigned to one of two experimental conditions. Depending on the condition, questions were asked either during or after listening to the story. Stories and conditions were counterbalanced in order to ensure that each story occurred in every condition across all children. Results showed that the children benefited more from causal questioning techniques during reading as compared to after reading, perhaps because of reduced working memory demands (Van den Brook et al., 2011). Dickinson and Smith (1994) examined correlations for 25 preschool *teachers' reading styles* and their students' scores on story retellings and the Peabody Picture Vocabulary Test—Revised (PPVT–R). Analysing one videotaped read-aloud session from each classroom, the researchers found that 10 teachers used a performance style, limited discussion during reading, and followed up with extended discussion after the reading performance. Fifteen teachers read with interactional styles but exhibited two different approaches. Dickinson and Smith identified 10 of these teachers as "didactic interactional" because they asked children to respond to questions, repeat factual information, and recite parts of the text in chorus during the reading. The other five interactional teachers were called "co-constructive interactional" by the researchers because they had children predict, analyse, generate word meanings, and draw conclusions as they read. According to Dickinson and Smith, the most beneficial reading style for students' comprehension and vocabulary development was a performance style of reading, in which there were few interruptions during the read-aloud, but more time was spent on discussion afterwards.

Sezer et al. (2021) performed a study in a Turkish language setting to examine three read-aloud styles using children's picture books: just reading, performance reading, and interactional reading, on the text reading fluency and reading comprehension of 152 first grade and third-grade students. The just reading approach consists of reading the story

without additional analysis. During the performance reading, the teacher and pupils engage in a discourse, albeit a limited one. After the story concluded, the reader engaged the pupils in a discussion regarding the story. By asking questions, the reader encouraged pupils to relate the narrative to their own experiences. Their findings showed that while the first graders' text reading fluency scores were not affected by the read-aloud approaches, their story comprehension scores were affected in favour of the group in the just reading condition. The third-grade students' reading fluency and story comprehension did not vary by the read-aloud method. According to the researchers, these findings do not provide a clear picture of the effectiveness and differences of various read-aloud approaches for children's picture books.

Reese and Cox (1999) suggested that the style of reading should take into consideration the child's initial level of skill. In their experiment, Reese and Cox (1999) investigated the relative advantages of three different teaching styles of extratextual talk during shared reading on children's language development in a six-week intervention. Preschoolers were randomly assigned to one of three intervention groups, in which they engaged in one-on-one shared reading with an adult who employed either a describer style (describing illustrations), a comprehender style (focusing on the content of the story), or a performance style (similar to the comprehender style but with discussion occurring after the story had been shared). The children's vocabulary, print awareness, and story comprehension skills were evaluated both before and after the intervention. The researchers found that the describer style was the most advantageous to children's vocabulary and print awareness. However, after the children's initial vocabulary skills were considered, the describer and performance-oriented styles resulted in larger vocabulary improvements. Study 2 attempts to contribute to this line of work on comprehension and vocabulary development by examining the different types of storybook scaffolding offered by a teacher and their effects on the literacy development of children learning English as an additional language.

2.6 Scaffolding and E-books

Research that examines adult–child interactions during shared storybook reading has identified key behaviours that appear to facilitate language learning (Zucker et al., 2021; Korat et al., 2011; Moody et al., 2010; Rvachew et al., 2017). However, adults may be less likely to make use of these facilitative behaviours during experiences with digital storybooks (Parish-Morris et al., 2013). E-books may be suitable as an addition to, rather

than a replacement for, high-quality adult–child interactions around storybooks (Kelley & Kinney, 2017). Scaffolding is also important for e-book reading. It has been found that young children benefited more from language acquisition while reading an e-book with adult scaffolding than when reading the same book independently (Segal-Drori et al., 2010; Strouse et al., 2013).

There are currently a number of experimental studies with young children that test the effect of independent e-book "reading", and these studies suggest that e-books may be a useful tool for fostering language and literacy development (e.g., Savva et al., 2022; Takacs et al., 2015). However, little is known about how children interact with adults when using these devices. Technology like e-books may provide a vast array of narratives and information for children to discover on their own; however, children may be exposed to material that is too complex for them to fully process without the help of an adult. In research comparing book reading in electronic and paper formats, it is common for an adult to read the print book aloud to the participant, while the electronic device generally utilises audio narration to "read" the book to the participant. A study by Strouse and Ganea (2016) suggests that not having the necessary vocabulary to understand the concepts presented in a non-fiction e-book may hinder a child's comprehension in the absence of appropriate scaffolding by an adult. Their study examined whether adult prompting during the reading of an e-book improved children's comprehension of a scientific concept. Ninety-one 4-year-olds listened to a non-fiction story in three conditions: (a) e-book, (b) e-book read by a researcher, or (c) print book read by a researcher. Although children were able to transfer the knowledge from the story and apply it to a problem, for children with lower vocabulary levels, performance was higher in the conditions with a researcher reading with them (Strouse & Ganea, 2016). This study shows that adult scaffolding is important for learning to occur in situations where children may be exposed to narratives and information that they may not have the vocabulary to fully grasp. An experimental research examining parent co-use of interactive media with a sample of 40 low-income 4- and 5-year-old children had comparable results. On post-tests, children in the parent-child condition performed significantly better than children who interacted with media independently (Griffith et al., 2022).

Scholars support adult scaffolding during e-book reading as research has demonstrated that young children learned more language from an e-book supported by adult scaffolding than

storybook reading without scaffolding (Savva et al., 2022; Segal-Drori et al., 2010; Strouse et al., 2013). However, traditional adult storytelling scaffolding has inevitably changed over the last ten years due to the inclusion of e-books. Young children today are increasingly reading e-books without adult mediation. For instance, 80% of parents say their child aged 5 to 11 years interact with a tablet computer or smartphone independently (Auxier et al., 2020). E-books provide a diverse array of digital attributes that may resemble the adult-child scaffolding process, therefore rendering e-books a potentially valuable educational tool for young children (Moody, 2010). Thus, the first study of this thesis aims to analyse the impact of these features on children's learning.

The constructivist approach to learning best supports this major change, since it enables children to actively create their knowledge via their own initiative while engaging with e-books through reading or listening (Haas et al., 2017). Children are able to actively engage and build new knowledge as they combine previous knowledge, experiences, skills and the use of digital features to comprehend the story's content and learn new vocabulary. For example, when engaging with an e-book the computer may narrate and highlight the text to support vocabulary and print awareness; it may provide animation to support comprehension and use vibrant illustrations to engage the young reader both visually and audibly (Kayaoglu & Akbas, 2011). Rvachew et al. (2017) compared shared reading interactions with e-books versus paper books, with an adult reader for the development of emergent literacy skills. Their study examined twenty-eight children from kindergarten participating in an interactive reading style offered by an adult reader versus an animated e-book linking words from the text with animated illustrations. The e-book condition exhibited higher levels of emergent literacy knowledge compared to the print book condition, particularly for children with limited letter knowledge. Therefore, e-books intended to promote supportive adult reading practices may increase emerging literacy skills, particularly in children who enter school with poor letter knowledge. Written text combined with synchronised dynamic graphics and sounds may enhance story content and aid children's mental imaging of the story (Bus et al., 2015; Korat, 2010).

According to Altun (2018), e-books have the potential to enhance information processing, promote learning, and provide children with valuable experiences that contribute to constructive learning. Consequently, e-books enable children to engage in scaffolding, as proposed by Bruner (1966). Ihmeideh (2014) compared the results of an e-book and a print

book with adult support in both conditions in a Jordanian preschool with a total of 92 children in order to measure the children's development in print awareness, vocabulary, alphabetic knowledge, and phonological awareness skills. The results showed that the children in the e-book condition outperformed those in the control condition. Korat et al. (2022a) conducted an intervention in kindergarten with 103 children (aged 5–6 years) from LSES families, using an e-book for vocabulary enrichment. The following three conditions were evaluated: (a) children read the e-book with a dictionary and the teacher's support, (b) children read the e-book with the dictionary independently, and (c) children read the e-book without a dictionary (control). Children who read the e-book with the dictionary and the teacher's support acquired more vocabulary in all three tested measures (receptive understanding, word explanations and word production) and outperformed the children who read the e-book independently with the dictionary, as well as the control group. These achievements were maintained after a month. The researchers support that the distinctive components of the e-book, combined with the adult scaffolding within the classroom context and curriculum, support the learning of new words.

There are limited studies comparing the effects of adult scaffolding in both print and e-book condition within a class context (see Savva et al., 2022). Most studies in which an adult is present during the intervention consist of the adult only reading the narrative to the child (either print or e-book condition); or assisting the child in matters pertaining to how the participant should operate the digital devise (e.g., Korat et al., 2014a) while not employing story-related language to scaffold children's learning (Chiong et al., 2012; Parish-Morris et al., 2013). Children are also reported to discuss more about device-related content rather than story-related content while reading e-books in comparison to print books (Richter & Courage, 2017). As a result, early childhood teachers play a critical role in the integration of technology in literacy instruction. Integrating technology into daily literacy instruction can offer rich, engaging, and creative experiences that expand young children's understanding of what it means to be literate in today's world. A deeper examination is needed to determine how teacher-child talk during shared reading of e-books versus print books can positively engage and scaffold language and literacy learning in the early years setting.

2.7 Summary

This chapter has explored teacher scaffolding during print book reading and e-book

reading, as well as two scaffolding techniques, the performance and interactive style. Overall, e-books and storybook applications provide teachers with possibilities to promote shared reading among young children. Numerous studies have investigated the educational advantages of youngsters reading digital books. Less is known, however, about how young children engage with and learn from e-books, as well as how teachers facilitate these early reading experiences, particularly for children whose native language is not the one read in the e-book. Therefore, this thesis explored the abovementioned teaching styles while children were listening to an e-book and print book for children learning English as an additional language (Chapter 5). Chapter 3 explores young children learning English as an additional language (EAL) from print books and e-books, which is explored in Study 2 of this thesis.

Chapter 3: Young Children Learning English as an Additional Language (EAL) and Storybooks (Print & E-books)

3.1 Introduction

English language is one of the most widely spoken languages in the world whilst it is the official language of more countries than any other language (Rao, 2019). Learning to speak more than one language is associated with numerous advantages (e.g., executive functioning, analytical thinking) (Bialystok & Craik, 2010) and an increasing proportion of children around the world are growing up learning multiple languages. These children are educated in English at school, yet they have been exposed to a language other than English at home since birth (Department for Education, 2015). Children who enter school with limited English vocabulary are at risk of underachievement as vocabulary skills lay the foundation for reading, which is essential for later subject area learning (Figueras-Daniel & Barnett, 2013) and the root of academic failure (Durham et al., 2007). Education is a long-term endeavour whose results continue to impact life outcomes. The primary objective of the Department for Education (2021) Statutory Framework for the Early Years Foundation Stage is to teach children the core skills upon which they will construct their future education as early school years are the foundation for academic outcomes (Department for Education, 2021). The most essential of these skills are language and literacy development. Consequently, it is not surprising that the majority of research evaluating interventions for children learning English as an additional language (henceforth EAL) have focused on the development of these essential developmental skills in children. It is, therefore, the purpose of this chapter, firstly, to describe the profile of young EAL children in Cyprus (where Study 2 took place), and secondly, to explore reading of print books and e-books, with and without support, and how digital elements contained in e-books might help children progress.

According to the UK Department for Education (2015), a child's first language is the language he or she has been exposed to since infancy. In the literature, learners for whom English is not their first language are referred to by a variety of terms including: Bilingual Student, Second Language Learners (SLL), English as a Second Language (ESL), Limited

English Proficient (LEP), Language Minority Student, English Learner (EL), and Learning English as an Additional Language (EAL). I propose that English as an Additional Language (EAL) may be the most appropriate term for this thesis as participants in the experimental study were taught English at school, although the majority of them spoke more than one language at home. Furthermore, in North America, individuals whose first language is not English are commonly referred to as English as Second Language (ESL) or English Language Learners (ELL). The term English as an Additional Language (EAL) is predominant in the United Kingdom (Siegel, 2016), and will be used throughout this thesis when referring to learners whose first language is not English; for some children, English may be their third or fourth language.

Children learning EAL are not a homogenous group; they reflect a wide range of linguistic, cultural, ethnic, and educational characteristics (Demie, 2018). Reading in English is more difficult for pupils who are simultaneously learning to speak English than for those who are already fluent in the language (Goldenberg, 2020). In addition to mastering English decoding skills, EAL children must develop adequate English language skills to understand what they are reading (Pico & Woods, 2023). Language assistance may be especially useful for this population. Many EAL children may attend school with poor English language skills, notably vocabulary knowledge, because their exposure to English prior to school entry varies (e.g., Mahon & Crutchley, 2006). According to statistics from the UK Department for Education, 20.2% of pupils in UK primary schools are learning English as an additional language (Department for Education, 2019). In the early years of schooling in the United Kingdom, national assessments of language and literacy demonstrate a persistent achievement disparity between EAL children and their monolingual English-speaking classmates (Strand et al., 2015). Undoubtedly, there is a need to provide support for EAL children's early language and literacy development starting as early as their first entry at school.

3.2 Characteristics of EAL Learners

Globalisation has brought a rise in cultural and linguistic heterogeneity in current educational settings (Scarino, 2014). Policymakers and educators have a vested interest in the topic of EAL; however, there is a lack of data on how to support this group of children when included in the mainstream classroom who are not native English speakers and who

speak a non-English language at home in English-speaking schools.

If children learning EAL differ from their monolingual peers, it is essential to examine the difficulties they face as well as any advantages they may have internalised as a result of their acquisition of more than one language. Festman (2021) argues that learning a new language is aided by the child's current linguistic repertoire, which includes the child's prior knowledge of language in the form of memorised vocabulary, grammatical structures, sound patterns, etc. Similarities between the new language and a previously taught one has been hypothesised to facilitate learning (Hammarberg, 2001). For children that are learning a third language it has been seen that words and phrases from both other languages have been incorporated into the target language (Rothman et al., 2019). There is also the fact that there seems to be a window of opportunity within which a child can acquire a second language and use it fluently (Lenneberg, 1967), which makes the early years stages quite critical for these young children that enter an English-speaking school but not knowing a word of English. Another factor to consider is that children under the age of eight years are not yet completely developed cognitively, and hence lack key abilities (such as the ability to generalise, abstract, or form inferences) that may be helpful for adults learning a second language (Grosjean, 2010). Cummins (1984) found that EAL learners need over five years to become fully academically proficient in their second language. Determining whether the language difficulties exhibited by children with EAL result from a lack of language exposure or an underlying language impairment is a significant difficulty for practitioners (Bedore & Peña, 2008; De Lamo White & Jin, 2011; Kohnert, 2010). Consequently, there are several factors to consider while educating EAL learners and assisting them in the acquisition of a new language, especially when early years educators may need to utilise a variety of contemporary materials to assist and develop children's literacy and language skills. Less research exists on the component processes that drive the vocabulary development of children learning to speak in English as an additional language (EAL), notably in Cyprus, where English language learners have a heterogeneous linguistic background.

3.3 The Case of Cyprus

Cyprus is an island nation in the Eastern Mediterranean Sea. It is the third largest and most populous island in the region and located east of Greece. Cyprus itself is de facto partitioned into the south, which is effectively under control of the Republic and accounts

for 59% of the island, while the northern region is handled by the self-declared Turkish Republic of Northern Cyprus. The North is recognised only by Turkey. The international community considers the northern region as part of Cyprus which is occupied by Turkish forces.

According to the preliminary data released by the Statistical Service of Cyprus regarding the population and housing census of Cyprus conducted on October 1, 2021, the population residing in the Government controlled areas of Cyprus was 923,272 individuals. Among this population, the total count of foreign nationals was determined to be 193,300, constituting approximately 21.1% of the total population. Regarding the population recorded by country of citizenship, the majority of the foreign nationals come from Greece, the UK, Romania, Bulgaria, the Philippines, Russia, Sri Lanka, Vietnam, Syria, Ukraine, India, Poland, Georgia, and Germany.

The right to education guaranteed by Article 20 of the Constitution of Cyprus (1960, April 6) does not apply just to residents of the republic, but also to the children of those who have obtained a permit to stay in Cyprus. Parents may enrol their children at a school within their educational zone, regardless of whether or not they are foreign nationals. Consequently, the right to education is guaranteed by the constitution of the Republic of Cyprus, and all pupils may enrol in public schools. Depending on the preferences of their parents, children may attend either a private or public school. The primary differences between the two schools are as follows: lessons in the public schools are taught in Greek and are provided at no cost. However, in addition to other subjects, children also learn basic English. There are also private schools in Cyprus, and each requires tuition fees. The majority of private schools teach English as their primary language and adhere to the National Curriculum of England. Educators in Cyprus commonly encounter various student populations in the classroom. In many instances, children enrol in preschool in Cyprus with no prior knowledge of English, and they may have considerable language knowledge gaps.

Similarly to the situation in Cyprus, EAL learners in England are a growing and diverse population, comprising little over 21.2% of primary school students (Department for Education, 2019). These children have different levels of English language competency upon arrival to school, ranging from complete fluency to new to English. In the United

States, around 21% of children and adolescents aged 5 to 17 years speak a language other than English at home (U. S. Census Bureau, 2021). According to Jiménez-Castellanos and Garcia (2017), about one in five students in the United States speak English as a second language. Thus, statistics suggest that a considerable proportion of young people nowadays are exposed to more than one language during their childhood (Crystal, 2003). Studying the effects of how to teach young EAL learners has implications for education policy not only in Cyprus but globally. As EAL students are educated alongside their non-EAL English-speaking peers, it is expected that English will be acquired solely through curriculum engagement and interaction with peers (Costley, 2014). However, EAL learners experience considerable challenges in becoming proficient readers and frequently struggle with developing their emerging literacy skills upon entering school, compared to their peers (Fitton et al., 2018). In addition, according to studies conducted in the United Kingdom, EAL learners typically perform worse than their first language English-speaking peers, on measures of expressive and receptive vocabulary, grammar, and story comprehension, even after five years of exposure to English from school entry (Burgoyne et al., 2011; Hutchinson et al., 2003). It is essential to note that the difference in performance on language assessments between monolingual and bilingual children depends on both the duration and frequency of language exposure (Bedore et al., 2012). Indeed, Bedore et al. (2012) found that Spanish-English bilingual children who were exposed to English at least 75% of the time performed comparable to children who were exposed to English 100% of the time on grammar and vocabulary assessments, indicating that more may be done in the school context to meet the educational needs of children learning EAL.

3.4 Storybook Reading and Scaffolding for Children Learning EAL

According to meta-analyses on the effects of storybook reading on language-related outcomes, the current evidence supporting the efficacy of shared reading interventions is far weaker than previously believed (e.g., Noble et al., 2019). Reviews described in Chapter 1 and Chapter 2 regarding storybook reading did not include research involving EAL learners and storybook reading; the studies were confined to those having fluent English speaker participants; in other cases authors made no mention of the language barrier of the participants.

This gap was identified by researchers, and a meta-analysis and two systematic reviews

were published recently (Fitton et al., 2018; Kennedy & McLoughlin, 2023; Pico & Woods, 2023). Fitton et al. (2018) examined in their meta-analysis how shared book reading affects the English language and literacy skills of young children (students up to 12 years of age) learning English as a second language. The final analysis included 54 studies of shared reading conducted in the United States, including both home- and school-based interventions. The primary analyses indicated that shared book reading interventions appear to affect EAL's English language and literacy skills positively. The overall combined effect size in the current study for the impact of shared book reading on EAL learner's outcomes was $g = 0.28$ with large heterogeneity, $Q_E(53) = 253.78$, $p < .001$, $I^2 = 79.12$. This meta-analysis, however, only included research conducted in the United States, an English-speaking country.

More recently, two systematic reviews were published relating to young EAL learners and shared storybook reading (i.e., Kennedy & McLoughlin, 2023; Pico & Woods, 2023). Pico and Woods (2023) in their systematic review synthesised findings from studies on the effects of shared book reading with Spanish-speaking children, who are simultaneously developing their English language proficiency in school settings in the United States. The objective of the review was to systematically analyse peer-reviewed experimental studies that investigated the impact of shared book reading on language-related outcomes for Spanish-speaking bilinguals. They identified 17 relevant studies, primarily examining vocabulary outcomes, with mostly medium to large effect sizes found on researcher designed measures. This review found positive effects of shared book reading on language outcomes for Spanish-speaking emergent bilinguals, particularly for vocabulary development.

In terms of scaffolding during shared storybook reading, the systematic review by Kennedy and McLoughlin (2023) demonstrates how scarce the literature is regarding the evaluation of adult scaffolding during storybook reading with young EAL learners as this was the only review found on adults scaffolding (specifically dialogic reading) for EAL learners relating to their learning from storybook reading. The researchers searched for articles published between 1988 to 2020 to include in their review. Six articles met their inclusion criteria investigating the effectiveness of dialogic reading in developing the emergent literacy skills of EAL learners (i.e., Brannon & Dauksas, 2014; Cohen et al., 2012; Correa et al., 2015; Huennekens & Xu, 2010; 2015; and McCabe et al., 2010). During dialogic reading,

children are encouraged to engage in conversation and interact with the reader in matters relating to the story's characters, the content of the story and personal experiences (Cohen et al., 2012). Overall, the studies indicated that storybook reading interventions are effective for developing EAL learner's vocabulary skills.

However, how a shared storybook intervention is carried out is crucial, especially for children where their first language is not the language narrated in the storybook. Simply exposing children to words by reading aloud a story is probably insufficient to encourage language development (Pico & Woods, 2023). During storybook reading, Chlapana and Tafa (2014) studied the effects of direct and interactive instruction on the vocabulary development of immigrant kindergarten children living in Crete. A total of 87 children, ages 4 to 6 years, were recruited from 12 public kindergarten classrooms. These children were learning Greek as a second language. The children were randomly assigned to two experimental groups and one control group. In the first experimental group, children were presented with brief explanations of target words through direct instruction. In the second experimental group, children actively engaged in discussions pertaining to target words, employing interactive instructional strategies. The findings of the study indicated that interactive instruction was more effective in facilitating the acquisition of target vocabulary compared to direct instruction. Collins (2010) investigated the effects of rich explanations and sophisticated vocabulary learning from storybook reading. Rich definitions consisted of pointing at the image of the target word, offering a broad meaning of the term, providing a synonym, making a gesture of the word when suitable, and utilising the word in a context other than that being described in the story. The author assigned 80 preschoolers to experimental (stories with rich explanations) and control (stories without explanations) conditions and found that rich explanations contributed significantly to EAL learners word acquisition from stories. Given the language-specific nature of vocabulary acquisition, it is crucial to determine the most effective ways for developing EAL leaners skills during storybook reading for vocabulary development as well as story comprehension.

A few studies have examined the effects of an adult offering translations and explanations in a different language than the story. The results of these studies, however, are mixed since they have often only examined results in a single language (e.g., Spanish: Fitton et al., 2018; Leacox & Jackson, 2014; Lugo-Neris et al., 2010; Pico & Woods, 2023; Ulanoff &

Pucci, 1999). Furthermore, in many classrooms, as is the situation in Cyprus, students who attend public or private schools come from diverse backgrounds, while their teacher does not speak their native language. Moreover, the majority of children that enter the preschools have little to no English skills, and their vocabulary is quite limited. Therefore, the educator should explore other scaffolding approaches that may be implemented within every class, regardless of the languages spoken by the children.

3.5 E-books and Young Children Learning EAL

E-books have potential for facilitating children's engagement (Richter & Courage, 2017) and fostering emergent literacy skills (Shamir & Korat, 2007), phonological awareness (Chera & Wood, 2003), as well as comprehension and vocabulary skills (Smeets & Bus, 2015). Well-designed e-books may support EAL learners, as e-books show enormous potential as they may stimulate readers' visual, aural, and even kinesthetic senses to absorb and comprehend a story with the support of the multimedia and interactive features included in e-books, such as hotspots, sounds and animation (De Jong & Bus, 2002, 2004; Neuman, 1997; Verhallen et al., 2006).

E-books have been suggested as highly efficient for enhancing vocabulary acquisition among children (Silverman, 2007, Verhallen & Bus, 2010; Verhallen et al., 2006), and they provide opportunities for teachers to support young children's shared reading experiences (Neumann & Merchant, 2022). Sun et al. (2019) evaluated an animated e-book with 102 preschoolers in Singapore learning Mandarin between the ages of 4 and 5 years. The researchers employed four conditions: (a) animated e-book, (b) static e-book with sound, (c) static e-book only, and (d) a control condition where children played a mathematics game on an iPad. The study examined the impact of the intervention conditions on children's target word acquisition and story comprehension. The findings of the study indicated that children who were exposed to the animated condition had superior performance in terms of target word production and storytelling compared to the rest of the conditions. No significant variations were seen between the two static settings. There were no consistent differences between the two static conditions. The authors stated that their study focuses on Mandarin, which is one of the "notorious" languages that is difficult to learn as a second language, and their positive findings from animated e-books suggests that such a reading format may be beneficial for EAL learners to acquire this difficult language. Silverman and Hines (2009) conducted a study that examined a multimedia-enhanced story

on vocabulary outcomes with English-language learners and non-English-language learners in pre-kindergarten through second grade. While non-English-language learners had no added benefits from media enhancements, there were positive vocabulary gains for English-language learners in both target word and general vocabulary knowledge. Verhallen and Bus (2010) conducted a study on low-income immigrant children living in the Netherlands and learning Dutch as a foreign language. In their experiment, they examined the effects of animated e-books on vocabulary acquisition of 5-year-old children. The story was presented with either static or video images. Reading the story aloud, with the addition of video, was found to be especially effective for vocabulary acquisition (g=0.36). In a similar study, Verhallen et al. (2006) investigated the effectiveness of animated features embedded in e-books and whether these had positive effects on students. Sixty kindergarten children participated in the study; all learning Dutch as a foreign language. They all read a traditional book and an e-book featuring music, narration, and sounds. The study showed that the vocabulary skills of the children were improved at the post-reading phase of the e-book (g=0.62). The study also suggests that the addition of the electronic features does not distract children's attention during reading. Instead, the results showed a connection between the electronic features and improvement of children's attention. Therefore, these studies demonstrate the potential benefits e-books may offer to young EAL learners. The effectiveness of animated e-books in relation to children's vocabulary development is recognised by these studies, as confirmed by the meta-analysis reported in Chapters 4 and 6 of this thesis.

3.6 E-books and Adult Scaffolding for Young Children Learning EAL

Prior studies have mostly focused on the advantages and disadvantages of e-books for young children, without adult scaffolding. Two studies have evaluated e-books with scaffolding support from adults; for native English speakers (Neumann & Merchant, 2022) and for bilingual children (Yang et al., 2022). A recent case study by Neumann and Merchant (2022) explored how one teacher scaffolded a young child's learning and interactions during shared reading of an e-book in her early years' classroom. The teacher used a wide range of words, repetition, and questioning strategies to engage the child with the story content and maintain her interest which provided a positive experience for the child. In the study, the teacher's comments, and questions offered during the shared reading with the story book app were useful in scaffolding the child's interactions with the story and helped prompt the child to respond. Shared reading of digital books, in which an adult

actively scaffolds the young learner, can provide positive opportunities for children to experience language within stories. Using teacher scaffolding to engage and keep the interest of young children through the interactive use of questions, new words, and repetition of words has the ability to engage the child in this activity (Neumann & Merchant, 2022). Although e-book features may be advantageous for native English speakers, this finding may not be generalisable to those who learn English as an additional language.

Yang et al. (2022) carried out a randomised controlled trial to investigate the impact of bilingual discussion prompts along with feedback in a multimedia interactive e-book on parent-child shared reading for young English language learners aged 3–7 years in China. In the treatment condition, a total of sixty-four parent-child pairs read a multimedia English storybook with bilingual discussion prompts. In comparison, forty-three parent-child pairs participated in the identical activity of reading the multimedia storybook without the inclusion of discussion prompts. After reading the storybook twice, it was observed that the children that participated in the discussion-prompt group had superior performance in terms of story comprehension and retelling measures when compared to the control group. This notable difference in outcomes suggests that engaging in discussions facilitated by prompts positively impacted children's comprehension and ability to retell the story. However, children in both groups showed comparable gains in English vocabulary. There is a dearth of research on teacher scaffolding and e-book versus print book reading for young children learning English as an additional language. The present thesis (Study 2; Chapter 5) attempts to contribute to this line of work on story comprehension and vocabulary development by examining the different types of storybook scaffolding by a teacher and their effects on children learning English as a second language. Designers, educators, and policymakers need such evidence and information to guide innovations, design, and policymaking regarding educational technologies in English education in English learning countries. English language is one of the most widely spoken languages in the world whilst it is the official language of more countries than any other language. Consequently, it is of vital importance to examine the effectiveness of e-books in terms of improving the vocabulary skills of children learning English as an additional language.

Furthermore, the limited research on the topic poses a significant problem to Cypriot teachers. Indeed, teachers in Cyprus are frequently faced with a diverse group of children

within their class context. Quite a few immigrants come every year to live and work in Cyprus from all over the world, especially Russia, Israel, and Spain. Immigrant children often enter preschool in Cyprus without any prior knowledge of the English language and in some instances have severe lags in their knowledge. Therefore, it is vital to carry out further research on the topic in order to reach some solid conclusions. This potential literature gap could present a new research quest for academia. To the best of my knowledge, no studies have investigated the effects of different storybook media (e-book and print) on young EAL children's vocabulary and story comprehension while the teacher scaffolds children's learning with different reading styles, specifically the interactive style, which engages children in discussion of text as they read, and the performance style, which presents stories in a skilful storytelling manner with few breaks in the text. Thus, the current study aims to examine and investigate these two factors: teaching style (interactive versus performance) and book medium (e-book versus print book).

3.7 Summary

Chapter 3 has examined additional language acquisition through e-book and print book reading, which is explored in Study 2. There is a paucity of studies evaluating e-books for young EAL learners, particularly those that include teacher scaffolding. Therefore, Study 2 aimed at investigating two different book mediums—the electronic book and the print book—using two different scaffolding techniques —the interactive teaching style and the performance teaching style, for EAL learners in terms of vocabulary development and story comprehension.

Chapter 4 presents the first of the two studies which makes up this thesis, with Study 1 serving as a meta-analysis which aimed to analyse the efficacy of e-books in facilitating young children’s language and literacy development when compared to more traditional presentations of stories, such as narrating a story aloud or reading a print storybook. An overview of the thesis’s research questions is now presented.

3.8 An Overview of the Thesis’s Research Questions

This section provides an overview of the research questions this thesis addresses. As outlined in the introduction, this PhD comprises of two, distinct, but complementary studies:

Study 1 is a meta-analysis with the purpose of examining the efficacy of e-books in facilitating young children's language and literacy development when compared to more traditional presentations of stories, such as narrating a story aloud or reading a print storybook. Study 2, as described in Chapter 5, evaluates e-books and print books with the use of two scaffolding techniques for young EAL learners. The two studies, therefore, work in unison, with the meta-analysis complementing the experimental study of this thesis in order to answer the broader research question of the PhD thesis; specifically, can e-books support children's language and literacy development?

The meta-analysis attempts to answer the following three research questions:

RQ1: Do e-books foster language and literacy development compared to traditional print-like story presentations?

RQ2: Which specific language and literacy outcomes are best developed from e-book reading with and without adult scaffolding?

RQ3: Are interactive or multimedia features helpful in an e-book for the development of language and literacy skills?

Study 2 addressed EAL learners and adult scaffolding with the use of e-books and print books. The purpose of the study was to compare the impact of e-books versus print books on children learning English as an additional language in terms of vocabulary and story comprehension. The study also compared two reading styles alongside the two media (print and digital) to assess whether word learning and comprehension were enhanced. The following research questions were tested:

RQ1: Which type of book media (i.e., e-book versus print book) produces better results in the development of vocabulary and story comprehension for children learning English as an additional language (EAL)?

RQ2: Which reading style (i.e., interactive versus performance) better facilitates young

children's (learning English as an additional language) vocabulary and story comprehension development?

Chapter 4 presents the first of the two studies which makes up this thesis, with Study 1 serving as a meta-analysis which can place itself within the field of e-books and print books.

Chapter 4: Study 1 – Meta-Analysis

The first and utmost goal of this meta-analysis is to examine current e-book studies and evaluate the efficiency of e-books in facilitating language and literacy development in young children. Thus, the first question raised in this study is whether e-books offer any educational advantages when compared to print books and hence should be used to develop young children's language and literacy skills. More specifically, the question is whether e-books can replace the benefits of an adult reading a story to young children for language (e.g., story comprehension, story recall, vocabulary learning) and literacy development (e.g., alphabet knowledge, phonological awareness, print awareness, word reading and writing). Their ability shall be assessed in terms of increasing a child's language and literacy skills with and without the support of an adult.

A second goal of this meta-analysis is to evaluate the presence of scaffolding support in either the print condition, the e-book condition, or both conditions and its effects on language and literacy development, and whether outcome measures are better developed with the support of digital features in e-books in comparison to print book reading with and without adult support.

A third aim of this meta-analysis is to analyse experimental studies involving interventions with e-books in an effort to evaluate the specific features embedded in e-books that may simulate extraneous support (e.g., adult scaffolding) provided to children while listening/reading a story for language and literacy development. To that end, the present meta-analysis investigates the embedded features within e-books, which may resemble adult scaffolding, and to what extent these digital features can promote learning when compared to traditional reading of print books.

Chapter 4 presents a published research paper that the author has written during her research studies. Durham University standards permit the inclusion of a published article in its original form within a student's research thesis, provided that the document was published during the course of their study. The published paper can be cited as follows: Savva, M., Higgins, S., & Beckmann, N. (2022). Meta-analysis examining the effects of electronic storybooks on language and literacy outcomes for children in grades Pre-K to grade 2. *Journal of Computer Assisted Learning, 3*8(2), 526-564. https://doi-org.ezphost.dur.ac.uk/10.1111/jcal.12623

4.1 Research Questions

As explained earlier, the aim of this meta-analysis is to analyse the efficacy of e-books in facilitating young children's language and literacy development when compared to more traditional presentations of stories, such as narrating a story aloud or reading a print storybook. Thus, only studies that compare e-book story presentations to more traditional presentations of the same or a similar story were included in the meta-analysis. The meta-analysis attempts to answer three research questions:

1. Do e-books foster language and literacy development compared to traditional print-like story presentations?
2. Which specific language and literacy outcomes are best developed from e-book reading with and without adult scaffolding?
3. Are interactive or multimedia features helpful in an e-book for the development of language and literacy skills?

4.2 Previous Meta-Analyses of the Effects of E-books Compared to Print Books

There are three meta-analyses currently available comparing e-books to print books. First, Zucker et al. (2009) focused on experimental studies published from January 1997 to January 2007 using e-books targeted at children aged 2 to 12 years old. Overall, seven experimental studies met their inclusion criteria. Findings explored the effectiveness of e-books in decoding and comprehension. For decoding (k = 2), an average, weighted effect of d = 0.09, (95% CI = [-0.35, 0.53]) was reported, which was statistically insignificant. For story comprehension (k = 7), a small positive significant effect of d = 0.31, (95% CI = [0.06, 0.55]) associated with e-books was found. Additional research in this area is required to determine to what extent e-books effectively support children in language and literacy development. The small number of experimental studies available at the time, and the fact that most included studies dated back more than a decade, suggests adding studies with newer types of digital e-books using current technology in a new meta-analysis is justified. Second, Takacs et al. (2014) evaluated multimedia e-books, television shows and films, in comparison to traditional print-like stories, for the years of 1980-2014, for comprehension and vocabulary development. Their analysis included 29 experimental and quasi-experimental studies. Multimedia-enhanced digital

stories were found to be more beneficial than traditional print books for story comprehension (g = 0.40; 95% CI = [0.22, 0.58]) and vocabulary development (g = 0.30; 95% CI = [0.07, 0.53]). These findings are partially based on digital stories presented as animated films, children's television series, and video clips, which were not within the scope of this meta-analysis. Indeed, we excluded studies with video and television presentations given their technological differences to e-books. The current meta-analysis sought to evaluate the specific features included in e-books which may resemble adult scaffolding while reading a print book. There is more emphasis on the text itself in e-books compared to video-based story presentations as the text is foregrounded; there is no emphasis on text or interactivity in video-based stories. Finally, in a third meta-analysis, Takacs et al. (2015) were interested in evaluating e-books with at-risk students. The participants consisted of a broad range of disadvantaged children with different risk factors, such as struggling readers, children with special needs, children with learning disabilities, severe language impairments and developmental delays. The present meta-analysis focuses on typically developing readers.

An important stage in any meta-analysis is the decision as to which types of studies are eligible for inclusion. A significant distinction between the abovementioned meta-analyses and the current study is the exclusion of studies which generally have a greater risk of allocation bias, i.e., non-random allocation to groups (Coolican, 2014). Risk of bias depends on how studies are carried out, including their design and their conduct (Higgins et al., 2013). Employing experimental designs with random allocation of participants into groups minimises allocation bias and controls for differences between participants (Sullivan, 2011). When quasi-experimental studies are introduced in a meta-analysis, there is a risk of introducing allocation bias as quasi-experimental studies involve non-random assignment of participants to conditions or orders of conditions (Coolican, 2014). Thus, to avoid any design bias, the current meta-analysis included only experimental studies. The quality or rigour of the research methodology used in each study was assessed based on the quality codes proposed by Troia (1999). The methodological strengths and limitations of each study included in the meta-analysis were identified using conventional evaluative criteria for quantitative research. The set of criteria for evaluating these studies with respect to internal and external validity are presented in Table 4.3.

Furthermore, findings from above mentioned research syntheses are not necessarily applicable to e-books available on the market today, as most of the primary studies included for analysis were published before 2008 and included e-books that are likely outdated today. Given the changes in technology, today's e-books are not easily comparable with the e-books available 20 years ago. For example, the study by De Jong and Bus (2004) used electronic compact discs read-only memory (CD-ROMs) (From Het Spectrum Electronic Publishing) which are no longer available to purchase today. Due to the fact that CD-ROMs were not as technologically evolved as e-books are today, it is important to continue the analysis of e-books which are being used by young children today. Modern e-books include various features, such as dictionaries, hotspots, puzzles and questions, which need to be examined in comparison to traditional reading of print books.

4.3 Method

4.3.1 Inclusion and Exclusion Criteria

Several inclusion criteria were defined for systematically collecting and reviewing primary studies (see Table 4.1). First, studies with experimental designs were included in the meta-analysis because experimental designs provide causal evidence of the effects of using e-books with children, and because there are fewer threats to validity in experimental compared to quasi-experimental designs (Shadish et al., 2002). For a study to be included its experimental design had to include a comparison condition in which the same or a similar story was presented using a print book. The comparison condition could also include presentations of static illustrations with audio narration on an e-book.

Second, we also limited our search to studies that used e-books with children between the ages of 3 and 8 years, in a peer-reviewed journal or unpublished dissertation - conducted in any country, published in English, from January 2008 to January 2021. Given the rapid pace at which technology changes, we were interested in studies within the last decade as older technologies are likely obsolete.

Third, we included studies that evaluated the e-books' efficacy in facilitating language and literacy development. The studies included at least one outcome measure, such as the child's language and/or literacy skills including story comprehension and vocabulary, and

code related literacy skills, such as phonological awareness, letter knowledge, concepts of print, spelling, word reading, or general reading skills.

Fourth, the meta-analysis included studies with regular developing children and children from low/medium and high socioeconomic status (SES) families (e.g., Korat et al., 2014b). These children might have smaller vocabularies (Takacs et al., 2015) but in any given mainstream classroom, teachers are more likely to encounter children from various backgrounds as well as low/medium socioeconomic status. The current meta-analysis was undertaken with the aim to give insight to educators and school administrators into the use of e-books in a class environment, where teachers read a story to the children with language and literacy objectives. Thus, e-book efficiency is being evaluated with high/medium and low socioeconomic status families.

Hence, the following criteria were used to define the set of studies to be *excluded* from the meta-analysis:

1. Non-experimental studies (e.g., Kendeou et al., 2008) and quasi-experimental studies (e.g., Altun, 2018; Phadung et al., 2016).
2. Studies investigating children at risk for learning difficulties (e.g., Shamir et al., 2012), children with learning problems, such as struggling readers and/or special needs (e.g., Shamir et al., 2011), children with developmental delays or children with severe learning impairments (Smeets et al., 2014).
3. Studies undertaken in a home environment (e.g., Chiong et al., 2012; Korat & Shneor, 2019; Noel, 2013). These studies were excluded, because parents play a unique role in a child's life compared to teachers, and hence findings cannot easily be generalised to adult-facilitated learning in school.
4. Studies with a control group that followed the regular school programme rather than reading or listening to a print book. These studies were not included (e.g., Korat, 2010; Korat & Blau, 2010; Korat et al., 2017) to ensure a clearly defined counterfactual condition.
5. Studies with films, video, and television shows were excluded (e.g., Neuman et al., 2020; Verhallen & Bus, 2009; 2010).

Table 4.1 *Inclusion and Exclusion Criteria*

Included	Excluded
Design	
Experimental random allocation studies	Quasi-experimental studies Qualitative or observational studies
Independent Variables	
Treatment condition: a digital presentation of a narrative story or informational text (tablet, desktop computer, personal computer or telephone) that: • Simulates a print book (e.g., pages that "turn"); • Has written text on page; • Includes either some form of hypermedia (e.g., images, sounds, music, animation) or is a static e-book (only highlighted text and oral narration).	Treatment condition: Digital media such as video, television presentations, cartoons
Control condition: • Print book which has the same or similar content to treatment condition; • Static-illustrations with audio narration on an e-book.	Control condition: Following the regular school timetable
Dependent Variables	
Story comprehension Vocabulary Decoding-related skills	
Participants	
Grades Pre-K through 2 or Children ages 3- to 8-years Typical developing from high/medium/low SES	Children at risk for learning difficulties
Educational context	
School environment	Home environment
Publication	
Peer-reviewed journals Unpublished dissertations (conducted in any country - printed in English) Publication dates January 2008 to January 2021	

4.3.2 Literature Search

We identified potential studies using electronic database searches, hand searches of key journals, and by searching the reference sections of identified studies. First, we searched for all articles involving e-books in the three major databases in the education and psychology fields: PsycINFO, ERIC, and Web of Science available from January 2008 to January 2021. The search strategy included these key words and the Boolean operator "AND" for these combinations of words: *e-books* AND *literacy, e-books* AND *language, electronic book, computer, tablet, e-storybook, digital book, multimedia book, media book, interactive book, interactive storybook, e-literature, talking book, living book, living storybook, emergent literacy, reading, vocabulary, word learning, story comprehension, story retelling, phonics, phonological awareness, writing, comprehension, reading, spelling, adult scaffolding, adult support, dialogic reading, adult mediation, children, kindergartner, preschooler, elementary.* Next, we hand-

searched the following relevant journals in order to obtain additional studies: *Journal of Computer Assisted Learning, Education and Information Technologies*, *Journal of Research on Technology in Education*, *Journal of Educational Psychology*, *Early Childhood Education Journal*, and *Reading Research Quarterly* for the dates January 2008 to January 2021. Furthermore, we searched the reference sections of review articles and the included articles that met our selection criteria. Finally, we searched for dissertations and theses reporting data that might be suitable for the present meta-analysis.

The database search produced 1,235 reports, which were scanned based on the titles and the abstracts, of which 206 studies were reviewed in full and several were excluded due to study design (e.g., quasi-experimental) or sample characteristics that differed from the characteristics specified for this meta-analysis (e.g., participants' age range, atypically developing children) (see Appendix A for PRISMA diagram of the literature search). Finally, 29 studies met the inclusion criteria. Of these, 18 articles reported on single studies, whereas eleven contained multiple treatments/experimental groups. The 29 studies that were submitted to the meta-analysis are marked with an asterisk (*) in the references section.

4.3.3 Study Coding

We selected the following research variables to examine more closely by assigning codes for the following aspects of each study: publication year, type of design (experimental between-subject design/within-subject design), characteristics of participants (e.g., age, ethnicity, SES, primary language), literacy outcomes measured (e.g., decoding, vocabulary or comprehension skills), software features (e.g., genre, game options embedded, hotspots, dictionary option, embedded prompts/lessons) and the length of the intervention. We also coded adult scaffolding/mediation: whether children received adult mediation while reading the paper book and/or the digital book. There were studies in which an adult guided the reading of both books; an adult guided the paper book reading but not the digital book and vice versa. All coding was completed by the first author and quality checked by the second and third authors (see Table 4.2 for a summary).

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language/ Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Scaffolding /Mediation – By whom	Number of Reading sessions	Outcome Measures
Altun (2021)	Experimental Matched comparison group design	Turkey- Turkish		5	E-book (n = 97) (iPad)	*Kırmızı Kanatlı Baykuş ("Red-Winged Owl")* *Who Stole the Moon?*	-	Some animation, background music, character movements.	Print book (n = 99)	No	One reading of each story	Story Comprehension (1 measure) Vocabulary (Receptive) (1 measure)
Broemmel et al. (2015)	Experimental Between – subjects	United States English, Spanish and Chinese African-American, Hispanic, Chinese	High/ Low	4-5	E-books plus traditional picture books (n = 10) (Computer)	*The Alphabet Song Book (2006)* *Icky Sticky Frog (2000)* *Coral Reef Hide and Seek (2005)*	-	High quality animation, rich narration, sound effects and music.	Print book (n = 14)	Yes- By researcher (E-book +Print condition)	Three readings of each book.	Story Comprehension (1 measure)
Critelli (thesis) (2011)	Experimental Between – subjects	Northern New Jersey		4–6	E-book (n = 5) (Computer)	*Bubbles* CD-ROM story by Diane Foushee	-	-	Print book (n = 5)	No	3 sessions	Phonological awareness (1 measure) Word reading (1 measure) Story Comprehension (1 measure)
Eng et al. (2020) Experiment 1	Within subject design (randomised order)	United States		3-5	Contingent E-book (n = 17) (Tablet)	*Cat's Pajamas and Zoom City*	The contingent responsivity story included animations that activated contingently on the child's vocalisations.		Board Book (n = 18)	No	One reading of each story	Story Recall (1 measure)
Eng et al. (2020) Experiment 2	Within subject design (randomised order)	United States		3-5	Contingent E-book (n = 16) (Tablet)	*Cat's Pajamas and Zoom City*	The contingent responsivity story included animations that activated contingently on the child's vocalisations.		Static E-book (n = 17) (Tablet)	No	One reading of each story	Story Recall (1 measure)

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language/ Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Mediation/Scaffolding – By whom	Number of Reading sessions	Outcome Measures
Gong and Levy (2009) Comparison 1	Experimental Between – subjects	Canada		4-5	E-book with 'Bouncing Ball' (n = 24) (Laptop)	6 stories including familiar topics.	-	A small ball bounced above each word in synchrony with the reader's voice.	Static e-book (n = 24) (Laptop)	No	10 days- 6 different storybook sessions	Print Knowledge (1 measure)
Gong and Levy (2009) Comparison 2	Experimental Between – subjects	Canada		4-5	E-book with 'Violation' (n = 24) (Laptop)	6 stories including familiar topics, such as animals, families, and friendship.	-	Bouncing ball condition + addition of two unreadable items per page of each book.	Static e-book (n = 24) (Laptop)	No	10 days	Print Knowledge (1 measure)
Gong and Levy (2009) Comparison 3	Experimental Between – subjects	Canada		4-5	E-book with 'Action' (n = 24) (Laptop)	6 stories including familiar topics, such as animals, families, and friendship.	Violation condition + child clicked on the violated item using the computer mouse.		Static e-book (n = 24) (Laptop)	No	10 days	Print Knowledge (1 measure)
Homer et al. (2014) Comparison 1	Experimental Between-subjects	USA-English		5-7	Kinect with activities (n = 12) (Microsoft's Xbox)	*Children Make Terrible Pets* by Microsoft Games Studio for the Kinect	Children were required to use movements to interact with the book.	On-screen animated character.	Book reading (n = 14)	Yes-By experimenter (Print condition)	1 reading	Reading Words (1 measure) Vocabulary (Expressive) (1 measure)
Homer et al. (2014) Comparison 2	Experimental Between-subjects	USA-English		5-7	Kinect without activities (n = 13) (Microsoft's Xbox)	*Children Make Terrible Pets* by Microsoft Games Studio for the Kinect	Kinect sensor detected the participant's image and displayed a live video-feed of the child on-screen.	On-screen animated character.	Book reading (n = 14)	Yes-By experimenter (Print condition)	1 reading	Reading Words (1 measure) Vocabulary (Expressive) (1 measure)

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language /Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Mediation/ Scaffolding – By whom	Number of Reading sessions	Outcome Measures
Ihmeideh (2014)	Experimental Between-subjects	Jordan Amman Arabic	Middle and Low	4-5	E-book (n = 48) (Computer)	Arabic books: *The Conceited Ibex, Rami, The Dreams' King, The Three Goats*	-	Animated illustrations	Print Book (n = 44)	Yes- By teacher (Both conditions)	15 min each day for eight weeks.	Vocabulary (Expressive) (1 measure) Print awareness (1 measure) Phonological awareness (1 measure)
Karemaker et al. (2017) Comparison 1	Experimental Between-subjects	Oxfordshire – England	Mix	5.6-7	E-book with E-friend button (n = 32) (Computer)	*The Parachute*	E-friend button opens up a window with story questions.	-	'Flat e-book' (n = 30) (Computer)	No	1 reading session	Vocabulary (Expressive) (1 measure) Word Reading (1 measure) Story Comprehension (2 measures)
Karemaker et al. (2017) Comparison 2	Experimental Between-subjects	Oxfordshire – England	Diverse SES	5.6-7	E-book with Dictionary (n = 28) (Computer)	*The Parachute*	Dictionary button highlighted challenging words. By clicking on a word children could listen to pronunciation and definition.	-	'Flat e-book' (n = 30) (Computer)	No	1 reading session	Vocabulary (Expressive) (1 measure) Word Reading (1 measure) Story Comprehension (2 measures)
Kelley and Kinney (2017)	Experimental Between-subjects	US	Diverse SES	3-5	Interactive e-book (Learn) (n = 15) (Tablet)	*Hansel and Gretel* by Mindshapes Ltd	Six embedded questions related to the story and children can tap pictures to respond to the questions.	Animated characters.	E-book without interactive features (Watch) (n = 15) (Tablet)	No	Three sessions	Vocabulary (Expressive) (2 measures) Vocabulary (Receptive) (1 measure) Vocabulary (1 measure) Story comprehension (1 measure)

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language /Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Mediation/ Scaffolding – By whom	Number of Reading sessions	Outcome Measures
Korat, Levin, Atishkin, Turgeman (2014a) Comparison 1	Experimental Between-subjects	Israel Hebrew	Middle	4-6	E-book with dynamic visual vocabulary support (Dictionary) (n = 38) (Computer)	*The Empty Pot* (1990)	-	Animated representations of target verbs in vocabulary support.	E-book without dictionary support (n = 37) (Computer)	No	Reading 3 times	Vocabulary (Expressive) (1 measure) Vocabulary (Receptive) (1 measure) Vocabulary (1 measure)
Korat, Levin, Atishkin, Turgeman (2014a) Comparison 2	Experimental Between-subjects	Israel Hebrew	Middle	4-6	E-book with static visuals dictionary support (n = 37) (Computer)	*The Empty Pot* (1990)	-	At the end of the narrators' reading of the screen, a large bubble appears with the target written form of the word and a figurative static presentation of a flower, with the narrator concomitantly saying a short explanation of the word	E-book without dictionary support (n = 37) (Computer)	No	Reading 3 times	Vocabulary (Expressive) (1 measure) Vocabulary (Receptive) (1 measure) Vocabulary (1 measure)
Korat, Levin, Atishkin, Turgeman (2014a) Comparison 3	Experimental Between-subjects	Israel Hebrew	Middle	4-6	E-book with adults vocabulary support (n = 37) (Computer)	*The Empty Pot* (1990)	-	At the end of the narrators' reading of the screen, a large bubble appears with the target written form of the word and a figurative static presentation of a flower, with the narrator concomitantly saying	E-book without dictionary support (n = 37) (Computer)	Yes-By researchers (E-book condition)	Reading 3 times	Vocabulary (Expressive) (1 measure) Vocabulary (Receptive) (1 measure) Vocabulary (1 measure)

								a short explanation of the word				

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language /Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Mediation/ Scaffolding – By whom	Number of Reading sessions	Outcome Measures
Korat, Levin, Ben-Shabt, Shneor and Bokovza (2014b) Comparison 1	Experimental Between-subjects	Israel Hebrew	Low	7-8	E-book with dictionary dynamic visuals (DVs) with the printed word (n = 41) (Computer)	*The Empty Pot* written and illustrated by Demi (1990)	-	Animated representations of target verbs in vocabulary support and printed words shown on screen.	Static E-book without a dictionary (control; n = 44) (Computer)	No	4 repetitions of e-book reading	Vocabulary (Expressive) (1 measure) Vocabulary (1 measure) Spelling (1 measure)
Korat, Levin, Ben-Shabt, Shneor and Bokovza (2014b) Comparison 2	Experimental Between-subjects	Israel Hebrew	Low	7-8	E-book with dictionary dynamic visuals (DVs) without printed words (n = 42) (Computer)	*The Empty Pot* (1990)	-	Animated representations of target words in the form of pictures.	Static E-book without a dictionary (control; n = 44) (Computer)	No	4 repetitions of e-book reading	Vocabulary (Expressive) (1 measure) Vocabulary (1 measure) Spelling (1 measure)
Korat, Levin, Ben-Shabt, Shneor and Bokovza (2014b) Comparison 3	Experimental Between-subjects	Israel Hebrew	Low	7-8	E-book with dictionary static visuals (SVs) with printed words (n = 43) (Computer)	*The Empty Pot* (1990)	-	Static representations of target verbs in vocabulary support e.g. a large bubble appears with the target written form of the word and a figurative static presentation of a flower.	Static E-book without a dictionary (control; n = 44) (Computer)	No	4 repetitions of e-book reading	Vocabulary (Expressive) (1 measure) Vocabulary (1 measure) Spelling (1 measure)
Korat, Levin, Ben-Shabt, Shneor and Bokovza (2014b)	Experimental Between-subjects	Israel Hebrew	Low	7-8	E-book with dictionary static visuals (SVs) without printed words	*The Empty Pot* (1990)	-	Static representations of target verbs in vocabulary support e.g. a large bubble	Static E-book without a dictionary (control; n = 44)	No	4 repetitions of e-book reading	Vocabulary (Expressive) (1 measure) Vocabulary (1 measure) Spelling

Comparison 4					(n = 45) Computer			appears with a static presentation of a flower.					(1 measure)

(Continued)

Table 4.2 *Study Coding*

Study and Year	**Design of the study**	**Country - Language/ Ethnicity**	**SES**	**Age (years)**	**E-book Intervention (Device)**	**Material**	**Interactive features**	**Multimedia features**	**Comparison condition**	**Adult Scaffolding – By whom**	**Number of Reading sessions**	**Outcome Measures**
Kozminsky and Asher-Sadon (2013)	Experimental Between-subjects	Israel Hebrew	Mix	5-6	E-book (n = 25) (Computer)	*Pochzanim*	-	-	Print book (n = 25)	Yes- By experimenter (Print condition)	5 reading sessions	Story Comprehension (1 measure) Print Knowledge (1 measure) Vocabulary (1 measure) Phonological Awareness (1 measure) Spelling (1 measure)
Lee (2020)	Within subject design (randomised order)	US 54 Anglo, 35 African American, 1 Middle Eastern, 5 Hispanic, and 5 multiracial students	Low	6-7	E-book with recorded word explanation (n = 50) (iPad)	*Frederick and Swimmy*	-	Recorded word explanations	Static e-book (n = 50) (iPad)	No	2 readings	Vocabulary (Expressive) (1 measure)
Liao et al. (2020) Comparison 1	Experimental Between-subjects	Taiwan Mandarin Chinese		4-5	E-book highlight synchronisation (implicit instruction) (n = 19) (Laptop)	*Six original Chinese storybooks*	-	Individual Chinese characters were highlighted in red when they were being pronounced, thus implicitly teaching the	Static Read-only E-book (n = 20)	No	1 reading of each book	Print Awareness (1 measure)

								children which Chinese characters were associated with which sounds.				

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language/Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Scaffolding /Mediation – By whom	Number of Reading sessions	Outcome Measures
Liao et al. (2020) Comparison 2	Experimental Between-subjects	Taiwan Mandarin Chinese		4-5	E-book print discussion (explicit instruction) (n = 20) (Laptop)	*Six original Chinese storybooks*	-	Verbal cues to or discussions of the print (references to the print) were explicitly added to the narration of the story. Also visual cues to synchronise with the verbal cues.	Static Read-only E-book (n = 20)	No	1 reading of each book	Print Awareness (1 measure)
Neuman et al. (2017)	Within subject design (randomised order)	US African American; Hispanic; 2% were of European descent	Low	3-4	E-book (n = 19) (iPad)	*Ish, Sid the Science Kid, Superkids: A sticky situation, The Valentine* all from Speakaboos	-	Animated characters	Print Book (n = 19)	No	2 sessions in each condition	Vocabulary (Expressive) (1 measure) Story Comprehension (2 measures)
O'Toole (2015) (thesis)	Experimental Between-subjects	Chicago 70 children were White; 2 Black; 4 Hispanic; 6 Asian; 14 children	Middle/High	4	E-book read aloud by a live adult and narrated by an	*Just in Passing* by Susan Bonners	-	-	Print book read aloud by a live adult and narrated	No	1 session	Vocabulary (Receptive) (1 measure) Story Comprehension (1 measure)

	were biracial; and 4 parents did not respond			audio device (n = 50) (Tablet)	(1989)				by an audio device (n = 50)			

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language/ Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Scaffolding /Mediation – By whom	Number of Reading sessions	Outcome Measures
O'Toole and Kannass (2018) Comparison 1	Experimental Between-subjects	US 70 White, 2 Black, 4 Hispanic, 6 Asian, 14 biracial	Middle and high	4-5	Live E-book (n = 25) (Tablet)	*n/a*	-	-	Live Print Book (n = 25)	No	1 session	Vocabulary (Receptive) (1 measure) Story Comprehension (1 measure)
O'Toole and Kannass (2018) Comparison 2	Experimental Between-subjects	US 70 White, 2 Black, 4 Hispanic, 6 Asian, 14 biracial	Middle and high	4-5	Audio narrated e-book (n = 25) (Tablet)	*n/a*	-	-	Audio narrated Print book (n = 25)	No	1 session	Vocabulary (Receptive) (1 measure) Story Comprehension (1 measure)
Pearman (2008)	Within subject design (randomised order)	United States 32 white; 1 black; 21 Hispanic		7-8	E-book (n = 27) (Computer – CD-ROM)	*Heather Hits Her First Home Run* and *A Long Hard Day on the Ranch*	Hotspots for word pronunciations, graphics, sound effects, object labels, and definitions	Animation	Print book (n = 27)	No	20 days-two sessions	Story Comprehension (1 measure)
Reich et al. (2019)	Experimental design Between	USA - Southern California	Middle and high	3-5	E-book (n = 100) (iPad)	*Chris P. Bacon: My Life so Far*	6 hotspots per page, that when tapped repeated the word or provided some animation.		Print book (n = 100)	No	1 reading	Story Comprehension (3 measures) Vocabulary (Expressive) (1 measure)

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language /Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Scaffolding /Mediation – By whom	Number of Reading sessions	Outcome Measures
Richter and Courage (2017)	Within subject design (randomised order)	Canada	Middle	3-5	E-book (n = 39) (iPad)	*Leo the Lightning Bug and A Frog Thing*	Hotspots to reactivate the multimedia features (e.g., thunder and lightning) or to produce word repetitions.	Multimedia features accompany the narration and provide additional visual or auditory information (e.g., sounds, animations)	Print Book (n = 40)	No	1 reading	Story Comprehension (1 measure)
Rvachew et al. (2017)	Within subject design (randomised order)	Canada (English)	Low	5-6	E-book (n = 14) (iPad)	*Caillou: What's That Funny Noise? and Caillou: My First Play*	-	Living words link animated text to animated illustrations. A prompt bar for the adult reader which suggests comments and questions.	Print Book (n = 14)	Yes-By teacher (Both conditions)	1 reading	Story Comprehension (1 measure) Phonological Awareness (1 measure)
Sapsaglam et al. (2020)	Experimental Between-subjects	Turkey		5-6	E-book (n = 10) (Computer to projector)	*Hungry Caterpillar, Brave Firfir, Tiny Seed, The*	-	-	Print book (n = 10)	No	1 reading of each story	Story Comprehension (1 measure)

						Most Ordinary Tree of the Forest, The Dinosaur Came Out of My Seed						

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language /Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Instruction /Scaffolding – By whom	Number of Reading sessions	Outcome Measures
Sari et al. (2019)	Experimental Between-subjects	Turkey Turkish	Diverse	4-6	E-book with animated illustrations with and without music/sounds (n = 41) (Laptop)	*Bear Is in Love with Butterfly, Little Kangaroo*	-	Animated characters and objects, sound effects, music	E-book with static illustrations with and without music/sounds (n = 42) (Laptop)	No	2 readings of each story	Story Comprehension (1 measure) Vocabulary (Receptive) (1 measure) Vocabulary (Expressive) (1 measure)
Segal-Drori et al. (2010) Comparison 1	Experimental Between-subjects	Israel Hebrew	Low	5-6	E-book without adult instruction (EB) (n = 32) (Computer)	*Confused Yuval and The Tractor in the Sandbox*	Hotspots	Automatic dynamic visuals that dramatise story details, sections and the complete story scene as well as extra music and film effects that may ‘‘bring the story content to life’’	Print book with adult instruction (PBI) (n = 32) (Computer)	Yes – By researchers (Print condition)	Four sessions	Phonological Awareness (1 measure) Reading Words (1 measure) Print Knowledge (1 measure)
Segal-Drori et al. (2010) Comparison 2	Experimental Between-subjects	Israel Hebrew	Low	5-6	E-book with adult instruction (EBI) (n =	*Confused Yuval and The Tractor in*	Hotspots	Automatic dynamic visuals that dramatize story details,	Print book with adult instruction	Yes – By researchers (Both	Four sessions	Phonological Awareness (1 measure) Reading Words (1 measure)

					32) (Computer)	*the Sandbox*		sections and the complete story scene as well as extra music and film effects that may ‘‘bring the story content to life’’	(PBI) (n = 32) (Computer)	conditions)			Print Knowledge (1 measure)

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language /Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Instruction /Scaffolding – By whom	Number of Reading sessions	Outcome Measures
Smeets and Bus (2015) Comparison 1	Experimental Between-subjects	Netherlands 50% Dutch L1		4-6	Animated e-books (n = 36) (Computer)	*Pete on the Pavement, Bear Is in Love with Butterfly, Rokko the Crocodile, Bolder and the Boat, Cycling With Grandpa*	-	Animated characters and objects, sound effects, music	Static e-book (n=34) (Computer)	No	4 repetitions of each story	Vocabulary (Expressive) (1 measure) Vocabulary (Receptive) (1 measure) Vocabulary (1 measure) Story Comprehension (1 measure)
Smeets and Bus (2015) Comparison 2	Experimental Between-subjects	Netherlands 50% Dutch L1		4-6	Interactive animated e-books (n = 33) (Computer)	*Pete on the Pavement, Bear Is in Love with Butterfly, Rokko the Crocodile, Bolder and the Boat, Cycling With Grandpa*	Hotspots shape as a magnifying glass to search for unknown words	Animated characters and objects, sound effects, music	Static e-book (n = 34) (Computer)	No	4 repetitions of each story	Vocabulary (Expressive) (1 measure) Vocabulary (Receptive) (1 measure) Vocabulary (1 measure) Story Comprehension (1 measure)
Takacs and Bus (2016)	Within Subject design (randomised order)	Netherlands	Middle	4-6	Animated e-book (n = 20) (Computer)	*The Little Kangaroo, Imitators*	-	Animated scenes	Static e-book (n = 19) (Computer)	No	3 sessions	Vocabulary (Receptive) (1 measure) Story comprehension (1 measure)

(Continued)

Table 4.2 *Study Coding*

Study and Year	Design of the study	Country - Language/Ethnicity	SES	Age (years)	E-book Intervention (Device)	Material	Interactive features	Multimedia features	Comparison condition	Adult Instruction/ Scaffolding – By whom	Number of Reading sessions	Outcome Measures
Willoughby et al. (2015)	Experimental Between-subjects	Ontario English		3-4	Alphabet e-books (n = 33) (iPad)	*A to Z Alphabet book, Letters A to Z, Interactive Alphabet, This place is a zoo, Alphabet Zoo, Z is for Zebra, ABC Magic, ABC Magic 2, ABC Funnimals, Animal ABC, Animal Alphabet*	Interactive games, audio hotspots	Animated hotspots	ABC Paper books (n = 30)	No	8 weeks – 16 sessions	Phonological Awareness (3 measures)
Zhou and Yadav (2017) Comparison 1	Experimental Between-subjects	United States All the participants speak English as the first language.		4-5	Multimedia e-book (n = 18) (iPad)	*The Polar Bear Horizon*	Hotspots to see and hear word labels when touching illustrations	Animated characters	Print book (n = 18)	No	2 reading sessions	Vocabulary (Receptive) (1 measure) Story Comprehension (1 measure)
Zhou and Yadav (2017) Comparison 2	Experimental Between-subjects	United States All the participants speak English as the		4-5	Multimedia e-book with questioning (n = 18)	*The Polar Bear Horizon*	Hotspots to see and hear word labels when	Animated characters	Print Book with questions (n = 18)	Yes- By researcher (Both	2 reading sessions	Vocabulary (Receptive) (1 measure)

		first language.			(iPad)		touching illustrations			conditions)		Story Comprehension (1 measure)
Zipke (2017) (Exp. 1)	Within subject design (randomised order)	New England State 15 Caucasian, 4 African American, 2 Latin American, 4 Asian American	Middle/ Low	4-5	E-book (n = 13) (Computer)	*Tacky Goes to Camp, Tacky in Trouble*	Hotspots on pictures to hear the object name	-	Print book (n = 12)	Yes By teacher (Print condition)	Two separate 30-min sessions	Story Comprehension (1 measure) Vocabulary (1 measure)

4.3.4 Methodological Rigour of Studies

The quality codes for establishing the methodological rigour of the studies included a selection of characteristics examined by Troia (1999) which can be found in Table 4.3. Twenty-one (72%) experimental studies met standards for high quality; the other eight studies (28%) were moderate in quality. All experimental studies used random assignment.

Participant characteristics were not adequately described in half of the studies as children's ethnicity or primary language were typically not mentioned. Treatment conditions were not described in adequate detail to permit replication attempts in 23 out of 29 studies. Of course, word-count limitations in journals often dictate how much information can be provided by authors. Nonetheless, conditions need to be adequately described for replication purposes as well as enabling researchers and educators to employ innovative treatments with their students. In regard to treatment fidelity, according to Troia (1999), all research studies need to ensure that a procedure is used to ensure that treatment conditions are being implemented faithfully. As seen in Table 4.3, fidelity of treatment was not reported in eight studies, so it is unclear how reliably reported treatment results can be attributed to the intervention. Only five experiments reported effect sizes. The provision of effect sizes would facilitate an evaluation of the relative effectiveness of the experimental treatments used in these intervention studies.

Table 4.3 *Assessment of Methodological Quality Based on Selected Internal and External Validity Criteria from Troia (1999)*

Study (alphabetically)	Random assignment (3) †	Control group intervention (3)	Sufficient participant description (3)	Treatment conditions explicitly described (2)	Operationalised measures (3)	Reliability of measures reported (2)	Treatment fidelity ensured (3)	Effect size reported (1)	Quality Rating
1. Altun (2021)	Y	Y	Y	Y	Y	Y	Y	N	High
2. Broemmel et al. (2015)	Y	Y	Y	Y	Y	N	Y	N	High
3. Critelli (2011)	Y	Y	N	Y	Y	N	N	N	Moderate
4. Eng, Tomasic & Thiessen (2020)	Y	Y	N	Y	Y	Y	Y	Y	High
5. Gong and Levy (2009)	Y	Y	N	Y	Y	Y	N	N	Moderate
6. Homer et al. (2014)	Y	Y	N	Y	Y	N	Y	N	Moderate
7. Ihmeideh (2014)	Y	Y	N	Y	Y	Y	N	N	Moderate
8. Karemaker et al. (2017)	Y	Y	N	N	Y	Y	Y	Y	High
9. Kelley & Kinney (2017)	Y	Y	N	N	Y	Y	Y	N	Moderate
10. Korat, Levin, Atishkin and Turgeman (2014)	Y	Y	Y	Y	Y	Y	N	N	High
11. Korat, Levin, Ben-Shabt, Shneor and Bokovza (2014)	Y	Y	Y	Y	Y	Y	N	N	High
12. Kozminsky & Asher-Sadon (2013)	Y	Y	N	Y	Y	Y	Y	N	High
13. Lee (2020)	Y	Y	Y	Y	Y	Y	Y	Y	High
14. Liao et al. (2020)	Y	Y	N	Y	Y	Y	Y	N	High
15. Neuman et al. (2017)	Y	Y	Y	Y	Y	Y	Y	N	High
16. O'Toole (2015)	Y	Y	Y	N	Y	Y	Y	N	High
17. O'Toole & Kannass (2018)	Y	Y	Y	N	Y	Y	Y	N	High
18. Pearman (2008)	Y	Y	Y	Y	Y	Y	Y	N	High
19. Reich et al. (2019)	Y	Y	Y	Y	Y	Y	Y	N	High

(Continued)

Table 4.3 *Assessment of Methodological Quality Based on Selected Internal and External Validity Criteria from Troia (1999)*

Study (alphabetically)	Random assignment (3) †	Control group intervention (3)	Sufficient participant description (3)	Treatment conditions explicitly described (2)	Operationalised measures (3)	Reliability of measures reported (2)	Treatment fidelity ensured (3)	Effect size reported (1)	Quality Rating
20. Richter and Courage (2017)	Y	Y	N	Y	Y	Y	Y	N	High
21. Rvachew et al. (2017)	Y	Y	Y	Y	Y	N	Y	N	High
22. Sapsaglam et al. (2020)	Y	Y	N	Y	Y	N	N	N	Moderate
23. Sarı, Basal, Takacs, Bus (2019)	Y	Y	Y	Y	Y	Y	Y	Y	High
24. Segal-Drori et al. (2010)	Y	Y	Y	Y	Y	Y	Y	N	High
25. Smeets and Bus (2015)	Y	Y	N	Y	Y	Y	N	N	Moderate
26. Takacs and Bus (2016)	Y	Y	N	N	Y	Y	Y	N	Moderate
27. Willoughby et al. (2015)	Y	Y	Y	N	Y	Y	Y	N	High
28. Zhou and Yadav (2017)	Y	Y	Y	Y	Y	Y	Y	N	High
29. Zipke (2017)	Y	Y	Y	Y	Y	Y	N	Y	High
Ratio of studies meeting criterion	29/29	29/29	16/29	23/29	29/29	24/29	21/29	5/29	
Percentage	100%	100%	55%	79%	100%	82%	72%	17%	

Note: †Each quality variable is weighted based on its importance for ensuring internal or external validity (adapted from Troia, 1999). Quality variables weighted: 3–indicate strong importance and it is considered a fatal flaw if one of these variables are missing, 2–indicate moderate importance, and 1–indicate some importance. A score was assigned of the full weight if all aspects of the variable were present in the study and a 0 if any single aspect of the variable was missing. Based on this adapted system, a sum score of 15-20 and no fatal flaws indicates High Quality, 8-14 indicates Moderate Quality, 0-7 indicates Low Quality.

4.3.5 Data Analysis

The index used to calculate effect sizes was Hedges's *g* statistic to correct for small sample size (Hedges & Olkin, 2014). Effect size is a standardised statistic that shows the direction (positive or negative) and magnitude of the intervention's effect. This effect size can be found by calculating the mean of the e-book intervention group minus the mean of the comparison group divided by the pooled standard deviation. The formula is:

$$g = \frac{y1 - y2}{sp}$$

with y1, y2, and sp denoting the mean of sample 1, the mean of sample 2, and the pooled standard deviation, respectively (Borenstein et al., 2009). To interpret this effect size (Hedges' *g* and Cohen's *d* are interpreted in the same way). Cohen recommended the following rule of thumb: a value of $d = 0.00$ represents a zero effect, $d = 0.20$ represents a small effect, $d = 0.50$ represents a moderate effect, and $d = 0.80$ represents a large effect (Cohen, 1988). We report Hedges' *g* as an indicator of effect size, which is provided by the statistical software package Comprehensive Meta-Analysis (Version 3.3) (Borenstein et al., 2013).

In order for all groups to be considered independent, Borenstein et al. (2009) suggests when dealing with multiple comparisons within a study to combine the data of the experimental groups and then compute the overall effect size for the control group versus the merged experimental groups. If studies included more than one treatment or more than one experimental group, the experimental groups were merged, however; they were treated as separate studies when examining outcome measures and interactive/multimedia e-books.

Moderator analyses were performed, using a random effects model, to contrast different categorical study variables: digital book features (interactive, multimedia, static, combinations); adult scaffolding (e-book condition, print book condition or both, or neither); study design (between/within study design); sample characteristics (SES, age range of participants); digital device (tablet versus computer); repetition of story reading (1 or 2 readings, more than two).

4.4 Results

4.4.1 Descriptive Statistics

We found 29 studies with 44 contrasts eligible for inclusion in this meta-analysis. Of the 29 studies, 27 appeared as journal articles, and two were published in the form of a dissertation. The majority of studies were conducted in a school setting (n = 27) and two in a university laboratory. The majority of studies were conducted in English-speaking countries, USA (13), UK (1), and Canada (4). Four studies were conducted in Israel (Hebrew), three in Turkey (Turkish), two in The Netherlands (Dutch), one in Taiwan (Mandarin) and one in Jordan (Arabic). Four studies were published in 2020, two in 2019, seven studies were published in 2017, four in 2015 and another four in 2014, whilst the remaining publications were evenly spread across the other years (2021, 2018, 2016, 2013, 2011, 2010, 2009, 2008). Twenty-four studies were carried out with participants from preschool and kindergarten and five studies with first grade (6-7 years old) and second grade (7-8 years old) children. Ten studies used a standardised test to assess the learning outcomes, whereas 19 studies used new tests that were developed by the authors. Duration of the treatment varied from one to eight weeks, whereas the number of sessions varied from one to 16 with average session duration varying from 6 to 60 minutes. In total 2,317 children participated across all studies, 1,450 as experimental participants and 867 as control participants. All studies had an experimental design (in line with the inclusion criteria). The majority of studies focused on story comprehension yielding 20 effect sizes. Eighteen studies were concerned with vocabulary learning (i.e., receptive, expressive), six studies with phonological awareness, five studies with print awareness, four studies with reading words, and another two studies were focused on spelling. The majority of studies included e-books with various digital features. Thirteen studies used e-books with multimedia features, two dealt with interactive e-books and eleven used interactive and multimedia e-books. Five studies dealt with basic ‘unembellished’ e-books which included oral narration.

4.4.2 Overall Effects

The associations between language and literacy outcomes and e-books in comparison to print books were examined. Estimates of the overall effect as well as five moderators can be found in Tables 4.4 and 4.5. The available statistics were entered in the Comprehensive Meta-Analysis (Version 3.3) software (Borenstein et al., 2013) to calculate Hedges' *g* for each comparison to correct for small sample size studies. For all included comparisons, an effect size of $g = 0.25$ was found, which represents a small positive significant effect favouring the e-book condition ($k = 29$; $SE = 0.08$; 95% CI = [0.09, 0.42]; $p = 0.002$). This effect was heterogeneous, $Q\ (28) = 92.88$, $p = 0.00$, $I^2 = 70$ (see Table 4.4).

4.4.3 Heterogeneity

The I-squared statistic (I^2) depicts the percentage of the total variability in effect estimates due to heterogeneity (between-study variability) (Borenstein et al., 2009). A high percentage in the I-squared index suggests high heterogeneity. The forest plot (Appendix B) confirmed the high degree of heterogeneity. The I-squared value indicated that 70% of variation in effect size was due to heterogeneity (between-study variability) rather than chance (sampling error).

4.4.4 Publication Bias

Meta-analysis, like all research, has limitations which must be addressed. One of the main limitations of meta-analysis is publication bias. It should be noted that publication bias is not only a limitation to meta-analysis, but to all research in general (Borenstein et al., 2009). In a meta-analysis, a researcher searches the literature for studies dealing with the topic in question. After the meta-analysis is performed the researcher comes to conclusions dependent on the studies included in the meta-analysis. If the studies available for synthesis are not representative or exhaustive, the validity of the conclusions is threatened (Vevea & Woods, 2005). Given the potentially serious implications of publication bias, a number of researchers have suggested statistical methods for detecting and correcting it in the context of meta-analysis

Table 4.4 *Statistics for Each Study*

Study	Outcome(s)†	Hedges's g	Standard error	95% confidence interval	Z-Value	p-value	Study Design	Publication Status	SES	Device	Adult Support
Altun (2021)	SC, RV	-0.00	0.14	[-0.28, 0.27]	-0.02	0.980	Between	Journal	-	iPad	
Broemmel (2015)	SC	-0.53	0.40	[-1.32, 0.26]	-1.30	0.192	Between	Journal	High & Low	Computer	Both conditions
Critelli (2011)	SC, PA, RW	-0.06	0.57	[-1.19, 1.05]	-0.11	0.907	Between	Dissertation	-	Computer	
Eng (2020)	SC	1.00	0.25	[0.50, 1.50]	3.95	0.000	Within	Journal	-	Tablet	
Gong (2009)	PK	0.42	0.23	[-0.03, 0.88]	1.79	0.072	Between	Journal	-	Laptop	
Homer (2014)	RW, EV	0.08	0.32	[-0.56, 0.72]	0.24	0.804	Between	Journal	-	Microsoft's Xbox	Print condition
Ihmeideh (2014)	EV, PA, PK	1.53	0.24	[1.05, 2.02]	6.26	0.000	Between	Journal	Middle & Low	Computer	Both conditions
Karemaker (2017)	SC, EV, RW	0.20	0.22	[-0.24, 0.65]	0.90	0.367	Between	Journal	Diverse SES	Computer	
Kelley (2017)	SC, V, RV, EV	0.06	0.35	[-0.63, 0.77]	0.19	0.848	Between	Journal	Diverse SES	Tablet	
Korat (2014a)	EV, RV, V	0.58	0.19	[0.20, 0.96]	3.04	0.002	Between	Journal	Middle	Computer	E-book condition
Korat (2014b)	EV, V, S	0.43	0.17	[0.10, 0.77]	2.57	0.010	Between	Journal	Low	Computer	
Kozminsky (2013)	SC, V, PA, PK, S	-0.44	0.28	[-1.00, 0.10]	-1.58	0.113	Between	Journal	-	Computer	Print condition
Lee (2020)	EV	0.42	0.20	[0.03, 0.81]	2.11	0.034	Within	Journal	Low	iPad	
Liao (2020)	PK	1.01	0.28	[0.45, 1.58]	3.54	0.000	Between	Journal	-	Laptop	
Neuman (2017)	SC, V	-0.04	0.31	[-0.66, 0.58]	-0.12	0.900	Within	Journal	Low	iPad	
O'Toole (2015)	SC, RV	0.28	0.20	[-0.11, 0.67]	1.40	0.159	Between	Dissertation	-	Tablet	
O'Toole (2018)	SC, RV	0.07	0.19	[-0.31, 0.46]	0.35	0.723	Between	Journal	-	Tablet	
Pearman (2008)	SC	0.42	0.27	[-0.11, 0.95]	1.55	0.12	Within	Journal	-	Computer	
Reich (2019)	SC, EV	-0.18	0.14	[-0.46, 0.09]	-1.31	0.189	Between	Journal	High	iPad	
Richter (2017)	SC	0.04	0.22	[-0.39, 0.48]	0.20	0.837	Within	Journal	Middle	iPad	

(Continued)

Table 4.4 *Statistics for Each Study*

Study	Outcome(s)†	Hedges's g	Standard error	95% confidence interval	Z-Value	p-value	Study Design	Publication Status	SES	Device	Adult Support
Rvachew (2017)	SC, PA	0.60	0.37	[-0.13, 1.35]	1.60	0.108	Within	Journal	Low	iPad	Both conditions
Sapsaglam (2020)	SC	-1.09	0.46	[-2.01, -0.17]	-2.32	0.020	Between	Journal	-	Computer to projector	
Sari (2019)	SC, EV, RV	0.16	0.21	[-0.26, 0.59]	0.74	0.457	Between	Journal	Diverse SES	Laptop	
Segal-Drori (2010)	PA, RW, PK	0.72	0.22	[0.29, 1.16]	3.26	0.001	Between	Journal	Low	Computer	Both conditions
Smeets (2015)	SC, RV, EV, V	-0.00	0.20	[-0.41, 0.40]	-0.01	0.988	Between	Journal	-	Computer	
Takacs (2016)	SC, RV	0.21	0.31	[-0.40, 0.83]	0.67	0.498	Within	Journal	Middle	Computer	
Willoughby (2015)	PA	-0.09	0.24	[-0.58, 0.39]	-0.38	0.700	Between	Journal	-	iPad	
Zhou (2017)	SC, RV	0.36	0.23	[-0.09, 0.82]	1.55	0.121	Between	Journal	-	iPad	Both conditions
Zipke (2017)	SC, V	0.36	0.40	[-0.42, 1.16]	0.90	0.364	Within	Journal	Middle and Low	Computer	Print condition
Random		**0.25**	**0.08**	**[0.09, 0.42]**	**3.11**	**0.002**					

Note: †SC= story comprehension, V=Vocabulary, RV= receptive vocabulary, EV=expressive vocabulary, PA=phonological awareness, PK=print knowledge, RW=reading words, S=spelling.

Table 4.5 *Overall Results of the 29 Studies and Moderator Analyses†*

		Effect Size and 95% confidence interval				Test of null (2-Tail)		Heterogeneity	
	k	*g*	SE	Lower Limit	Upper Limit	Z-value	P-value	*Q*	I^2
Overall	29	0.259	0.083	0.096	0.422	3.119	0.00	92.88	70
High/Middle SES	18	0.17	0.09	-0.00	0.36	1.86	0.06	49.58	65
Low or diverse SES	11	0.39	0.14	0.11	0.68	2.72	0.00	33.61	70
Tablet/iPad studies	12	0.18	0.09	-0.00	0.37	1.90	0.05	24.43	55
Computer/Laptop	17	0.29	0.12	0.04	0.54	2.34	0.01	60.98	73
High quality rating studies	21	0.26	0.08	0.98	0.42	3.15	0.00	54.14	63
Moderate quality rating studies	8	0.20	0.25	-0.29	0.70	0.79	0.42	37.82	81
1 or 2 repetitions of story reading	18	0.24	0.08	0.06	0.41	2.74	0.00	41.66	59
More than 3 repetitions of story reading	11	0.26	0.17	-0.07	0.60	1.53	0.12	48.10	79
Studies with children aged 3-6 years	24	0.24	0.10	0.04	0.43	2.38	0.01	89.90	74
Studies with children over 6 years old	5	0.35	0.09	0.16	0.55	3.58	0.00	1.54	00

† Moderator analyses for digital features and adult support are described on separate tables.

4.4.4.1 Funnel Plot. For the investigation of publication and other biases in meta-analyses researchers may use funnel plots as a primary visual tool (Sterne et al., 2005). This can be done by visually inspecting the funnel plot to see if effect sizes are symmetrically distributed in a funnel shape.

Asymmetrical funnel plots may indicate publication bias. As seen in Figure 4.1, small scale studies appear towards the top of the plot and show a higher concentration on the left side of the mean than on the other. However, publication bias is only one of the possible reasons behind asymmetrical plots; there may be other reasons explaining funnel plot asymmetry. Poor methodological design in smaller studies may yield exaggerated estimates of intervention effects (Egger et al., 2003). Funnel plots can be useful for detecting bias, but their interpretation can be tricky, and they leave open the question of how to proceed if publication bias is suspected (Vevea & Woods, 2005). In the case of a small meta-analysis, such as the current one, Lipsey and Wilson (2001) argue that plots may be hard to interpret and caution reviewers against overanalysing funnel plots.

4.4.4.2 The Trim and Fill Method. The "trim and fill" method developed by Duval and Tweedie (2000), after observing an asymmetrical funnel plot, aims at both identifying publication bias and adjusting results for it (Duval, 2005). More specifically, it is used to estimate an average effect size that is corrected for publication bias (Vevea & Woods, 2005).

The number of studies missing from a biased funnel plot are estimated by reflecting on the negative side of the funnel plot, the largest effects, so studies with small size are added to the set (Vevea & Woods, 2005) (Figure 4.2). A new mean effect size with the new small size studies is added in. The final estimate is interpreted as the average (weighted) effect size estimate corrected for publication bias. Duval (2005) suggests that this approach should be seen as a sensitivity analysis of the potential effect that missing studies have had on the observed result.

Figure 4.1 *Funnel Plot of Standard Error by Hedge's g*

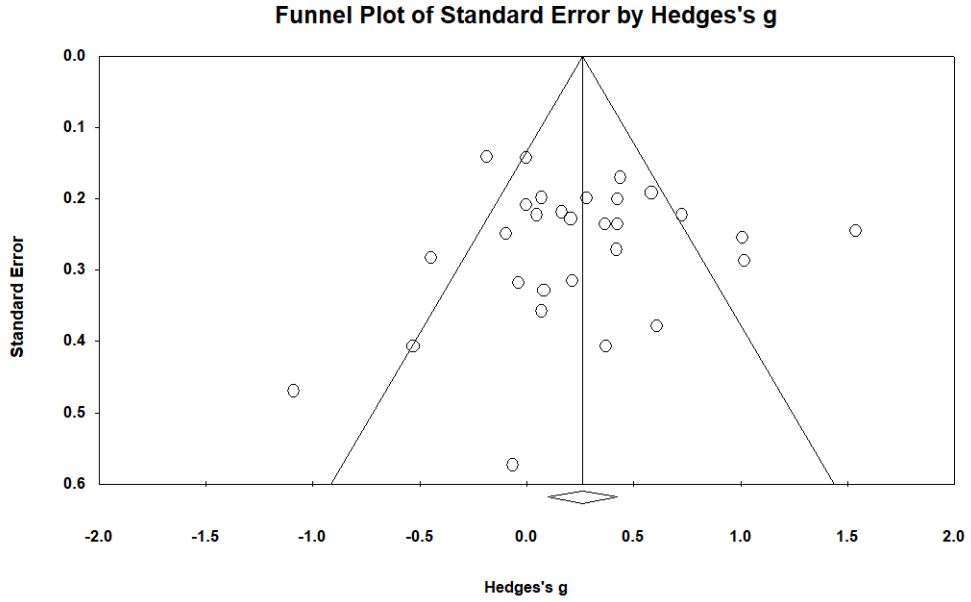
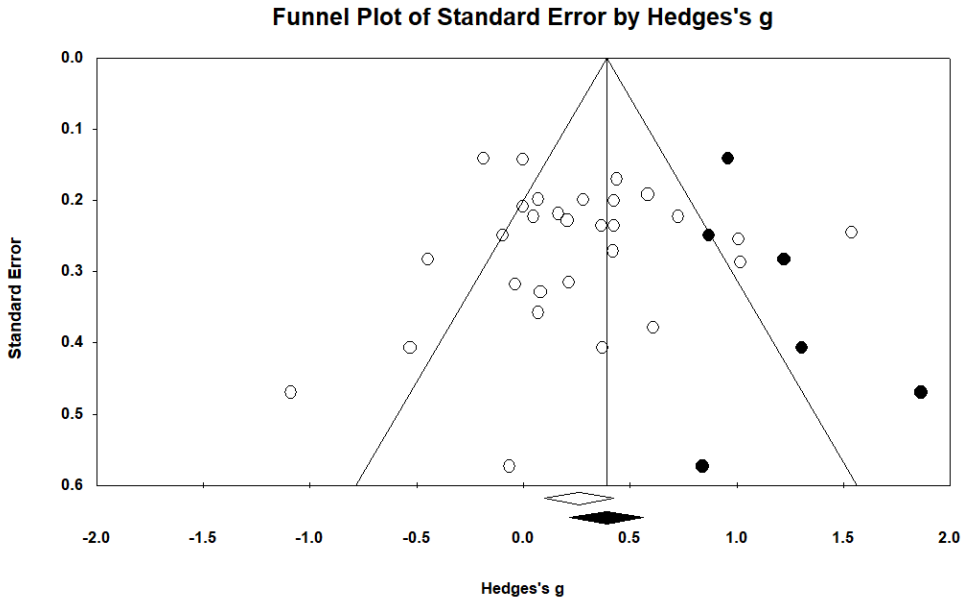


Figure 4.2 *Trim and Fill Funnel Plot Hedges's g and Standard Error*



4.4.5 Effect Sizes for Each Outcome

To answer the first and second research questions, effect sizes were inspected to evaluate the differences between e-books and traditional print book presentations in terms of children's language and literacy outcomes (Table 4.6, Table 4.7 and Figure 4.3).

4.4.5.1 Story Comprehension. We found 24 contrasts in 20 articles/reports in which story comprehension was measured from a paper book in comparison to an e-book. The 20 studies assessing story comprehension were based on measures of children's retelling of the story, ten used questions, seven asked the children to retell the story and three utilised a mix of the two measures. For story comprehension, a zero effect of $g = 0.05$ was found when comparing e-books to traditional print books ($k = 20$; $SE = 0.08$; 95% CI = [-0.11, 0.21]; $p = 0.54$). This effect was heterogeneous, Q (19) = 41.62, $p = 0.002$, $I^2 = 54$.

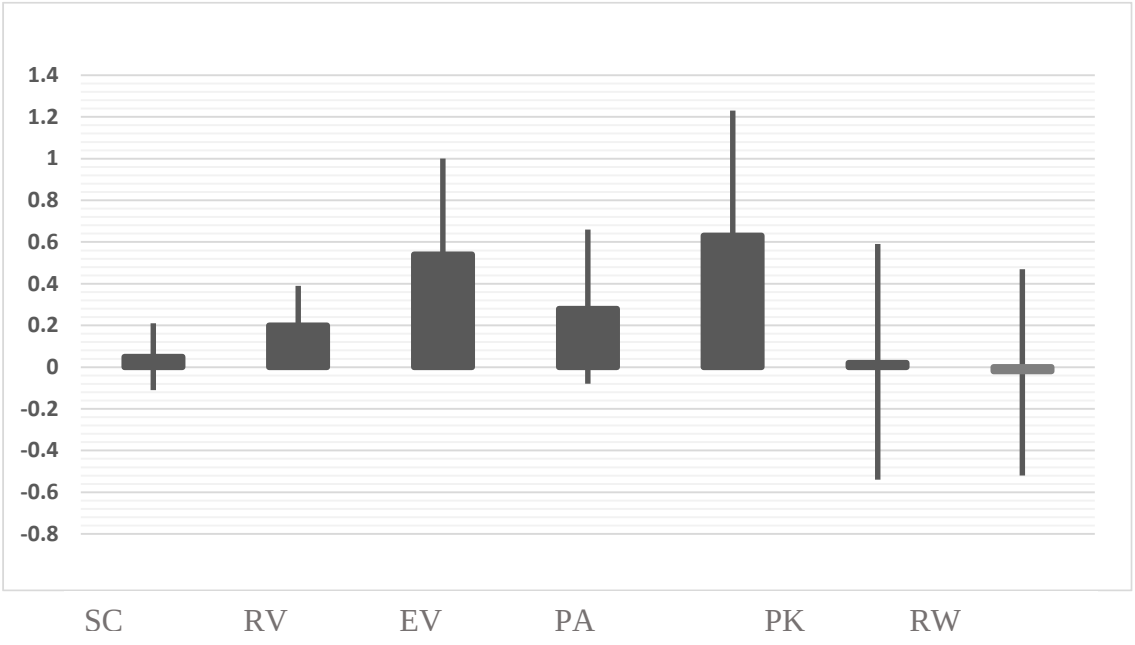
4.4.5.2 Vocabulary Learning. All comparisons assessing vocabulary focused on story-based word knowledge were analysed from 18 studies and 28 comparisons. Of the 18 studies interested in vocabulary development, 11 studies assessed expressive vocabulary and nine measured receptive vocabulary. For overall vocabulary learning, a positive significant effect of moderate size was found ($g = 0.40$; $k = 18$; $SE = 0.14$; 95% CI = [0.10, 0.69]; $p = 0.00$). This effect was heterogeneous, Q (17) = 135.82, $p = 0.00$, $I^2 = 87$. Specifically, a moderate positive and significant effect was found for expressive vocabulary ($g = 0.54$; $k = 11$; $SE = 0.23$; 95% CI = [0.08, 1.00]; $p = 0.02$; $I^2 = 91$), and a small positive and significant effect for receptive vocabulary ($g = 0.20$; $k = 9$; $SE = 0.09$; 95% CI = [0.01, 0.39]; $p = 0.03$; $I^2 = 45$).

Table 4.6 *Overall Results for Outcome Measures*

Outcome Measure	Number of comparisons included†	Effect size (Hedges's g)	Standard error	95% confidence interval	*p*
Story Comprehension	20	0.05	0.08	[-0.11, 0.21]	.54
All Vocabulary	18	0.40	0.14	[0.10, 0.69]	.00
Expressive Vocabulary	11	0.54	0.23	[0.08, 1.00]	.02
Receptive Vocabulary	9	0.20	0.09	[0.01, 0.39]	.03
All code related	11	0.28	0.16	[-0.03, 0.59]	.08
Phonological Awareness	6	0.28	0.19	[-0.08, 0.66]	.12
Print Knowledge	5	0.63	0.30	[0.02, 1.23]	.04
Reading Words	4	0.02	0.28	[-0.54, 0.59]	.93
Spelling	2	-0.02	0.25	[-0.52, 0.47]	.93

†Combined e-book interventions against print books in same studies.

Figure 4.3 *Effect Sizes and 95% CIs of Outcome Measures*



Note: SC= story comprehension, RV= receptive vocabulary, EV=expressive vocabulary, PA=phonological awareness, PK=print knowledge, RW=reading words, S=spelling.

Table 4.7a *Statistics of Each Study for Comprehension and Outcome Measures Descriptions*

Study	Age	N_{total} ($n_{e\text{-}book} + n_{print}$)	Intervention Group	Comparison Group	Measured Outcomes	Effect size for treatments	95% CI for treatment
Comprehension-Related Outcomes							
Altun (2021)	5	196 (97 + 99)	E-book	Print Book	Five story comprehension questions	0.09	[-0.18, 0.37]
Broemmel (2015)	4-5	24 (10 + 14)	E-book and print book	Print Book	Audiotaped book retellings	-0.53	[-1.32, 0.26]
Critelli (2011)	4-6	10 (5 + 5)	E-book	Print Book	10-item comprehension subtest	0.00	[-1.12, 1.12]
Eng (2020) Exper. 1	3-5	35	Contingent E-book	Board Book	10 Story recall questions	0.70	[0.03, 1.36]
Eng (2020) Exper. 2	3-5	33	Contingent E-book	Static E-book	10 Story recall questions	1.46	[0.71, 2.21]
Karemaker (2017) Comparison 1	5.6-7	47 (32 + 15)	E-friend group	Flat E-book	Story comprehension tasks and recall test	0.07	[-0.53, 0.67]
Karemaker (2017) Comparison 2	5.6-7	43 (28 + 15)	Dictionary group	Flat E-book	Story comprehension tasks and recall test	-0.32	[-0.94, 0.29]
Kelley (2017)	3-5	30 (15 + 15)	Interactive E-book (Learn)	E-book without interactive features (Watch)	Story retell measure	-0.10	[-0.80, 0.58]
Kozminsky (2013)	5-6	50 (25 + 25)	E-book	Print Book	Plot understanding test	-0.71	[-1.27, -0.14]
Neuman (2017)	3-4	38	E-book	Print Book	Free recall and Story sequencing	-0.07	[-0.69, 0.55]
O'Toole (2015)	4	100 (50 + 50)	E-book	Print Book	Story comprehension test	0.14	[-0.24, 0.53]
O'Toole (2018) Comparison 1	4	50 (25 + 25)	Live E-book	Live Print Book	7 Open-ended 'wh' questions	0.03	[-0.51, 0.57]
O'Toole (2018) Comparison 2	4	50 (25 + 25)	Audio narrated e-book	Audio narrated print book	7 Open-ended 'wh' questions	-0.13	[-0.68, 0.41]

(Continued)

Table 4.7a *Statistics of Each Study for Comprehension and Outcome Measures Descriptions*

Study	Age	N_{total} (^{n}e-book + ^{n}print)	Intervention Group	Comparison Group	Measured Outcomes	Effect size for treatments	95% CI for treatment
Comprehension-Related Outcomes							
Pearman (2008)	7-8	54	E-book	Print Book	Oral retelling	0.42	[-0.11, 0.95]
Reich (2019)	3-5	200 (100 + 100)	E-book	Print Book	➢ 14 Free recall questions ➢ Story Sequence ➢ 8 questions on story events and characters	-0.10	[-0.38, 0.16]
Richter (2017)	3-5	79	E-book	Print book	9 Recall questions	0.04	[-0.39, 0.48]
Rvachew (2017)	5-6	28	E-book	Print Book	Recall of story	0.35	[-0.37, 1.07]
Sapsaglam (2020)	5-6	20 (10 + 10)	E-book	Print book	5 Story comprehension questions	-1.09	[-2.01, -0.17]
Sari (2019)	4-6	83 (41 + 42)	E-book with animated illustrations with and without music/sounds	E-book with static illustrations with and without music/sounds	Story comprehension questions	0.52	[0.08, 0.95]
Smeets (2015) Comparison 1	4-6	53 (36 + 17)	Animated e-book	Static e-book	Retelling story	0.12	[-0.44, 0.68]
Smeets (2015) Comparison 2	4-6	50 (33 + 17)	Interactive e-book	Static e-book	Retelling story	0.05	[-0.52, 0.63]
Takacs (2016)	4-6	39	Animated e-book	Static e-book	Story retelling	0.24	[-0.37, 0.86]
Zhou (2017) Comparison 1	5	36 (18 + 18)	Multimedia e-book	Print book	Story comprehension test	0.06	[-0.57, 0.70]
Zhou (2017) Comparison 2	5	36 (18 + 18)	Multimedia e-book with questioning	Print book with questions	Story comprehension test	0.44	[-0.20, 1.08]
Zipke (2017)	4-5	25	E-book	Print Book	Story comprehension test	-0.42	[-1.19, 0.34]

Table 4.7b *Statistics of Each Study for Vocabulary and Outcome Measures Descriptions*

Study	Age	N_{total} ($n_{e\text{-}book}$ + n_{print})	Intervention Group	Comparison Group	Measured Outcomes	Effect size for treatments	95% CI for treatment
Vocabulary-Related Outcomes							
Altun (2021)	5	196 (97 + 99)	E-book	Print Book	The Turkish Receptive Language Test	-0.10	[-0.38, 0.17]
Homer (2014) Comparison 1	5-7	19 (12 + 7)	Kinect with activities	Book reading	Expressive vocabulary: 10 Words from Active Decoding Words	0.28	[-0.59, 1.17]
Homer (2014) Comparison 2	5-7	20 (13 + 7)	Kinect without activities	Book reading	Expressive vocabulary: 10 Words from Active Decoding Words	0.37	[-0.52, 1.27]
Ihmeideh (2014)	4.7-5.2	92 (48 + 44)	E-book	Print Book	Target vocabulary: Ten words were selected from the e-books' text Children were shown ten pictures of objects and were asked to say the word of the object.	2.82	[2.25, 3.40]
Karemaker (2017) Comparison 1	5.6-7	47 (32 + 15)	E-friend E-book	Flat e-book	Expressive vocabulary: Target definitions	-0.43	[-1.04, 0.17]
Karemaker (2017) Comparison 2	5.6-7	43 (28 + 15)	Dictionary E-book	Flat e-book	Expressive vocabulary: Target definitions	-0.23	[-0.85, 0.37]
Kelley (2017)	3-5	30 (15 + 15)	Interactive e-book (Learn)	E-book without interactive features (Watch)	➢ Expressive vocabulary: Definitional expressive vocabulary test Decontextual expressive vocabulary test ➢ Receptive vocabulary test ➢ Target vocabulary test Target vocabulary used in story retell	0.40 0.31 -0.33	[-0.29, 1.10] [-0.38, 1.01] [-1.03, 0.36]
Korat (2014a) Comparison 1	4-6	50 (38 + 12)	E-book with dynamic visual vocabulary	E-book without dictionary	➢ Expressive vocabulary: Word meaning expressive test ➢ Receptive vocabulary test ➢ Target words test Target vocabulary used in story retell	0.60 0.56 0.38	[-0.04, 1.25] [-0.08, 1.20] [-0.25, 1.02]
Korat (2014a) Comparison 2	4-6	49 (37 + 12)	E-book with static visual vocabulary	E-book without dictionary	➢ Expressive vocabulary: Word meaning expressive test ➢ Receptive vocabulary test ➢ Target words test Target vocabulary used in story retell	0.47 0.36 0.00	[-0.17, 1.12] [-0.27, 1.01] [-0.64, 0.64]

(Continued)

Table 4.7b *Statistics of Each Study for Vocabulary and Outcome Measures Descriptions*

Study	Age	N_{total} ($n_{e\text{-}book}$ + n_{print})	Intervention Group	Comparison Group	Measured Outcomes	Effect size for treatments	95% CI for treatment
Vocabulary-Related Outcomes							
Korat (2014a) Comparison 3	4-6	49 (37 + 12)	E-book with adult vocabulary support	E-book without dictionary	➢ Expressive vocabulary: Word meaning expressive test ➢ Receptive vocabulary test ➢ Target words test Target vocabulary used in story retell	1.26 0.85 0.72	[0.57, 1.95] [0.19, 1.51] [0.06, 1.38]
Korat (2014b) Comparison 1	7-8	52 (41 + 11)	E-book with dictionary dynamic visuals (DVs) with the printed word	E-book without dictionary	➢ Expressive vocabulary: Word Meaning: Expressive test ➢ Target words test Target vocabulary used in story retell	1.02 0.65	[0.34, 1.71] [-0.01, 1.32]
Korat (2014b) Comparison 2	7-8	53 (42 + 11)	E-book with dictionary dynamic visuals (DVs) without printed words	E-book without dictionary	➢ Expressive vocabulary: Word Meaning: Expressive test ➢ Target words test Target vocabulary used in story retell	0.55 0.34	[-0.11, 1.21] [-0.30, 1.00]
Korat (2014b) Comparison 3	7-8	54 (43 + 11)	E-book with dictionary static visuals (SVs) with printed words	E-book without dictionary	➢ Expressive vocabulary: Word Meaning: Expressive test ➢ Target words test Target vocabulary used in story retell	0.69 0.37	[0.03, 1.36] [-0.28, 1.03]
Korat (2014b) Comparison 4	7-8	56 (45 + 11)	E-book with dictionary static visuals (SVs) without printed words	E-book without dictionary	➢ Expressive vocabulary: Word Meaning: Expressive test ➢ Target words test Target vocabulary used in story retell	0.67 0.19	[0.00, 1.33] [-0.45, 0.84]
Kozminsky (2013)	5-6	50 (25 + 25)	E-book	Print Book	Target Vocabulary test Target vocabulary used in story retell	-0.51	[-1.07, 0.04]
Lee (2020)	6-7	100	E-book with recorded word explanation	Static e-book	Target Vocabulary Express meaning test	0.42	[0.03, 0.81]
Neuman (2017)	3-4	38	E-book	Print Book	Vocabulary target test	-0.00	[-0.63, 0.61]
O'Toole (2015)	4	100 (50 + 50)	E-book	Print Book	The Peabody Picture Receptive Vocabulary Test (PPVT-4) (Dunn & Dunn, 2007)	0.41	[0.02, 0.80]
O'Toole (2018) 1	4	50 (25 + 25)	Live E-book	Live Print Book	Receptive word learning test	0.24	[-0.30, 0.79]
O'Toole (2018) 2	4	50 (25 + 25)	Audio narrated e-book	Audio narrated print	Receptive word learning test	0.17	[-0.37, 0.71]

				book			
Reich (2019)	3-5	200 (100 + 100)	E-book	Print Book	The vocabulary related questions	-0.26	[-0.54, 0.01]

(Continued)

Table 4.7b *Statistics of Each Study for Vocabulary and Outcome Measures Descriptions*

Study	Age	N_{total} ($n_{e\text{-}book} + n_{print}$)	Intervention Group	Comparison Group	Measured Outcomes	Effect size for treatments	95% CI for treatment
Vocabulary-Related Outcomes							
Sari (2019)	4-6	83 (41 + 42)	E-book with animated illustrations with music/sounds	E-book with static illustrations with music/sounds	➢ Receptive target vocabulary test ➢ Expressive target vocabulary test	0.05 -0.08	[-0.37, 0.48] [-0.51, 0.33]
Smeets (2015) Comparison 1	4-6	53 (36 + 17)	Animated E-book	Static e-book	➢ Expressive vocabulary: TvK Expressive vocabulary test ➢ Receptive: PPVT standardised test ➢ Target vocabulary test sentence completion task	-0.37 -0.23 0.06	[-0.94, 0.19] [-0.80, 0.33] [-0.50, 0.63]
Smeets (2015) Comparison 2	4-6	50 (33 + 17)	Interactive e-book	Static e-book	➢ Expressive vocabulary: TvK Expressive vocabulary test ➢ Receptive: PPVT standardised test ➢ Target vocabulary test sentence completion task	-0.08 -0.07 0.55	[-0.66, 0.49] [-0.65, 0.49] [-0.03, 1.13]
Takacs (2016)	4-6	39	Animated e-book	Static e-book	Vocabulary receptive test	0.18	[-0.43, 0.80]
Zhou (2017)	5	36 (18 + 18)	Multimedia-book	Print book	Target Receptive vocabulary test	0.65	[-0.00, 1.30]
Zhou (2017) Comparison 2	5	36 (18 + 18)	Multimedia e-book with questioning	Print book with questions	Target Receptive vocabulary test	0.30	[-0.34, 0.94]
Zipke (2017)	4-5	25	E-book	Print Book	Word Recognition test	1.16	[0.33, 1.98]

Table 4.7c *Statistics of Each Study for Decoding and Outcome Measures Descriptions*

Study	Age	N_{total} ($n_{e\text{-}book}$ + n_{print})	Intervention Group	Comparison Group	Measured Outcomes	Effect sizes for treatments	95% CI for treatment
Code-Related Outcomes							
Critelli (2011)	4-6	10 (5 + 5)	E-book	Print book	➢ 10 questions for Phonological awareness ➢ 10 reading words	-0.33 0.13	[-1.46, 0.79] [-0.98, 1.25]
Gong (2009) Comparison 1	4-4.9	32 (24 + 8)	E-book with 'Bouncing Ball'	Static e-book	Print discrimination task - Reading subtest of Wilkinson's (1993) the WRAT-3	0.61	[-0.17, 1.41]
Gong (2009) Comparison 2	4-4.9	32 (24 + 8)	E-book with 'Violation'	Static e-book	Print discrimination task - Reading subtest of Wilkinson's (1993) the WRAT-3	0.26	[-0.52, 1.04]
Gong (2009) Comparison 3	4-4.9	32 (24 + 8)	E-book with 'Action'	Static e-book	Print discrimination task - Reading subtest of Wilkinson's (1993) the WRAT-3	0.39	[-0.39, 1.17]
Homer (2014) Comparison 1	5-7	19 (12 + 7)	Kinect with activities	Book reading	Reading words: 20 Sight Words Active Decoding Words High Frequency Words	-0.25	[-1.14, 0.64]
Homer (2014) Comparison 2	5-7	20 (13 + 7)	Kinect without activities	Book reading	Reading words: 20 Sight Words Active Decoding Words High Frequency Words	-0.14	[-1.02, 0.73]
Ihmeideh (2014)	4.7-5.2	92 (48 + 44)	E-book	Print Book	➢ Ten questions were developed to measure phonological awareness skills ➢ Print Awareness: Clay's (1979) test	0.78 1.00	[0.36, 1.20] [0.57, 1.43]
Karemaker (2017) Comparison 1	5.6-7	47 (32 + 15)	E-friend E-book	Flat e-book	Target word reading test	-0.47	[-1.08, 0.13]
Karemaker (2017) Comparison 2	5.6-7	43 (28 + 15)	Dictionary E-book	Flat e-book	Target word reading test	-0.35	[-0.97, 0.26]
Korat (2014b) Comparison 1	7-8	52 (41 + 11)	E-book with dictionary dynamic visuals (DVs) with the printed word	E-book without dictionary	Word Spelling test	0.19	[-0.46, 0.85]
Korat (2014b) Comparison 2	7-8	53 (42 + 11)	E-book with dictionary dynamic visuals (DVs) without printed words	E-book without dictionary	Word Spelling test	0.17	[-0.48, 0.82]

(Continued)

Table 4.7c *Statistics of Each Study for Decoding and Outcome Measures Descriptions*

Study	Age	N_{total} ($n_{e\text{-}book} + n_{print}$)	Intervention Group	Comparison Group	Measured Outcomes	Effect sizes for treatments	95% CI for treatment
Code-Related Outcomes							
Korat (2014b) Comparison 3	7-8	54 (43 + 11)	E-book with dictionary static visuals (SVs) with printed words	E-book without dictionary	Word Spelling test	0.28	[-0.37, 0.93]
Korat (2014b) Comparison 4	7-8	56 (45 + 11)	E-book with dictionary static visuals (SVs) without printed words	E-book without dictionary	Word Spelling test	0.10	[-0.54, 0.75]
Kozminsky (2013)	5-6	50 (25 + 25)	E-book	Print Book	➢ Phonological Awareness test ➢ Print Knowledge test ➢ Orthographic Awareness test All based on existing tests (Blum, 2001; Drori, 1998; Tuvaland Zeiler, 1995)	-0.10 -0.58 -0.33	[-0.64, 0.44] [-1.14, -0.02] [-0.87, 0.22]
Liao (2020) Comparison 1	4-5	29 (19 + 10)	E-book highlight synchronization	Static Read-only E-book	Preschool Word and Print Awareness (PWPA) test	0.43	[-0.32, 1.18]
Liao (2020) Comparison 2	4-5	30 (20 + 10)	E-book print discussion	Static Read-only E-book	Preschool Word and Print Awareness (PWPA) test	1.91	[1.03, 2.79]
Rvachew (2017)	5-6	28	E-book	Print Book	Letter sound Phonological tests: matching a spoken sound to the appropriate printed letter, matching pictures of words that share a common rime or onset, identifying a frequently occurring word from a list of three, and identifying a new word on the basis of a familiar first letter.	0.86	[0.10, 1.62]
Segal-Drori (2010) Comparison 1	5-6	48 (32 + 16)	E-book without adult instruction	Print Book with adult instruction	➢ Phonological Awareness test ➢ Reading 9 words ➢ 16 questions dealing with print awareness (Shatil, 2001)	-0.05 -0.64 0.55	[-0.64, 0.53] [-1.24, -0.04] [-0.04, 1.15]
Segal-Drori (2010) Comparison 2	5-6	48 (32 + 16)	E-book with adult instruction	Print Book with adult instruction	➢ Phonological Awareness test ➢ Reading 9 words ➢ 16 questions dealing with print awareness (Shatil, 2001)	0.95 2.76 3.04	[0.33, 1.57] [1.95, 3.57] [2.19, 3.88]
Willoughby (2015)	3-4	63 (33 + 30)	Alphabet e-books	ABC Paper books	Letter-naming task Letter-sound task Test of phonological awareness kindergarten version (TOPA-K; Torgesen & Bryant, 1994)	-0.09	[-0.58, 0.39]

4.4.5.3 Code-related Literacy Skills. Overall, of the 20 contrasts in 11 studies with code-related literacy skills as outcome measure, six studies targeted phonological awareness, five print awareness, four word reading skills, and two spelling. The overall effect for the 11 studies measuring the additional effect of technology was positive but small and non-significant (g = 0.28; k = 11; SE = 0.16; 95% CI = [-0.03, 0.59]; p = 0.08). The effect was heterogeneous, Q (10) = 41.18, p = 0.00; I^2 = 75. Results of code-related skills are presented separately as follows. Most effects were statistically non-significant suggesting that children in the e-book condition performed as well as children in the print condition. Specifically, six studies compared the effects of e-books to print books for *phonological awareness* with a small positive though non-significant effect (g = 0.28; k = 6; SE = 0.19; 95% CI = [-0.08, 0.66]; p = 0.12; I^2= 61). Five studies including nine contrasts were under the category of *print knowledge* with a moderate positive significant effect: (g = 0.63; k = 5; SE = 0.30; 95% CI = [0.02, 1.23]; p = 0.04; I^2 = 86). Studies investigating the ability of children to *read words* following their intervention showed a non-significant effect (g = 0.02; k = 4; SE = 0.28; 95% CI = [-0.54, 0.59]; p = 0.93; I^2 = 73). Of the 29 studies, only two studies (with five contrasts) investigated *spelling* revealing a negative effect (g = -0.02; k = 2; SE = 0.25; 95% CI = [-0.52, 0.47]; p = 0.93; I^2 = 60).

4.4.6 Multimedia versus Interactive E-books versus "Non-Embellished" E-books

To answer the third research question, the effects of multimedia and interactive features were compared to traditional print book reading. For a summary of the findings, see Table 4.8. As the effects of the different e-book features (e.g., hot-spots, dictionary, animation) on outcome measures were heterogeneous, the differences among stories including only multimedia, only interactive features, and those with both multimedia and interactive features were tested. There were 20 experimental interventions from 13 studies which investigated the effects of e-books with multimedia features (overall g = 0.38; SE = 0.13; 95% CI = [0.12, 0.63]; p = 0.00; I^2 = 75), two studies with interactive e-books (g = 0.24; SE = 0.19; 95% CI = [-0.14, 0.63]; p = 0.21; I^2 = 00), and eleven studies with 15 contrasts with e-books including both interactive and multimedia features (overall g = 0.26; SE = 0.12; 95% CI = [0.02, 0.49]; p = 0.03; I^2 = 62). Overall, the effects for e-books with multimedia features were found to be more beneficial when compared to print book reading. The other two categories were statistically non-significant as indicated by the confidence intervals. The meta-analysis also coded studies with non-embellished, basic e-

books without any multimedia and interactive features (k = 5). For all included contrasts, an effect size of g = -0.15 was found, which represents a small negative but non-significant effect (SE = 0.21; 95% CI = [-0.56, 0.26]; p = 0.47; I^2 = 59).

4.4.6.1 Story Comprehension. Stories including both multimedia and interactive features (k =7) had a small positive but non-significant effect on story comprehension compared to print books, g = 0.21, (95% CI = [-0.07, 0.50]). The same non-significant effect for story comprehension was found in multimedia stories as well. Interactive stories (k = 2) and basic non-embellished stories (k = 5) yielded significant negative effects for story comprehension favouring the print condition.

4.4.6.2 Vocabulary Learning. Multimedia-only stories for expressive and receptive vocabulary yielded a positive moderate but non-significant effect of g = 0.46 (k = 9; SE = 0.24; 95% CI = [-0.01, 0.94]; p = 0.06; I^2 = 91). For e-books including both multimedia and interactive features a small positive but non-significant effect of g = 0.11 (k = 5; SE = 0.16; 95% CI = [-0.20, 0.43]; p = 0.47) was observed. Specifically, for expressive vocabulary, which had the most contrasts in both groups, multimedia-only e-books yielded a moderate positive and significant effect of g = 0.60 (k = 7; 95% CI = [-0.03, 1.24]). An effectively zero effect was observed for multimedia-interactive e-books (g = -0.01; k = 4; 95% CI = [-0.32, 0.30]).

4.4.6.3 Code-related Literacy Skills. Multimedia-only stories showed an additional positive significant advantage for e-books over print books when code-related skills were concerned (specifically print knowledge k = 3, spelling k = 1, phonological awareness k = 2), g = 0.63, SE = 0.18, 95% CI = [0.28, 0.99], p = .00, I^2 = 62.

However, it was not possible to test the difference between interactive-only stories and multimedia-only stories, as there was only one contrast for interactive-only stories. E-book stories with both multimedia and interactive features yielded positive non-significant effects in all outcomes when compared to print books.

Table 4.8 *E-books With and Without Multimedia and Interactive Features on Language and Literacy Outcomes*

Type of technology story	Number of comparisons included	Effect size (g)	Standard error	95% confidence interval	*p*
Multimedia E-books only	**13†**	**0.38**	**0.13**	**[0.12, 0.63]**	**.00**
Story Comprehension	7	0.15	0.09	[-0.03, 0.35]	.11
Vocabulary	9†	0.46	0.24	[-0.01, 0.94]	.06
Receptive vocabulary	5	0.09	0.15	[-0.20, 0.39]	.54
Expressive vocabulary	7	0.60	0.32	[-0.03, 1.24]	.06
Code related	5†	0.63	0.18	[0.28, 0.99]	.00
Phonological Awareness	2	0.80	0.18	[0.43, 1.17]	.00
Print Knowledge	3	0.81	0.19	[0.44, 1.19]	.00
Reading Words	0	-	-	-	-
Spelling	1	0.18	0.16	[-0.14, 0.52]	.26
E-books with both Interactive and Multimedia features	**11†**	**0.26**	**0.12**	**[0.02, 0.49]**	**.03**
	7	0.21	0.14	[-0.07, 0.50]	.14
Story Comprehension	5†	0.11	0.16	[-0.20, 0.43]	.47
Vocabulary	3	0.22	0.18	[-0.13, 0.58]	.21
Receptive vocabulary	4	-0.01	0.16	[-0.32, 0.30]	.94
Expressive vocabulary	4	0.23	0.22	[-0.20, 0.67]	.29
Code related	2	0.14	0.22	[-0.29, 0.57]	.51
Phonological Awareness	2	0.83	0.42	[0.00, 1.66]	.04
Print Knowledge	2	0.24	0.38	[-0.50, 0.98]	.52
Reading Words	0	-	-	-	-
Spelling					
Interactive E-books only	**2†**	**0.24**	**0.19**	**[-0.14, 0.63]**	**.21**
Story Comprehension	2	-0.19	0.19	[-0.57, 0.18]	.31
Receptive Vocabulary	0	-	-	-	-
Expressive Vocabulary	1	1.16	0.23	[0.70, 1.63]	.00
Phonological	0	-	-	-	-
Awareness	0	-	-	-	-
Print Knowledge	1	-0.43	0.22	[-0.87, 0.00]	.05
Reading Words	0	-	-	-	-
Spelling					
E-books without Multimedia and Interactive features (static/basic)	**5†**	**-0.15**	**0.21**	**[-0.56, 0.26]**	**.47**
	5	-0.27	0.21	[-0.69, 0.14]	.19
Story Comprehension	2	0.31	0.14	[0.03, 0.58]	.02
Receptive Vocabulary	0	-	-	-	-
Expressive Vocabulary	2	-0.14	0.25	[-0.63, 0.34]	.56
Phonological Awareness	1	-0.58	0.28	[-1.14, -0.02]	.03
Print Knowledge	1	0.13	0.57	[-0.98, 1.25]	.81
Reading Words	1	-0.33	0.28	[-0.87, 0.22]	.24
Spelling					

†Combined e-book interventions against print books in same studies with same (or without) technological features.

4.4.7 Animation and Hotspots

When comparing studies with only animation as an e-book feature from the list of studies with various multimedia features, ten studies evaluated the effects of animation in comparison to traditional print books. The overall effect was small in size (g = 0.32) and significant (95% CI = [0.01, 0.63]; k = 11; SE = 0.15; p = 0.04; I^2 = 76). In regard to vocabulary development (k = 9), when animation in e-books was compared to a print-like condition, a positive non-significant effect was found (g = 0.49; 95% CI = [-0.04, 1.03]; SE = 0.27; p = 0.07; I^2 = 91). Animation did not make a significant contribution to story comprehension as well, resulting in a small positive non-significant effect (g = 0.15; 95% CI = [-0.03, 0.35]; k =7).

Only two studies evaluated hotspots in e-books without other digital features (Karemaker et al., 2017; Zipke, 2017), thus we were not able to evaluate the results of hotspots as a feature. However, we were able to evaluate ten studies which included hotspots combined with animation in their e-book condition and found an overall significant positive effect on language and literacy development (k = 10; g = 0.20; SE = 0.10; 95% CI = [0.00, 0.40]; p = 0.04; I^2 = 45). For separate outcome measures, the results were small and non-significant: story comprehension (g = 0.01; 95% CI = [-0.15, 0.17]; k = 7); vocabulary development (g = 0.49; 95% CI = [-0.10, 1.08]; k = 5). For code-related skills, only four studies assessed the effects of hotspots in combination with animation (g = 0.14; 95% CI = [-0.39, 0.68]).

4.4.8 Adult Scaffolding/Mediation Effects

We calculated the effects of adult support in either the print condition, the e-book condition or both conditions in order to find out the effects of adult scaffolding during storybook reading (see Table 4.9). The calculated effect of adult scaffolding in any condition produced a positive non-significant effect (g = 0.44; k = 9; SE = 0.23; 95% CI = [-0.01, 0.89]; p = 0.05; I^2 = 81). In five out of 29 studies, e-books were assessed for language and literacy outcomes when adult support was present in both the paper and e-book condition. In this small set of studies, we found a large positive effect favouring the e-book condition. However, the confidence interval crosses zero, showing that this effect was not statistically different from zero, indicating that children in the e-book condition performed as well as children in the print book condition (g = 0.86, 95% CI = [-0.01,

1.73]). When comparing the effects of adult scaffolding in the print book condition with the independent use of e-books with various features, we found a negative effect favouring the print book condition (g = -0.07; k=4; SE = 0.16; 95% CI = [-0.40, 0.24]; p = 0.63; I^2 = 88), meaning that adult scaffolding in print books outperformed the digital features offered in e-books.

Table 4.9 *Studies With and Without Adult Scaffolding / Mediation in Print and E-books*

	Number of studies	Effect size (g)	Standard error	95% confidence interval	*p*
Studies with adult support either in e-book condition, or in print condition or both conditions	9†	0.44	0.23	[-0.01, 0.89]	.05
Studies with adult support in both conditions (e-book and print are supported)	5†	0.86	0.44	[-0.01, 1.73]	.05
Story Comprehension	3	0.12	0.29	[-0.45, 0.70]	.68
Vocabulary	2	1.57	1.26	[-0.90, 4.06]	.21
Code related	3	1.30	0.42	[0.48, 2.13]	.00
Studies with adult support in print condition only	4†	-0.07	0.16	[-0.40, 0.24]	.63
	2	-0.61	0.23	[-1.06, -0.15]	.00
Story Comprehension	3	0.29	0.47	[-0.63, 1.21]	.54
Vocabulary	3	-0.19	0.17	[-0.54, 0.14]	.25
Code related					
Studies with adult support in e-book condition only (not in print book)	1	1.00	0.24	[0.52, 1.49]	.00
Studies without adult support in e-book condition (independent use) and all included comparisons in print condition (with and without support print)	26†	0.18	0.06	[0.04, 0.31]	.00
	18†	0.04	0.08	[-0.12, 0.22]	.59
Story Comprehension	17†	0.25	0.10	[0.04, 0.45]	.01
Vocabulary	9†	0.06	0.14	[-0.23, 0.35]	.68
Code related					
Studies without adult support in both conditions (independent use of e-book versus only narration of print book – no scaffolding)	22†	0.21	0.07	[0.06, 0.35]	.00
	16†	0.10	0.08	[-0.05, 0.27]	.19
Story Comprehension	14†	0.25	0.10	[0.04, 0.46]	.01
Vocabulary	6†	0.17	0.20	[-0.21, 0.57]	.37
Code related					

†Combined e-book interventions against print books in same studies.

4.4.9 Adult Scaffolding for Multimedia and Interactive E-books

Due to the small number of studies, there was no way to control for adult scaffolding (multimedia e-books and adult support in both conditions k = 3, interactive e-books and adult support k = 1, interactive and multimedia e-book conditions and adult support k = 3).

4.5 Discussion

The aims of this meta-analysis were, (1) to evaluate the effectiveness of e-books in comparison to traditional print books when they are being read by an adult either with scaffolding or handled independently; (2) to investigate whether outcome measures are better developed with the support of digital features in e-books in comparison to print book reading with and without adult support; and (3) to explore which type of digital features offer valuable and educational support to our young learners. The overall experimental data surrounding the efficiency of e-books are rather controversial, and there is no general agreement regarding their use for the development of language and literacy skills. Therefore, this meta-analysis offers the most recent data in an effort to better understand and evaluate e-books used by young children today. It has been hypothesised, that the specific features in e-books may mirror or resemble teacher/adult scaffolding when the adult is reading a traditional print book in an effort to develop young children's story comprehension, vocabulary knowledge and code-related skills. The overall impact of the 29 primary studies published between 2008 and 2021 appear modest as the results produced a small positive overall effect (g = 0.25; 95% CI = [0.09, 0.42]) favouring the e-book condition, however effect sizes vary across studies and subgroups.

The results differ when they are based on separate effects of language or literacy outcomes. It is apparent that various cognitive factors and content elements can influence how well young children learn from storybooks in any format (Nueman et al., 2021; Richter & Courage, 2017). The variation among the procedures and outcome measures that have been reported in the literature further complicate the evaluation of effectiveness (Takacs et al., 2015). Therefore, the effect of story comprehension in e-books versus adult narration was investigated in print conditions and this result offers a unique contribution. When comparing these findings with those of the two existing meta-analyses (Takacs et al., 2014; Zucker et al., 2009), the most striking difference relates to the effect on story comprehension. Both prior meta-analyses found positive and significant effects on story comprehension, whereas this meta-analysis found a small positive but non-significant effect on story comprehension (g = 0.05; 95% CI = [-0.11, 0.21]), indicating that children in the e-book conditions performed as well as children in the print conditions. This finding is consistent with that of Liman Kaban and Karadeniz (2021) who evaluated the use of different digital reading media in 96 students. Despite the use of diverse reading media in

the experimental and control groups, there was no significant difference in their reading comprehension levels.

Vocabulary development results are in line with results reported in Takacs et al.'s (2014) meta-analysis as well as recent experimental studies (e.g., Korat et al., 2022a; Korat et al., 2017; Lee, 2020) supporting that digital books are more effective than print books especially for expressive vocabulary. Expressive vocabulary is one of the most difficult types of vocabulary for a child to develop. Children need to express the meaning of new words using definitions and by explaining the full meaning of a word. If an e-book is able to achieve this based on the digital features of storybooks, then this result is incredibly promising. Indeed, half of the studies with expressive vocabulary as an outcome had a medium to large positive effect size favouring the e-book condition. This might be explained by the type of features included within e-books. For example, the study by Korat et al. (2014b) produced large positive effect sizes in all four comparisons (see Table 4.7b) as their e-book included a dynamic and static dictionary. Regardless of digital design effects (static versus dynamic), the dictionary offered the opportunity to the students to observe unknown words in the form of an image by giving them an immediate answer to an unknown word. This example contradicts the effectiveness of audio narration of definitions and pronunciations as used in the study of Karemaker et al. (2017), which included an auditory dictionary, resulting in negative effects on expressive vocabulary (g = -0.23; 95% CI = [-0.85, 0.37]). The study by Korat et al. (2014b) is in line with Mayer's (2005) cognitive theory of multimedia learning which argues that multimedia narrations paired with images generate verbal and visual mental representations that are elaborated in working memory and can be combined with prior information to form new knowledge, such as expressive vocabulary development.

When comparing multimedia additions in e-books our findings revealed a small positive effect favouring the e-book condition, which showed that e-books are more beneficial than encounters with traditional print books with or without adult scaffolding. This effect was significant for code-related skills (g = 0.63; 95% CI = [0.28, 0.99]. However, previous experimental literature evaluating multimedia e-books in relation to the development of code-related skills (e.g., Arslan-Ari & Ari, 2022; Yow & Priyashri, 2019), supported that e-book reading may not be an activity that develops phonological awareness, print knowledge and reading words as children tend to pay more attention to the pictures rather

than the text. A possible explanation for this might be that teacher mediation was evident in the studies included in this meta-analysis, indicating that teacher scaffolding with the use of multimedia e-books has a positive impact on the acquisition of code-related skills.

In regard to interactive features added to e-books, only two studies tested the difference between an interactive story and a non-interactive (print or static) story (Karemaker et al., 2017; Zipke, 2017). These studies showed no significant differences between interactive and non-interactive stories. A similar non-significant effect was also identified in e-book studies that included both interactive and multimedia features (k = 11). However, when analysing the results of e-books without any features, such as static e-books with basic oral narration, compared to children listening to print book narrations, results showed a small negative though non-significant effect (g = -0.15; 95% CI = [-0.56, 0.26]). This finding, although preliminary due to the small number of studies with "unembellished" e-books (k = 5), might suggest that interactive and multimedia components, either separately or added together in an e-book, might serve as a scaffolding tool for young children, thus suggesting that e-books may have the potential to scaffold children's literacy development.

When analysing the effects of digital features as scaffolding tools in comparison to print books without adult support, the results reveal a small positive, non-significant effect indicating that unsupported e-books offer the same results as unsupported print book reading. However, in accordance with an earlier meta-analysis (Takacs et al., 2014), the same non-significant result was expected to be found when adult mediation was present during print book reading in comparison to independent use of e-books. This meta-analysis revealed that adult mediation during print book reading outperformed digital features when e-books were used independently. This result is based on only four studies; the positive effects of adult–child interactions during storytelling sessions cannot be replaced by digital features. In light of this finding, e-books with support were compared with print books with support, revealing that adult scaffolding combined with digital features offered in e-books facilitated children's learning. It has been argued in past studies that adults may be less likely to scaffold children's understanding and elicit dialogic reading during e-book narrations in contrast to print book storytelling sessions (Eggleston et al., 2022; Munzer et al., 2019; Parish-Morris et al., 2013). However, the results of the current study are in agreement with Neumann's (2020a) findings which showed that the teacher discussed more and read the e-book for a longer period of time than the print book. The current

findings suggest that the combination of digital features and adult content-related discussions is significantly more effective in comparison to adult support offered during print book reading. This study supports evidence from recent observations (e.g., Korat et al., 2022b) which also found a considerable advantage for children who read the e-book with adult scaffolding in terms of story comprehension. Overall, the findings suggest that adult scaffolding in combination with e-books' digital features may be important factors to consider during adult-child storybook reading.

4.5.1 Limitations

The main limitations of this study are the relatively small number of primary studies that were available and the range of outcomes that these studies included, as this means that the influence of a number of key features could not be evaluated robustly. First, the analysis was unable to test whether the quality of scaffolding affects learning and comprehension. It would be helpful to evaluate different types of scaffolding and review any differing effects. Second, discrete effects from different kinds of multimedia (such as animation, music and sound effects) as well as particular interactive features (such as games, hotspots, and the availability of a dictionary function) could not be assessed. The embedded features included in the e-books of the meta-analysed studies did not address a particular feature in more than one or two studies but were categorised as more broadly as multimedia and/or interactive. Third, a number of studies investigated the effects of e-books on reading words, phonological awareness or spelling, in contrast to other studies which focused on story comprehension and vocabulary learning, even though the acquisition of code-related skills are equally important to acquire at this sensitive period of a child's educational development. Finally, adult scaffolding in both e-books and print books was limited. In the current study digital features in combination with adult scaffolding outperformed adult mediated print books; future studies could further explore this new finding in order to consolidate our findings. A further limitation is the relatively small samples in some studies which compounds the issues listed above. The meta-analysis may also be susceptible to publication bias, as, whilst every effort was made to identify relevant studies systematically, the scale of these studies may have further compounded publication bias, as smaller studies would need larger effect sizes to reach a threshold for statistical significance. Finally, a number of the included studies have limitations in terms of their methodological rigour or in the details of their reporting which may also have

affected the findings from the overall synthesis.

4.5.2 Practical Implications

In this meta-analysis e-books and print books were examined, the digital features of e-books as well as the support given by adults while reading a story for the promotion of language and literacy development. The findings of this study offer a number of important implications for future practice and the construction of e-books. Story comprehension is a major skill which young children need to acquire. Reading an e-book and expecting children to understand the content and meaning of the story independently might be a little misguided. Most e-book studies in this meta-analysis involved e-books with the incorporation of hotspots. This means that while the children are listening to the story, they have the opportunity to place their finger on the screen and listen to words shown on the specific page of the story. This feature could be assumed as an advantage as words are repeated, and the child has the opportunity to listen to the pronunciation of the word and connect the word to the picture. However, this action might also be a source of interference while the narrator is reading the story and as a result, hotspots direct the child's attention towards the hotspots, and the child is unable to absorb important and necessary information in order to understand the content of the story. The distracting hotspots placed on the page of an e-book are considered extraneous information, which may have a negative impact on children's learning processes resulting in cognitive load. The child's natural urge to press each hotspot numerous times might come from the notion that children expect interactivity because they are accustomed to game-like activities, which diverts their attention away from the storyline. There is, therefore, a definite need for digital book designers to assess the specifics incorporated in e-books and the timing of appearance of these features in order to maximise children's ability to learn.

Furthermore, our meta-analysis highlights the fact that when children are using an e-book without adult scaffolding their learning and development depends on the variety of features embedded in e-books which, more often than not, are contrasting one another. Each feature, depending on the frequency and timing included in an e-book, may harm or support children's learning. Looking closely at the studies included in this meta-analysis, the studies that offered multiple interactive and multimedia support did not benefit children as well as the print book condition with adult support. In addition, children in the e-book conditions were responsible for their own learning whereas children that were supported

in the print conditions were guided by an educated and experienced adult using instructional scaffolding to reach his/her educational goals. Teachers are extremely important in promoting children's e-book reading experiences (Christ et al., 2018; Reich et al., 2016). The teacher knows and understands the objectives of the educational activity and uses storytelling and scaffolding techniques to get the most out of every story. Most commercially available e-books do not include features that resemble external support (e.g., adult scaffolding) and as a result e-books may not be able to replace adult scaffolding. In order to reduce cognitive load designers should take into consideration Mayer's multimedia principles. Designing with the coherence principle in mind entails the exclusion of simultaneous presentation of words, sounds and animation, as text and animation together may overload the visual channel (Mayer, 2005). An implication of these findings is that both digital features and adult scaffolding should be taken into account by teachers and parents, as well as book designers. Our findings could be used to expand on existing designs of digital storybook apps for educational purposes.

4.5.3 Implications for Future Research

It is recommended that future interventions investigate in more detail the effects of specific interactive features. The past decade has seen very few studies concerning interactivity in e-books. As technology evolves, interactive features evolve as well. In addition, future studies should include a wider spectrum of outcome variables. Most studies have focused on vocabulary development and story comprehension; thus, it is recommended that future studies include a wider range of outcome variables and could include network meta-analysis approaches. Indeed, outcomes, such as reading, spelling, phonological awareness, and print awareness, are equally important to children's literacy development. This meta-analysis is the first that included code-related skills in the analysis showing that code-related outcomes have the potential to be developed through e-book reading, even though the number of studies included was small (especially for spelling and reading words). It is furthermore suggested that future studies include follow-up testing, by re-administering their outcome measures, to investigate whether the effects of e-book and print book reading interventions extend beyond the period of the intervention and may have measurable long-term effects. It should be noted that none of the studies included in this meta-analysis performed a re-administration of post-tests to evaluate retention. It is recommended that future studies investigate the role of scaffolding and the type of

scaffolding offered to young children during e-book reading sessions. It is further recommended the investigation of separate digital effects with adult support in either the print condition, the e-book condition or both. It is important to evaluate each feature separately and to evaluate and make clear which of these features, if any, could lead to long-term benefits to learning.

4.6 Conclusion

In the present research synthesis, which included 29 studies and 2,317 young children, evidence was found to suggest that e-book story telling sessions are able to support language and literacy learning equally well as traditional print book storytelling sessions. For the development of children's vocabulary, e-books are more effective than print books, especially in expressive vocabulary. Small and non-significant effects were found for story comprehension. A key concern about e-books for preschoolers is that their multimedia and interactive features could be a distraction during reading and might interfere with children's learning. However, a small positive significant effect was found for multimedia e-books in contrast to e-books with minimal to no digital features. Our results confirmed that comprehension, vocabulary and code-related skills are facilitated as a result of e-book reading and were not affected negatively by e-books with both interactive and multimedia features.

The meta-analysis was also able to assess the effect of e-book reading in comparison to print book reading with and without the presence of an adult. Adult support was either in the print condition, the e-book condition or both conditions. Adult support was not instructional in the sense of providing guidance on how to use a tablet/computer or to keep a child on task. Instead, the adult asked questions regarding the story either during or after teaching, explained unknown words, discussed the content of the story based on children's own personal experiences and played games relating to comprehension of the story content, vocabulary and code related skills. The independent use of e-books showed a small positive non-significant effect in comparison to print book reading with and without the presence of an adult. The findings suggest that the specific digital features offered by the studies included in the meta-analysis are equal to adult scaffolding and appear to have the ability to scaffold children's learning. Moreover, adult support combined with e-book features outperformed all comparison conditions. The evidence from this study suggests

that activities such as storybook reading accompanied with adult-child dialogic interactions offer a unique experience and play an important role in language and literacy development - regardless of book type.

The next chapter of this thesis introduces the second study, which is an experimental investigation that assesses the effectiveness of e-books and print books for young English as an Additional Language (EAL) learners. The findings of the meta-analysis presented in Chapter 4 indicated that providing adult support during e-book reading, such as asking questions and engaging in discussions about story content, has demonstrated significant advantages for children's language and literacy development. Therefore, the purpose of Study 2 was to evaluate the effectiveness of two scaffolding techniques, namely interactive and performance teaching approaches, in facilitating the learning process of non-native English-speaking children. The primary objective was to determine whether or not these techniques are effective when children are exposed to either an electronic book or a print book during shared storybook reading. Study 2 aimed to assess the efficacy of two scaffolding techniques, namely interactive and performance teaching styles, in facilitating the learning process of children learning English as an additional language. The primary focus was to determine if these teaching styles are effective when children are exposed to either an e-book or a print book during shared storybook reading.

Chapter 5: Experimental Study

The purpose of this study was to investigate two different book mediums—the electronic book and the print book—while reading two different stories twice using two different teaching styles—the interactive teaching style and the performance teaching style. The children (*n*=60) who participated in the study were learning English as an additional language, from diverse backgrounds who resided in Cyprus and attended a private English school. Both the book medium and the teaching styles were assessed on measures linked to the development of vocabulary (expressive and receptive vocabulary) through the use of target words featured in the stories as well as story comprehension (implicit and explicit).

The meta-analysis presented in Chapter 4 (i.e., Savva et al., 2022) examined the specific impact of e-book reading on language and literacy development of young children when compared to traditional reading of print books with or without adult scaffolding in a structured and controlled environment. Within the meta-analysis, the authors evaluated specific e-book features and their effect in terms of supporting children's learning progress. Some aspects of e-books were considered more beneficial than others when looking at language and literacy outcomes. The effect sizes of the studies included in the meta-analysis, as well as the overall literature review that this study is based upon, offer some conclusions as to what constitutes a "perfect" e-book. Perfect in this sense describes the specific features included in e-books which were found to promote language and literacy development for typical developing children. In this study, these "perfect" e-books were put to the test for children learning English as an additional language.

5.1 The "Perfect" E-book

Today, children use new devices, from smartphones to tablets to personal computers, and they are exposed to digital literacy environments from an early age (Bers et al., 2014; Marsh et al., 2005; Parette et al., 2010). They experience digital storybooks along with printed ones (Altun, 2017; Rideout, 2011). Digital storybooks provide multimedia enhancements: animated pictures, background sounds, music, sound effects and video as well as interactive features such as hotspots, games, and dictionaries (Bus et al., 2015; Korat, 2010; Verhallen et al., 2006). A key concern about e-books for preschoolers is that

their multimedia and interactive features could be a distraction during reading and might interfere with children's learning. However, apart from being vibrant, many children's digital books offer a rich source for learning as is confirmed by meta-analytic findings (e.g., Savva et al., 2022; Takacs et al., 2014; Zucker et al., 2009). The findings of the meta-analysis by Savva et al. (2022), whose objective and methods are explained in the preceding chapter (Chapter 4), are summarised below in order to understand the concept of the "perfect" e-book.

After reviewing all meta-analyses on e-books for young children and evaluating the effect sizes of included studies, conclusions can be drawn as to the quality of e-books and the quantity of embedded features (see Table 5.1 and Table 5.2). Table 5.1 presents the studies included in the meta-analysis by Savva et al. (2022) that exhibited a positive effect size favouring the e-book condition for vocabulary and story compression. Table 5.2 presents the studies that reported a negative effect size favouring the print condition for vocabulary and story compression. There are some variables to consider when evaluating the e-books included in the meta-analysis. The first variable is the comparison condition. For a study to be included in the meta-analysis its experimental design had to include a comparison condition in which the same or a similar story was presented using a print book format or an e-book with static-illustrations without multimedia or interactive features. The second variable had to do with multimedia and interactive features. The e-books included in the meta-analysis had various features and the e-books were eventually categorised in four categories: (a) e-books with multimedia features, (b) e-books with interactive features, (c) e-books that had both interactive and multimedia features, and (d) e-books with no features versus a traditional print book. The third variable that could have an effect on the results was relating to the presence of adult scaffolding. Adult support was either in the print condition, the e-book condition or both conditions. Adult support was not instructional in the sense of providing guidance on how to use a tablet/computer or to keep a child on task. Instead, the adult asked questions regarding the story either during or after the reading session, explained unknown words, discussed the content of the story based on children's own personal experiences and played games relating to comprehension of the story content, for the development of vocabulary, story comprehension and code related skills.

Table 5.1 *Vocabulary Development and Story Comprehension - What Worked?*

Study and Year	Sample Size	E-book Intervention	Features included in e-book	Outcome measures	Effect Size Hedges's g	95% CI for treatment
Eng, Tomasic & Thiessen (2020) Experiment 1	35	Contingent E-book	Animations that activated contingently on the child's vocalisations	Story Comprehension	0.70	[0.03, 1.36]
Eng, Tomasic & Thiessen (2020) Experiment 2	33	Contingent E-book	Animations that activated contingently on the child's vocalisations	Story Comprehension	1.46	[0.71, 2.21]
Ihmeideh (2014)	92	E-book	Animated illustrations	Target vocabulary	2.82	[2.25, 3.40]
Korat, Levin, Atishkin & Turgeman (2014)	49	E-book with adult vocabulary support	Dictionary of target words	Expressive vocabulary Receptive vocabulary Target vocabulary used in story retell	1.26 0.85 0.72	[0.57, 1.95] [0.19, 1.51] [0.06, 1.38]
Korat, Levin, Ben-Shabt, Shneor & Bokovza (2014) Comparison 1	52	E-book with dictionary dynamic visuals with the printed word	Animated representations of target verbs and printed words shown on screen	Expressive vocabulary	1.02	[0.34, 1.71]
Korat, Levin, Ben-Shabt, Shneor & Bokovza (2014) Comparison 3	54	E-book with dictionary static visuals with printed words	Static representations of target verbs and printed words shown on screen	Expressive vocabulary	0.69	[0.03, 1.36]
Korat, Levin, Ben-Shabt, Shneor & Bokovza (2014) Comparison 4	56	E-book with dictionary static visuals without printed words	Static representations of target verbs	Expressive vocabulary	0.67	[0.00, 1.33
Lee (2020)	100	E-book with recorded word explanation	Multimedia future: Recorded word explanations	Expressive vocabulary	0.42	[0.03, 0.81]
O'Toole (2015)	100	E-book	-	Receptive vocabulary	0.41	[0.02, 0.80]
Zipke (2017)	25	E-book	Interactive hotspots on pictures to hear the object name	Receptive vocabulary	1.16	[0.33, 1.98]

Table 5.2 *Vocabulary Development and Story Comprehension - What Did Not Work?*

Study and Year	Sample Size	E-book Intervention	Features included in e-book	Outcome measures	Effect Size Hedges's g	95% CI for treatment
Altun (2021)	196	E-book	Some animation, background music, character movements.	Receptive Vocabulary	-0.10	[-0.38, 0.17]
Broemmel et al. (2015)	24	E-book	Animation, rich narration, sound effects and music	Story Comprehension	-0.53	[-1.32, 0.26]
Karemaker (2017)	58	Interactive E-book (n=28)	Dictionary button highlighted challenging words. By clicking on a word children could listen to pronunciation and definition.	Expressive Vocabulary Story Comprehension	-0.23 -0.32	[-0.85, 0.37] [-0.94, 0.29]
Kelley and Kinney (2017)	30	Interactive and Animated E-book	Six embedded questions related to the story and children can tap pictures to respond to the questions. Animated characters.	Target vocabulary Story Comprehension	-0.33 -0.10	[-1.03, 0.36] [-0.80, 0.58]
Kozminsky (2013)	50	E-book	-	Story Comprehension Target Vocabulary	-0.71 -0.51	[-1.27, -0.14] [-1.07, 0.04]
O'Toole (2018)	50	Audio narrated e-book	-	Story Comprehension	-0.13	[-0.68, 0.41]
Reich et al. (2019)	200	Interactive and Animated E-book	Interactive: 6 hotspots per page, that when tapped repeated the word or provided some animation	Story Comprehension Receptive Vocabulary	-0.10 -0.26	[-0.38, 0.16] [-0.54, 0.01]
Sari et al. 2019	81	E-book with music and sounds	Animated characters and objects, sound effects, music	Receptive Vocabulary Expressive Vocabulary Story Comprehension	-0.77 -0.31 -0.10	[-1.23, -0.32] [-0.75, 0.12] [-0.53, 0.32]

(Continued)

Table 5.2 *Vocabulary Development and Story Comprehension - What Did Not Work?*

Study and Year	Sample Size	E-book Intervention	Features included in e-book	Outcome measures	Effect Size Hedges's g	95% CI for treatment
Smeets & Bus (2015) Comparison 2	50	Interactive and Animated E-book	Hotspots shape as a magnifying glass to search for unknown words Animated characters and objects, sound effects, music	Expressive Vocabulary Receptive Vocabulary	-0.08 -0.07	[-0.66, 0.49] [-0.65, 0.49]
Smeets & Bus (2015) Comparison 1	53	Animated E-book	Animated characters and objects, sound effects, music	Expressive Vocabulary Receptive Vocabulary	-0.37 -0.23	[-0.94, 0.19] [-0.80, 0.33]
Zipke (2017)	25	E-book	Interactive hotspots on pictures to hear the object name	Story comprehension	-0.42	[-1.19, 0.34]

It is suggested that the "perfect e-book" could include a story with animated illustrations and/or characters which highlight the objectives of the study. For example, if a study is seeking to develop a child's vocabulary, then it is suggested to include animated representations of target words for vocabulary development and story comprehension. The animated features should be closely related and helpful towards achieving the study objectives. For example, the study by Eng et al. (2020) used a within-subject design with 3 experiments with ninety 3- to 5-year-old children. Children were presented with a contingent e-book (animations that activated contingently on the child's vocalisations) and two non-contingent control conditions: a print book and a static e-book. The results revealed that children's recall scores were significantly higher in the contingent book condition compared to the other two conditions for children with less developed attention regulation for story comprehension. Therefore, the first requirement an e-book must meet in order to be deemed effective is that animations need to be congruent to the text as it enhances children's story recall by orienting their attention to nonverbal information that matches the story narrative. This result was also confirmed by the study of Korat et al. (2014b) that utilised different functions on an e-book (i.e., a dictionary with static visuals with and without printed focal words and dynamic visuals with and without printed focal words), for 250 second graders from low- socioeconomic status families. All experimental conditions produced positive effect sizes, favouring the e-book conditions with the dictionary in comparison to the control condition with an e-book without a dictionary. The comparison with the highest effect size favouring the e-book condition was the e-book with animation (dynamic visuals with the printed words; g=1.02, CI=[0.34, 1.71) which shows that animation combined with a dictionary improves children's expressive vocabulary skills.

It should be noted, however, that the popular expression by Ludwig Mies van der Rohe *less is more* may apply to an e-book's effectiveness as well, according to the results of the studies presentenced in Tables 5.1 and 5.2. Studies that attempted to evaluate the effectiveness of animation combined with background music and sounds in comparison to print or static storybooks were found to have negative effects favouring the print book condition (e.g., Altun, 2021; Broemmel et al., 2015; Sari et al., 2019; Smeets & Bus, 2015 [comparison 1]). It appears that the combination of animation, music, and sounds may interfere with the narrative, preventing the development of children's vocabulary and comprehension skills. Sarı et al.'s (2019) study included 99 typically developing children

aged 4–6 years from two public kindergartens in Turkey. Their primary objective was to distinguish between the impacts of visual and auditory enhancements in digital books. The music and sounds featured in the e-books matched the story events. The music, which was present the majority of the time and took a new form in each scene, conveyed the mood of the main characters or emphasised dramatic events. Their results revealed that animated pictures supported children's story comprehension (g=0.52, CI=[0.08, 0.95]) while music and background sounds did not (g=-0.10, CI=[-0.53, 0.32]). They argued that music and background features may require additional operations that surpass a child's capability for working memory. When additional auditory information is presented, this uses the auditory channel just as the narrative, thereby competing with the narration for limited processing capacity in the auditory channel (Mayer, 2009). In accordance with Mayer's (2009) coherence model, when processing capacity is used to process the music and sounds, there may be less capacity available for paying attention to the narration, making inferences, and linking the narration with the visual information, which could result in poorer performance on story comprehension tests (Moreno & Mayer, 2000). Background music and sounds cause superfluous processing that uses limited working memory capacity in the auditory channel, consequently diminishing children's ability to deduce the meaning of new words from their context (Kirschner, 2002).

Another feature highlighted in the meta-analysis as non-effective are interactive features such as hotspots (e.g., Karemaker et al., 2017; Kelley & Kinney, 2017; Reich et al., 2019; Smeets & Bus, 2015 [comparison 2]; Zipke, 2017). In Karemaker et al. (2017), the researchers included an e-book with dictionary button with challenging words - by clicking on a word children could listen to the pronunciation and definition. This did not improve children's expressive vocabulary and story comprehension as opposed to the comparison condition which was an e-book without any hotspots (named Flat e-book by the authors). One reason might be that when children press on hotspots and digital buttons, it may interfere with their ability to concentrate. The study of Smeets and Bus (2015) included an interactive animated e-book with hotspots shaped as a magnifying glass for children to search for unknown words. Authors noted that the interactivity included in the e-books were highly controlled: the researchers inserted only one hotspot per interactive moment, children were allowed to play for a maximum of 30 seconds with a hotspot, and the number of hotspot moments were restricted to four per session. Even though the interaction with the hotspots was monitored and supervised by adults, the results for expressive and

receptive vocabulary favoured the control condition (the static e-book). The inclusion of animation and interaction in an e-book may also account for the fact that the aforementioned study's results did not result in the development of children's skills. Other studies that included both interactive and animated features within an e-book produced similar results (e.g., Kelley & Kinney, 2017; Reich et al., 2019). Overall, every feature included in an e-book should have an educational goal.

Moving on to another important variable that may interfere with the results is adult scaffolding. Korat et al. (2014a) included in their study an e-book with a dictionary. The dictionary was displayed on four distinct channels, each of which provided the same oral reading of the text and oral explanations of target verbs, which automatically appeared on the screen once the full page had been read by the narrator. The four channels of the dictionary were as follows: reading the book (1) with adults' support for target verbs; (2) with a dynamic visuals dictionary of target verbs; (3) with a static visuals dictionary of target verbs; (4) with no dictionary support. The condition that outperformed all the other conditions was the *E-book with adult vocabulary support.* This suggests that regardless of the features offered in an e-book, it cannot outperform an adult reading the e-book with the child. The meta-analysis presented in this thesis revealed that adult mediation during print book reading outperformed digital features when e-books were used independently. However, when e-books with adult support were compared with print books with support, the combination of digital features and adult content-related discussions were significantly more effective in comparison to adult support offered during print book reading. Therefore, another requirement for achieving the best outcomes when reading an e-book is that adult scaffolding is essential in the e-book condition for both vocabulary development and story comprehension. Based on the above findings, the current study sought to search for an online e-book to be included in the experimental study that is considered the "perfect" e-book.

The features which are considered beneficial in this context are:

- Narration and highlighted text. This is a typical feature included in e-books, but it is very important that the language used is pronounced clearly and words are highlighted while appearing on the screen.

- Story with animated illustrations and/or characters and/or some animated scenes which highlight the objective of the study (e.g., if the study is seeking to evaluate the learning of a specific word such as “jump” then the character of the story might be seen jumping while saying the word. This type of animation is clearly connected with the objective of the study).
- Embedded questions regarding the story content (as a digital feature or adults asking the questions). This will help children with story comprehension and also make them think about various events in the story.
- All included features should be selected and restricted to exactly what a study is seeking to answer. For instance, the e-book should not include 10 hotspots on any page, but rather every hotspot should be carefully selected and should be aligned with the goals of the study.

5.2 Research Questions

The purpose of the study was to compare the impact of e-books versus print books on children learning English as an additional language in terms of vocabulary and story comprehension. The study also compared two reading styles alongside the two media (print and digital) to assess whether word learning and comprehension were enhanced. The following research questions were tested:

1. Which type of book medium (i.e., e-book versus print book) produces better results in the development of vocabulary and story comprehension for children learning English as an additional language (EAL)?

2. Which teaching style (i.e., interactive versus performance) better facilitates young children’s (learning English as an additional language) vocabulary and story comprehension development?

5.3 Method

5.3.1 Participants

Participants in this study were 60 typically developing children (32 boys and 28 girls) aged 3–7 years (M = 5.26 years, SD = 1.16) from different socioeconomic status families residing in Larnaca, Cyprus. Children were recruited from four classrooms in one private English school attending the following classes: Pre-Kindergarten (3-4 years old), Kindergarten (4-5 years old), Pre-Primary (5-6 years old) and First Grade (7 years old). In order for children to be eligible for participation it was important for children not to speak English as their first language. Thus, children learning English as an additional language, with no apparent developmental delays, were eligible for participation.

Ethics approval was obtained before recruiting participants. To obtain written informed consent for eligible children, the school principal was provided with written information about the study explaining the scientific goals and the opportunity for the children to listen to children's stories. The activities were deemed as being part of common classroom practice and therefore no additional parental consent was sought. Only when the school principal gave written consent for the children's participation were the children included in the study. All procedures were approved by the ethical review board of Durham University.

An a priori power analysis was conducted using G*Power version 3.1.9.7 (Faul et al., 2007) to determine the minimum sample size required to answer the research questions of the study. Results indicated the required sample size to achieve 80% power for detecting a medium effect, at a significance criterion of α = .05, was N = 60 for ANOVA analyses. Thus, the obtained sample size of N = 60 is adequate to test the study's research questions. Therefore, the study included 60 children recruited from the four classes mentioned above and the main languages spoken by participants were: 17 children spoke Greek, 14 children spoke Russian, eight spoke Spanish, five children spoke Hebrew, three children spoke Arabic, five French, two Indian, one German, one Turkish, one Bulgarian, two Czech, and one Slovak. The children attended the school from 0 to 2 years, with the majority of children entering the school the year that the intervention took place (60%).

5.3.2 Covid-19 Pandemic

The initial plan was to acquire the necessary data for this study from schools in Cyprus between September 2019 and June 2020. Throughout the first few months of the school year, I met with school principals and teachers to brief them on the research project. However, I was unable to continue due to Covid-19, as Cyprus was under full lockdown after the New Year. The Ministry of Education instructed school closures due to an unknown virus whose duration was unknown. We believed that the school would be closed for two weeks. Schools did not reopen for the remainder of the school year. When the new school year began, after receiving ethical approval from the University and consent from the school principal (see Appendix C), I was still concerned whether or not I should begin collecting data, since I knew it would take time to complete the research and the situation with Covid-19 was still unpredictable. In November of 2020, a second lockdown was implemented because so many Cypriots had contracted the virus; however, schools for younger children (preschools and nurseries) remained open with numerous safety measures in place. In December 2020, I began testing the study tests on a group of children whose first language was English, in order to evaluate the instructions and other issues that may arise during official administration (for more information, see Section 5.3.4.7 Testing the measures). I concluded my pilot testing at the end of 2020 and was prepared to begin administering the pre-tests as soon as the school reopened after the Christmas break. When schools reopened in January 2021, I started administering the standardised test in addition to the receptive and expressive vocabulary tests. Although high school students were not required to attend school, the government insisted that children of lower ages do so since it was difficult for parents to work from home while caring for their children. Preschools functioned as normal as possible as a result of the implementation of several protocols and the frequent testing of all staff members. This provided me the opportunity to start gathering my data at the school that I was working at, however I was unable to visit other schools in the area in order to gather a larger sample size.

By March, I gathered all of the pre-tests and then began the intervention. At the beginning of April 2021, the intervention sessions were completed, and I began conducting the post-tests (i.e., expressive and receptive tests, story comprehension tests). During that time, I was infected with the virus as well. In May-June 2021, I re-administered the vocabulary

tests alongside the transfer task. The school year ended with the collection of all post-tests. Nonetheless, I wanted to conduct the standardised test again. Therefore, I waited until September 2021 for the school to begin. Fortunately for the study, due to the pandemic, few of the children of study participants' families elected to migrate overseas. The majority of families remained in Cyprus, allowing me to collect data from 49 of 60 children. It is also important to note that some participants left Cyprus before May 2021, which prevented me from collecting their second post-tests.

Moreover, in this study, I had a dual role as both a researcher and practitioner/assessor. As a result of Covid-19 restrictions, there was a lack of a second assessor present throughout the administration of the research tools. Nevertheless, during the development of the research tools for this study, I was mindful of the fact that it was conducted during the midst of the Covid-19 pandemic. Given the uncertainty of when the situation would return to normal, I took great care to ensure that my research tools and the procedure I implemented were both accurate and straightforward. The research tools of the study may be found in *Section 5.3.4* and Appendix N, which provides information on the process of selecting research tools.

Overall, it was a challenging academic year for me as well as for the participants of the study. There were several protocols in place, and things were not operating as normally or as easily as before. I was required to wear a mask in order to speak and read to the children, and it was imperative that they not be in close proximity. In addition, during the post-test administration, some children were absent due to the virus or being in close contact of an infected family member, making it difficult to gather all data on the same day or week as the rest of the participants in the condition. Moreover, during the design phase of the project, I intended to visit more schools in the Larnaca region to recruit additional data from additional participants to increase the size of my sample. However, strict protocols prevented me from entering other schools, so I could only collect data from the pupils at the school where I worked. This is a limitation of the study, as it was intended to have at least twice as many children in each condition.

5.3.3 Materials

5.3.3.1 The Storybooks Included in the Study (Print and E-book). During the story selection process, the following actions took place: a) the stories had to be age-appropriate for all age groups; b) the storybook needed to be available in an e-book format; c) the content of the e-book had to include a set of criteria established as predictors of language and literacy learning (Savva et al., 2022). Two stories were selected: The Kissing Hand (Audrey Penn, 1993) and Elmer and Rose (David McKee, 2005). The Kissing Hand is a story about a young raccoon named Chester who was anxious about leaving home and going to school. So, his mother decided to share a "family secret" with him: the "kissing hand". She gave him a kiss on his paw and told him to press the kiss to his cheek whenever he missed her. The Elmer and Rose story is part of a series involving Elmer the elephant. The synopsis of the story is that Grandpa Eldo asks Elmer and Wilbur (Elmer's cousin) to help a young elephant (i.e., Rose) find her way back to her herd - and they get a shock when they see she is pink! No wonder she is called Rose. But there is an even greater surprise in store when they reach her herd - because everyone single one of them is pink.

The print storybooks were available as e-books by Oceanhouse Media (http://www.oceanhousemedia.com). The Oceanhouse Media e-book apps are much like the corresponding print books: the text and illustrations are preserved, and there is little animation. An oral reading is available, with sound effects, and text highlighting that follows the narration. After the text on a page has been read, the e-book reader can tap on individual pictures in the text to listen to the name of the object or action pop up and hear the word spoken again. No other hotspots, animation, or games appear in the app. In sum, the reader is in control of this e-book and all of the media effects are integral to the storyline. Children were asked if they knew the stories and only one child knew *The Kissing Hand* and none of them listened to *Elmer and Rose* before, although Elmer is a beloved character for children of this age group (3-7 years old) as the series includes more than 30 different stories with Elmer the elephant.

5.3.3.2 Teaching Styles: Interactive and Performance. Two different teaching styles were selected for each story condition, the interactive style which engages children in discussion during the narration of the story, and the performance style which presents stories with questions and discussion at the beginning and end of the story. More specifically, the interactive style entails that before reading the book, necessary

information about the book was provided, which focused on the features of the book. The book was read with an emphasis on discussion, the images were shown to the children, and the children's responses to the text and illustrations were discussed. Before, during, and after reading, the degree of interaction between the teacher and the children increased about the book by employing extratextual talk practices. Thus, the participants were given a range of opportunity to generate their own interpretations of the text. After finishing the story, the participants' reactions to the book's plot were discussed. Regarding the performance style, before reading the story, the children were asked questions and made predictions about its content. The relevant details regarding the book and its author(s) were given. The story was read without any discussions, and the illustrations were presented to the pupils. After the reading, the teacher and the children discussed the story's plot.

For each story a "plan" was created with the use of questions and discussion points to be asked for each page of the story. Identical questions were posed to children regardless of book medium. The children were asked the same questions, at the same time point, while being exposed to either an e-book or a print book. During the interactive style these questions were asked during appropriate points. For example, when the front cover was shown, children were asked the following questions: *"Can you read the title? The title is The kissing hand. What animals do you see on the front cover? What are the animals doing?"*. During the performance teaching style, the children were asked these questions at the beginning and at end of the story. Detailed plans of each story can be found in Appendix D.

In the intervention sessions each condition listened to the two stories twice. Condition 1 listened to the e-book with interactive style adult scaffolding (*n*=15; 7 boys and 8 girls); condition 2 listened to the e-book with performance style adult scaffolding (*n*=15; 9 boys and 6 girls); condition 3 listened to the print book with interactive style adult scaffolding (*n*=15; 8 boys and 7 girls), and condition 4 listened to the print book with performance style adult scaffolding (*n*=15; 8 boys and 7 girls). All participants had initial experience with computers individually and in small groups as part of the curriculum. All children were speaking English as an additional language, who according to the teachers' records had normal learning development without any recognised impairments.

5.3.4 Research Tools

This study focused on children's receptive and expressive vocabulary knowledge, as well as story comprehension by applying the following research tools:

5.3.4.1 English Language Proficiency Test. The following standardised assessment was administered to the children before and after the intervention. The standardised test was the PLS-5 UK Preschool Language Scale - Fifth Edition (https://www.pearsonclinical.co.uk/store/ukassessments/en/Store/Professional-Assessments/Speech-%26-Language/Preschool-Language-Scale---Fifth-Edition/p/P100009263.html). The PLS-5 UK offers a comprehensive developmental language assessment, with items that range from pre-verbal, interaction-based skills to emerging language and early literacy. The test tests children's auditory comprehension and expressive communication. The standardised test consists of 67 items, and administration begins at a point specified by the child's age at the time of administration. The administration of the test is halted after the child made five consecutive errors. Then the raw scores are calculated by recording the last item administered and subtracting the zero scores from this item number. The difference is the raw score for either auditory comprehension or expressive communication. The total language score is calculated by adding these scores together. The standard score of each child was used in the analysis. The results obtained from the PLS-5 English Language Proficiency Test supported the separation of the participants into different groups, ensuring that the groups were comparable in terms of their language competency. In order to assure the rigour of the study, it was crucial to employ a standardised test to separate the participants into groups, as opposed to a test created by the researcher.

5.3.4.2 English Language 5-Point Scale. The class teachers of the children who participated in the study were provided with five language levels, ranging from Low Ability to High Ability, and asked to indicate where they considered their pupil fell regarding children's use of the English language (see Appendix E). The five language levels were the following:

- Low Ability: Student uses gestures more often than words to communicate.
- Upper Low Ability: Student communicates using one word (sometimes with pronouns: I, he, she).

- Medium Ability: Student produces sentences using 2-3 words with pronouns and nouns or verb. Grammar/vocabulary might not be correct.
- Upper Medium Ability: Student uses 4 words to communicate combined with pronouns, verbs and nouns. Able to describe situations. Grammar/vocabulary might not be correct.
- High Ability: Student speaks fluently using correct grammar and vocabulary.

Each item was scored on a scale from 1 to 5 (i.e., Low Ability=1; Upper Low Ability=2; Medium Ability=3; Upper Medium Ability=4; High Ability=5).

5.3.4.3 Receptive and Expressive Vocabulary Tests of Words Included in the Stories. The following tests were developed for this study and were administered to the children before and after the intervention: (a) *Receptive target vocabulary test*. To assess children's receptive knowledge of word meanings, children were asked to select the target word out of four pictures. The correct image was presented among three distractors, all of which were selected from the same storybook. The experimenter scored the receptive word learning test (1 point = correct; 0 points = incorrect). Children aged 3-4 years answered 20 words and 4–7-year-olds 30 words. Internal reliability assessed by Cronbach's alpha was .86 for the pretest and .86 for the posttest. (b) *Expressive target vocabulary test.* This test assessed children's knowledge of the meaning of target words. The children had to explain in their own words the meaning of words. The child was asked to explain the meanings of 15 words for ages 4-7 years and 8 words for ages 3-4 years that appeared in the two e-books. Definitions were scored on a scale of 0 to 4: 0 was given if the child said, "I don't know"; 1 was given if the child provided a definition for a word that sounded like the target word or rhymed with the target word; 2 was given when the child used the target word within a sentence; 3 was given when the child used a word similar or close to the target word; 4 was given when the child provided a precise definition for the word (the receptive and expressive vocabulary tests can be found in Appendix F and Appendix G, respectively). That is, a general definition that is not related to the specific context of the story. Internal reliability assessed by Cronbach's alpha was .85 for the pretest and .87 for the posttest.

5.3.4.4 Implicit Story Comprehension Test (ISC). The Implicit Story Comprehension test (ISC) includes making inferences about the feelings of the story protagonists, causal relations, predictions, and theme. ISC requires deeper story comprehension skills. Six

questions were asked for implicit comprehension (feelings, causal inference, dialogue, prediction, and theme). Each question was scored on a scale from 0 to 2 (0: No answer / I don't know; 1: Partially correct answer. Only one part of the question answered; 2: Complete correct answer) (the test is presented in Appendix H). Internal reliability assessed by Cronbach's alpha was 0.75.

5.3.4.5 Explicit Story Comprehension (ESC) Recall with Prompts Test. The Explicit Story Comprehension test (ESC) is related to the identification of the story elements (characters, setting, initiating event, problem, and solution). Children were to freely recall the answers. If they could not recall the answers correctly, the researcher read a list of multiple-choice options to select from. Scoring: children were asked 7 questions to freely recall the answer. If they were not able to answer the open-ended question, the children were offered three multiple-choice options. Considering free recall as a higher level of memory, the researcher calculated a total score with recall based on accuracy and whether the child freely recalled events or needed prompting. For this, correct answers that are freely recalled were given 2 points, correct answers derived from the multiple-choice options were given 1 point and incorrect answers received 0 points (the test is presented in Appendix I). The explicit story comprehension questions were intended to assess surface story comprehension, and the implicit questions addressed deeper comprehension. Internal reliability assessed by Cronbach's alpha was 0.80. The rationale for choosing these research tools which were designed by the experimenter, may be found in the Appendix N.

5.3.4.6 Transfer Task. The children listened to a simple and short story created by the author in order to assess their ability to transfer some of the knowledge acquired during the interventions to other story listening sessions (information regarding the Lexile level of the text are presented in Appendix J). With this task, children were put in a position where they needed to identify important target words and story-related characteristics (e.g., setting, main characters, problem-solution) in order to determine if their experience with the other two stories led to the development of skills that can be observed when reading other stories. Therefore, children listened to a short and simple story with one sentence on each page (12 pages). The story was created by the experimenter and the illustrations by students not involved in the study. After listening to the story, in print or e-book format depending on their condition, the children were asked seven questions, and the

experimenter recorded their answers (the test is presented in Appendix J). Each question was scored on a scale from 0 to 2 (0: No answer / I don't know / random answer; 1: Partially correct answer. Only one part of the question answered; 2: Complete correct answer). Internal reliability assessed by Cronbach's alpha was 0.82.

5.3.4.7 Testing the Measures. A pilot session was conducted to ensure that the research measures utilised for this study were suitable to children of this age learning English as an additional language. The measures were administered to a group of children (*n*=7; ages: 4-6 years) whose first language was English in order to determine if the measurements and questions asked were understandable to English-speaking children. In fact, children scored quite well on all study instruments and obtained high scores for the majority of the items included in the tests. Some modifications were made to the wording in order to simplify instructions for EAL children.

5.3.5 Design

5.3.5.1 Research Design. This study is a 2x2x2 factorial design (a between-within design); 2 (e-book, print book) by 2 (teaching style 1/teaching style 2) is between-person and 2 repeated measures (pre-test, post-test 1), where participants were allocated to conditions, taking into account a balanced representation of age, gender, and language proficiency. Prior to the reading sessions, the participants received the Preschool Language Scale - Fifth Edition (PLS-5 UK), which was used to check if the participants had similar language knowledge among the four conditions. Furthermore, the student's teacher answered a language 5-point scale test for each of their students'. The scale included five language related statements starting from low ability to high ability. After analysing the results of these two tests, the children were allocated to the four experimental conditions. The participants were randomly allocated to conditions, in a stratified way to control for the following key variables, i.e., English level based on the standardised test, gender, age and teachers' 5-point language scale level.

One week after the pre-tests, participants in all four conditions received two reading sessions of two storybooks over four-weeks. Variations in reading procedures can affect the quantity of words children learn. For instance, children acquire more vocabulary from

a book that has been read aloud multiple times as opposed to only once (McLeod & McDade, 2011; Sénéchal, 1997). Biemiller (2004) and Penno et al. (2002) expressed concern that children become bored after three repeats of a story, which is the number of repetitions that is most frequently suggested as effective. In addition, children are not exposed to new contexts for the target words during repeated readings. Therefore, this study engaged participants in two reading sessions, a procedure that has been used in previous research on young children's learning from story reading and found to be sufficient for generating observable learning outcomes (Verhallen et al., 2006). At the end of the second reading session, children received the post-tests. See tables following (Table 5.3 and Table 5.4) for the description of each condition.

Table 5.3 *Description of Conditions*

Condition	Description
"Perfect" e-book with teaching style 1 (*n*=15)	Children listen to the e-book while teacher scaffolds using teaching style 1 (Performance style)
"Perfect" e-book with teaching style 2 (*n*=15)	Children listen to the e-book while teacher scaffolds using teaching style 2 (Interactive style)
Print book with teaching style 1 (*n*=15)	Children listen to the teacher reading print book while teacher scaffolds using teaching style 1 (Performance style)
Print book with teaching style 2 (*n*=15)	Children listen to the teacher reading print book while teacher scaffolds using teaching style 2 (Interactive style)

5.3.6 Procedure

5.3.6.1 Pretest Phase. During the pretest phase the children received the Preschool Language Scale - Fifth Edition (PLS-5 UK) which is a standardised test in order to evaluate participants' language skills at baseline. The test lasted around 20-40 minutes depending on children's age and language capabilities. Then the children received the receptive and expressive tests for target vocabulary which took around 10 minutes to administer. All participants were tested individually in a quiet classroom prior to the intervention. This study was conducted within the participant's school setting, which may have increased the children's focus on the adult reader due to the demanding nature of the setting and situation. The experimenter was responsible for reading the stories to the children during the print storybook intervention, observing the e-book conditions, providing adult scaffolding (i.e., interactive and performance style), and administering the research tools.

5.3.6.2 Intervention

E-book Condition. After the pre-test data were collected, four sessions followed in which children listened to the two stories presented on a tablet. During small group sessions with two children, they heard one story per session totalling to four sessions (each story was heard twice). The decision to have the children work in pairs was based on research indicating that learning in small groups had a significant impact on improving young children's literacy (Karweit & Wasik, 1996; Leslie & Allen, 1999), including research on e-books (Shamir, 2009; Shamir & Korat, 2007; Shamir et al., 2008). The reason that the sessions were spread over four days (one story a day) was because each comparison condition included children as young as 3 years old and it is hard for them to concentrate for long periods, considering that each story session included scaffolding.

All children who participated in the study had initial experience with tablets individually and in small groups as part of the curriculum. The children's activity with the tablet took place in a quiet classroom, working two at a time. Each child was shown how the application operates and was given the following instructions: "*You will listen to a story on the tablet. You will have to touch the screen to change the page or go back and you may also touch the characters*". The children were given technical support if needed. During the performance teaching style, the experimenter would ask questions relating to the story before and after the story was read. During the interactive style, the experimenter asked questions during the narration of the story and making conversation after a page or a sentence was complete. Each reading session lasted about 20-25 minutes in total. Children were instructed not to talk with each other while they listened to the narration, and they rarely did.

Print-book Condition (Control). Children were in small groups of 6-8 children each time. The experimenter sat in front of them holding the print-story book narrating the story while showing the pictures at the same time. Depending on the experimental condition (performance teaching style versus interactive teaching style), the experimenter asked questions during the storytelling session, or at the beginning and end, respectively. Each reading session lasted about 20-25 minutes in total. The print book condition is designated as the control group as print storybook reading is considered a standard and common

procedure in early years settings, and it is a language and literacy development activity conducted on a daily basis in classes with young children aged 3-7 with the aim to develop listening and communication skills, vocabulary, grammar, improve concentration, memory, imagination and creativity.

5.3.6.3 Posttest Phase. After the intervention sessions, two sessions took place for posttesting which included the (a) story comprehension test (implicit and explicit tests), and (b) the expressive and receptive knowledge of the target words. The expressive vocabulary test was administered first to avoid exposing children to the target words beforehand and applied the receptive test second. The posttests took place 2 days after completing the two reading sessions of each story. Each posttest (vocabulary tests and story comprehension) lasted about 15-30 minutes in all. After one month the experimenter administered the receptive and expressive tests again. Finally, the transfer task was administered in order to evaluate children's learnable skills developed during the interventions. After six months children received the Preschool Language Scale - Fifth Edition (PLS-5 UK) again. The procedure is summarised in Table 5.4.

Table 5.4 *An Example of the Schedule of the Experiment*

Pretest Phase	Standardised test PLS-5 UK Receptive and Expressive Vocabulary tests
Story reading Phase	**Day 1** Listening to *The Kissing Hand*
	Day 2 Listening to *Elmer and Rose*
	Day 3 Listening to *The Kissing Hand*
	Day 4 Listening to *Elmer and Rose*
Posttest Phase	**Day 5-6** Receptive and Expressive Vocabulary tests Story Comprehension tests
2nd Posttest	**After 1 month** Receptive and Expressive Vocabulary tests
Transfer Task	When posttests were completed
Standardised test PLS-5 UK	After 6-7 months from first administration of the PLS-5 UK

5.3.7 Statistical Analyses

The IBM SPSS Statistics Version 28 software (IBM Corp., Armonk, NY, USA) was used for performing the statistical analyses using the results from the measures reported above. The analysis was performed on the following dependent variables on condition:

- Vocabulary:
    - Receptive Vocabulary
    - Expressive Vocabulary
- Story Comprehension:
    - Implicit Story Comprehension
    - Explicit Story Comprehension
    - Both tests combined to report overall comprehension of the story
- Transfer Task
- PLS-5 UK

To test the effects of the intervention in order to answer the research questions of the study, two contrasts were created: (a) the two conditions with print book format (control) versus the two conditions with e-book format (comparison of book mediums) (RQ1); and (b) the two conditions with performance teaching style versus the two conditions with interactive teaching style (comparison of teaching styles) (RQ2). Therefore, this entails a 2 (teaching styles) x 2 (book mediums) x 2 (pre, post) between-within subjects factorial design.

In order to answer the first research question: *Which type of book medium (i.e., e-book versus print book) produces better results in the development of vocabulary and story comprehension for children learning English as an additional language (EAL)?*, the e-book and print book (control) conditions were compared for each dependent variable. The data were analysed with the utilisation of repeated measures ANOVA for the dependent variables receptive, expressive vocabulary and the standardised language test PLS-5 UK.

Similarly, to answer the second research question: *Which teaching style (i.e., interactive versus performance) better facilitates young children's (learning English as an additional language) vocabulary and story comprehension development*, the interactive and

performance conditions were compared for each dependent variable. The data were analysed with repeated measures ANOVA for the dependent variables receptive, expressive vocabulary and the standardised language test PLS-5 UK.

The results section begins with a check for baseline differences. The first research question is then analysed, beginning with the receptive and expressive vocabulary results, story comprehension, transfer task, and concluding with the standardised test results. Then the second research question is analysed.

5.4 Results

5.4.1 Preliminary Analyses

Sixty typically developing children (28 girls and 32 boys) aged 3–7 years (M = 5.26 years, SD = 1.16) were enlisted from four classrooms from one private English school. The children attended the following grades: Pre-Kindergarten (ages 3–4; n=7; m=4, f=3), Kindergarten (ages 4-5.4; n=19; m=8, f=11), Pre-Primary (5.5–7; n=18; m=12, f=6), and First Grade (6-7.5 years old; n=16; m=8, f=8). Each class had one teacher. The participants were randomly allocated to conditions, in a stratified way taking into account a balanced representation of age, gender, language proficiency English level based on the Preschool Language Scale - Fifth Edition (PLS-5) standardised test, and their teachers' evaluation on a 5-point language scale level.

A preliminary analysis was performed to assess pre-intervention differences across conditions regarding children's language skills with the Preschool Language Scale - Fifth Edition (PLS-5). Using Univariate Analysis of Variance (ANOVA), **no significant differences were found among children in the four conditions at baseline** based on the means of the PLS-5 standardised test with an effect size of 0.00 ($F(3, 56)=0.02$, $p=0.99$), suggesting participants had similar general vocabulary knowledge. Furthermore, in order to establish that the conditions were indeed well-matched, each class's teachers also completed a 5-point English language scale. Table 5.5 presents an overview of descriptive statistics for all conditions. According to Table 5.5, the conditions were evenly balanced at the beginning in terms of the participants' language level as measured by the PLS-5 standardised the test.

Table 5.5 *Means (and standard deviations) of Basic Characteristics per Condition*

Teaching style		**Interactive Style**		**Performance Style**		**Total**	**Statistics**		
Book medium		E-book	Print book	E-book	Print book		*F*	*p*	η_p^2
N		15	15	15	15	60			
Age	M SD	5.27 (1.38)	5.80 (0.94)	5.00 (0.92)	5.27 (0.96)	5.27 (1.16)			
Boys/Girls		7/8	8/7	9/6	8/7	32/28			
PLS-5 UK	M SD	67.47 (13.98)	67.33 (17.02)	66.27 (13.59)	67.13 (13.23)	67.05 (14.17)	0.02	0.99	0.00
English Language 5-point scale	M SD	3.67 (1.23)	3.73 (1.33)	3.73 (1.28)	3.47 (1.24)	3.65 (1.24)			

Due to the Covid-19 pandemic, there were 11 missing cases on the standardised post-test PLS-5 UK. For the first story, *The Kissing Hand*, there were five missing cases on story comprehension and 11 missing cases for the receptive and expressive vocabulary (2nd post-test). For the second story, *Elmer and Rose*, there were 11 missing cases for both first and second post administration of the receptive vocabulary tests and nine for the expressive vocabulary tests (first and second posttests), and 13 missing cases for the story comprehension test. Table 5.6 provides an overview of the number of participants with available data across research tools.

Table 5.6 *The Number of Participants Who Responded to Each Measure for Each Story*

Condition/ Measures	**Receptive Vocabulary**		**Expressive Vocabulary**		**Implicit Story Comprehension**		**Explicit Story comprehension**		**Transfer Task**	**PLS-5 UK**
					Pre test					
Stories*	**KH**	**ER**	**KH**	**ER**	**KS**	**ER**	**KS**	**ER**		
E-book Interactive style	15	15	15	15						15
E-book Performance style	15	15	15	15						15
Print-book Interactive style	15	15	15	15						15
Print-book Performance style	15	15	15	15						15
					1st Post test					
E-book Interactive style	15	15	15	15	15	13	15	13	11	14
E-book Performance style	15	12	15	12	15	11	15	11	11	11
Print-book Interactive style	15	11	15	11	13	10	13	10	11	12
Print-book Performance style	15	13	15	13	15	13	15	13	13	12
					2nd Post Test					
E-book Interactive style	15	14	15	15						
E-book Performance style	12	12	12	12						
Print-book Interactive style	11	10	11	11						
Print-book Performance style	13	13	13	13						

***KS= The story "Kissing Hand", ER=The story "Elmer and Rose"**

Comparing the four conditions from pre to post, each outcome was examined separately and described in different sections below. The dependent variables were also analysed based on teaching style (i.e., interactive versus performance) and book medium (print versus e-book). If a second post-test was administered, the findings are reported and compared to the first (pre) and second (post 1) test administrations. To assess story comprehension, participants were evaluated at posttest only.

5.4.2 Research Question 1 - Comparison of Book Mediums: E-book versus Print Format

5.4.2.1 Receptive and Expressive Vocabulary - E-book versus Print Format.

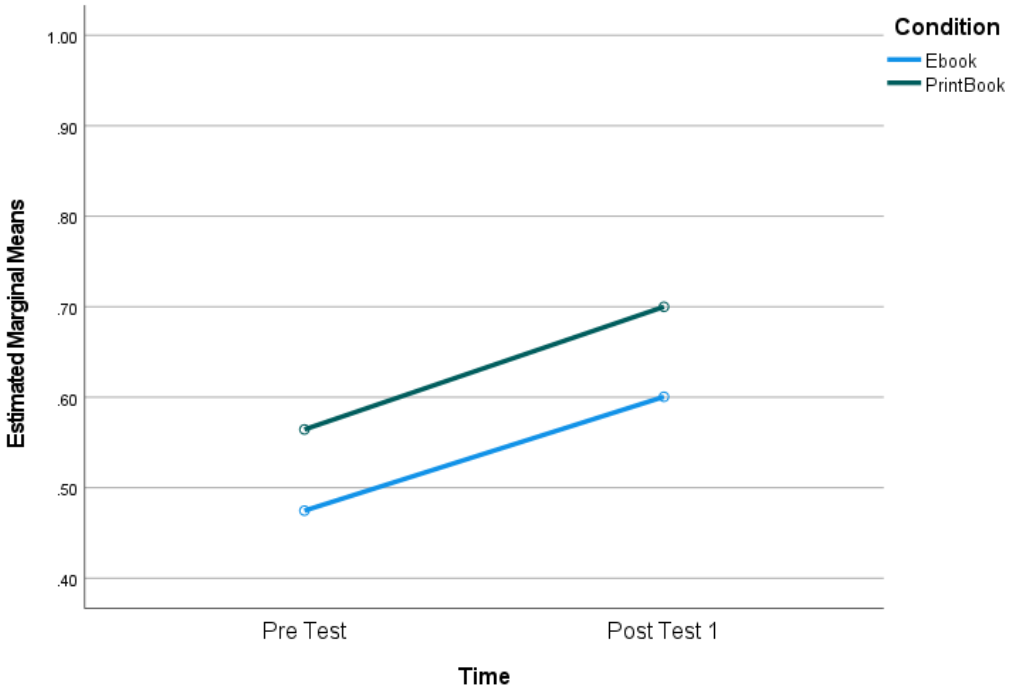
A repeated measures analysis of variance (ANOVA) test was performed to compare the effect of book medium on receptive (Table 5.7) and expressive vocabulary (Table 5.8) from pre-test to post-test 1. Due to covid-related issues, the second post-test that took place one month after the intervention restricted the collection of data from all participants; therefore, the repeated measures analyses below analysed the results obtained from the pre-test and the first post-test where the sample in both conditions was present (results for the second posttest are found in Appendix M). Therefore, the effect of time (pretest, first posttest) as a within-person factor, and condition (e-book, print book) a between-person factor were assessed.

For *receptive* vocabulary there was a statistically significant effect for time with a large effect size ($F(1, 58) = 127.936$, $p < .001$, $\eta_p^2=0.68$). There was no interaction effect ($F(1, 58) = 0.177$, $p=0.67$, $\eta_p^2=0.00$), i.e., the two conditions performed equally well over time. Furthermore, statistically significant results were found for condition ($F(1, 58) = 4.597$, $p=0.03$, $\eta_p^2=0.07$), which reveals that participants differ on receptive vocabulary depending on their condition, such that the print book outperformed the e-book (see Figure 5.1). In addition, the effect sizes for the two conditions revealed a large effect for print book with $d=0.93$ and a medium effect for e-book with $d=0.68$. However, it is important to exercise caution when interpreting the main effect finding, given the baseline results differ between conditions. The significant result found for main effects, as in Table 5.8, may be driven by this variation rather than the intervention itself. The study's conclusions will thus be derived from the interaction effect (condition x time) of the repeated measures ANOVA analyses presented from this point onwards.

Table 5.7 *Repeated Measures ANOVA Results for Receptive Vocabulary Based on Book Medium (pre-test versus post-test 1)*

	Time							
	Pre				Post 1			
Condition	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
E-book	30	0.47 (0.19)	0.03	[0.41, 0.53]	30	0.60 (0.19)	0.03	[0.53, 0.66]
Print Book	30	0.56 (0.15)	0.03	[0.50, 0.62]	30	0.70 (0.15)	0.03	[0.63, 0.76]
Total	60	0.51 (0.17)	0.02	[0.47, 0.56]	60	0.65 (0.18)	0.02	[0.60, 0.69]
ANOVA results		***F***			***p***			η_p^2
Time effect		127.936			<.001			0.68
Condition effect		4.597			0.036			0.07
Condition x Time		0.177			0.676			0.00

Figure 5.1 *Repeated Measures for Receptive Vocabulary Based on Book Medium*



For expressive vocabulary (Table 5.8, Figure 5.2) the effect of time was again statistically significant with a moderate effect size ($F(1, 58) = 31.044$, $p < .001$, $\eta_p^2=0.34$), however, the condition effect and the condition by time effect were not ($p>0.05$), which shows that

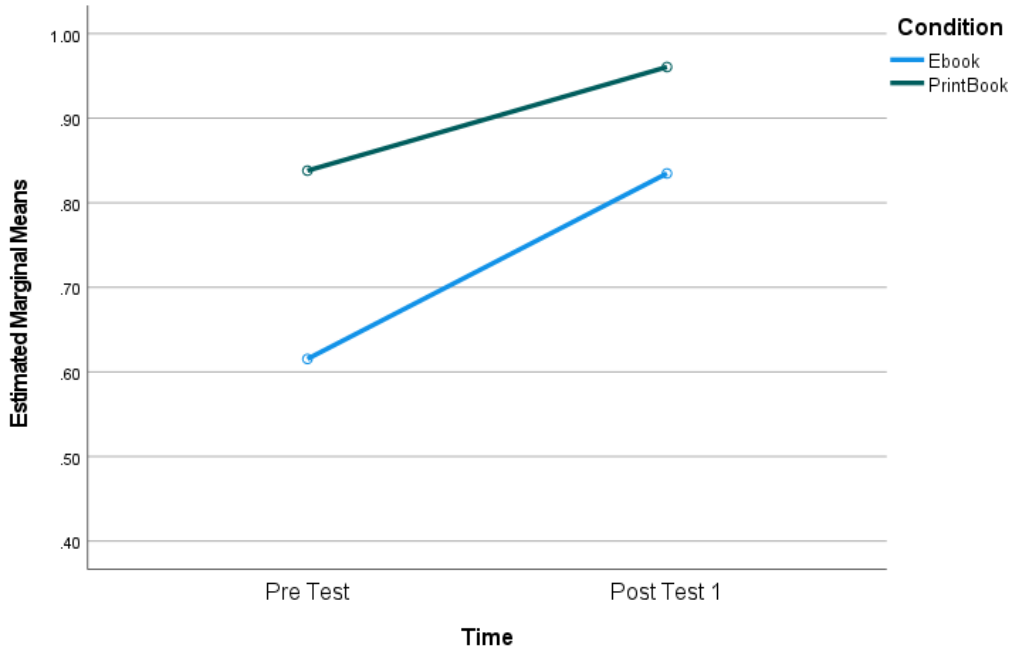
everyone improved from pre-test to post-test in expressive vocabulary (DV) regardless of condition. In addition, it was observed that e-books had a medium effect size (d = 0.35), which was found to be greater than the medium effect size observed for print books (d = 0.19).

Table 5.8 *Repeated Measures ANOVA Results for Expressive Vocabulary Based on Book Medium (pre-test versus post-test 1)*

	Time							
	Pre				Post 1			
Condition	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
E-book	30	0.61 (0.58)	0.11	[0.39, 0.84]	30	0.83 (0.66)	0.12	[0.58, 1.08]
Print Book	30	0.83 (0.64)	0.11	[0.61, 1.06]	30	0.96 (0.72)	0.12	[0.70, 1.21]
Total	60	0.72 (0.62)	0.08	[0.56, 0.88]	60	0.89 (0.69)	0.09	[0.71, 1.07]

ANOVA results	F	p	η_p^2
Time effect	31.044	<.001	0.34
Condition effect	1.095	0.30	0.01
Condition x Time	2.490	0.12	0.04

Figure 5.2 *Repeated Measures for Expressive Vocabulary Based on Book Medium*



5.4.2.2 Implicit and Explicit Story Comprehension Results - E-book versus Print Format. One-way ANOVA was performed to analyse the effect of book medium – e-book versus print book – on implicit, explicit and overall story comprehension of the story at post-test 1. These results were obtained after the intervention and three one-way ANOVAs were conducted in order to obtain the results presented in Table 5.9. The results revealed that for the *Implicit* story comprehension test there was no statistically significant main effect for medium (e-book versus print book conditions, $F(1, 56)=3.22$, $p=0.07$, $\eta_p^2=0.05$). The effect size for e-books versus print books for the Implicit story comprehension test was $d=-0.48$ favouring the print book condition.

The results analysed for *Explicit* story comprehension and both tests combined revealed that there was a statistically significant effect ($p<0.05$) with the print book condition outperforming the e-book condition on both measures (explicit story comprehension: $F(1, 56)=4.36$, $p=0.04$, $\eta_p^2=0.07$; Both tests combined: $F(1, 56)=4.32$, $p=0.04$, $\eta_p^2=0.07$). The effect size for e-books versus print books for the Explicit story comprehension test was $d=-0.56$ favouring the print book condition.

Table 5.9 *One-way ANOVA Results for Implicit and Explicit Story Comprehension (post-test 1)*

		E-book condition				Print book condition						
Dependent Variables	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	***F***	***p***	η_p^2	**Cohen's *d***
Implicit Story Comprehension	30	0.85 (0.44)	0.08	[0.69, 1.01]	28	1.06 (0.43)	0.08	[0.89, 1.22]	3.22	0.07	0.05	-0.48
Explicit Story Comprehension	30	0.78 (0.41)	0.07	[0.63, 0.92]	28	1.00 (0.37)	0.07	[0.85, 1.15]	4.36	0.04	0.07	-0.56
Both Tests combined	30	0.81 (0.40)	0.07	[0.67, 0.96]	28	1.03 (0.37)	0.07	[0.88, 1.17]	4.32	0.04	0.07	-0.57

5.4.2.3 PLS-5 Results - E-book versus Print Format. Two one-way ANOVAs were performed to analyse the effect of book medium – e-book versus print book - on the standardised language test PLS-5 UK at pre-test and post-test. The results revealed that there was no statistically significant main effect for book medium at either time point (Pre: $F(1,58)=0.01$, $p=0.92$, $\eta_p^2= 0.00$; Post: $F(1, 47)=0.64$, $p=0.42$, $\eta_p^2= 0.01$). The effect size for e-book versus print book for the standardised post-test revealed a small effect size of $d= 0.22$, $\eta_p^2= 0.01$, favouring the e-book condition (Table 5.10).

Table 5.10 *One-way ANOVA Results of PLS-5 Based on Book Medium (pre-test and post-test)*

	E-book condition				Print Book condition							
Dependent Variable	**N**	**Mean**	**SD**	**Std. Error**	**N**	**Mean**	**SD**	**Std. Error**	***F***	***p***	η_p^2	**Cohen's *d***
PLS-5 Pre	30	66.87	13.56	2.61	30	67.23	14.98	2.61	0.01	0.92	0.00	-0.02
PLS-5 Post	25	67.84	13.72	2.72	24	64.71	13.58	2.78	0.64	0.42	0.01	0.22

Moreover, a repeated measures analysis was conducted to assess time, condition, and condition x time effects for the standardised language test PLS-5 from pre-test to post-test. The results of this test were collected before the intervention as a baseline measure and six months later after the intervention. The results were statistically non-significant for all effects (Table 5.11). The effect size for the e-book and print book conditions was small, with *d*=0.02 and *d*=0.04 for each condition, respectively.

Table 5.11 *Repeated Measures ANOVA Results for PLS-5 Based on Book Medium (pre-test versus post-test)*

	Time							
	Pre				**Post 1**			
Condition	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
E-book	30	68.20 (14.19)	2.73	[62.69, 73.70]	25	67.84 (13.72)	2.72	[62.35, 73.32]
Print Book	30	65.29 (13.10)	2.79	[59.67, 70.90]	24	64.71 (13.52)	2.78	[59.11, 70.30]
Total	60	66.78 (13.61)	1.95	[62.81, 70.67]	49	66.31 (13.57)	1.94	[62.35, 70.19]
ANOVA results		***F***				***p***		η_p^2
Time effect		0.287				0.595		0.00
Condition effect		0.631				0.431		0.01
Condition x Time		0.016				0.900		0.00

5.4.3 Research Question 2 - Interactive versus Performance Teaching Style

5.4.3.1 Receptive and Expressive Vocabulary - Interactive versus Performance Teaching Style.

A repeated measures ANOVA was performed to compare the effect of the two teaching styles on receptive vocabulary (Table 5.12) and expressive vocabulary (Table 5.13) over time (pre-test versus post-test 1). Therefore, the effect of time (pretest and first posttest) as a within-person factor, and condition (interactive teaching style, performance teaching style) a between-person factor were assessed. The second post-test was not included in this repeated measures analysis as a number of participants did not complete the second post test due to covid-related issues (results for the second post-test can be found in Appendix M).

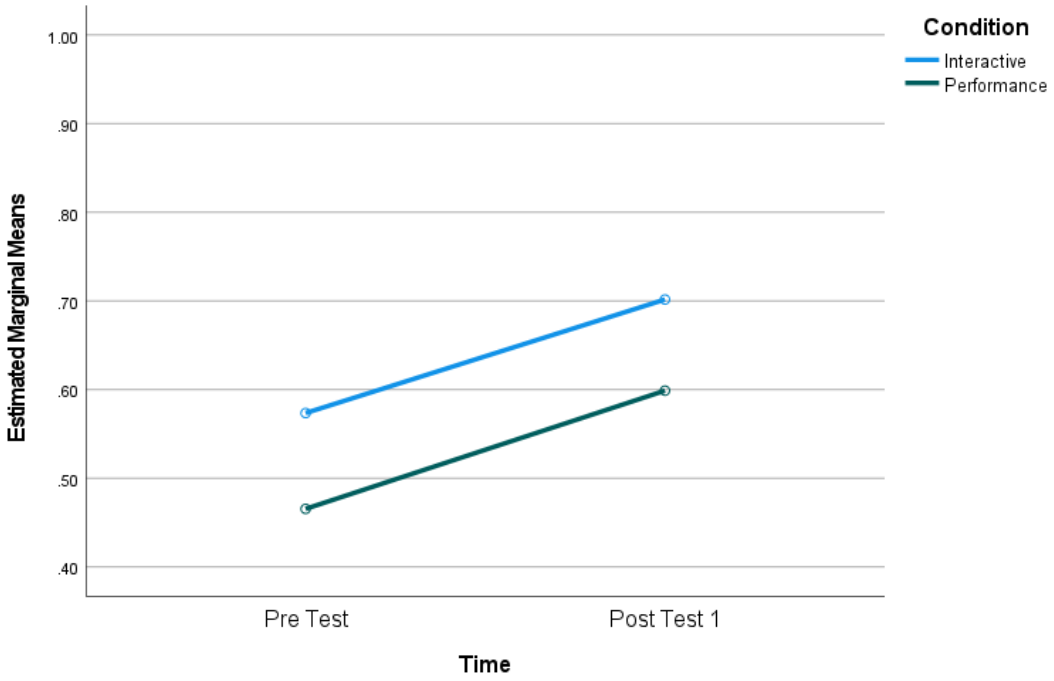
There was a significant main effect for time on receptive vocabulary with a large effect size ($F(1,58)=127.661$, $p=<.001$, $\eta_p^2=0.68$). Effects for teaching style were also statistically significant, as differences between conditions were found at both time points, ($F(1,58)=5.823$, $p=0.019$, $\eta_p^2=0.09$). However, there was a non-significant interaction effect between time and condition ($F(1,58)=0.052$, $p=0.820$, $\eta_p^2=0.00$), suggesting that everyone improved from pre-test to post-test in receptive vocabulary regardless of condition (see Figure 5.3). Regarding effect size, the study observed Cohen's *d* of 0.81 and 0.74 for interactive style and performance style, respectively, indicating a large effect. Nevertheless, it is critical to exercise caution when interpreting the finding of the main effect, considering that the receptive vocabulary outcomes differed between groups at pretest. Rather than the intervention per se, this variation might have contributed to the significant outcome.

Table 5.12 *Repeated Measures ANOVA Results for Receptive Vocabulary Based on Teaching Style (pre-test versus post-test 1)*

	Time							
	Pre				Post 1			
Condition	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
Interactive style	30	0.57 (0.16)	0.03	[0.51, 0.63]	30	0.70 (0.16)	0.03	[0.63, 0.76]
Performance style	30	0.46 (0.17)	0.03	[0.40, 0.52]	30	0.59 (0.18)	0.03	[0.53, 0.66]
Total	60	0.51 (0.17)	0.02	[0.47, 0.56]	60	0.65 (0.18)	0.02	[0.60, 0.69]

ANOVA results	***F***	***p***	η_p^2
Time effect	127.661	<.001	0.68
Condition effect	5.823	0.01	0.09
Condition x Time	0.052	0.82	0.00

Figure 5.3 *Repeated Measures for Receptive Vocabulary Based on Teaching Style*



The same analysis was run for expressive vocabulary (Table 5.13). The presentation of the repeated measures ANOVA results includes subtotals across groups for each time point. The effect of time was again significant with p<.001 and a small positive effect size

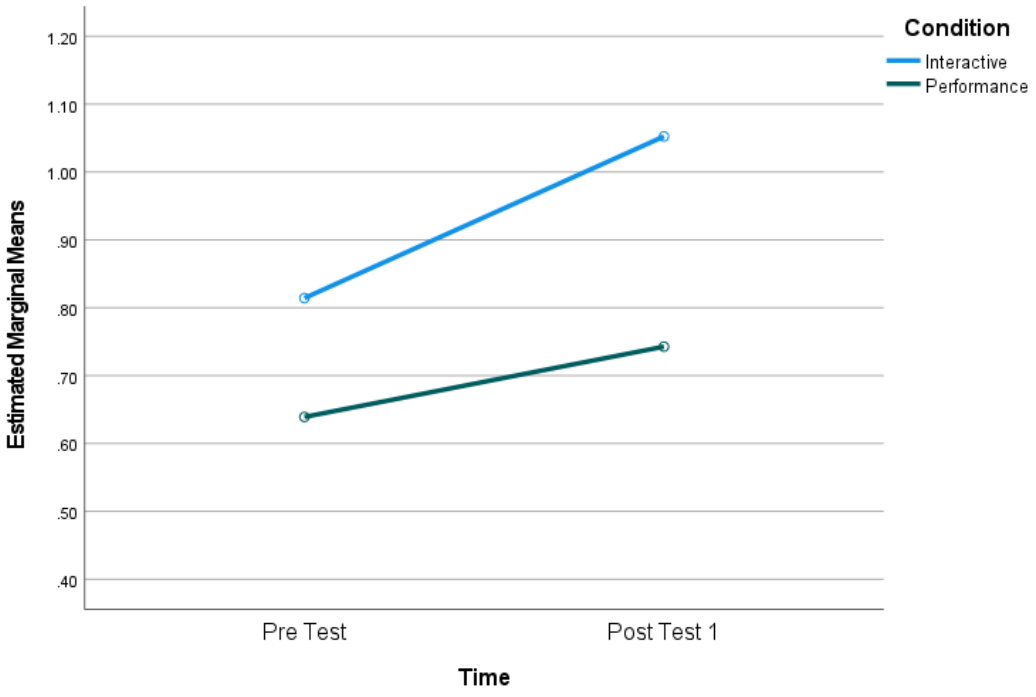
η_p^2=0.22 illustrating that the two teaching styles support expressive vocabulary development. In terms of Cohen's *d*, a medium effect size was found for the interactive style (*d*=0.34) and a small effect size was found for the performance style (*d*=0.18). Furthermore, statistically significant results were found for the time by condition interaction effect ($F(1, 58) = 5.014$, p=0.02, η_p^2=0.08), which reveals that the interactive versus performance teaching style condition made a difference over time, whereas condition effect was non-significant ($F(1, 58) = 2.157$, p=0.14, η_p^2=0.03). Specifically, participants improved at different rates over time in terms of their expressive vocabulary (see Figure 5.4), i.e., children participating in the interactive style condition improved more over time than participants in the performance style condition.

Table 5.13 *Repeated Measures ANOVA Results for Expressive Vocabulary Based on Teaching Style (pre-test versus post-test 1)*

	Time							
	Pre				Post 1			
Condition	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
Interactive style	30	0.81 (0.65)	0.11	[0.58, 1.04]	30	1.05 (0.73)	0.12	[0.80, 1.30]
Performance style	30	0.63 (0.57)	0.11	[0.41, 0.86]	30	0.74 (0.61)	0.12	[0.49, 0.99]
Total	60	0.72 (0.62)	0.08	[0.56, 0.88]	60	0.89 (0.69)	0.08	[0.72, 1.07]

ANOVA results	F	p	η_p^2
Time effect	32.339	<.001	0.35
Condition effect	2.157	0.14	0.03
Condition x Time	5.014	0.02	0.08

Figure 5.4 *Repeated Measures for Expressive Vocabulary Based on Teaching Style*



5.4.3.2 Implicit, Explicit and Overall Story Comprehension Results - Interactive versus Performance Teaching Style. One-way ANOVA was performed to compare the effect of teaching style on story comprehension separately for the three story comprehension test scores (implicit, explicit, and combined, see Table 5.14) at post-test 1. The *implicit* story comprehension analysis revealed that there was a statistically significant effect of teaching style on Implicit story comprehension ($F(1, 56)=4.47$, $p=0.03$, $\eta_p^2=0.07$) favouring the Interactive style. There was no statistical significant difference between the Interactive and Performance teaching styles for *explicit* comprehension ($F(1, 56)=2.76$, $p=0.10$, $\eta_p^2=0.04$). When these two test results were combined and analysed in order to evaluate an overall score for comprehension the results were statistically significant ($F(1, 56)=4.15$, $p=0.04$, $\eta_p^2=0.06$). Overall, the three study instruments analysed for story comprehension demonstrated that interactive scaffolding delivered superior outcomes compared to performance scaffolding.

Table 5.14 *One-way ANOVA Results of Implicit, Explicit and Overall Story Comprehension Results Based on Teaching Style (post-test 1)*

	Interactive Teaching Style				Performance Teaching Style							
Dependent Variables	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	***F***	***p***	η_p^2	**Cohen's *d***
Implicit Story Comprehension	28	1.07 (0.46)	0.08	[0.91, 1.24]	30	0.83 (0.41)	0.08	[0.67, 0.99]	4.47	0.03	0.07	0.55
Explicit Story Comprehension	28	0.98 (0.39)	0.07	[0.82, 1.13]	30	0.80 (0.41)	0.07	[0.65, 0.95]	2.76	0.10	0.04	0.44
Both Tests combined	28	1.02 (0.40)	0.07	[0.88, 1.17]	30	0.81 (0.37)	0.07	[0.67, 0.96]	4.15	0.04	0.06	0.54

Using Cohen's d, the effect size calculation for teaching styles for the Implicit story comprehension test revealed a medium effect size of $d=0.55$ and for Explicit story comprehension test revealed a moderate effect size of $d=0.44$, favouring the Interactive teaching style.

5.4.3.3 PLS-5 Results - Interactive versus Performance Teaching Style. One-way ANOVA was performed to analyse the effect of the interactive and performance teaching style conditions on the standardised language test PLS-5 UK at pre-test and post-test (Table 5.15). The results revealed that there were no statistically significant main effects for teaching style (interactive versus performance) at pre or post-test (Pre: $F(1, 58)=0.03$,

p=0.85, η_p^2= 0.00; Post: F (1, 47)=0.12, p=0.72, η_p^2= 0.00).

Table 5.15 *One-way ANOVA Results of PLS-5 Based on Teaching Style (pre-test and post-test)*

	Interactive Teaching Style				**Performance Teaching Style**							
Research Tool	**N**	**Mean**	**SD**	**Std. Error**	**N**	**Mean**	**SD**	**Std. Error**	***F***	***p***	η_p^2	**Cohen's *d***
PLS-5 Pre	30	67.40	15.31	2.60	30	66.70	13.19	2.60	0.03	0.85	0.00	0.04
PLS-5 Post	26	66.96	14.04	2.68	23	65.57	13.31	2.85	0.12	0.72	0.00	0.10

Moreover, a repeated measures analysis was conducted to assess time effects (see Table 5.16), condition effects, and condition x time for the standardised language test PLS-5 from pre-test to post-test based on teaching styles. The results were statistically non-significant for all effects (p>0.05). In addition, the effect sizes for the two conditions revealed small effects for both teaching styles, with d=0.04 for the interactive style and d=0.12 for the performance style.

Table 5.16 *Repeated Measures ANOVA Results for PLS-5 Based on Teaching Style (pre-test versus post-test)*

	Time							
	Pre				**Post 1**			
Condition	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
Interactive style	26	66.35 (13.65)	2.69	[60.92, 71.76]	26	66.96 (14.04)	2.68	[61.55, 72.36]
Performance style	23	67.26 (13.85)	2.86	[61.49, 73.02]	26	65.57 (13.31)	2.85	[59381, 71.31]
Total	49	66.78 (13.61)	1.96	[62.84, 70.76]	49	66.31 (13.57)	1.96	[62.31, 70.20]
ANOVA results		***F***				***p***		η_p^2
Time effect		0.389				0.536		0.00
Condition effect		0.004				0.950		0.00
Condition x Time		1.780				0.189		0.00

5.4.4 Transfer Task

The interaction effect of book medium by teaching style for the Transfer Task was not significant, $F(1, 42) = 0.725$, $p = .399$, $\eta_p^2=0.01$, nor were the main effects of book medium and teaching style. Therefore, these results suggest that there is no transfer effect (Table 5.17).

Table 5.17 *Two-way ANOVA Results for Transfer Task of Book Medium by Teaching Style (post-test 1)*

Book Medium	**Teaching Style**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
E-book	Interactive style	11	0.66 (0.62)	0.16	[0.32, 0.99]
	Performance style	11	0.90 (0.52)	0.16	[0.57, 1.24]
Print Book	Interactive style	11	0.76 (0.56)	0.16	[0.43, 1.10]
	Performance style	13	0.73 (0.49)	0.15	[0.42, 1.04]
ANOVA results			F	p	η_p^2
Book Medium effect			0.045	0.833	0.00
Teaching Style Effect			0.445	0.508	0.01
Book Medium x Teaching Style			0.725	0.399	0.01

5.4.5 Bonferroni Correction

Within the scope of my study, four crucial analyses were performed using repeated measures ANOVA.

- **Comparison of Book Mediums (RQ1):** This set of analysis include comparing the effects of e-books and print books on each dependent variable, namely vocabulary and story comprehension. I conducted two analyses for vocabulary: one for receptive skills and one for expressive skills. To enhance understanding of the story, I conducted two types of analyses: implicit and explicit. Given that there are four dependent variables, there will be four comparisons within this family.
- **Comparison of Teaching Styles (RQ2):** This family of analyses involves comparing interactive versus performance teaching conditions for each dependent variable (vocabulary and story comprehension). In the same manner, I conducted

two analyses for vocabulary: one for receptive skills and one for expressive skills. For story comprehension, I conducted two analyses: implicit and explicit. Given that there are four analyses, there will be four comparisons within this family.

When using the Bonferroni adjustment, the adjusted significance level becomes 0.012, which is obtained by dividing 0.05 by 4. Based on the new significance level the story comprehension outcomes do not survive the adjustment.

Prior to adjusting the significance level, the analysis for RQ1 (e-books versus print books) using the explicit story comprehension test (refer to Table 5.9) demonstrated a statistically significant outcome with a p-value of 0.04. Due to the revised significance level, this outcome does not meet the criteria for statistical significance after adjustment, thereby rendering the results as non-significant. In relation to RQ2, which examines the difference between interactive and performance teaching styles, the implicit story comprehension test (refer to Table 5.16) yielded a p-value of 0.03 before applying the Bonferroni correction. Given the modified p-value, this finding is not statistically significant. Hence, the aforementioned story comprehension effects are being examined with caution. It is imperative to underscore the consistent inclusion of confidence intervals (CIs) and effect sizes. The evaluation of the results should not be predicated solely on the p-value and the statistical significance of the findings.

5.5 Discussion

The current study demonstrates the importance of selecting appropriate book mediums and teaching styles when teaching young children whose first language is not the language taught within the stories. The aims of this experimental study were: (1) to evaluate which type of media produces better results in the development of vocabulary and story comprehension for children learning English as an additional language; and (2) to investigate which reading style better facilitates young children's (learning English as an additional language) vocabulary and story comprehension development. Thus, the study assessed the effects of e-book and print book reading with two different teaching styles on vocabulary development and story comprehension. The study recruited 60 participants from ages three to seven years, residing in Larnaca, Cyprus, and learning English as an additional language (EAL).

In line with our expectations, all experimental conditions progressed from pre-intervention to post-intervention as evidenced by increased mean scores. An initial objective of the study was to identify which book medium could better develop children's vocabulary skills and story comprehension abilities, the "perfect" e-book or the print book. While the participants' mean score differences before and after the intervention increased, there was no interaction effect observed for receptive vocabulary and expressive vocabulary. This indicates that everyone showed improvement from the pre-test to the post-test, regardless of the condition they were in. The second research question of this research was to determine which teaching style could potentially support children learning EAL, the interactive style or the performance style. In all dependent variables, the interactive teaching style enhanced children's learning more effectively than the performance teaching style. One of the study's strengths is that the findings are based on an intervention that comprised two different stories rather than simply one. When children are learning a new language, repetition or repeated exposure to essential information promotes a better comprehension of the material (Takanishi & Le Menestrel, 2017). These findings are discussed below in detail.

5.5.1 E-book versus Print Book

5.5.1.1 Vocabulary Growth

Two different levels of vocabulary development were measured in this study, receptive vocabulary and expressive vocabulary. It is important to note that there were differences between conditions at pre-test, as indicated by the results of the receptive and expressive vocabulary tests. Consequently, the use of repeated measures analysis was imperative in order to control for the pre-test variations.

In both conditions (e-book versus print book), children improved their receptive vocabulary. When comparing the participants' pre-test to post-test receptive vocabulary growth, the print book condition produced better results (see Table 5.8 and Figure 5.1), however results were non-significant (p>0.05). To the best of my knowledge, there is no research comparing the efficacy of e-books versus print books, with adult support, for children learning EAL; consequently, these results cannot be compared to those of earlier studies. However, when comparing the results of this study with previous studies concerning the use of digital media and bilingual children, this finding is contrary to previous studies which have suggested that animated stories (i.e., videos) supported children learning a new language more than static e-books (i.e., Silverman & Hines, 2009; Verhallen et al., 2006).

Expressive vocabulary was statistically non-significant in terms of book medium (F(1, 58) = 1.095, p >0.05, η_p^2=0.01*)*. Compared to the findings of the meta-analysis in Chapter 4 of the thesis, where expressive vocabulary was found to have a medium positive effect size in favour of the e-book condition (g = 0.54; 95% CI = [0.08, 1.00]), this result demonstrates that typically developing children and children learning EAL absorb information differently. Digital media with various technological enhanced features may be effective for children acquiring vocabulary in their native language but should not be assumed to be equally effective for children whose native language is not the language being taught during storybook reading. In addition, EAL learners typically find it simpler to employ receptive language skills than expressive language abilities (Uchikoshi, 2014). Although the studies by Silverman and Hines (2009) and Verhallen et al. (2006) may demonstrate a favourable trend in the use of multimedia stories to increase vocabulary development among bilinguals, Silverman's study (2013) produces different results. Silverman performed research on the function of video in vocabulary development in kindergarten

classes with a mix of monolingual and bilingual pupils in each class. Silverman investigated the effects of video viewing and book reading on vocabulary learning (n=78). There was no significant difference in vocabulary learning between the two groups (F(1,77) = 0.06, p = .81, d=0.00), contrary to the findings of Verhallen et al. (2006; F(1, 53)=26.63, p <.001, η_p^2=0.33). In light of these results, Silverman qualifies her findings with a few limitations, notably the limited sample size and quasi-experimental nature of the study. The common limitation of this study with Silverman's study (2013) is its small sample size.

5.5.1.2 Improvement in Story Comprehension

While analysing the results retrieved from book medium analyses, post-scores revealed a statistically significant result for explicit story comprehension (p=0.04, η_p^2=0.07) and non-significant results for implicit story comprehension (p=0.07, η_p^2=0.05; see Table 5.10). Implicit story comprehension includes making inferences about the feelings of the story protagonists, causal relations, predictions, and theme; it requires deeper story comprehension skills. Explicit story comprehension is related to the identification of the story elements (characters, setting, initiating event, problem, and solution). The significant outcome regarding explicit story comprehension could potentially be explained by the assumption that children who do not speak the language of the narrative as their primary language may experience greater ease in comprehending basic story components, such as the setting and main characters, as opposed to grasping and articulating the emotions and feelings of said characters. The utilisation of illustrations holds significant value in this context, as children are able to visually comprehend the various story elements through the accompanying images. While the first findings suggested that print books might enhance story comprehension, it is important to highlight that these results lost their statistical significance after applying the Bonferroni adjustment.

Furthermore, when comparing the two book mediums, the condition with the highest mean-score in both implicit and explicit story comprehension tests (the two test combined) was the print book (M= 1.03, SD = 0.37, F(1, 27)=210.56, p=<.001; 95% CI = [0.88, 1.17]; η_p^2*=0.07, d=-0.57).* This result is closely linked with the result found by the meta-analysis (Study 1) which found a small positive but non-significant effect size on story comprehension, favouring the print book condition (g = 0.05; 95% CI = [-0.11, 0.21]). The

high overall scores found for the print book condition might be explained by the meta-analysis performed by Hadley et al. (2022), in which they investigated how teacher language practices differed according to activity setting and group size. They found that shared book-reading increased the use of language activities, but a small group featured less positive language practices compared to other contexts. In this study, the number of students that took part every session of the e-book condition was two, and for the print book condition were seven. Therefore, group size may also impact literacy development. Recent research by Korat et al. (2022a) stands in sharp contrast with the results found in this study, which found a considerable advantage for children who read the e-book with adult scaffolding in terms of story comprehension. Their study examined 103 children (aged 5–6 years) from LSES families. The participants were separated in three conditions: (a), the children read the e-book with a dictionary and the teacher's support; (b), the children read the e-book with the dictionary independently; and (c), the children read the e-book without a dictionary - static presentation of story pictures (control). The findings suggest that children who received support from both a dictionary and a teacher while reading an e-book demonstrated a greater acquisition of vocabulary compared to those who relied solely on the dictionary for assistance. Additionally, the results indicate that this group outperformed the control group, which listened to an e-book that closely resembled a print book with static illustrations.

5.5.2 Interactive Teaching Style versus Performance Teaching Style

5.5.2.1 Vocabulary Growth

The current study found that in terms of expressive vocabulary development (receptive vocabulary results were non-significant, $p>0.05$) the interactive teaching style produced better results in comparison to the performance teaching style ($M = 0.70$, $SD = 0.16$, F (1, 58) = 5.042, $p = 0.02$, $\eta_p^2=0.08$, $d=0.64$). The results support previous evidence from Thomas et al. (2020). In their study, they examined the influence of interactive reading on children from low socioeconomic status (SES) families whose home language was different from their school language. The 194 children in the interactive reading condition had accomplished greater vocabulary gains than those in the control condition. This emphasises the importance of children who are learning multiple languages participating during interactive reading sessions in order for vocabulary development (Chlapana & Tafa, 2014). Furthermore, these findings reinforce the notion that explaining word definitions

during the reading session is more effective than exposing learners to unfamiliar terms while reading a story without explaining any words (Schatz & Baldwin, 1986), particularly for children whose first language is not the language spoken within the story.

The findings highlight the advantage of employing the Dual Coding Theory (Paivio, 2008), which claims that children learn better when information is offered to them concurrently through both the visual and verbal channels, as opposed to just one channel. In addition, the results confirm Vygotsky's (1978) Cognitive-Social Theory, which emphasises the significance of adult mediation for increasing children's learning. This finding may imply that, when reading a narrative to young children, it is the teaching approach, not the medium, that makes the difference, as children in the interactive style condition made a much greater improvement from pre-test to post-test in terms of expressive vocabulary acquisition than those in the performance style condition (see Table 5.15 and Figure 5.4). According to Sun et al. (2020) many teachers utilise the performance teaching style, which entails little to no breaks during storytelling sessions. In their study, 37 kindergarten teachers and 440 kindergartners aged 4-5 years in Singapore were observed during story time in order to determine the relationship between teachers' instructional approaches and children's language development. Their findings revealed that teacher's language strategies varied considerably, with the majority not using scaffolding techniques during the reading session. Sun et al. (2020) indicate that medium-level instruction was the most beneficial approach, which is consistent with the aforementioned finding when comparing interactive and performance teaching styles.

5.5.2.2 Improvement in Story Comprehension

Comparing the two teaching styles with regard to implicit and explicit story comprehension, results revealed that implicit story comprehension provided statistically significant outcomes (p=0.03, η_p^2=0.07, d= 0.55), favouring the interactive teaching style condition, whereas explicit story comprehension yielded non-significant results (p=0.10). Although the results obtained from the interactive teaching condition and their improvement of implicit story comprehension, it is crucial to note that these improvements lost their statistical significance when the Bonferroni correction was implemented. Nonetheless, contrary to the results obtained for story comprehension based on the book medium, where explicit story comprehension was statistically significant in comparison to implicit story comprehension, this result indicates that the type of adult scaffolding used

to support EAL learners may indeed have a significant impact in advancing children's story comprehension in more demanding skills. Implicit story comprehension requires children whose first language is not the language used in the narrative to form inferences about the emotions of the story's protagonists, causal relationships, predictions, and theme, which the Interactive teaching style seems to be able to develop in young EAL learners.

5.5.3 Limitations of the Study

Some limitations of the current study should be taken into account in future studies. The small number of participants in each learning intervention group restricts findings' generalisability across different learning contexts. Additionally, as a consequence of COVID-related issues, certain analyses were limited by missing data, thus necessitating careful interpretation of those findings. A larger sample size is required, in order to achieve broader generalisation of the findings. Future research should investigate if reading group sizes matter in this type of investigation, as the way of teaching in terms of group size was different in the two media types (print book and e-book). Second, an e-book narrator that includes more interactive digital support of the kind provided here by adults can be developed. This option can be implemented regarding vocabulary support as well for other language aspects and might be highly productive. Third, since the intervention (e-book conditions) was administered with pairs of children working together, potential influence of the peer context should be taken into account when considering the intervention effects. Fourth, the study acknowledges that the absence of a second assessor during the delivery of research tools is a limitation. In order to address these constraints in future research, I suggest integrating inter-rater reliability assessments, which would include the participation of other assessors. Finally, since only one teacher implemented the experimental study, caution should be used in assuming that the results can be generalised to teachers from other backgrounds, including implementation of this study in a larger sample of teachers.

5.5.4 Theoretical Implications

The "perfect" e-book utilised in this study had minimal or no sound effects, no background music, and animations relevant to the story's content without distracting pupils from the narrative; thus, positive results were expected, which would have been consistent with Mayer's multimedia learning (Mayer, 2005), Paivio's dual coding theory (Paivio, 1986),

and Sweller's cognitive load theory (Sweller, 1988; Sweller et al., 2011). Specifically, it was expected that animated e-books are able to support children's vocabulary and story comprehension development, as evident by the results in Study 1 (i.e., Chapter 4). However, according to Boers et al. (2017), contrary to previous studies, this may not be the case for EAL learners when reading/listening to e-books. Boers et al. (2017) noted that the effect of multimedia support in the acquisition of new words differs for first language learners and EAL learners, as first language learners already have a mental association between the images and the words. Specifically, the benefits of multimedia support in vocabulary learning may not necessarily reflect how visual cues may strengthen words' concreteness or elicit a mental image (Paivio et al., 1968), and it is quite possible that native speakers already preserve these words in memory. For EAL learners, such a relationship between a shown image and a mental word does not exist; hence, the superiority of multimedia e-books over print books cannot be based only on Paivio's dual coding theory (Boers et al., 2017).

5.5.5 Practical Implications

One of the most common early years practice, storybook reading, has been found to have positive effects on children's language and literacy development (Bus et al., 1995; Mol & Bus, 2011; Hindman et al., 2014). Although the benefits of adult-child shared reading for children whose first language is the language of the story have been well-documented, shared reading in second language or multilingual contexts has received less attention. In reality, more than half of the global population is multilingual and can read in many languages (McBride, 2015). Alkaaby and Mavriqi (2021) suggest that in order for children to acquire a new language, it is essential for them to be exposed to it through listening. According to Chou (2014), when teachers read stories aloud to their pupils, the pupils' vocabulary expands and develops significantly. Storybooks have been investigated as a tool for teaching vocabulary, with studies indicating a retention rate of 20–30% for new terms learned (Biemiller & Boote, 2006). When reading aloud to children it allows them to build a foundation of knowledge that prepares them for the next stage of their education, which is to practise their ability to communicate verbally (Alkaaby & Mavriqi, 2021). As a result, research strongly supports adult guidance while listening to a storybook, as well as the importance of adult scaffolding during storytelling in developing young children's literacy skills (Homer et al., 2014; Korat et al., 2011; Moody et al., 2010; Rvachew et al.,

2017; Neumann & Neumann, 2014; Yelland & Masters, 2007; Zucker et al., 2020). Participants of this study progressed from pre-test to post-test, in all conditions. This result emphasises that children learning EAL are able to develop their vocabulary and comprehension skills through storybook reading combined with adult scaffolding.

Participants *receptive vocabulary* skills were developed and progressed similarly in both book mediums and teaching styles. This may be due to the fact that receptive vocabulary requires the learner to concentrate on listening to the word read by the teacher or narrated by the e-book and developing a mental image of what the item may look like. For instance, children were asked to identify which image corresponded to the word "raccoon". During the teacher's scaffolding intervention, the receptive vocabulary test words were either stated, discussed, or illustrated scenes from the storybook were shown, in order to engage pupils' attention. This technique, therefore, supported children's receptive vocabulary development either before, during or after the storytelling session. *Expressive vocabulary* (results were non-significant) is somewhat more difficult to acquire than receptive vocabulary, especially for children learning EAL. The development of an expressive vocabulary demands the pupil to comprehend the meaning of a term and attempt to explain it by providing a definition. The children in the study had limited vocabulary, making it more difficult for them to define a term in English. During the storytelling session, participants were able to engage in discussion and ask questions, which may have aided them in acquiring the meaning of an unknown term. With the performance teaching style, the children were required to wait until the end of the story to ask questions. Due to their young age and unfamiliarity with the language, it is likely that by that time the majority of participants will have forgotten their question. Therefore, the interactive teaching style delivers immediate support, and additionally it generates possibilities for dialogue, which enhances children's learning.

For *story comprehension*, however, the print book condition outperformed the e-book condition in overall story comprehension scores favouring the print book condition ($F(1, 56)=4.32$, $p=0.04$, $\eta_p^2=0.07$, $d=-0.57$). These results come as a stark contrast to the two other studies found on e-books and EAL learners (Sun et al., 2019; Yang et al., 2022). Sun et al. (2019) evaluated an animated e-book with 102 preschoolers in Singapore learning Mandarin between the ages of 4 and 5 years. The researchers employed four conditions: (a) animated e-book, (b) static e-book with sound, (c) static e-book only, and (d) a control

condition where children played a math game on an iPad. Sun et al. (2019) found that the animated e-book condition produced a positive effect on children's story comprehension ($F(3,151,78) = 4.29$, $p = .006$). Furthermore, Yang et al. (2022) conducted a randomised controlled trial to investigate the impact of bilingual discussion prompts accompanied by feedback within a multimedia interactive e-book on parent-child shared storybook reading. The study included 64 young English language learners, aged 3 to 7 years, residing in China. After reading the storybook twice, children in the discussion-prompt group outperformed the control group (listened to a multimedia interactive e-book without bilingual discussion prompts) on story comprehension and retelling measures. The current study differs from the previous two in that they did not include a print book condition. Therefore, it could be concluded that print books combined with interactive scaffolding may support children's story compression.

5.5.6 Implications for Future Research

Despite these promising results on book mediums and teaching styles for EAL learners, questions remain. There is limited research concerning e-books and EAL learners (i.e., Silverman, 2007; Silverman & Hines, 2009; Sun et al., 2019; Verhallen & Bus, 2011; 2010; Verhallen et al., 2006) and e-books combined with scaffolding techniques for EAL learners (i.e., Neumann & Merchant, 2022; Yang et al., 2022), plus most of these were published more than ten years ago. Therefore, future studies on the current topic are recommended. It is furthermore suggested that future studies include follow-up testing after six months, by re-administering their outcome measures, to investigate whether the effects of book medium and teaching style extend beyond the period of the intervention and may have measurable long-term effects, as transfer effects were not evident within this study. In addition, to develop a full picture of book mediums and teaching styles for young EAL learners, additional studies will need to be conducted to assess literacy related outcomes such as phonological awareness, print awareness, word reading and writing, alphabet knowledge.

5.5.7 Conclusion

The aim of this study was to examine some of the mechanisms underpinning young EAL learners' vocabulary acquisition and story compression development via different book formats. Therefore, this study evaluated two book mediums and two teaching styles for children learning English as an additional language. The findings highlight that children learning EAL may expand their vocabulary and improve their understanding through storybook reading with Interactive adult scaffolding. The factors that determine differences in scaffolding across book formats requires further investigation; however, it is possible that the benefits of shared reading may lie not in the form of the book, but rather in how they are employed by a teacher. In conclusion, by enhancing teachers' understanding of EAL vocabulary and story development, several generations of EAL children are likely to benefit.

Chapter 6: Discussion and Conclusion

The chapter discusses the findings from Study 1 (Meta-Analysis) and Study 2 (Experimental Study) regarding traditional print book and e-book reading and their use for young children, in relation to their language and literacy development. The overall findings are analysed, and the insights gained from the research are examined. The final section presents concluding remarks for both studies. Study 1 compared children's language and literacy development from narrative e-books to more traditional presentation of print stories with and without the support of an adult. As outcome measures, the emphasis was primarily on language development (vocabulary, story comprehension, speaking) and literacy development (phonological awareness, print awareness, word reading and writing, alphabet knowledge). Study 2 examined the effects of e-books and print books, as well as two teaching styles (performance and interactive) on children (aged 3-7 years) learning English as an additional language for story comprehension and vocabulary development.

6.1 Returning to the Purpose of the Thesis: Connecting the Two Studies

The main question raised in this thesis is whether e-books have any educational value for young children and whether they can be used to develop young children's language and literacy skills. There is no doubt that stories read to young children are one of the most important sources of language and literacy development (Bus et al., 1995; Hindman et al., 2014; Mol & Bus, 2011). Storybook reading can be a uniquely valuable and motivating window into the literate world of young children. As mentioned in Chapter 1, print book reading is well established in the literature, and it is regarded as a leading avenue for building early academic skills (Bus et al., 2000; Scarborough & Dobrich, 1994). By engaging in the activity of listening to stories, children expand their story comprehension skills and acquire sophisticated language. Additionally, this type of activity aids in the development of code-related skills, including phonological awareness and concepts of print. As a result, these findings were studied with the use of e-books in order to compare and contrast different book formats, namely children's e-books and print books. Most of the e-books aimed at young children are equipped with interactive and multimedia features, e.g., written text, oral reading, background music and sounds, hotspots activating animations, video, on-demand word definitions, synonyms, and other functions that may

support language and literacy development in unique ways. Another potential benefit of e-books is their ability to serve as a source of motivation, particularly for those who exhibit a reluctance towards reading, as well as for children with learning difficulties. However, many e-books may contain distracting digital features unrelated to the story, which prevent the reader from comprehending the story and acquiring new vocabulary. There is an urgent need to deepen our understanding of the effectiveness of e-books which can either support or hinder language and literacy development in young children.

Increasingly, policy and learning standards require teachers to use technology to support literacy instruction, and e-books are a popular approach for meeting these standards and supporting children's language and literacy development. However, there is a lack of consensus concerning e-books with regard to:

a. the extent to which e-books actually support different aspects of children's language and literacy development;
b. which learners may benefit from use of this technology (e.g., typical developing, EAL learners);
c. which digital features within e-books improve language and literacy outcomes; and
d. what kind of adult scaffolding may support children's language and literacy development when using e-books.

We need to continue our e-book analyses and make recommendations on what comprises beneficial e-books for young children, in order to better serve e-book designers, parents, educators and children. The initial investigation of this thesis, specifically Chapter 4 which involves a *meta-analysis*, examined experimental research that employed e-books versus printed books for children in the age range of 3 to 8 years old, between 2008 and 2021. The study aimed to evaluate the impact of these two formats on the language and literacy development of young children. The meta-analysis yielded insights into the types of features and added components integrated into e-books that can facilitate children's educational attainment. The e-book in question was identified as the optimal type in Study 2, specifically in Chapter 5. Study 2 (Chapter 5) referred to this type of e-book as the "perfect" e-book.

The "perfect" e-book is believed to have minimal or no sound effects, no background music, and animations that are relevant to the story's content without distracting pupils

from the narrative. The present thesis utilised a particular form of e-book in its second phase (Study 2). The findings derived from the subsequent meta-analysis indicate that they align with established theories in the field of multimedia learning, such as Mayer's (2005) theory, Paivio's (1986) dual coding theory, and Sweller's (1988; Sweller et al., 2011) cognitive load theory.

Paivio's dual coding theory proposes that the information-processing system is assumed to contain two channels—an auditory/verbal channel and a visual/pictorial channel—thereby enabling simultaneous processing of visual and narrative information in short-term memory (Paivio, 2008). Cross-channel links between the mental representations of the narrative and visual elements may potentially enhance the comprehension of the text, even if there are delays in vocabulary acquisition, which can contribute to the development of vocabulary skills despite complex language in narrations (Sari et al., 2019). The integration and connection between verbal (text) and visual (illustration) elements of digital storybooks could help organise information from stories and lead to successful subsequent recall as suggested by the cognitive theory of multimedia learning (Mayer, 2005). Well-designed animated e-books hold good promise for children's vocabulary skills, as such books can stimulate readers' visual and auditory senses to comprehend unfamiliar language via the congruence between non-verbal sources (motion pictures, images) and the narration (Sun et al., 2019), as predicted by the dual coding theory of learning. The "enhanced" message may facilitate learners' acquisition of the target information and establishment of a coherent mental representation (Sun & Yin, 2020). These theories have been used as supporting pieces of evidence to explain the positive findings of Study 1 regarding the effectiveness of e-books with multimedia features (Bus et al., 2015; Kelley & Kinney, 2017; Takacs & Bus, 2016).

Building upon the findings of Study 1, Study 2 aimed to assess the efficacy of e-books that incorporate multimedia elements. Specifically, the study examined the concept of a "perfect" e-book, characterised by the absence of extraneous sound effects and background music, as well as the inclusion of animations that are pertinent to the narrative without detracting from the reader's focus in comparison to a print book. Furthermore, the effectiveness of scaffolding techniques was assessed and analysed (interactive style versus performance style). The results obtained from Study 1 indicated that the utilisation of adult scaffolding in conjunction with e-book features yielded superior outcomes when compared

to print book conditions. The aforementioned variables were subjected to testing among a sample of children who did not have English as their primary language, but rather a second and third language. Since Paivio's dual coding theory (Paivio, 1986; Sadoski & Paivio, 2013) suggests that animation embedded in an e-book may be more effective in conveying the meaning of a word than a static illustration, this theory may also hold true for children who are learning English as an Additional Language (EAL). Therefore, Study 2 hypothesised that educational media may provide dynamic visual and auditory forms of input that function as scaffolds for learners learning English as an additional language.

Despite the fact that all participants exhibited improved performance after the intervention, in the current study it was observed that the print book condition was more beneficial to enhancing the performance of EAL learners in vocabulary acquisition and story comprehension. Study 2 results come as a stark contrast to the study by Wong and Samudra (2021), in which they investigated whether language learners benefit from media content that is both audibly and visually presented, using English language proficiency as a significant contextual component that may influence vocabulary learning on screens. Their within-subject design study included 43 preschool-aged children from predominantly native Spanish-speaking households. In this study, children viewed six Sesame Street video segments on an eye-tracking Tobii device. Three of the videos taught English vocabulary words with visual-auditory congruence (dual-coding condition), in which a visual representation of the vocabulary word appeared concurrently with an auditory label. In the other condition – the visual-auditory incongruence (non dual-coding) condition children watched three clips where the visual and auditory labels occurred at different points. Researchers reported a main effect for dual-coding as visual-auditory congruence better supporting vocabulary learning in language learners than visual-auditory incongruence, F (1, 38) = 6.07, p =.018. They concluded that when children have the opportunity to simultaneously view and hear, they form cohesive mental representations of on-screen material, which facilitates in-depth language acquisition (Wong & Samudra, 2021). As previously stated, Study 2 demonstrated progress in both e-book and print book conditions from pre-tests to post-tests. However, it is important to note that Study 2 differs from Wong and Samudra's (2021) study in that it compared the e-book condition to a print book condition. However, despite the overall differing outcomes and study designs, the two studies shared a common feature. Wong and Samudra (2021) conducted a study on the efficacy of video with visual-auditory congruence in enhancing children's learning

outcomes. Their findings suggest that their multimedia educational medium (dual-coding condition) shares similarities with the "perfect" e-book described in Study 2. Consequently, it is plausible that an e-book meeting the criteria of a "perfect" e-book could potentially facilitate the development of vocabulary skills among EAL learners.

According to Vygotsky's theory of the Zone of Proximal Development, scaffolds play a pivotal role in facilitating language development by aiding students in comprehending new words and guiding them towards a more profound understanding of the new vocabulary (Vygotsky, 1980). As mentioned earlier, a second variable under investigation in Study 2 was the use of scaffolding techniques during e-book and print book reading. It is important to note that the zones of proximal development for children do not uniformly fall within a consistent range. A number of children may possess more robust EAL vocabularies and/or have increased opportunities for EAL exposure in their home environment, potentially enhancing their ability to acquire knowledge from electronic media. Therefore, Study 2 included two scaffolding techniques in order to support all children during the intervention. The *interactive teaching style* outperformed the *performance teaching style* in all comparisons. This finding was also evident in studies comparing the two teaching styles with young children (Dickinson, 2001; Dickinson & Smith, 1994; Greene Brabham & Lynch-Brown, 2002; Reese & Cox, 1999).

6.2 The Outcomes of the Study for EAL Learners in Cyprus

The findings of the study conducted in Cyprus during the 2020-2021 academic year provide valuable insights into the language learning experiences of children attending a private English school in Cyprus. Despite English being taught as the main language of instruction in this setting, it is important to recognize that for the participants, English was considered an additional language. This distinction is crucial as it underscores the diverse linguistic backgrounds and varying levels of English proficiency within the participant population. Cyprus, situated in the Eastern Mediterranean, has a complex linguistic landscape shaped by its historical and geopolitical contexts. Although Greek and Turkish are recognised as the official languages of Cyprus, English retains considerable significance on account of Cyprus's colonial history during British rule and the official position of English as a language of the European Union. As a result, English language education is pervasive in the Cypriot schooling system, with many private schools offering

English-medium instruction. The population of the study consisted of sixty children between the ages of 3 and 7, reflecting the early childhood years when language acquisition and development are particularly salient. The age range of the participants is noteworthy as it corresponds to the critical period for language learning, during which children are highly receptive to linguistic input and environmental stimuli.

The intervention took place within the school setting, providing a familiar and conducive environment for the participants to engage in the language learning activities. The use of storybooks, both in print and electronic formats, served as a medium for language exposure and skill development. By comparing the efficacy of print books versus e-books, the study addressed contemporary debates surrounding the integration of technology in education and its impact on learning outcomes. Furthermore, the study examined the influence of teaching styles on language acquisition, specifically comparing an interactive style with a performance style. This aspect of the research is particularly relevant as it speaks to pedagogical practices tailored to the needs of EAL learners. The emphasis on adult scaffolding and active engagement in the interactive teaching style aligns with best practices in language education, emphasizing the importance of supportive learning environments and meaningful interactions for language development.

These findings have implications for language education policies and practices in Cyprus, as they highlight the importance of incorporating interactive teaching methods in language learning curricula. The study's findings contribute to the understanding of the impact of interactive teaching styles on language learning by providing evidence for the effectiveness of using interactive methods in English language education in Cyprus. The findings suggest that incorporating interactive teaching methods, such as simulation games, workshops, brainstorming, and translanguaging, can enhance language learning for children who are acquiring English as an additional language in Cyprus. These findings have implications for language education policies and practices in Cyprus, as they highlight the importance of incorporating interactive teaching methods in language learning curricula.

Moreover, these findings have important implications for educational practices in Cyprus, where the need to support the acquisition of English as an additional language is a pressing concern. The results suggest that interactive storybook reading, whether in print or digital

format, can be an effective approach to enhancing the vocabulary and comprehension skills of children who are learning English as an additional language. By considering the unique linguistic and cultural context of Cyprus, educators and policymakers can develop targeted interventions and instructional strategies that leverage the potential of both print and digital resources to support the language development of this specific population of learners.

6.2 Lessons Learned from the Studies Reported in this Thesis

The significance of e-book quality and how e-books are used has been highlighted in both studies of this thesis. Study 1 (Savva et al., 2022) found that adult scaffolding combined with e-book features outperformed the print book conditions. Although there are limited studies comparing the effects of adult scaffolding in both print and e-book conditions within a class context with young children, Strouse et al. (2023) published a recent study on parent-child dialogic conversations during e-book reading (with built-in, researcher-designed prompts) and print book reading. Their findings (n=67) showed that there was no indication that reading the digital version of the book or listening to the narration while it was automatically playing reduced the language or conversation quality compared to reading the print version. This study suggests that skilfully designed digital books, especially those with narration, offer prospects for high-quality shared reading that are comparable to those of print books. It should be noted that their e-book included built-in prompts, which, according to the researchers, could be a potent aid for engaging conversation.

However, when it comes to children whose first language is not the language narrated within the e-book, Study 2 revealed that EAL learners performed better with the print book condition in both vocabulary development and story comprehension. Previous studies (with L1) have reported quality differences between print and digital books, such as a higher frequency of on-topic talk in print books (Lauricella et al., 2014; Munzer et al., 2019; Parish-Morris et al., 2013). Study 2 employed a lesson plan that was descriptive in nature, incorporating targeted questions and discussion prompts on specific book pages based on the teaching style that was being assessed (performance versus interactive) to mitigate the aforementioned concerns. Therefore, identical questions were posed to children regardless of book medium. It is important to acknowledge that the sample size for each condition in Study 2 was relatively small, consisting of only 30 participants. This

limitation emphasises the need for further research on EAL learners and studies similar to Study 2, with a larger sample size. Nonetheless, revisiting the recent research conducted by Strouse et al. (2023), wherein an e-book was utilised that included built-in, researcher-designed prompts, it is plausible that the outcomes may vary for EAL learners (as opposed to the results of Study 2) if the aforementioned e-book is complemented with the qualities of a "perfect" e-book.

An essential factor to contemplate when teaching young EAL learners through e-books for their development of vocabulary and story comprehension is the level of proficiency of teachers in utilising e-books as a pedagogical tool. The pedagogical expertise of educators in utilising e-books as a teaching tool is a crucial factor, particularly when teaching EAL learners. Bay (2022) conducted a study where 43 pre-school teachers were asked regarding their views on using digital technology in early childhood learning settings in Turkey. The study revealed that educators had access to web-based technologies, with a predominant usage of smartphone applications (97%). Conversely, a lesser proportion of educators incorporated digital technology within their instructional practises, accounting for 48.8%. In relation to the perspectives of educators, the advantages of digital technology include enhanced job performance (46%), improved educational learning (39%), streamlined knowledge transfer (41%), and improved communication with families (34%). The study reveals that a significant proportion of respondents had negative perceptions regarding the impact of digital technology on children and teachers. It is believed that educators may harbour apprehensions stemming from their limited proficiency and knowledge in utilising digital technology. Specifically, 16% of respondents believed that digital technology causes distraction, while 11% asserted that it leads to addiction in children. Additionally, 7% contended that it causes teachers to lose time in searching for information, health problems (4%), and developmental problems (2%) in children (Bay, 2022). According to Koehler et al. (2007), the cultivation of technology literate individuals necessitates the prior attainment of technological literacy by teachers, who must then apply their technological expertise in classroom practices in a manner that is both meaningful and appropriate. Balçın and Ergün (2016) argue that the integration of technology in the educational process is of paramount importance in fostering individuals who are proficient in the effective utilisation of technology. The literature indicates that teachers play a crucial role in determining children's technology usage (Barron et al., 2011; Puerling, 2012), yet keeping up with the swift pace of technological advancements can pose a

challenge for educators (Ozbay & Ugurelli, 2023).

6.3 Contributions to the research literature

This thesis aimed to evaluate the efficacy of e-books compared to the traditional practice of reading stories using printed books in the early years' classroom. Currently, more teachers are increasingly incorporating e-books into their lessons. While the advantages of print books and their impact on vocabulary and story comprehension development have been well studied, there is a lack of comprehensive research on the effects of e-books, a relatively new medium, on the development of these skills in young children.

The meta-analysis conducted in this thesis revealed significant findings that were not previously reported in other meta-analyses. Consensus has been reached among several meta-analyses and other experimental research that the outcomes have had a modest nevertheless beneficial overall impact in favour of the e-book condition. The findings regarding vocabulary development align with the results reported in previous studies which provide support for the notion that digital books are more effective than print books. An additional advantage of e-books, according to the meta-analysis reported in the thesis, is their capacity to facilitate the growth of expressive vocabulary. When comparing multimedia enhancements in e-books, the results of the meta-analysis indicated a marginally positive effect in favour of the e-book condition, indicating that e-books are more advantageous than traditional print book encounters, regardless of adult scaffolding in the print book condition. For code-related skills, this effect was statistically significant (g = 0.63; 95% CI = [0.28, 0.99]). On the contrary, prior empirical research that examined the impact of multimedia e-books on code-related skill development (e.g., Arslan-Ari & Ari, 2022; Yow & Priyashri, 2019) suggested that e-book reading might not be a productive way for children to enhance their phonological awareness, print knowledge, and word reading abilities. This is because children tended to focus more on the illustrations rather than the textual content. One plausible hypothesis for this phenomenon is that the studies incorporated in this meta-analysis demonstrated teacher mediation, suggesting that the implementation of multimedia e-books by teachers to facilitate learning in code-related skills is beneficial.

Regarding the comprehension of the story, previous meta-analyses demonstrated that story

comprehension was positively and significantly affected by e-books in comparison to print books. However, this meta-analysis revealed a small positive effect on story comprehension, which was not statistically significant (g = 0.05; 95% CI = [-0.11, 0.21]). This suggests that children in the e-book conditions performed equally well compared to children in the print conditions. This conclusion aligns with the study conducted by Liman Kaban and Karadeniz (2021), where they examined the utilisation of various digital reading platforms among a sample of 96 students. Although various reading mediums were utilised in both the experimental and control groups, there was no notable disparity in their story comprehension scores. Hence, it was crucial to examine this finding in the experimental investigation of the thesis to see whether story comprehension might be enhanced by utilising e-books as opposed to print books, together with the addition of scaffolding support.

Another key discovery within the meta-analysis, that propelled Study 2 of the thesis was the comparison between the impact of digital features as scaffolding tools and print books without adult support. The results indicated a minor positive effect, although not statistically significant, suggesting that reading unsupported e-books yields similar outcomes as reading unsupported print books. However, based on a previous meta-analysis (Takacs et al., 2014), it was anticipated that a similar lack of significant findings would be observed when adults mediated print book reading compared to autonomous usage of e-books. The findings of this meta-analysis indicated that when adults offered scaffolding support during the reading of print books, it yielded superior outcomes compared to reading e-books in isolation. Nevertheless, the presence of both an e-book and adult scaffolding resulted in superior performance compared to reading a print book with or without adult scaffolding. Hence, the meta-analysis enhanced the existing body of research by emphasising that the incorporation of digital components and discussion pertaining to the narrative is significantly more influential than the support offered during conventional print book reading. In summary, the findings suggest that the participation of adults in assisting children with reading e-books is an important factor to take into consideration during adult-child storybook reading.

Considering the aforementioned findings and the significant role of adult scaffolding in assisting learners, Study 2 examined the impact of using e-books compared to print books with adult scaffolding. In the literature, there a very few research that explored scaffolding

support with the usage of e-books. As a result, an additional measure was devised to assess the effectiveness of two distinct teaching techniques: interactive and performance teaching styles. The majority of research in the literature have mostly concentrated on assessing the impacts of a single teaching approach employed by adults during instruction, whether it be teaching a specific subject or engaging in storytelling. Both teaching techniques, interactive and performance teaching styles, discussed in the literature appear to provide favourable outcomes. Hence, it was crucial to compare these two teaching styles in the context of reading e-books and print books, as no research have previously compared these two methods using different media.

Furthermore, throughout my examination of the literature, it became evident that only a small number of studies have incorporated children who do not speak English as their primary language. The majority of research comparing e-books to paper books focused on typically developing children or children with special educational needs. It was very significant for me to incorporate children whose first language is not English, as the study was conducted in Cyprus, a country that attracts many immigrants each year whose first language is not English. However, these students were being educated in English at private schools, which is often where they enrol.

After completing a thorough search of the literature, only one research was discovered that assessed the use of an e-book in bilingual children and provided scaffolding support (Yang et al., 2022). Several studies have assessed the use of e-books with bilingual children, L2 versus L1 children, or EAL learners, but they did not include adult support in discussing the story. Comparing the utilisation of e-books with adult support to that of print books with adult support, with EAL leaners, was crucial to this investigation so as to advance beyond the conclusions drawn from the meta-analysis. Yang et al. (2022) conducted a randomised controlled study to examine the effects of bilingual conversation prompts and feedback in a multimedia interactive e-book on parent-child shared reading for young English language learners aged 3-7 years in China. Within the treatment condition, a grand total of sixty-four pairs consisting of parents and children engaged in the activity of reading a multimedia English storybook while utilising multilingual conversation prompts. By contrast, a total of forty-three sets of parents and children took part in the same activity of reading the multimedia storybook, but without any conversation prompts included. Upon reading the storybook twice, it was noted that the children who took part in the discussion-

prompt group had higher performance in terms of their understanding of the story and ability to repeat it, as compared to the control group. The significant disparity in results indicates that participating in guided conversations enhanced children's understanding and capacity to recount the narrative. Nevertheless, children in both groups shown similar improvements in their English vocabulary. There is a lack of study on the use of teacher scaffolding and the comparison between e-books and print books for young children who are learning English as an additional language. Hence, the study aimed to determine if an e-book is as effective in facilitating English language acquisition for children with additional language needs compared to typically developing children. Which scaffolding approach, interactive or performance, would be more effective in supporting this target population? Can both forms of media, namely e-books and print books, benefit EAL learners?

The findings of Study 2 indicated that both e-books and print books were beneficial for EAL learners, since the average scores for all dependent variables (i.e., vocabulary and story comprehension) rose from the pre-test to the post-test. However, it is important to note that these results were not statistically significant ($p>0.05$). Therefore, both media have the capacity to support EAL learners. Furthermore, when it comes to providing support through scaffolding, the interactive teaching style produced superior outcomes compared to the performance style, particularly in relation to the development of expressive vocabulary. This finding is significant, particularly for the specific group being studied, since it demonstrates that teachers may employ an interactive teaching approach to assist their students in improving their vocabulary and understanding of stories. This can be achieved by utilising many forms of media, such as e-books or print books. The findings of the thesis enhance our comprehension of the influence of an interactive teaching style on language acquisition by presenting evidence of the efficacy of utilising interactive approaches in English language instruction for children who are learning English as an additional language. The study discovered that children who are learning English as an additional language may improve their vocabulary skills by participating in storybook reading with interactive adult scaffolding. Interactive adult scaffolding refers to the process in which learners engage in active participation and interactive conversations to create information (Kim & Wilkinson, 2019; Wells, 2015). Both investigations conducted in this thesis have demonstrated that facilitating students' engagement in interactive scaffolding optimises the process of learning. This method entails engaging in

interactive dialogues where students engage in the exchange of ideas through logical reasoning, discussion, critical analysis, and expressing their thoughts (Yıldırım & Uzun, 2021). Both learners and teachers cooperate to exchange perspectives and ideas, participating in dialogic discussions to attain favourable learning outcomes. Reznitskaya (2012) states that interactive instruction comprises several essential elements. These strategies encompass asking open-ended questions to stimulate innovative thinking, distributing responsibility between educators and students, offering constructive feedback to facilitate understanding and stimulate critical thinking, engaging in metacognitive reflection for clarification, and collectively building knowledge in a social setting through interaction with peers. Lefstein (2005) describes the use of interactive teaching styles in education as democratic because it involves equal participation, self-reflection, openness, and challenging power dynamics via joint efforts to create meaning. This scaffolding technique is student-centered and child-friendly. It requires learners to actively participate in order to achieve the lesson objectives and promote their educational development, specifically in vocabulary and story comprehension.

The findings of the thesis underscore the importance of considering instructional strategies alongside the choice of educational materials. While e-books offer interactive features that can enhance engagement, traditional print books remain viable resources, particularly when supplemented with effective scaffolding techniques. These findings have several implications for educators and curriculum developers. Firstly, they underscore the importance of considering the pedagogical approaches embedded within instructional materials, whether digital or traditional. Secondly, the results highlight the potential of e-books with scaffolding support as a viable alternative to traditional print books, particularly in catering to the diverse needs of EAL learners. Additionally, the study emphasizes the significance of interactive teaching strategies in fostering vocabulary development and overall learning outcomes.

In conclusion, the thesis aimed to assess the efficacy of utilising e-books with scaffolding help as opposed to typical teaching methods with print books. There is a limited number of research that have directly evaluated the impact of scaffolding in both print and e-book forms (i.e., Broemmel et al., 2015; Ihmeideh, 2014; Rvachew et al., 2017; Segal-Drori et al., 2010; and Zhou & Yadav, 2017). Furthermore, there are even fewer studies that have examined the impacts of scaffolding among EAL learners, such as the study conducted by

Yang et al. (2022). The effectiveness of e-books, especially when combined with scaffolding support, has not been thoroughly studied in educational research, particularly in relation to EAL learners. This study sought to address this disparity by examining the effects of e-books with scaffolding assistance vs traditional print books on vocabulary acquisition and story comprehension among EAL learners in a classroom setting. The results showed that participants in both the e-book and print book groups made improvements in vocabulary from the pre-test to the post-test. This suggests that both mediums are successful in helping EAL learners expand their vocabulary. Nevertheless, a noteworthy insight arose concerning the significance of interactive teaching methods. The use of interactive teaching methods, whether through e-books or print books, helped students expand their expressive vocabulary. These findings indicate that the method of instruction, rather than the medium used, had a significant impact on enhancing learning results.

This study contributes to the growing body of literature on the use of technology in education, particularly concerning the effectiveness of e-books with scaffolding support compared to traditional print books. While both mediums demonstrated efficacy in supporting vocabulary development among EAL learners, the study emphasizes the pivotal role of interactive scaffolding in facilitating learning outcomes. Moving forward, educators and curriculum developers should consider a balanced approach that leverages both instructional strategies and technological resources to meet the diverse needs of learners in today's digital age.

6.4 Conclusion

The 21st century has witnessed significant advancements in technology, leading to rapid changes in our world. Consequently, children are growing up in an environment where their lives are significantly influenced by digital technologies (Flewitt & Cowan, 2019). Based on the findings of the two studies included in this thesis, e-books may appear to be an effective educational resource for young children. However, educators and parents may need to take certain factors into account when selecting appropriate e-books. The first study has demonstrated which characteristics and elements can support children's learning, particularly for those whose native language is the book's language of narration. Moreover, Study 1 has suggested that the combination of adult scaffolding and suitable e-books is

more effective in facilitating children's learning compared to children engaging with e-books independently. However, there are limited studies comparing the effects of adult scaffolding in both print and e-book conditions within a class context with young children (see Savva et al., 2022). Consequently, Study 2 was formulated with the inclusion of an additional element, which involved the participation of EAL learners in the process of listening to an e-book narrated in the English language. As far as existing research is concerned, there is a dearth of studies that have examined the impact of different book mediums (namely, e-books and print) on the vocabulary and story comprehension of young EAL learners. Additionally, it is worth noting that the teacher's role in facilitating the learning process through two distinct reading styles - interactive and performance - has not been explored in this context. For children whose first language is not the language of the e-book, the teacher's input and scaffolding support have proven to be of great value for their language development. In the context of EAL learners, adult scaffolding support plays a vital role in facilitating progress in language development, whether it be through electronic or print media. This was demonstrated in Study 2, where participants showed improvement in both book formats. However, the print book intervention outperformed the “perfect” e-book intervention, suggesting that for EAL learners’ other factors may play a role. It is plausible that the advantages of shared reading may not be attributed to the book's format, but rather to the scaffolding technique employed by an educator. In summary, enhancing teachers' comprehension of EAL vocabulary and narrative development is likely to benefit multiple generations of EAL students.

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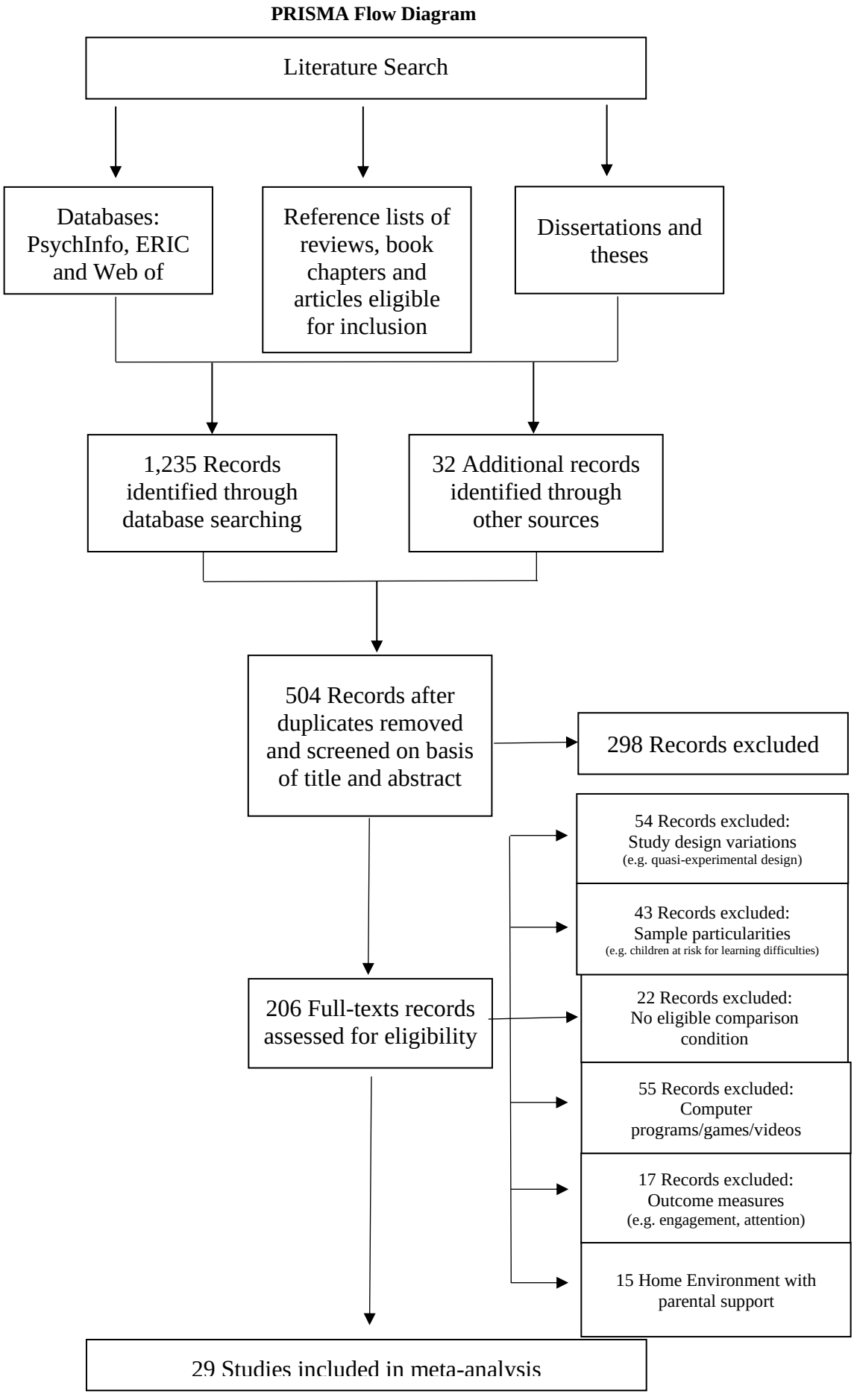
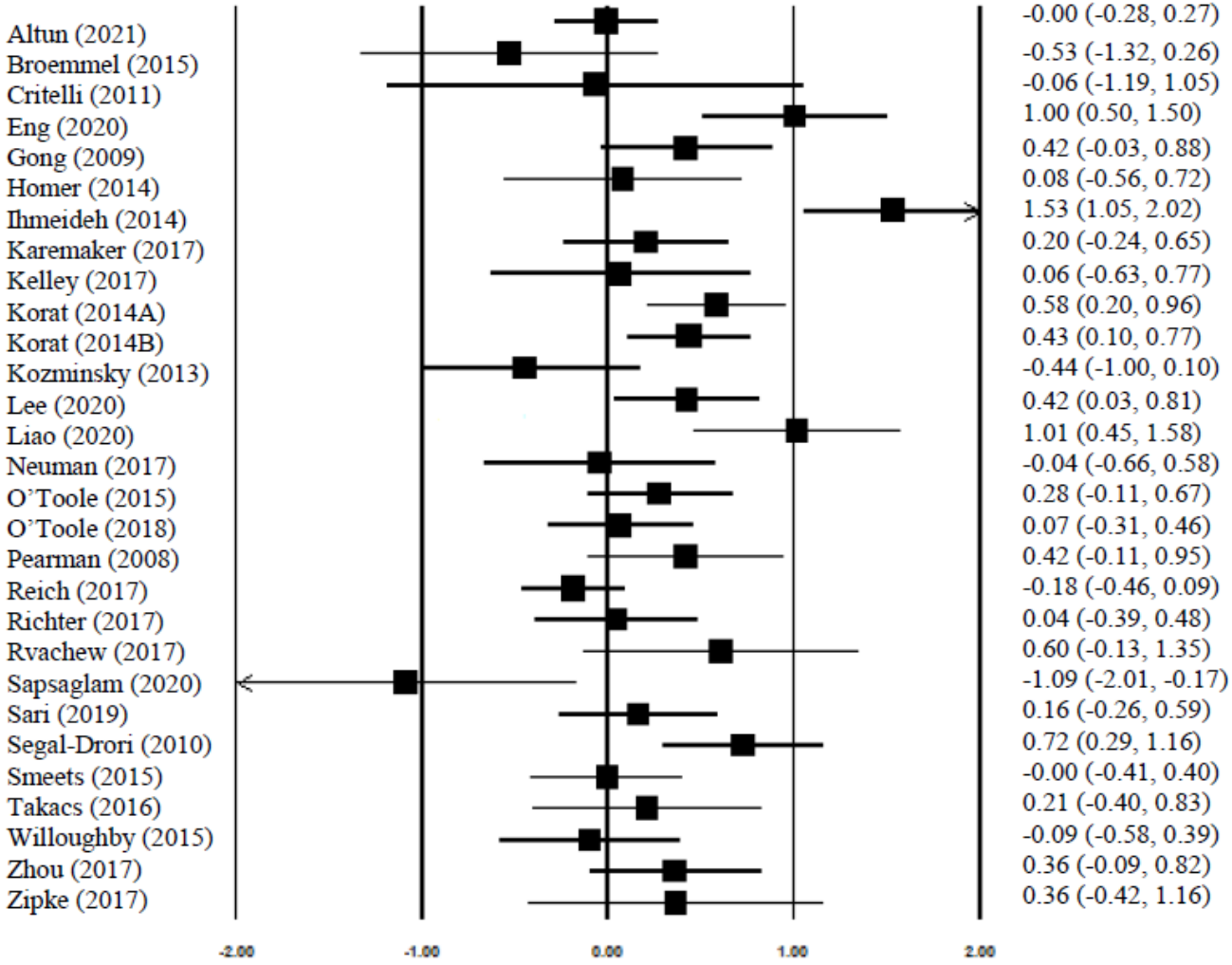
Appendices

Appendix A: *PRISMA Diagram of the Literature Search*



Appendix B: *Forest Plot – Hedges's g and 95% CI*



Appendix C: *Consent Form*

Durham University
School of Education

Shaped by the past, creating the future

Project title: The 'perfect' e-book vs video story vs print: A comparison of different types of media and reading styles of teachers for vocabulary and story comprehension for children learning English as an additional language.
Researcher: Marilena Savva
Department: School of Education

Dear Mrs. Mouzourou,

The aim of this study is to explore whether different types of storybook media (e-book, video stories and print books) have an effect on young children's vocabulary and story comprehension for children learning English as an additional language. This research project is supervised by Dr Nadin Beckmann (nadin.beckmann@durham.ac.uk) and Professor Steve Higgins (s.e.higgins@durham.ac.uk) from the School of Education at Durham University, UK.

My plan, with your permission, is to undertake the research as outlined in the attached proposal. Neither your school, nor any participants, will be identifiable in my account. My aim is to begin data collection in November and to end by the second week of December.

Please confirm your permission to undertake the outlined data collection activities at your school and also confirm that my plans are considered part of usual school/classroom practice at your school. Your permission and declaration is required by the School of Education Ethics Committee at Durham University as part of my ethics approval process. Your decision will be reported to the Ethics Committee to confirm to them that these conditions have been met (see the required declaration below).

If you consider that the activities proposed do not fall within usual school/classroom practice, then I will employ an active opt-in parental consent process in line with the School of Education's Ethics Code of Conduct.

Thank you for considering this request.

Yours sincerely,

Marilena Savva
marilena.savva@durham.ac.uk

October 2020

Declaration (please delete as appropriate):

I give *permission / ~~*do not give~~ permission for Marilena Savva to carry out the proposed exploration of usual school/classroom practice.

In the case where permission is not given, please provide reasons in the box below.

30/10/20 Ilona Ilarionau

Date | Head Teacher Name (please print) | Head Teacher Signature

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Durham University is the trading name of the University of Durham

October 2020

Appendix D: ***Discussion Points and Questions Asked During the Intervention***

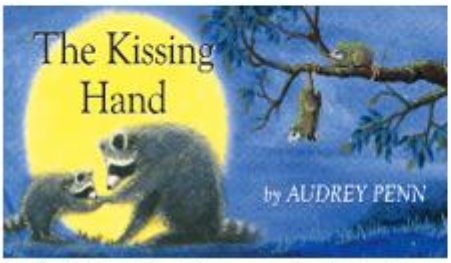
During the *Performance Teaching Style*, only the book's cover was presented while the discussion questions are located beneath the title page. After reading the story, the remainder of the discussion points were made while the experimenter revisited some of the illustrations.

While reading the story, the experimenter posed the questions displayed on each page as part of the *Interactive Teaching Style*.

Story 1: The Kissing Hand

The Kissing Hand

Title Page:



Look at the title. Show me the title. Show me the author.
Say that this is the cover page.
Can you read the title?
The title is the kissing hand. What does that mean?
What animals do you see on the front cover?
What are the animals doing? Do you think they are boys or girls?
Where are the animals?
What do you think the story is about?

Page 1a:

What is the name of the animal? What animal is it? Is it a boy or a girl?
Describe the animal.
What was Chester's problem? Did he hurt himself or he did not want to go to school? Why was Chester sad?

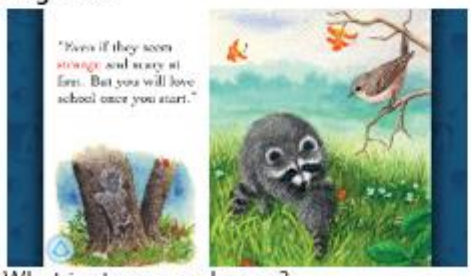
Page 1b:

Why Chester wanted to stay home?
How old do you think Chester is? How old did you go to school?
With who did Chester wanted to stay home? His mother or father?
What did he ask his mummy?

Page 2a:

Who is Mrs Racoon?
What did Mrs Racoon do to Chester?
What is nuzzled him on the ear? Say nuzzle.
What does gently mean? The story says that his mummy talked to Chester gently.

Page 2b:



What is strange and scary?
What things did mummy refer to when she said about strange and scary things?

Page 3b:

What time did Chester go to school?
Chester's mum said she knows a wonderful secret that will make Chester's night at school warm and cosy. What secret do you think it is?
What is warm and cosy? What is wonderful?

Page 4a:

Chester wiped away his tears. What did he do? Show me.

Page 4b: |

Why was the secret old?
Where did Chester's mum learn the secret from?
What was the secret?

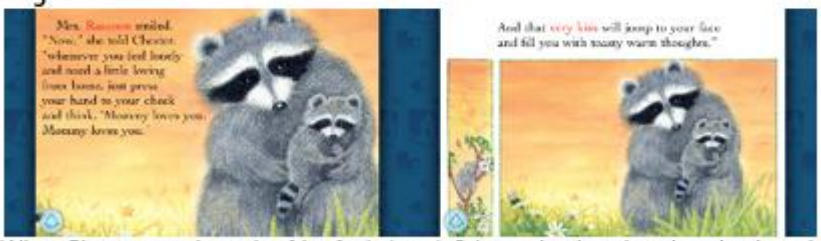
Page 5:

What is the kissing hand?
How can you give your mummy a kissing hand?
What is palm? Is it a dog or a hand?
Spread open like a fan. Do it with me.

Page 6:

What happened with the kiss? Where did the kiss rush? What is rushed?
Where did Chester feel the kiss?
(rushed from his hand up his arm and into his heart)

Page 7a+b:



What Chester needs to do if he feels lonely? (press his hand on his cheek and think mommy loves you) Show how to feel your mommy's love if you had a kissing hand.
How else do we feel our mommy's love?
What does lonely mean? Is it jumping up high or being alone?
Do you ever feel lonely?
What are thoughts?

Page 8a:

Mummy wrapped Chester's fingers around the kiss. How can we do that?
Can you wrap your hands? Can you say wrapped? What is wrapped?
Why did she do that? (Not to lose the kiss)

Page 8b:

What will happen if Chester washes his hands?

Page 10a+b:

What time did Chester go to school? What colour is the sky?
Where was Chester's school? On the tree or under the ground?
Is our school like that?
Where is the story taking place?
Suddenly he turned to his mother and grinned.
What does grinned means? Say grinned.

Page 11a+b:

What did Chester do to his mummy's hand?
Where did he kiss? (the centre of her hand)

Page 13a:

What does scamper mean? (Chester scamper across the tree limb). Say scamper.

Page 14:

What did mummy do after Chester while Chester was going to school?
Did she cry? Or did she put her hand on her cheek?
Why did she do that?
Show me our cheeks.

Page 15:

What other animals went to school?
Who do you think will be Chester's friend? Why?

Page 16:
Would you do the kissing hand to your mommy?

At the end:
Did you like the story? What was your favourite part?
Did you hear any music while listening to the story? What kind of music?

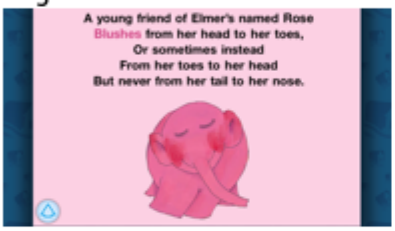
Story 2: Elmer and Rose

Elmer and Rose

Title Page:

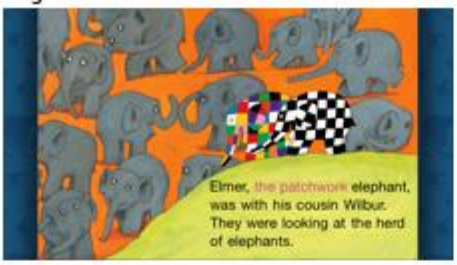
Look at the title. Show me the title. Show me the author.
Say that this is the cover page.
Can you read the title?
The title is *Elmer and Rose*. Who do you think is Elmer and who is Rose?
What animals do you see on the front cover?
What are the animals doing? Do you think they are boys or girls?
Where are the animals?
What do you think the story is about?

Page 1:



What is the name if this elephant?
Why do you think her name is Rose?
What does it mean when the story says that Rose blushes?
Show me your head and your toes.

Page 2:



Who is Elmer and who is Wilbur?
Are they brothers? What does it mean when someone is your cousin?
What does the word patchwork mean?

Page 3:

Are the elephants unique? Are Elmer and Wilbur unique? Why?
What does a herd of elephants mean?
Do they look jolly?

Page 5:

Who is this?
Show me the bush. Make your body a small bush, now a big bush.

Page 6:

Who are they talking about? Who is she?
So is Rose a boy or a girl?

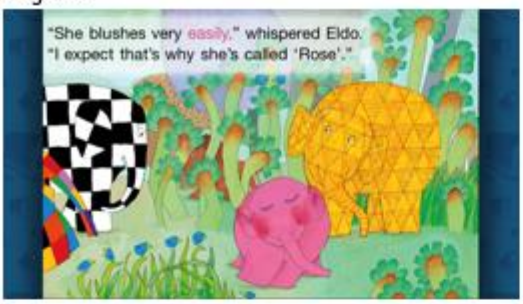
Page 7:

What happened to Rose? Why do you think she was hiding?
How did she get there?

Page 8:

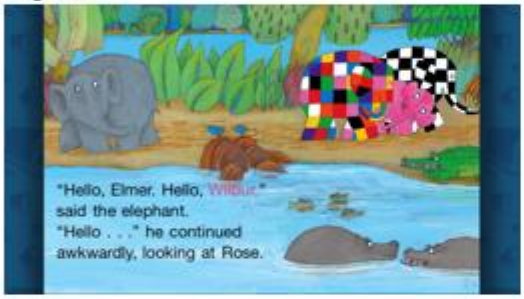
Why do you think Rose was frightened? What does this word mean?

Page 11:



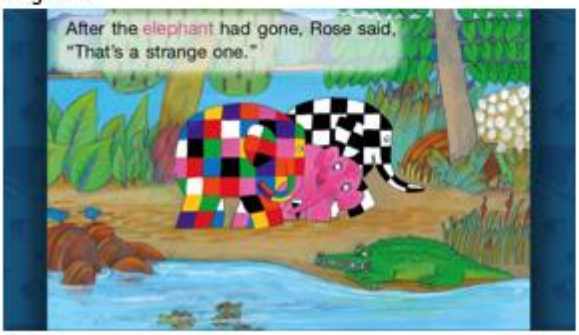
What has happened to Rose here? Why is her name Rose?

Page 16:



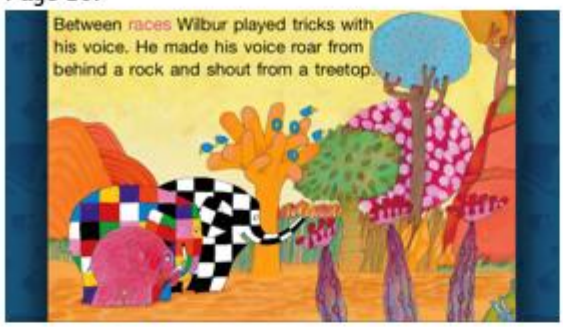
Why did the grey elephant looked at Rose awkwardly? Let's role play this page who wants to be Elmer, Rose, Wilbur and the grey elephant?

Page 17:



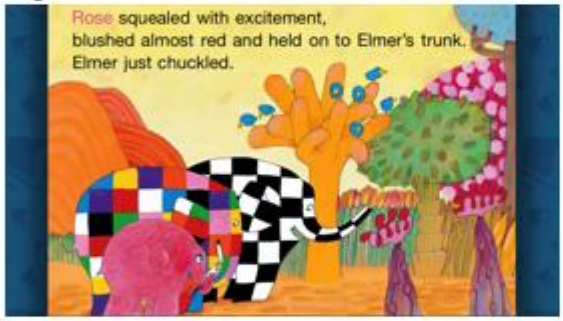
Why did Rose think that the grey elephant was strange?

Page 20:



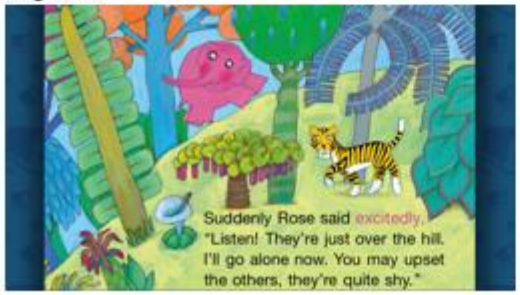
What kind of game where the elephants playing?

Page 21:



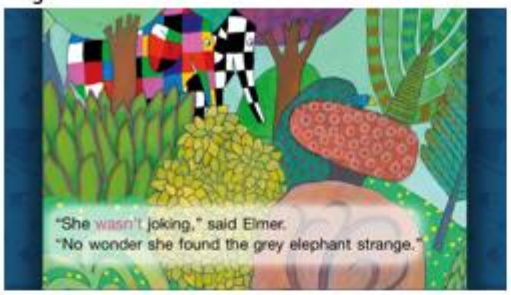
How did Rose react here? Why?

Page 22:



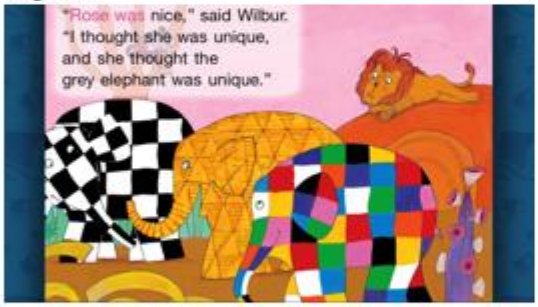
Why do you think Rose wanted to go alone to her herd?

Page 26:



Can you predict why Rose found the grey elephant strange?

Page 31:



Was the grey elephant unique?
Are they all unique? Why? Are we unique?

At the end:
Did you like the story? What was your favourite part?

Appendix E: *English Language 5-Point Scale*

	Low Ability	Upper low ability	Medium ability	Upper medium ability	High ability
Student's Code	Student uses gestures more often than words to communicate.	Student communicates using one word (sometimes with pronouns: I, he, she).	Student produces sentences using 2-3 words with pronouns and nouns or verb. Grammar/vocabulary might not be correct.	Student uses 4 words to communicate combined with pronouns, verbs and nouns. Able to describe situations. Grammar/vocabulary might not be correct.	Student speaks fluently using correct grammar and vocabulary.

Appendix F: *Receptive Vocabulary Tests*

Story 1: The Kissing Hand

The Kissing Hand
Receptive Vocabulary Test 3 and 4 years old

Words	PRE-TEST	POST-TEST 1	POST-TEST 2
raccoon			
forest			
scary			
warm			
cheek			
palm			
fan			
lonely			
secret			
press			
day			
tears			
wipe			
rush			
fill			
mother			
in front			
give me			
old			
watch			

The Kissing Hand
Receptive Vocabulary Test for 5-7 years old

Words	PRE-TEST	POST-TEST 1	POST-TEST 2
raccoon			
forest			
swing			
scary			
warm			
cheek			
palm			
fan			
mask			
jump			
lonely			
secret			
press			
grin			
thoughts			
day			
wash			
stood			
tears			
wipe			
centre			
rush			
fill			
mother			
stick			
in front			
turn			
give me			
old			
watch			

Story 2: Elmer and Rose

Elmer and Rose
Receptive Vocabulary Test 3 and 4 years old

Words	PRE-TEST	POST-TEST 1	POST-TEST 2
young			
toes			
tail			
patchwork			
herd			
jolly			
bush			
under			
different			
pinker			
peeped			
behind			
surprise			
lake			
between			
treetop			
excitement			
trunk			
stared			
blushes			

Elmer and Rose
Receptive Vocabulary Test 5-7 years old

Words	PRE-TEST	POST-TEST 1	POST-TEST 2
young			
toes			
tail			
patchwork			
herd			
jolly			
bush			
under			
different			
pinker			
frightened			
peeped			
behind			
surprise			
lake			
hid			
between			
race			
treetop			
excitement			
held			
trunk			
grandpa			
elephant			
faster			
staring			
chuckled			
blushes			
journey			
tricks			

Appendix G: *Expressive Vocabulary Tests*

The Kissing Hand
Expressive vocabulary test 3 and 4 years old

	PRE TEST		POST TEST 1		POST TEST 2	
Words	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
wonderful						
gentle						
worry						
night						
large						
middle						
suddenly						
heart						

The Kissing Hand
Expressive vocabulary test 5-7 years old

	PRE TEST		POST TEST 1		POST TEST 2	
Words	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
end						
nuzzle						
heart						
wonderful						
strange						
gentle						
cosy						
worry						

special						
tiny						
suddenly						
large						
wrap						
careful						
middle						

Elmer and Rose
Expressive Vocabulary Test 3 and 4 years old

	PRE TEST		POST TEST 1		POST TEST 2	
Words	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
wander						
chuckle						
voice						
cousin						
trunk						
whisper						
pretty						
unique						

Elmer and Rose
Expressive vocabulary test 5-7 years old

	PRE TEST		POST TEST 1		POST TEST 2	
Words	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
arrive						
chuckle						
squealed						
voice						
tricks						
journey						
awkward						
cousin						

treetop						
trunk						
whisper						
pretty						
wander						
nearby						
unique						

Appendix H: *Implicit Story Comprehension Tests*

Story 1: The Kissing Hand

IMPLICIT
Story comprehension questions

Experimental Group: _____

Question 1: How is Chester feeling here?

Why?

Answer: _____

Question 2: Why he did not want to go to school?

Answer: _____

Question 2: How does the kissing hand work?

Answer:

_____

_____

Question 3: How did Chester feel here? Why did he feel like that?

Answer:

_____

_____

Question 4a: What is Chester doing here?

Answer:

_____

Question 4b: Why is he doing that?

Answer:

_____

Question 5a:

What did Mrs Raccoon do after Chester left for school?

Answer:

_____

Question 5b:

What special words filled her heart? How do you think she felt?

Answer:

_____

Question 6: How do you think Chester is feeling on his first day of school?

Why do you think that?

Answer:

_____

_____

The Kissing Hand - IMPLICIT
Story comprehension questions
FOR PRE-KINDERGARDEN ONLY (3-4 years old)

Experimental Group: _____

Question 1: How is Chester feeling here? Why?

Answer: _____

Question 2: Why he did not want to go to school?

Answer: _____

Question 3: How did Chester feel here? Why did he feel like that?

Answer: _____

Question 5b: What special words filled his mum's heart? How do you think she felt?

Answer: _____

Question 6: How do you think Chester is feeling on his first day of school? Why do you think that?

Answer: _____

Story 2: Elmer and Rose

ELMER AND ROSE - IMPLICIT
Story comprehension questions

Experimental Group: _____

Question 1: Why was Rose hiding behind the tree?

Answer: _____

Question 2: Why is her name Rose?

Answer:

_____

Question 3a: What happens to Rose's face?

Answer:

_____

Question 3b: Why does this happens to Rose?

Answer:

_____

Question 4: What did Rose do when she saw the grey elephant?

Answer:

_____

Question 5: Why did Rose find the grey elephant strange?

Answer:

_____

_____

Question 6: What do you think Elmer and Wilbur think of Rose?

Answer:

_____

Question 7: What colour do you think are the elephants in Wilbur's herd?

Answer:

_____

Question 8: How is Rose different from the other elephants?

Answer:

_____

ELMER AND ROSE - IMPLICIT
Story comprehension questions
FOR PRE-KINDERGARDEN ONLY (3-4 years old)

Experimental Group: _____

Question 1: Why was Rose hiding behind the tree?

Answer: _____

Question 3a: What happens to Rose's face?

Answer: _____

Question 3b: Why does this happens to Rose?

Answer: _____

Question 4: What did Rose do when she saw the grey elephant?

Answer: _____

Question 5: Why did Rose find the grey elephant strange?

Answer: _____

Question 5: What was your favourite part of the story?

Answer: _____

Appendix I: *Explicit Story Comprehension Tests*

Story 1: The Kissing Hand

EXPLICIT
Recall with prompts story comprehension measure

Experimental Group: _____

1. What is the title of the story?

Free recall answer: _____

2. What animal was the main character? Where was the main character going?

Free recall answer: 1)_____ 2)_____

2A. The main character was an animal. Was he. . .
a. A monkey?
b. A raccoon?
c. A mouse?

2B. Where was the main character going?
a. At the park
b. At school
c. To play with his friends

2. I am going to show you a picture from the story. Tell me the names of the animals in this picture. Who is the second animal?

Free recall answers: 1)_____ 2)_____

2A. Is it?
a. Chester
b. Cheetah
c. Christmas

2B. Name of second animal?
a. Mrs Chester
b. Mrs Mommy
c. Mrs Raccoon

2C. The other animal is?
a. Chester's dad
b. Chester's mum
c. Chester's teacher

3. Where was Chester's school? What time of the day did he go to school?

Free recall answer: : 1)_____ 2)_____

3A: ***Chester's school was...***
a. At the beach.
b. On a tree.
c. In a cave.

3B: ***What time of the day did Chester go to school?***
a. Morning
b. Afternoon
c. Night

4. What was Mrs Raccoon's secret?

Free recall answer: _____

4A: ***Mrs Raccoon secret was…***

a. The kissing hand
b. The kissing toe
c. The kissing finger

5. What is the Kissing Hand?

Free recall answer: _____

5A: ***What is the Kissing Hand?***

a. Mrs Raccoon touched Chester's hand.
b. Mrs Raccoon kissed Chester's hand.
c. Mrs Raccoon kissed Chester's cheek.

6. What did Mrs Raccoon say to Chester to do with the kissing hand?

Free recall answer: _____

6A: ***She said…***

a. To press his fingers on his cheek.
b. To press his hand on his heart..
c. To press his hand on his cheek.

7. What other animals went to school with Chester?

Free recall answer: _____

7A:

a. Possums and foxes.
b. Ladybugs and butterflies.
c. Elephants and alligators.

7. I'm going to give you 4 pictures from the story. Put them in order for me. What happened first, second, third, and last?

Proceed by showing the cards and having them put them in order: put what happened first here, what happened next, and what happened last.

_____ _____ _____ _____

Story 2: Elmer and Rose

ELMER AND ROSE - EXPLICIT
Recall with prompts story comprehension measure

Experimental Group: _____

1. What is the title of the story?

Free recall answer: _____

2. What's the name of the black and white elephant?

Free recall answer: _____

2A. The name of the black and white elephant is..
a. Whale
b. Wilbur
c. William

3. What colour was the old elephant and what is his name?

Free recall answers: A)_____ B)_____

3A. The colour of the old elephant is..
a. Yellow
b. Pink
c. Orange

3B. The name of the old elephant is..
a. Grandpa Eldo
b. Grandpa Elmer
c. Grandma Elli

4. Where do the elephants in the story live?

Free recall answer: _____

4A: ***They live...***
a. At the beach.
b. In the jungle.
c. In a forest.

5. Who was hiding behind a tree? What colour is that elephant?

Free recall answers: A)_____ B)_____

5A. Is was..
a. Rose
b. Pink
c. Elmer

5B. Colour of the elephant?
a. Green
b. Purple
c. Pink

6. What is Rose's problem?

Free recall answer: _____

6A: ***Her problem is that…***
a. She got lost from her family/herd.
b. She lost her ice-cream.
c. She is afraid of the lion.

7. Who did they see at the lake?

Free recall answer: _____

7A: ***They saw..***
a. A yellow crocodile.
b. A grey elephant.
c. Nobody.

8. What colour were the elephants in Rose's herd/family?

Free recall answer: _____

8A: ***They were all…***
a. Different colours.
b. Pink.
c. Grey.

9. I'm going to give you 4 pictures from the story. Put them in order for me. What happened first, second, third, and last?

Proceed by showing the cards and having them put them in order: put what happened first here, what happened next, and what happened last.

_____ _____ _____ _____

Appendix J: *Transfer Task Text Analysis*

Given the significance of analysing the Lexile level of a text, I unfortunately found that a considerable number of Lexile level software programmes are not available for free. Consequently, I identified four pieces of free software that I utilised to analyse the text. Each software assessed distinct components of the text. However, a downside of these software is that they analyse text starting from ages 5-6 years old. I could not find a text analyser for a younger audience. Additionally, their emphasis lies on children engaging in the act of reading the text themselves, rather than comprehending the material when it is read aloud by an adult. As a preschool teacher with 12 years of experience, I possess extensive expertise in reading stories to children and collaboratively developing stories with them. Thus, the language included in this specific story comprises terms that children are acquainted with. As a result, the vocabulary employed in this specific narrative comprises terms that that children are acquainted with. Moreover, the particular story that I authored depicted illustrations that my pupils had created two years prior to the experimental study. These were children aged 5 to 6 years old, whose primary language was not English. They created the illustrations that accompanied the written material. I read the story to them in English and they created the illustrations based on their imagination. Hence, this was an additional factor that led me to conclude that the story is suitable for use during the transfer task. The following table depicts the results obtained from each software. From the results obtained, it seems that the text is a simple text and it is easily understood for ages 5-6 years old.

Table J1 *Readability statistics of story used in Transfer Task*

Readability statistics (Readability Stats in Word)		
Counts	Words	88
	Characters	274
	Sentences	13
Averages	Sentences per paragraph	1.0
	Words per sentence	6.7
	Characters per word	2.9
Readability	Flesch reading ease	100.0
	Flesch-Kincaid Grade level	0.0
	Passive sentences	0.0%
Readability Formulas: https://readabilityformulas.com/readability-scoring-system.php#formulaResults		
Reading Difficulty	Extremely Easy	
Lexical Text Density Analysis	Text Score: 54.5%	
	Density Range: 50%-59%	
	Scale: Above average density	
	Style: Texts in the 50%-59% lexical density range balance between accessibility and detail. They cater to a wider audience, providing substantial content without overwhelming readers with specialized language.	
Lexical Word Diversity Analysis	Text Score: 48.9%	
	Diversity Range: 40%-49%	
	Scale: Average diversity	
	Word Diversity: This writing style showcases a varied vocabulary. Many texts may fall into this category, striking a balance between introducing new terms and reinforcing existing ones. This could indicate the author is using a broad range of terms and expressions, possibly avoiding repetitiveness.	
Tests Document Readability: https://www.online-utility.org/english/readability_test_and_improve.jsp		
Lexical Density	54.68	
Gunning Fog index	2.71	
Flesch Reading Ease	107.67	
Coleman Liau index	-2.90	
ARI (Automated Readability Index)	-4.18	
Readability test: https://www.webfx.com/tools/read-able/		
Overall result		Your direct input has an average reading ease of about 107.7 of 100. It should be easily understood by 5- to 6-year-olds.
Flesch Kincaid reading ease: the score is based on a ranking scale of 0-100, and the higher your score the better.		107.7
Gunning Fog score estimates the years of formal education needed to comprehend text on the first reading.		2.7
Smog index estimates the years of education a person needs to comprehend writing.		1.8
Coleman Liau index indicates the U.S. school level a person needs to be to understand the text.		1.1

Transfer Task AGES 3-4

Story: Fin the Fox and Oli the Ox

1. What was the title of the story?

2. What kind of animals are in the story?

3. What happened to Oli?

4. How was Oli feeling?

5. What objects did Fin get?

6. What happened at the end?

7. What do you think Fin should do next time Oli is stuck in the mud?

Transfer Task AGES 5-7
Fin the Fox and Oli the Ox

1. What was the title of the story?

2. What's the story about?

3. What is Oli's problem?

4. How was Oli feeling?

5. What did Fin do to help Oli?

6. What happened at the end?

7. What do you think Fin should do next time Oli is stuck in the mud?

Appendix K: *Intraclass Correlation Coefficient (ICC)*

Calculating the Intraclass Correlation Coefficient (ICC) is a crucial step when dealing with nested data, like students within classes. ICC helps quantify the proportion of variance attributable to the clustering structure. If the ICC is high, it indicates that a significant portion of the variability in the outcome can be attributed to the group level (class in this case), which would justify using multilevel models or accounting for the clustering effect in the analysis.

In this study, sixty typically developing children (28 girls and 32 boys) aged 3–7 years (M = 5.26 years, SD = 1.16) were enlisted from four classrooms from one private English school. The children attended the following grades: Pre-Kindergarten (ages 3–4; n=7; m=4, f=3), Kindergarten (ages 4-5.4; n=19; m=8, f=11), Pre-Primary (5.5–7; n=18; m=12, f=6), and First Grade (6-7.5 years old; n=16; m=8, f=8). Each class had one teacher. The participants were randomly allocated to conditions, in a stratified way taking into account a balanced representation of age, gender, language proficiency English level based on the Preschool Language Scale - Fifth Edition (PLS-5) standardised test, and their teachers' evaluation on a 5-point language scale level. The following table presents the means and standard deviations of basic characteristics for each condition at baseline, as mentioned in the thesis.

Table K1 *Means (and standard deviations) of Basic Characteristics per Condition*

Teaching style		**Interactive Style**		**Performance Style**		**Total**
Book medium		E-book	Print book	E-book	Print book	
N		15	15	15	15	60
Age	M	5.27	5.80	5.00	5.27	5.27
	SD	(1.38)	(0.94)	(0.92)	(0.96)	(1.16)
Boys/Girls		7/8	8/7	9/6	8/7	32/28
PLS-5 UK	M	67.47	67.33	66.27	67.13	67.05
	SD	(13.98)	(17.02)	(13.59)	(13.23)	(14.17)
English Language 5-point scale	M	3.67	3.73	3.73	3.47	3.65
	SD	(1.23)	(1.33)	(1.28)	(1.24)	(1.24)

In order to understand the extent of the clustering effect, I have run a Multilevel model in SPSS. I computed a multi-level null model using the Linear Mixed Models procedure. This

allowed me to account for the hierarchical structure of the data, where observations are nested within higher-level units (i.e., 60 children within 4 classes across different age groups from pre-kindergarten (3-4 years old) to first grade (6-7.5 years old) from one school).

The formula for $ICC = \frac{\sigma_b^2}{\sigma_b^2 + \sigma_w^2}$ ICC is:

Where:

- σ_b^2 is the between-group variance.
- σ_w^2 is the within-group variance.

Table K2 *ICC Results*

DV	ICC
Standardised Test	0.05
Receptive Vocabulary Test	0.01
Expressive Vocabulary Test	0.00
Implicit Story Comprehension Test	0.23 (includes some missing values)
Explicit Story Comprehension Test	0.30 (includes some missing values)

The Intraclass Correlation Coefficient (ICC) values I have computed for the different dependent variables (DVs) within the clustered data (children/participants nested within classes) provide insights into the degree of similarity or agreement among measurements within the same class for each DV. The ICC values provide information about the extent to which class membership contributes to the variability in each DV. Higher ICC values indicate that class membership plays a more significant role in explaining differences in test scores among children, whereas lower ICC values suggest that individual differences within classes are more influential. The IES What Works Clearinghouse (2014) estimates an ICC 0.20 for achievement outcomes. It important to note that "class" is confounded with "age", therefore, this factor needs to be considered when interpreting the ICCs (which reflects the nesting of 60 pupils within 4 classes of one school, i.e. the classes differ by age group). Nevertheless, except for one dependent variable, the ICC values derived from this study appear to be close to 0.20, which aligned with the Clearinghouse's (2014) estimate

of an ICC of 0.20 for educational outcomes.

Appendix L: *Analysis of Covariance (ANCOVA) Results*

Statistical Analyses

The IBM SPSS Statistics Version 29 software (IBM Corp., Armonk, NY, USA) was used for performing the statistical analyses using the results from the measures reported above. The analysis was performed on the following dependent variables on condition:

- Vocabulary:
    - Receptive Vocabulary
    - Expressive Vocabulary
- Story Comprehension:
    - Implicit Story Comprehension
    - Explicit Story Comprehension
    - Both tests combined to report overall comprehension of the story
- Transfer Task
- PLS-5 UK

To test the effects of the intervention in order to answer the research questions of the study, two contrasts were created: (a) the two conditions with print book format versus the two conditions with e-book format (comparison of book mediums) (RQ1); and (b) the two conditions with performance teaching style versus the two conditions with interactive teaching style (comparison of teaching styles) (RQ2). Therefore, this entails a 2 (teaching styles) x 2 (book mediums) x 2 (pre, post) between-within subjects factorial design.

The majority of the data was analysed with analysis of covariance (ANCOVA) for the dependent variables' receptive vocabulary, expressive vocabulary and the standardised language test PLS-5 UK.

Here's a breakdown of the components:

1. Independent Variables (IVs):
    - Book Medium: This has two levels (print or e-book).
    - Teaching Style: This also has two levels (interactive style or performance style).

2. Dependent Measures (DVs):

- Receptive Vocabulary
- Expressive Vocabulary

3. Covariate:

- Preexisting group differences: This is a variable that you want to control for, likely because there were differences between groups before the experiment or treatment occurred. Controlling for this variable helps to isolate the effects of the independent variables on the dependent measures.

ANCOVA is particularly useful when there are preexisting differences between groups that might affect the dependent variable. By using the preexisting group differences as a covariate, ANCOVA allows you to statistically remove the effects of these differences from the dependent variable, thus providing a clearer understanding of the effects of the independent variables.

In order to answer the first research question: *Which type of book medium (i.e., e-book versus print book) produces better results in the development of vocabulary and story comprehension for children learning English as an additional language (EAL)?*, the e-book and print book conditions were compared for each dependent variable. The data was analysed with ANCOVA for the dependent variables receptive, expressive vocabulary and the standardised language test PLS-5 UK while controlling for the effects of a covariate, which is likely the preexisting group differences, and a one-way ANOVA for story comprehension as results were obtained at pre-test only.

Similarly, to answer the second research question: *Which teaching style (i.e., interactive versus performance) better facilitates young children's (learning English as an additional language) vocabulary and story comprehension development,* the interactive and performance conditions were compared for each dependent variable. The data was analysed with one-way ANOVA for story comprehension, and ANCOVA was used for the dependent variables receptive, expressive vocabulary and the standardised language test PLS-5 UK while controlling for the effects of a covariate, which is likely the preexisting group differences.

The results section begins with a check for baseline differences. The first research question

is then analysed, beginning with the receptive and expressive vocabulary results, story comprehension, transfer task, and concluding with the standardised test results. Then the second research question is analysed.

Results

Research Question 1 - Comparison of Book Mediums: E-book versus Print Format

Receptive and Expressive Vocabulary - E-book versus Print Format.

In this ANCOVA analysis (Table L1), the impact of the e-book condition compared to the control condition, which is the print book, on receptive vocabulary as the DV was examined. The mean score for the e-book condition was 0.60 (SD=0.19), with an adjusted mean of 0.64. In contrast, the mean score for the control condition was 0.70 (SD=0.15), with an adjusted mean of 0.66. The ANCOVA results indicated a non-significant main effect of the condition on receptive vocabulary, as evidenced by a nonsignificant F-value of 0.743 ($F(1, 57) = 0.743$, $p=0.39$, $\eta_p^2=0.01$). Additionally, the partial eta squared value of 0.01 suggests that only 1% of the variance in receptive vocabulary scores can be attributed to the condition variable. Moreover, Cohen's d for the comparison between the e-book condition and the control condition is approximately -0.58. This indicates a moderate effect size, with the negative sign indicating that the e-book condition has a slightly lower mean than the control condition. Despite the lack of statistical significance, these findings provide valuable insights into the comparative performance between the e-book and print book, indicating a minimal difference in receptive vocabulary outcomes between the two conditions.

Table L1 *Analysis of Covariance (ANCOVA) Results for Receptive Vocabulary Based on Book Medium*

Receptive vocabulary								
Condition	**N**	**Pre-test Mean (SD)**	**Post-test Mean (SD)**	**Adjusted Mean**	**95% CI**	***F***	***p***	$\boldsymbol{\eta_p^2}$
E-book	30	0.47 (0.19)	0.60 (0.19)	0.64	[0.60, 0.67]	0.743	0.392	0.013
Print book (control)	30	0.56 (0.15)	0.70 (0.15)	0.66	[0.62, 0.69]			

In the following ANCOVA analysis (Table L2 below), the primary objective was to investigate the influence of the e-book condition compared to the control condition on expressive vocabulary, serving as the DV. The mean score for the e-book condition was 0.83 (SD=0.66), accompanied by an adjusted mean of 0.95 and a corresponding 95% confidence interval ranging from 0.86 to 1.04. Conversely, the mean score for the control condition was 0.96 (SD=0.72), with an adjusted mean of 0.84. The ANCOVA yielded a non-significant result with $F(1, 57) = 3.123$, $p=0.08$, $\eta_p^2=0.05$, suggesting no statistically significant difference between the e-book and control conditions concerning expressive vocabulary outcomes. Nonetheless, the effect size, as indicated by the partial eta squared value of 0.05, demonstrates a modest proportion of the variance in expressive vocabulary scores attributable to the condition variable. Cohen's d for the comparison between the e-book condition and the control condition is approximately -0.19. This indicates a small effect size, with the negative sign indicating that the e-book condition has a slightly lower mean than the control condition. Despite the lack of statistical significance, these findings contribute to the understanding of the nuanced effects of e-book versus traditional instructional methods on expressive vocabulary acquisition.

Table L2 *Analysis of Covariance (ANCOVA) Results for Expressive Vocabulary Based on Book Medium*

Expressive vocabulary								
Condition	**N**	**Pre-test Mean (SD)**	**Post-test Mean (SD)**	**Adjusted Mean**	**95% CI**	***F***	***p***	$\boldsymbol{\eta_p^2}$
E-book	30	0.61 (0.58)	0.83 (0.66)	0.95	[0.86, 1.04]	3.123	0.083	0.052
Print book (control)	30	0.83 (0.64)	0.96 (0.72)	0.84	[0.75, 0.93]			

Implicit and Explicit Story Comprehension Results - E-book versus Print Format. (The implicit and explicit story comprehension results are the same as the results presented in the main text in Chapter 5. I have duplicated these results here to provide the reader with a comprehensive view of the results).

One-way ANOVA was performed to analyse the effect of book medium – e-book versus print book – on implicit, explicit and overall story comprehension of the story at posttest 1. These results were obtained after the intervention and three one-way ANOVAs were

conducted in order to obtain the results presented in Table L3. The results revealed that for the *Implicit* story comprehension test there was no statistically significant main effect for medium (e-book versus print book conditions, $F(1, 56)=3.22$, $p=0.07$, $\eta_p^2=0.05$. The effect size for e-books versus print books for the Implicit story comprehension test was $d=-0.48$ favouring the print book condition.

The results analysed for *Explicit* story comprehension and both tests combined revealed that there was a statistically significant effect ($p<0.05$) with the print book condition outperforming the e-book condition on both measures (explicit story comprehension: $F(1, 56)=4.36$, $p=0.04$, $\eta_p^2=0.07$; Both tests combined: $F(1, 56)=4.32$, $p=0.04$, $\eta_p^2=0.07$). The effect size for e-books versus print books for the Explicit story comprehension test was $d=-0.56$ favouring the print book condition.

Table L3 *One-way ANOVA Results for Implicit and Explicit Story Comprehension (post-test 1)*

	E-book condition				Print book condition							
Dependent Variables	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	***F***	***p***	η_p^2	**Cohen's *d***
Implicit Story Comprehension	30	0.85 (0.44)	0.08	[0.69, 1.01]	28	1.06 (0.43)	0.08	[0.89, 1.22]	3.22	0.07	0.05	-0.48
Explicit Story Comprehension	30	0.78 (0.41)	0.07	[0.63, 0.92]	28	1.00 (0.37)	0.07	[0.85, 1.15]	4.36	0.04	0.07	-0.56
Both Tests combined	30	0.81 (0.40)	0.07	[0.67, 0.96]	28	1.03 (0.37)	0.07	[0.88, 1.17]	4.32	0.04	0.07	-0.57

PLS-5 results - E-book versus Print Format.

In this ANCOVA analysis (Table L4), the investigation centered on discerning the differential impact of the e-book condition relative to the control condition on performance as measured by the PLS-5 standardised test, serving as the DV. The mean score for the e-book condition was 67.84 (SD=13.72), accompanied by an adjusted mean of 66.56 and a corresponding 95% confidence interval ranging from 64.11 to 69.01. In contrast, the mean score for the control condition was 64.71 (SD=13.58), with an adjusted mean of 66.03. The ANCOVA revealed a non-significant result with F (1, 46) = 0.092, $p=0.763$, $\eta_p^2=0.00$), indicating the absence of a statistically significant difference between the e-book and control conditions concerning performance on the PLS-5 standardised test. Moreover, the partial eta squared value of 0.00 suggests that negligible variance in PLS-5 scores can be attributed to the condition variable. Cohen's d for the comparison between the e-book

condition and the control condition remains approximately 0.23, indicating a small effect size.

Table L4 *Analysis of Covariance (ANCOVA) Results of PLS-5 Based on Book Medium*

PLS-5 standardised test								
Condition	**N**	**Pre-test Mean (SD)**	**Post-test Mean (SD)**	**Adjusted Mean**	**95% CI**	***F***	***p***	η_p^2
E-book	25	68.20 (14.19)	67.84 (13.72)	66.56	[64.11, 69.01]	0.092	0.763	0.002
Print book (control)	24	65.29 (13.10)	64.71 (13.58)	66.03	[63.53, 68.53]			

Research Question 2 - Interactive versus Performance Teaching Style

Receptive and Expressive Vocabulary - Interactive versus Performance Teaching Style

In this ANCOVA analysis (Table L5), the focus was on comparing the effects of interactive teaching style condition versus performance teaching style condition on receptive vocabulary, serving as the DV. The mean score for the interactive teaching style condition was 0.70 (SD=0.16), with an adjusted mean of 0.65 and a standard error of 0.01, accompanied by a 95% confidence interval ranging from 0.62 to 0.68. Conversely, the mean score for the performance teaching style condition was 0.59 (SD=0.18), with an adjusted mean of 0.64 and a standard error of 0.01, with a 95% confidence interval ranging from 0.61 to 0.68. The ANCOVA analysis resulted in a non-significant *F*-value of 0.071 ($F(1, 57) = 0.071$, $p=0.79$, $\eta_p^2=0.00$), suggesting no statistically significant difference between the interactive teaching style and performance teaching style conditions concerning receptive vocabulary outcomes. Furthermore, the partial eta squared value of 0.001 indicates a minimal proportion of the variance in receptive vocabulary scores attributable to the teaching style condition variable. Cohen's d for the comparison between the interactive teaching style condition and the performance teaching style condition is 0.64. This indicates a moderate effect size, suggesting a meaningful difference between the two teaching styles in terms of their impact on receptive vocabulary.

Table L5 *Analysis of Covariance (ANCOVA) Results for Receptive Vocabulary Based on Teaching Style*

Receptive vocabulary								
Condition	**N**	**Pre-test Mean (SD)**	**Post-test Mean (SD)**	**Adjusted Mean**	**95% CI**	***F***	***p***	$\boldsymbol{\eta_p^2}$
Interactive style	30	0.57 (0.16)	0.70 (0.16)	0.65	[0.62, 0.68]	0.071	0.790	0.001
Performance style	30	0.46 (0.17)	0.59 (0.18)	0.64	[0.61, 0.68]			

In the following ANCOVA analysis (Table L6), the primary objective was to compare the effects of interactive teaching style condition against performance teaching style condition on expressive vocabulary, serving as the dependent variable. The mean score for the interactive teaching style condition was 1.05 (SD=0.73), with an adjusted mean of 0.96 and a standard error of 0.04, accompanied by a 95% confidence interval ranging from 0.87 to 1.04. Conversely, the mean score for the performance teaching style condition was 0.74 (SD=0.61), with an adjusted mean of 0.83, with a 95% confidence interval ranging from 0.74 to 0.91. The ANCOVA analysis yielded a statistically significant result with $F(1, 57) = 4.510$, $p=0.03$, $\eta_p^2=0.07$, indicating a significant difference between the two teaching style conditions concerning expressive vocabulary outcomes. Furthermore, the partial eta squared value of 0.073 suggests that approximately 7.3% of the variance in expressive vocabulary scores can be attributed to the teaching style condition variable. Cohen's d for the comparison between the interactive teaching style condition and the performance teaching style condition is approximately 0.46. This indicates a moderate effect size, suggesting a meaningful difference between the two teaching styles in terms of their impact on expressive vocabulary. These findings underscore the importance of considering teaching style variations in educational contexts and provide valuable insights into their differential impacts on expressive vocabulary acquisition.

Table L6 *Analysis of Covariance (ANCOVA) Results for Expressive Vocabulary Based on Teaching Style*

Expressive vocabulary								
Condition	**N**	**Pre-test Mean (SD)**	**Post-test Mean (SD)**	**Adjusted Mean**	**95% CI**	***F***	***p***	η_p^2
Interactive style	30	0.81 (0.65)	1.05 (0.73)	0.96	[0.87, 1.04]	4.510	0.038	0.073
Performance style	30	0.63 (0.57)	0.74 (0.61)	0.83	[0.74, 0.91]			

Implicit, Explicit and Overall Story Comprehension Results - Interactive versus Performance Teaching Style

One-way ANOVA was performed to compare the effect of teaching style on story comprehension separately for the three story comprehension test scores (implicit, explicit, and combined, see Table L7) at post-test 1. The *Implicit* story comprehension analysis revealed that there was a statistically significant effect of teaching style on Implicit story comprehension ($F(1, 56)=4.47$, $p=0.03$, $\eta_p^2=0.07$) favouring the Interactive style. There was no statistical significant difference between the Interactive and Performance teaching styles for *Explicit* comprehension ($F(1, 56)=2.76$, $p=0.10$, $\eta_p^2=0.04$). When these two test results were combined and analysed in order to evaluate an overall score for comprehension the results were statistically significant ($F(1, 56)=4.15$, $p=0.04$, $\eta_p^2=0.06$). Overall, the three study instruments analysed for story comprehension demonstrated that Interactive scaffolding delivered superior outcomes compared to Performance scaffolding.

Table L7 *One-way ANOVA Results of Implicit, Explicit and Overall Story Comprehension Results Based on Teaching Style (post-test 1)*

	Interactive Teaching Style				**Performance Teaching Style**							
Dependent Variables	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	***F***	***p***	η_p^2	**Cohen's *d***
Implicit Story Comprehension	28	1.07 (0.46)	0.08	[0.91, 1.24]	30	0.83 (0.41)	0.08	[0.67, 0.99]	4.47	0.03	0.07	0.55
Explicit Story Comprehension	28	0.98 (0.39)	0.07	[0.82, 1.13]	30	0.80 (0.41)	0.07	[0.65, 0.95]	2.76	0.10	0.04	0.44
Both Tests combined	28	1.02 (0.40)	0.07	[0.88, 1.17]	30	0.81 (0.37)	0.07	[0.67, 0.96]	4.15	0.04	0.06	0.54

Using Cohen's *d*, the effect size calculation for teaching styles for the Implicit story comprehension test revealed a medium effect size of *d*=0.55 and for Explicit story comprehension test revealed a moderate effect size of *d*=0.44, favouring the Interactive teaching style.

PLS-5 Results - Interactive versus Performance Teaching Style.

In this ANCOVA analysis (Table L8), the aim was to examine the differential effects of interactive teaching style condition compared to performance teaching style condition on performance as measured by the PLS-5 standardised test, serving as the dependent variable. The mean score for the interactive teaching style condition was 66.96 (SD=14.04), with an adjusted mean of 67.34 and a standard error of 1.16, accompanied by a 95% confidence interval ranging from 64.99 to 69.70. Conversely, the mean score for the performance teaching style control condition was 65.57 (SD=13.31), with an adjusted mean of 65.12 and a standard error of 1.24, with a 95% confidence interval ranging from 62.62 to 67.62. The ANCOVA analysis yielded a non-significant *F*-value of 1.692 (p = 0.200), suggesting no statistically significant difference between the interactive teaching style and performance teaching style conditions regarding performance on the PLS-5 standardised test. Furthermore, the partial eta squared value of 0.035 indicates that approximately 3.5% of the variance in PLS-5 scores can be attributed to the teaching style condition variable. Cohen's d for the comparison between the interactive teaching style condition and the performance teaching style condition is approximately 0.10. This indicates a very small effect size, suggesting a minimal difference between the two teaching styles in terms of their impact on performance on the PLS-5 standardised test.

Table L8 *Results of Analysis of Covariance (ANCOVA) for the Standardised Test PLS-5 in the post-test*

PLS-5 standardised test							
Condition	**N**	**Mean (SD)**	**Adjusted Mean**	**95% CI**	F	p	η_p^2
Interactive style	26	66.96 (14.04)	67.34	[64.99, 69.70]	1.692	0.200	0.035
Performance style	23	65.57 (13.31)	65.12	[62.62, 67.62]			

Appendix M: *Exploratory Analysis*

Receptive and Expressive Vocabulary - E-book versus Print Format.

One-way ANOVA was performed for the receptive and expressive vocabulary test. More specifically, the data were analysed by running six one-way ANOVAs, one for each time point (pre, post1, post2) and one for each dependent variable (expressive vocabulary, receptive vocabulary). Table M1 following presents descriptive statistics of receptive and expressive vocabulary scores in the pretest, posttests, and second post-tests. The analysis revealed that there was a statistically significant main effect of medium (e-book versus print book) for the pre receptive vocabulary test (F (1, 58) = 3.92, p = 0.05, η_p^2=0.06) and the post receptive vocabulary test (F (1, 58) = 4.69, p = 0.03, η_p^2=0.07). The effect size for e-books versus print books for post-receptive vocabulary scores was d=-0.58, favouring the print book condition. For expressive vocabulary the results were non-significant with a p>0.05 for both pre and posttests. The effect size for e-books versus print books for the post-expressive vocabulary test was d=-0.18, favouring the print book condition. Results from the second post-test revealed that there was no difference, neither for receptive nor expressive vocabulary at post-test 2, one month following the intervention.

Table M1 *One-way ANOVA Results for Receptive and Expressive Vocabulary Based on Book Medium (pre-test, post-test 1, post-test 2)*

		E-book condition				**Print Book condition**						
Dependent Variables	**Test**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	***F***	***p***	η_p^2	**Cohen's *d***
Receptive Vocabulary	Pre	30	0.47 (0.19)	0.03	[0.41, 0.53]	30	0.56 (0.15)	0.03	[0.50, 0.62]	3.92	0.05	0.06	-0.52
	Post1	30	0.60 (0.19)	0.03	[0.53, 0.66]	30	0.70 (0.15)	0.03	[0.63, 0.76]	4.69	0.03	0.07	-0.58
	Post2	27	0.59 (0.19)	0.03	[0.52, 0.65]	24	0.65 (0.13)	0.03	[0.58, 0.72]	1.929	0.17	0.03	-0.36
Expressive Vocabulary	Pre	30	0.61 (0.58)	0.11	[0.39, 0.84]	30	0.83 (0.64)	0.11	[0.61, 1.06]	1.95	0.16	0.03	-0.36
	Post1	30	0.83 (0.66)	0.12	[0.58, 1.08]	30	0.96 (0.72)	0.12	[0.70, 1.21]	0.49	0.48	0.00	-0.18
	Post2	27	0.82 (0.66)	0.14	[0.53, 1.10]	24	0.97 (0.79)	0.14	[0.67, 1.27]	0.549	0.46	0.01	-0.20

Receptive and Expressive Vocabulary - Interactive versus Performance Teaching Style. A series of one-way ANOVAs was performed for comparing the scores before and after the intervention in terms of receptive vocabulary and expressive vocabulary for the two teaching styles. More specifically, the data were analysed by running six one-way ANOVAs, one for each time point (pre, post1, post2) and one for each dependent variable (expressive vocabulary, receptive vocabulary). Table M2 presents descriptive statistics for the pre-test, post-test 1 and post-test 2 for receptive and expressive vocabulary as dependent variables and the teaching style, performance and interactive style, as independent variables. According to the results illustrated in Table 5.13, receptive vocabulary scores were statistically significant (p<.05) and there is a difference between teaching styles at pre and at post-test. More specifically, the analysis revealed that there was a statistically significant main effect of teaching style (interactive versus performance) for the pre receptive vocabulary test (F (1, 58) = 5.869, p = 0.01, η_p^2=0.09, d=0.66) and the post receptive vocabulary test (F (1, 58) = 5.042, p = 0.02, η_p^2=0.08, d=0.64). The effect size for teaching styles for the post-receptive vocabulary test revealed a large effect size of d= 0.64, favouring the interactive teaching style.

Following the first post-test, participants completed a second post-test after one month for the dependent variables receptive and expressive vocabulary. The second post-test revealed a statistically non-significant main effect for both dependent variables, suggesting that teaching style did not make a difference in terms of vocabulary skills.

Table M2 *One-way ANOVA Results for Receptive and Expressive Vocabulary Based on Teaching Style (pre-test, post-test 1, post-test 2)*

		Interactive teaching style condition				Performance teaching style condition							
Dependent Variables	**Test**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	***F***	***p***	η_p^2	**Cohen's *d***
Receptive Vocabulary	Pre	30	0.57 (0.16)	0.03	[0.51, 0.63]	30	0.46 (0.17)	0.03	[0.40, 0.52]	5.869	0.019	0.09	0.66
	Post1	30	0.70 (0.16)	0.03	[0.63, 0.76]	30	0.59 (0.18)	0.03	[0.53, 0.66]	5.042	0.029	0.08	0.64
	Post2	26	0.64 (0.16)	0.03	[0.57, 0.71]	25	0.59 (0.17)	0.03	[0.53, 0.66]	0.921	0.342	0.01	0.30
Expressive Vocabulary	Pre	30	0.81 (0.65)	0.11	[0.58, 1.04]	30	0.63 (0.57)	0.11	[0.41, 0.86]	1.197	0.278	0.02	0.29
	Post1	30	1.05 (0.73)	0.12	[0.80, 1.30]	30	0.74 (0.61)	0.12	[0.49, 0.99]	3.129	0.082	0.05	0.46
	Post2	26	0.92 (0.78)	0.14	[0.64, 1.21]	25	0.85 (0.67)	0.14	[0.55, 1.14]	0.139	0.711	0.00	0.09

Interaction Effect of Book Medium and Teaching Style

In this section, all possible combinations of the levels of the factors are investigated by analysing both factors (2 x 2) by time (pre, post) in order to evaluate main effects and interaction effects for each dependent variable. Therefore, in order to evaluate the main effects and the interaction effect of the two factors (book medium and teaching style) a series of two-way repeated measures ANOVAs were performed which included data from pre-test to post-test 1. It was important to evaluate the two variables (book medium and teaching style) with two time points (pre-test and post-test 1) first as most participants were present at both time points. Following this analysis, repeated measures ANOVA was performed that included the third time point, i.e., the second post-test which was administered to the participants a month after the interventions. The second post-test was not administered to the entire sample resulting from factors such as pupils leaving the school or pandemic-related circumstances.

Receptive Vocabulary. A repeated measures ANOVA with two factors for receptive vocabulary (pre-test and post-test 1; 2x2x2) revealed non-significant effects for both teaching style effect and its interaction with book medium (Table M3).

Table M3 *Repeated Measures ANOVA Results for Receptive Vocabulary of Book Medium by Teaching Style (pre-test versus post-test 1)*

		Time							
		Pre				Post 1			
Book Medium	**Teaching Style**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
E-book	Interactive style	15	0.53 (0.18)	0.04	[0.44, 0.62]	15	0.64 (0.19)	0.04	[0.55, 0.74]
	Performance style	15	0.41 (0.19)	0.04	[0.32, 0.50]	15	0.55 (0.20)	0.05	[0.44, 0.64]
Print Book	Interactive style	15	0.61 (0.15)	0.04	[0.52, 0.70]	15	0.75 (0.11)	0.05	[0.64, 0.86]
	Performance style	15	0.51 (0.16)	0.04	[0.42, 0.60]	15	0.64 (0.16)	0.04	[0.56, 0.76]
ANOVA results			***F***		***p***			η_p^2	
Book Medium Effect			0.173		0.679			0.00	
Teaching Style Effect			0.051		0.822			0.00	
Book Medium x Teaching Style			0.560		0.458			0.01	

A two-way repeated measures ANOVA was then performed including the three time points, post-test, post-test 1 and post-test 2 (Table M4). Results revealed a p-value of 0.053 for book medium effect (F (1, 47)=3.940, p=0.053, η_p^2= 0.07) indicating the results do not meet the threshold for statistical significance. While a p-value of 0.053 suggests that there is some evidence to suggest that the book medium may have an effect on children's receptive vocabulary scores favouring the print book, the results do not meet the traditionally accepted threshold for statistical significance. For teaching style effect and its interaction with book medium non-significant results were revealed.

Table M4 *Repeated Measures ANOVA Results for Receptive Vocabulary of Book Medium by Teaching Style (pre-test, post-test 1 and post-test 2)*

			Time					
			Pre		**Post 1**		**Post 2**	
Book Medium	**Teaching Style**	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
E-book	Interactive style	15	0.53	0.18	0.64	0.19	0.62	0.19
	Performance style	12	0.41	0.19	0.54	0.20	0.55	0.19
Print Book	Interactive style	11	0.60	0.14	0.75	0.11	0.67	0.13
	Performance style	13	0.54	0.16	0.66	0.16	0.64	0.14
ANOVA results			***F***		***p***		η_p^2	
Book Medium Effect			3.940		0.053		0.07	
Teaching Style Effect			2.769		0.103		0.05	
Book Medium x Teaching Style			0.163		0.688		0.00	

Expressive Vocabulary. A repeated measures ANOVA with two factors for expressive vocabulary (pre-test and post-test 1; 2x2x2) revealed non-significant effects for book medium and its interaction with teaching style effect (Table M5). However, the main effect of teaching style revealed statistically significant results with $F(1, 56) = 5.211$, $p = 0.02$, $\eta_p^2 = 0.08$, which reveals that no matter what book medium is used for expressive vocabulary the teaching style matters (see Figures M1 and M2).

Table M5 *Repeated Measures ANOVA Results for Expressive Vocabulary of Book Medium by Teaching Style (pre-test versus post-test 1)*

		Time							
		Pre				Post 1			
Book Medium	**Teaching Style**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
E-book	Interactive style	15	0.58 (0.58)	0.15	[0.27, 0.90]	15	0.83 (0.74)	0.17	[0.49, 1.18]
	Performance style	15	0.64 (0.59)	0.15	[0.32, 0.95]	15	0.83 (0.58)	0.17	[0.48, 1.17]
Print Book	Interactive style	15	1.04 (0.66)	0.15	[0.72, 1.35]	15	1.26 (0.68)	0.17	[0.92, 1.61]
	Performance style	15	0.63 (0.57)	0.15	[0.32, 0.95]	15	0.65 (0.63)	0.17	[0.30, 1.00]

ANOVA results	***F***	***p***	η_p^2
Book Medium effect	2.696	0.106	0.04
Teaching Style Effect	5.211	0.026	0.08
Book Medium x Teaching Style	1.589	0.213	0.02

Figure M1 *Repeated Measures for Expressive Vocabulary of Book Medium by Teaching Style for the Performance Teaching Style (pre-test to post-test 1)*

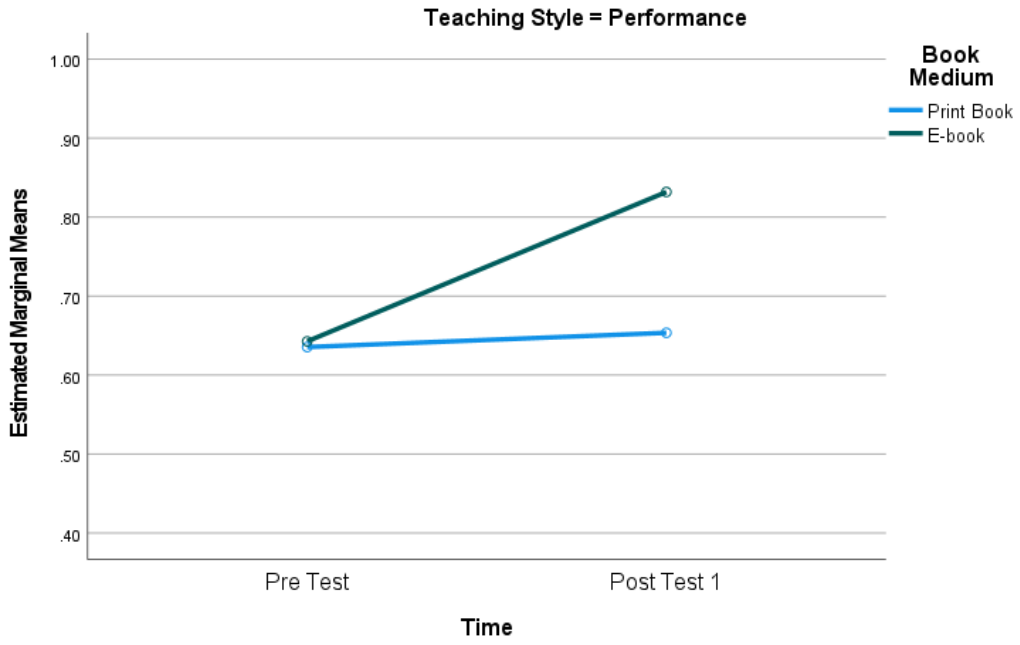
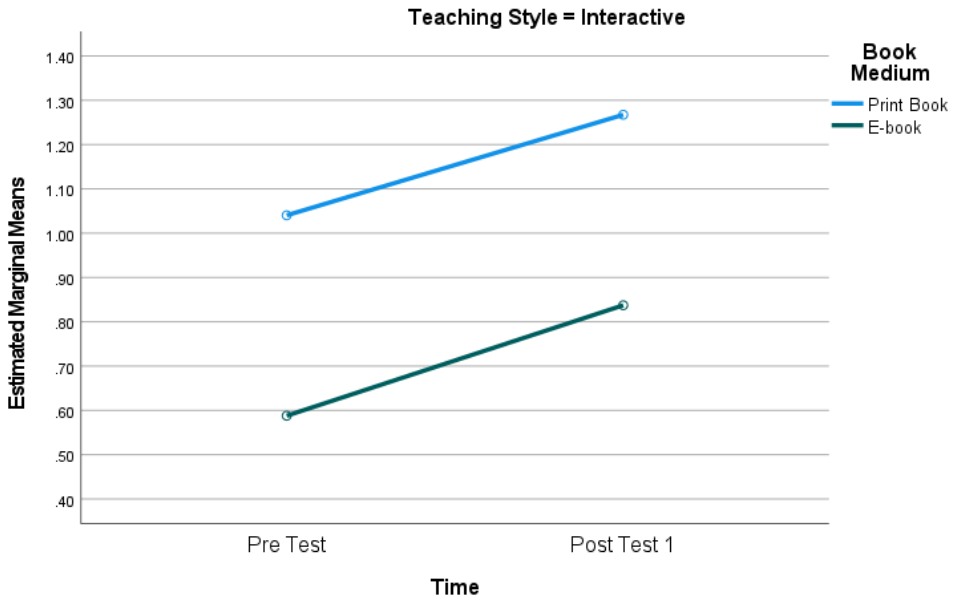


Figure M2 *Repeated Measures for Expressive Vocabulary of Book Medium by Teaching Style for the Interactive Teaching Style (pre-test to post-test 1)*



Following the analysis shown in Table M5, Table M6 presents a repeated measures ANOVA for expressive vocabulary which revealed that the interaction effect for the dependent variable expressive vocabulary, measured at three time-points, was not significant ($F(1, 47) = 2.071$, $p = 0.15$, $\eta_p^2 = 0.04$), as well as the effects of book medium and teaching style.

Table M6 *Repeated Measures ANOVA Results for Expressive Vocabulary of Book Medium by Teaching Style (pre-test, post-test 1 and post-test 2)*

			Time					
			Pre		**Post 1**		**Post 2**	
Book Medium	**Teaching Style**	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
E-book	Interactive style	15	0.58	0.58	0.83	0.74	0.72	0.61
	Performance style	12	0.71	0.63	0.87	0.65	0.94	0.71
Print Book	Interactive style	11	0.98	0.72	1.21	0.75	1.21	0.92
	Performance style	13	0.68	0.60	0.70	0.67	0.76	0.64

ANOVA results	F	p	η_p^2
Book Medium Effect	0.610	0.439	0.01
Teaching Style Effect	0.569	0.454	0.01
Book Medium x Teaching Style	2.071	0.157	0.04

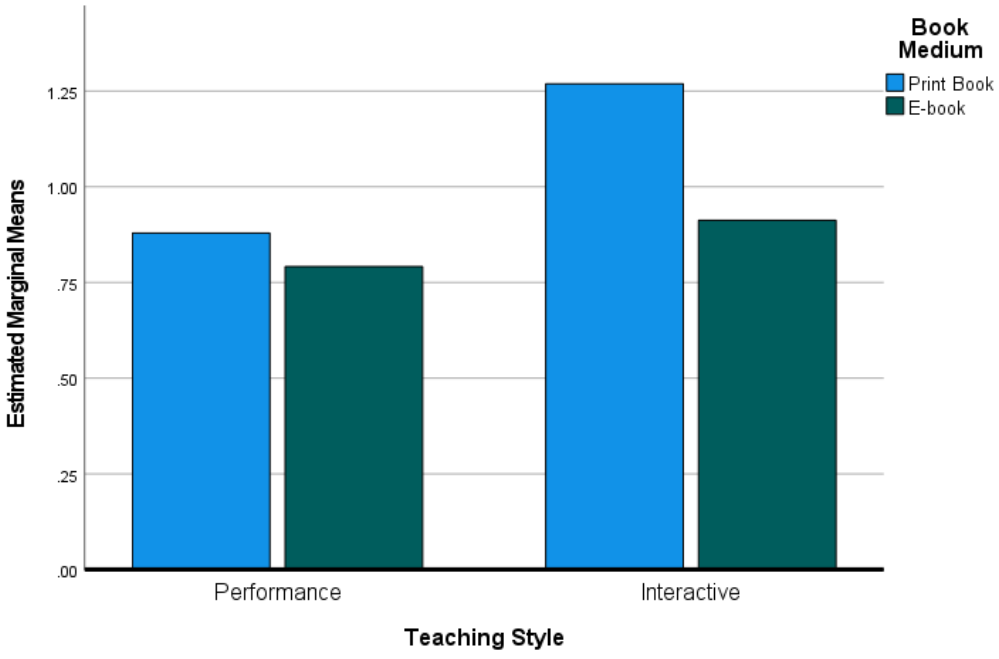
Story Comprehension (Implicit and Explicit). For implicit and explicit story comprehension results a series of two-way ANOVAs were performed at post-test 1. Specifically, two separate two-way ANOVAs were conducted to evaluate the interaction between the two variables (book medium and teaching style).

Implicit Story Comprehension. For implicit story comprehension (Table M7, Figure M3) the teaching style effect was statistically significant $F(1, 54) = 5.223$, $p = 0.02$, $\eta_p^2 = 0.08$, but not the book medium effect, $F(1, 54) = 3.949$, $p = 0.052$, $\eta_p^2 = 0.06$. The interaction effect of teaching style by book medium on implicit story comprehension was not significant, $F(1, 54) = 1.450$, $p = 0.23$, $\eta_p^2 = 0.02$.

Table M7 *Two-way ANOVA Results for Implicit Story Comprehension of Book Medium by Teaching Style (post-test 1)*

Book Medium	**Teaching Style**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
E-book	Interactive style	15	0.91 (0.47)	0.11	[0.69, 1.13]
	Performance style	15	0.79 (0.42)	0.11	[0.57, 1.01]
Print Book	Interactive style	13	1.26 (0.38)	0.18	[1.03, 1.50]
	Performance style	15	0.87 (0.40)	0.11	[0.65, 1.09]
ANOVA results			***F***	***p***	η_p^2
Book Medium effect			3.949	0.052	0.06
Teaching Style Effect			5.223	0.026	0.08
Book Medium x Teaching Style			1.450	0.234	0.02

Figure M3 *Implicit Story Comprehension of Book Medium by Teaching Style at Post-test 1*

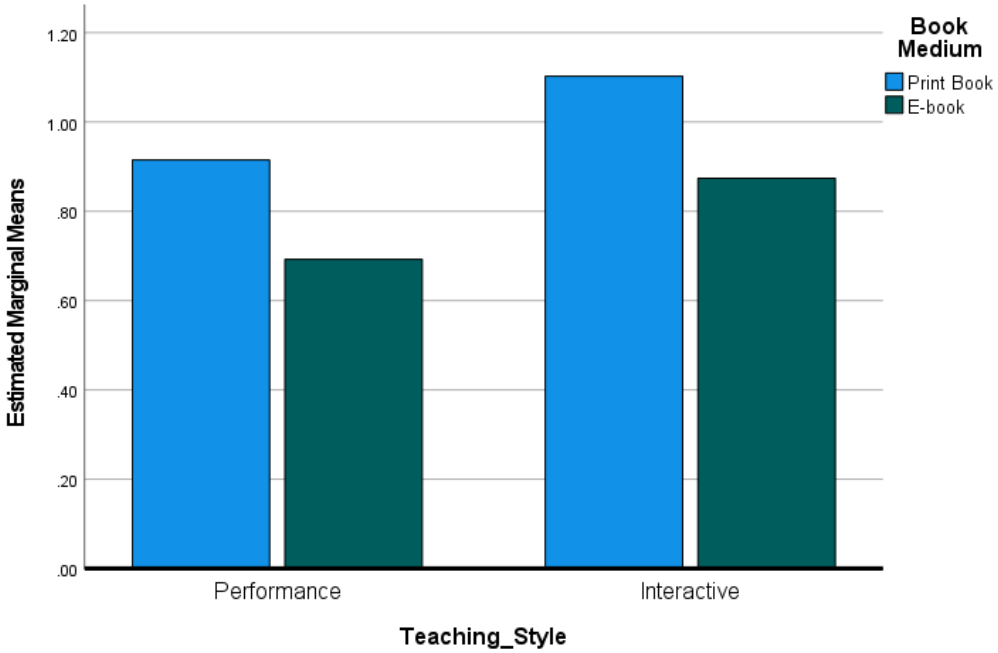


Explicit Story Comprehension. The book medium effect for explicit story compression was statistically significant with a small effect size ($F(1, 54) = 4.718$, $p = 0.03$, $\eta_p^2 = 0.08$), which reveals that no matter what teaching style a participant is taught with the book medium makes the difference for explicit story comprehension. The interaction effect of book medium by teaching style on explicit story comprehension was not significant, $F(1, 54) = 0.001$, $p = .976$, $\eta_p^2 = 0.00$, which means that the effects of medium and teaching style on explicit story comprehension are not dependent on each other (Table M8, Figure M4).

Table M8 *Two-way ANOVA Results for Explicit Story Comprehension of Book Medium by Teaching Style (post-test 1)*

Book Medium	**Teaching Style**	**N**	**Mean (SD)**	**Std. Error**	**95% CI**
E-book	Interactive style	15	0.87 (0.39)	0.10	[0.67, 1.07]
	Performance style	15	0.69 (0.43)	0.10	[0.48, 0.89]
Print Book	Interactive style	13	1.10 (0.36)	0.10	[0.88, 1.32]
	Performance style	15	0.91 (0.37)	0.10	[0.71, 1.11]
ANOVA results			***F***	***p***	$\boldsymbol{\eta_p^2}$
Book Medium effect			4.718	0.034	0.08
Teaching Style Effect			3.167	0.081	0.05
Book Medium x Teaching Style			0.001	0.976	0.00

Figure M4 *Explicit Story Comprehension of Book Medium by Teaching Style at Post-test 1*



Standardised Test PLS-5 UK. The interaction effects of book medium by teaching style from the repeated measures ANOVA were not significant, $F(1, 45) = 0.040$, $p = .842$, η_p^2=0.00 (Table M9), suggesting that there is no standardised test effect.

Table M9 *Repeated Measures ANOVA Results for Standardised Test PLS-5 UK of Book Medium by Teaching Style (pre-test versus post-test 1)*

			Time			
			Pre		Post 1	
Book Medium	**Teaching Style**	**N**	**Mean (SD)**	**Std. Error**	**Mean (SD)**	**Std. Error**
E-book	Interactive style	14	68.21 (14.20)	3.75	68.71 (14.20)	3.71
	Performance style	11	68.18 (14.88)	3.75	66.73 (13.69)	4.19
Print Book	Interactive style	12	64.17 (13.25)	3.75	64.92 (14.18)	4.01
	Performance style	12	66.42 (13.44)	3.75	64.50 (13.46)	4.01
ANOVA results			***F***		***p***	$\boldsymbol{\eta_p^2}$
Book Medium Effect			0.004		0.953	0.00
Teaching Style Effect			1.699		0.199	0.03
Book Medium x Teaching Style			0.040		0.842	0.00

Appendix N: *Research Tools Selection Process*

To choose the appropriate research instruments for the experimental investigation, it was crucial to review similar studies and examine the tools they used. This resulted in the development of Table N1, which presents the study tools utilised in the studies evaluated in the meta-analysis, as well as studies involving children learning EAL with the support of an e-book.

Vocabulary Research Tools

The vocabulary measures were created by building upon other studies that investigated the acquisition of expressive and receptive vocabulary in young children (e.g., Homer et al., 2014; Kelley & Kinney, 2017; Korat et al., 2014a; Takacs & Bus, 2016; Yang et al., 2022). Target words were selected from each story. All of the target words were categorised as Tier 2 words, which are regarded to be high utility and high frequency vocabulary words that can be beneficial for children to learn in order to improve their vocabulary and comprehension skills as suggested by Beck et al. (2013) and Beck et al. (2007). The process of selecting words involved carefully choosing wide-ranging and practical vocabulary (i.e., useful for story comprehension), seeking terms that conveyed ideas familiar to preschool children while enabling more precise communication (e.g., using "between" instead of "middle"). The focus was on words that children with limited vocabulary were unlikely to be familiar with but were probably familiar with among their peers who had larger vocabularies or older children. The criteria for selecting words were operationalized based on the following factors as in Spencer et al. (2012): (a) the word should not be uncommon in the vocabularies of pre-K children with limited knowledge; (b) it should appear relatively frequently in the discourse of adult speakers; (c) it should have a straightforward definition suitable for children (e.g., the definition of *grin* was *to smile*); and (d) it should be contextually relevant to the storybook.

Receptive Vocabulary

The receptive vocabulary test demonstrated resemblance to measures employed in prior studies (see Table 1; Kelley & Kinney, 2017; Korat et al., 2014a; O'Toole, 2015; O'Toole & Kannass, 2018; Sari et al., 2019; Zhou & Yadav, 2017; Silverman, 2007; Sun et al., 2019; Takacs & Bus, 2016; Yang et al., 2022). The receptive vocabulary test was created

in the same format as the standardised test Peabody Picture Vocabulary Test (PPVT-test; Dunn & Dunn, 1981). The children were asked to choose the illustration that best represents the word's meaning out of a set of four illustrations. The visual representation of the word did not precisely replicate the depiction in the story. The selected images consisted of recognisable things (e.g., pencil, chair) that were incorporated to sustain children's engagement (refer to Sénéchal et al., 1995).

Expressive Vocabulary

Previous studies investigating the effectiveness of e-books for improving expressive vocabulary skills in both typically developing children and children learning EAL assessed children's expressive vocabulary by asking children to provide a definition for words included in the story (Homer et al., 2014; Kelley & Kinney, 2017; Korat et al., 2014a; Silverman, 2007; Yang et al., 2022). The children were instructed to provide explanations for the meanings of the target words. For example, the child was asked: "What is the meaning of *suddenly*?".

Story Comprehension Research Tools

According to Florit et al. (2011), story comprehension is a complex process that requires the processing of explicit (i.e., information presented in the text) and implicit information (i.e., information inferable from the text / illustrations or from previous knowledge). Paris and Paris (2003) devised a narrative comprehension test specifically designed to evaluate the explicit and implicit story comprehension skills of young children. Explicit story comprehension (ESC) involves the recognition and understanding of the many components of a story, such as characters, setting, initiating event, issue, and solution. Implicit story comprehension (ISC) encompasses the ability to deduce the emotions of the story's main characters, establish cause-and-effect relationships, make predictions, and identify the underlying theme. ISC necessitates a more profound ability to understand and interpret stories. The objective of this study was to assess the effectiveness of e-books in enhancing young children's story comprehension skills, including both implicit and explicit aspects. Twelve prompted open-ended comprehension questions (Paris & Paris, 2003) were employed to assess children's story comprehension. Seven questions were related to explicit comprehension (characters, setting, initiating event, problem, and outcome or solution) and five to implicit comprehension (feelings, causal inference,

dialogue, prediction, and theme). Open-ended *Wh*-questions were created to measure children's story comprehension, a style of measurement consistent with prior work in e-book interventions and young children (Altun, 2021; Critelli, 2011; Karemaker et al., 2017; Kozminsky & Asher-Sadon, 2013; O'Toole, 2015; O'Toole & Kannass, 2018; Reich et al., 2019; Richter & Courage, 2017; Zhou & Yadav, 2017). In addition, children (during the implicit test) were allowed to refer to the story illustrations while answering the questions, which helped to reduce the impact of working memory on children's story comprehension performance (Cain et al., 2004). During the explicit test, children were asked to freely recall the answers and if they were not able to answer the open-ended question, I offered three multiple-choice options (e.g., Reich et al., 2019).

Table N1 *Research Tools Used in Studies Related to E-books and Young Children*

		Research Tools
Study and Year	**Outcome measures**	**Details**
Altun (2021)	Story Comprehension (1 measure)	The children were asked to respond to five questions to ascertain their story comprehension levels. The questions involved story elements such as characters, settings, plots, problems, and outcomes.
	Vocabulary (Receptive) (1 measure)	The Turkish Receptive Language Test was used to assess the participating children's vocabulary levels of Turkish children aged 2–12 years old.
Broemmel et al. (2015)	Story Comprehension (1 measure)	The participant was given the book and invited to look at the pictures and tell the story.
Critelli (2011)	Story Comprehension (1 measure)	A 10-item comprehension test which consisted of various questions regarding the story.
Eng et al. (2020)	Story Recall (1 measure)	Children were asked questions that probed their memory for details about the story that fit the narrative reconstruction criteria.
Homer et al. (2014)	Vocabulary (Expressive) (1 measure)	Children were asked to explain the meaning of a set of words. For example, experimenters asked, "Can you tell me what the word 'secret' means? What does it mean when something is secret?".
Ihmeideh (2014)	Vocabulary (Expressive) (1 measure)	Children were shown ten pictures of objects and were asked to say the word of the object. Afterward, children were asked a follow-up question related to the picture shown. The raters corrected children's responses based on one of two domains: "knows the meaning of the word" or "does not know".
Karemaker et al. (2017)	Vocabulary (Expressive) (1 measure)	Target definitions test to assess children's knowledge of the meaning of 21 target words in the e-books that had 'definitions' in the Dictionary format.
	Story Comprehension (2 measures)	Story comprehension task that included 6 open ended questions about the story events (1 inferential question, 1 complex phrase question and 4 factual questions).
		Recall measure to assess children's recall of the e-book story. Children had to recall the story without the aid of the book.
Kelley and Kinney (2017)	Vocabulary (Expressive) (2 measures)	On the definitional measure, participants were asked to respond to open-ended definitional questions.
		Participants were asked to respond to four yes–no questions.
	Vocabulary (Receptive) (1 measure)	On the receptive vocabulary measure, participants were asked to select from a plate of four pictures a picture that illustrates the target word. Pictures were high-quality photographs chosen to clearly represent the target word.
	Story comprehension (1 measure)	Story comprehension was measured using a story retell task.
Korat, Levin, Atishkin, Turgeman (2014a)	Vocabulary (Expressive) (1 measure)	The children were presented orally with the 14 target words, one at a time, and were asked to explain their meaning.
	Vocabulary (Receptive) (1 measure)	Researchers created a receptive word meaning test in the same format as the PPVT-test (Dunn & Dunn, 1981). The children were asked to choose the illustration that best represents the word's meaning out of a set of four illustrations.

(continued)

Table N1 *Research Tools Used in Studies Related to E-books and Young Children*

		Research Tools
Study and Year	**Outcome measures**	**Details**
Kozminsky and Asher-Sadon (2013)	Story Comprehension (1 measure)	Four questions based on a picture from the story and two moral inference questions about the story.
	Vocabulary (1 measure)	Examined the child's understanding of difficult words in the story.
Lee (2020)	Vocabulary (Expressive) (1 measure)	In a multiple-choice vocabulary pretest, students were asked to select the meaning of 14 target words out of four choices [e.g., abandon: (a) to show off; (b) to give up; (c) to jump; and, (d) I don't know].
Neuman et al. (2017)	Vocabulary (Expressive) (1 measure)	Five words from each story were chosen as target words. Children were first given a word, such as ''gigantic'' then given a sentence with the word in context. Children were asked to identify the meaning of the word.
	Story Comprehension (2 measures)	The child was asked to retell the story. A point was given for each story element described (e.g., setting (1), characters (1), events (3), plot or theme (1), resolution (1)).
		Researchers created five pictures with event scenes from each story. Cards were mixed, and children were asked to sequence the story.
O'Toole (2015)	Vocabulary (Receptive) (1 measure)	The test consisted of a series of plates. Each plate contained four pictures of objects or actions (one per quadrant). Fourteen plates were constructed. Four of the 14 plates contained familiar objects (e.g., a pencil, a spoon, a teddy bear, and a cup).
	Story Comprehension (1 measure)	Seven *Wh*-questions were created in order to measure children's story comprehension.
O'Toole and Kannass (2018)	Vocabulary (Receptive) (1 measure)	The word learning test consisted of 14 plates, and each plate contained four pictures of objects or actions (one per quadrant).
	Story Comprehension (1 measure)	Story comprehension questions. Open-ended ''wh-" questions were created to measure children's story comprehension.
Pearman (2008)	Story Comprehension (1 measure)	Upon completion of the reading, students performed an oral retelling following the cues of "Tell me about the story" or "Can you tell me the story that you just read?"
Reich et al. (2019)	Story Comprehension (3 measures)	The child was asked 14 questions about the book that were drafted specifically for this study. The first was a global recall question, "What was the book about?" followed by specific questions about the characters. For eight of the questions, children were asked to freely recall the answers. If they could not recall the answers correctly, the researcher read a list of multiple-choice options to select from. Children were asked to freely recall the answer and if they were not able to answer the open-ended question, we offered three multiple-choice options.
		Sequencing of story events: children placed four images from the story in the order that they occurred.
		Story events and characters. There were eight questions on characters or events in the story. Questions were presented verbally or with a picture.
	Vocabulary (Expressive) (1 measure)	Three questions about words presented in the book. Two asked meaning (e.g., *He was a veterinarian. But what is a veterinarian?*) with recognition and free recall and one asked for visual recognition of a word that is large and phonetically spelled in the book.
Richter and Courage (2017)	Story Comprehension (1 measure)	Children were assessed with nine questions that were asked after each reading.

(continued)

Table N1 *Research Tools Used in Studies Related to E-books and Young Children*

		Research Tools
Study and Year	**Outcome measures**	**Details**
Rvachew et al. (2017)	Story Comprehension (1 measure)	Story retell was elicited by showing the child the cover page of the book along with the following standard script.
Sapsaglam et al. (2020)	Story Comprehension (1 measure)	The researcher asked children five questions regarding the story.
Sari et al. (2019)	Story Comprehension (1 measure)	Researchers used a retelling procedure in which we prompted children to explain how the characters respond to various events. The questions targeted the problem, the initiating event, the reaction, the solution, and the emotions of characters elicited by the problem or solution.
	Vocabulary (Receptive) (1 measure)	Children completed the receptive test by selecting one of four pictures that corresponded to the target word spoken out loud by the experimenter (similar to the procedure of the PPVT).
	Vocabulary (Expressive) (1 measure)	Expressive knowledge of the target words was tested with a sentence completion task in which children were asked to complete a sentence presented with a picture from the story.
Smeets and Bus (2015)	Vocabulary (Receptive) (1 measure)	The Peabody Picture Vocabulary Test is a standardized test that was used to assess children's level of general receptive vocabulary. Children were asked to select one of four pictures matching a word named by the examiner.
	Vocabulary (Expressive) (1 measure)	To assess children's level of general expressive vocabulary, the experimenter showed pictures while reading aloud incomplete sentences. Children were asked to complete sentences such as "A bird flies in the . . . ? [air]".
	Story Comprehension (1 measure)	Children were asked to retell one of the four stories they had heard during the intervention.
Takacs and Bus (2016)	Vocabulary (Receptive) (1 measure)	This test was a multiple-choice test where children had to choose the corresponding picture from 4 options.
	Story comprehension (1 measure)	Resembling the common activity of independently "reading" a familiar storybook, we asked children to retell the three stories using the static illustrations of the stories.
Zhou and Yadav (2017)	Vocabulary (Receptive) (1 measure)	The target vocabulary test required children to select among four pictures the one picture that best represented the given target word.
	Story Comprehension (1 measure)	The story comprehension test contained six open-ended questions.
Zipke (2017)	Story Comprehension (1 measure)	Participants were asked to retell the story to the experimenter.
	Vocabulary (1 measure)	Participants were asked to choose a salient word from an array of comparable words to see if they recognized the target word.

(continued)

Table N1 *Research Tools Used in Studies Related to E-books and Young Children*

		Research Tools
Study and Year	**Outcome measures**	**Details**
Studies with children learning EAL & e-books		
Silverman (2007)	Vocabulary (Receptive) (1 measure)	Students were presented with four pictures and asked to "Point to the picture that shows that someone is afraid".
	Vocabulary (Expressive) (1 measure)	Children were asked without picture prompts, "What is….? " or "What does….mean?".
Silverman and Hines (2009)	Vocabulary (1 measure)	For each target word, children were asked four yes-or-no questions.
Sun et al. (2019)	Vocabulary (Expressive) (1 measure)	The productive vocabulary test measured whether children could orally produce the target words in the context of the storybooks.
	Vocabulary (Receptive) (1 measure)	The multiple-choice format of the test was similar to PPVT, were children were asked to choose the corresponding picture from four options.
	Story Comprehension (1 measure)	Children were asked to retell the three stories using the static illustrations of the stories.
Verhallen and Bus (2010)	Vocabulary (Receptive) (1 measure)	Among three distracters, children chose the illustration that represented the target item.
	Vocabulary (Expressive) (1 measure)	Children filled in the last word of a stimulus sentence that the experimenter orally presented while the computer screen showed a matching picture from the story.
Verhallen et al. (2006)	Story Comprehension (1 measure)	The researchers asked form children to retell the story with the help of story pictures.
Yang et al. (2022)	Vocabulary (Receptive) (1 measure)	Children heard one English word or phrase from the story and selected which four pictures displayed on the screen best illustrate that term.
	Vocabulary (Expressive) (1 measure)	Children were shown four big pictures consisting of 25 story-related items and asked children had to name it in English.
	Story Comprehension (1 measure)	The comprehension test consisted of seven sets of questions, with closed-ended question and open-ended questions.