

**Leaving no Pre-Schooler Behind: Using Digital Technology to Foster Emergent
Literacy Skills of Preschool Children from Resource-Constrained
Environments in Lusaka Province, Zambia**

by

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**A thesis submitted to the University of Zambia in partial fulfilment of the
requirements for the degree of Doctor of Philosophy in Sociology of Education**

The University of Zambia

Lusaka

2024

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AUTHOR'S DECLARATION

I, Janet Serenje, do hereby declare that this thesis titled "*Leaving no Pre-Schooler Behind: Using Digital Technology to Foster Emergent Literacy Skills of Preschool Children from Resource-Constrained Environments in Lusaka Province, Zambia*" represents my own work and has never been previously submitted for the award of any degree at the University of Zambia or any other university. It does not incorporate any published work or material without acknowledgement.

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CERTIFICATE OF APPROVAL

This thesis of **Janet Serenje** is approved as a fulfilment of the requirements for the award of a Degree of Doctor of Philosophy in Sociology of Education by the University of Zambia.

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DEDICATION

This thesis is dedicated to my late mother, Mary Sailus Tembo, who provided unwavering moral support throughout my PhD program. She instilled in me the values of hard work, devotion, and excellence. She was my utmost inspiration. May her soul rest in eternal peace.

This thesis is also dedicated to my sister, Lydia Serenje, and my brother-in-law, Newstead Samson Mseteka, who supported my educational endeavours and made many sacrifices to help me get to where I am today.

ACKNOWLEDGEMENTS

My deepest gratitude goes to my principal supervisor Professor Beatrice Matafwali. I am very grateful to her for all the professional support she provided over the course of my doctoral pursuit. Her expert guidance helped me to complete my thesis successfully. I will forever be appreciative of her.

I also extend my most profound appreciation to Professor Adriana G. Bus, my other supervisor, for her invaluable guidance, support, and insightful feedback she always provided on my work. She taught me much more about scientific research in ways far above what I could ever give her credit for. She demonstrated what it takes to be a proficient researcher through the discussions we had and the insightful feedback she provided on my work. I shall eternally be indebted to her.

Furthermore, I would like to express my gratitude to Dr Sylvia Mwanza-Kabaghe, who served as my co-supervisor for providing both professional and emotional support during my PhD journey. I am grateful for all her insightful suggestions on my thesis, as well as her consistent encouragement and motivation throughout my studies. I am also immensely thankful to Mubanga Mofu and Dr. Gabriel Walubita, two of my fellow PhD students and colleagues, who supported me in various ways during my PhD journey. We ate, drank, laughed, cried, and worked through the nights together. I am grateful that you never tired from reading through the numerous iterations of my work. I truly appreciate all the assistance you rendered to me, my ‘jobbies.’

I want to extend my sincere appreciation to my husband, Ferdinand Mwaka Chipindi, for always being a source of support and serving as a continual source of inspiration. Throughout my studies, he had been a source of strength, and his words of encouragement provided me with the necessary motivation to persevere during challenging times. I am also

thankful to my children, Maanka, Munalula, and Priscilla, for their unwavering support and understanding throughout the pursuit of my doctoral degree.

Conducting this experimental study was costly, and I am thankful to the Lolle Nauta Foundation of the Netherlands for funding this study. I also extend my gratitude to UNZA management for awarding me the special research fellowship (SRF) and allowing me the time necessary to pursue my doctoral programme. Lastly, I want to express my appreciation to the Department of Educational Psychology, Sociology, and Special Education staff for their support of my professional aspirations and work activities.

ABSTRACT

This study investigated how a digital intervention programme influenced the development of emergent literacy skills, including rhyme awareness, vocabulary, and story comprehension, in preschool children from resource-constrained environments in Lusaka province, Zambia. The study was quantitative and employed a between-subjects randomised controlled experimental design. A sample of 353 children ($M_{age}=81.1$ months; $SD=15.7$) from 14 government preschools in Lusaka, Chilanga, and Kafue districts of Lusaka province was randomly assigned to one intervention and two control groups. Children in the intervention group listened to and watched digital animated stories and rhymes 4 times a week for six weeks (which translated into a total intervention time of 4 hours, 46 minutes, and 8 seconds per child). To control for the effect of technology, the children in the control I group played a non-literary video game (*Subway Runner downloaded from Combine, Inc.*). In control group II, children continued with their usual classroom activities (scheduled on the school timetable). Data at pretest and post-test were collected using various assessment tools, including the picture rhyming test rhyme production test, expressive one-word picture vocabulary test, receptive one-word picture vocabulary test, retelling, and question-and-answer comprehension tests. A linear mixed effect analysis was used to assess the intervention's impact on rhyme awareness, vocabulary, and story comprehension skills. Results revealed that the intervention group significantly outperformed the two control groups in vocabulary and story comprehension but not in rhyme awareness. Thus, the study provides empirical evidence supporting the efficacy of digital animated stories and rhymes in enhancing early literacy skills, particularly vocabulary and story comprehension, among Zambian preschool children. The study recommends integrating these resources as supplements to printed materials for preschoolers in preschools and homes. By using these digital instructional tools alongside traditional printed materials, educators and parents can create engaging learning experiences that support children's overall early literacy development.

Keywords: digital educational materials, preschool education, rhyme awareness skills, vocabulary, story comprehension skills.

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LIST OF ABBREVIATIONS AND ACRONYMS

CDC	Curriculum Development Centre
ECE	Early Childhood Education
ECZ	Examinations Council of Zambia
EGRA	Early Grade Reading Assessment
ESO	Education Standards Officer
DEBS	District Education Board Secretary
ICT	Information and Communications Technologies
MESVTEE	Ministry of Education, Science, Vocational Training and Early Education
MoE	Ministry of Education
MoGE	Ministry of General Education
NLAF	National Learning Assessment Framework
OECD	Organisation for Economic Cooperation and Development
PEO	Provincial Education Officer
PISA	Programme for International Student Assessment
PS	Permanent Secretary
SACMEQ	Southern and Eastern Africa Consortium for Measuring Educational Quality
TESS	Teacher Education and Specialised Services
ZECF	Zambia Education Curriculum Framework
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
UNZA	University of Zambia
USAID	United States Agency for International Development

CHAPTER ONE: INTRODUCTION

Overview

In today's society, the use of digital technology in both social and educational settings is becoming more prominent. With the widespread availability of digital devices such as desktops, laptops, iPads, tablets, and smartphones, the use of technology, particularly in the education of young children, has gained prominence (Altun, 2021; Bankmycell, 2022; Wastiau et al., 2013). Scholars have conducted numerous investigations to gain insight into the impact of digital technology on various aspects of early childhood education (ECE), particularly its role in the development of emergent literacy skills (Dore et al., 2018; Korat, 2009). Various research undertakings have yielded divergent conclusions about the impact of technology-enhanced instructions on the acquisition of early literacy skills in young children (Chen & Chan, 2019; Korat & Shneor, 2019; Ritcher & Courage, 2017; Zhou & Yandav, 2017). Due to the observed heterogeneity in results pertaining to the efficiency of digital instructional resources, continued research has been encouraged to inform policymakers, educators, and parents on the ways in which digital technology can be used appropriately to foster the development of emergent literacy skills in young children. The current study is a response to this growing need for studies to deepen society's understanding of the role of digital technology in the learning of early literacy skills. The study will help to advance knowledge on this subject.

The purpose of this introductory chapter is to present the topic under investigation and provide background information about the role of technology (specifically, digital animated stories and rhymes) in the development of emergent literacy skills in young children. Additionally, the chapter discusses the problem that

was explored, the purpose, research objectives, research questions, hypotheses, and significance of the study. The chapter also presents the delimitation, limitations, and definition of key terms used in this study. It also outlines the organisational structure of the thesis and concludes with the chapter summary.

Background to the Study

Literacy, which includes the ability to identify, comprehend, interpret, and communicate printed and written materials, is the cornerstone of academic success and meaningful participation in society (Mwanza-Kabaghe et al., 2022; United Nations Educational, Scientific, and Cultural Organisation [UNESCO], 2010; 2017). Past research has established a connection between poor literacy skills and lower levels of academic achievement as well as higher risks of social problems, including poverty, criminality, poorer health outcomes, and unemployment (Baker, 2001; Kapur, 2022; Miles & Stipek, 2017; World Bank, 2016, 2018). Thus, improving literacy rates has become a key policy priority area for many countries due to its significant impact on individuals and society (UNESCO, 2010, 2022).

Literacy development is a continuous process that starts at birth and persists across an individual's lifespan (Rachmani, 2020; Sulzby & Teale, 1991). Scholarly works suggest that children must first develop a set of foundational literacy skills, known as emergent literacy skills, to become skilled readers (Clay, 1966; Erikson & Koppenhaver, 2020; Whitehurst & Lonigan, 1998). Whitehurst and Lonigan (1998) define emergent literacy skills as “the skills, knowledge, and attitudes that are presumed to be the developmental precursors to conventional reading and writing” (p. 849). Children exhibit these skills through observable actions, such as mimicking reading and writing acts, even though they have not yet acquired conventional reading skills. Essential elements of emergent literacy skills comprise letter

knowledge, phonological awareness skills, oral language, story comprehension, and concepts about print (Arrow & McLachlan, 2011; National Early Literacy Panel [NELP], 2008).

Letter knowledge is defined as a child's ability to recognise and identify individual letters. Children need these skills to decode words efficiently (Ehri, 2013). Phonological awareness, on the other hand, is defined as the ability to recognise and manipulate language sounds (Pinto et al., 2016). Phonological awareness skills are essential for improving decoding and spelling abilities. The concept of print awareness refers to an understanding of written language's forms and functions. Children with print awareness can distinguish between print and pictures, understand the directionality of text, and recognise familiar signs and symbols in their environment (Pavelko et al., 2018). Vocabulary refers to the words a person knows and uses in different contexts (Kamil & Hiebert, 2005). A rich vocabulary serves as the foundation for understanding and expressing ideas effectively. Story comprehension entails understanding narrative elements such as plot, characters, and events (Hamoud, 2022). All these emergent literacy skills are critical for a child's overall literacy development.

Research has consistently demonstrated that emergent literacy skills acquired in preschool years are critical for later reading and academic success, as they form the basis for reading development (Hjetland et al., 2020). When children enter primary school with strong emergent literacy skills, they are better positioned to learn to read and achieve academic milestones (Castro & Barrera, 2019; Hjetland et al., 2020; Lonigan, 2000; NELP, 2008; Stanovich, 1990; Whitehurst & Lonigan, 1998). For instance, a longitudinal study conducted by Castro and Barrera (2019) on 34 Brazilian children from public preschools to grade one found that early literacy

skills, particularly phonological awareness, vocabulary, comprehension, and letter knowledge, significantly predicted reading achievement in grade one, showing the critical role of emergent literacy skills in predicting later reading abilities. Similarly, research by Lonigan (2000) found that letter knowledge and phonological awareness at the end of preschool accurately predicted more than 50% of the variation in children's decoding skills in grade one.

Other studies (NELP, 2008; Stanovich, 1990; Whitehurst & Lonigan, 1998) have yielded similar results that substantiate the critical role of emergent literacy skills acquired before formal schooling in reading development. Consequently, it is essential to support the development of emergent literacy skills in the preschool years to help bridge the gap between children's pre-reading abilities and the demands of formal reading instruction. This will set them up for success in school and ensure that they continue to read throughout their lives.

Emergent literacy skills develop through exposure to a variety of experiences and materials in both home and preschool settings (Whitehurst & Lonigan, 1998). Activities such as shared book reading, singing, playing literacy games, reciting nursery rhymes (Whitehurst & Lonigan, 1998), and eBooks (Smeets & Bus, 2017) are just a few of the many ways that are employed to support the development of emergent literacy skills in young children. However, preschoolers in resource-constrained environments, such as Zambia, often face challenges in developing these skills due to limited access to educational resources and opportunities for language-rich interactions (Matafwali & Chansa-Kabali, 2017; World Bank, 2016; USAID Education Activity Data, 2020). Without access to a variety of reading materials and literacy-promoting activities, children miss out on the opportunity to

develop early literacy skills, like phonological awareness, vocabulary and comprehension, critical for future academic success.

Literacy Situation in Zambia

Young children in Zambia, especially those from low-resourced homes who attend government schools, have consistently performed poorly on regional and national literacy tests (Southern African Consortium for Monitoring Educational Quality [SACMEQ], 2011; United States Agency for International Development [USAID] Education Data Activity, 2019). For instance, in a survey conducted by SACMEQ (2011) on grade 6 primary school learners' reading performance, learners in all 9 provinces of Zambia scored an overall mean of 434.4, which was below the SACMEQ mean of 500. Out of the 15 nations that participated, learners in Zambia were the lowest performing in the region. In another study conducted by the Programme for International Students Assessment for Development [PISA-D] in 2018, which compared the reading levels of 15-year-old learners in 7th grade or above in seven developing countries, only 5% of Zambian test takers achieved the minimum reading proficiency. Zambia had an average score of 275, which was more than two standard deviations below the Organisation for Economic Co-operation and Development (OECD) mean score of 500. Zambia ranked last out of the seven countries that participated in the study.

Similarly, national literacy tests, such as the Early Grade Reading Assessments (EGRA), have also revealed low literacy levels among Zambian early-grade learners. For example, the EGRA 2018 national survey of 15,071 grade 2 learners in five provinces of Zambia revealed poor performance on literacy tasks (USAID Education Data Activity, 2019). Results showed that participants performed poorly in all the measured literacy skills, which included reading

comprehension, oral language, non-word reading, letter-sound reading, and listening comprehension. According to the results, 64% of the learners could not read a single word, 50% could not recognise a single syllable, and 40% could not sound out a single letter (USAID Education Data Activity, 2019). Furthermore, a 2018 World Development Report discovered that 58% of grade 2 learners assessed were unable to read a single word from short texts. More recently, the 2021 World Vision Zambia end-line assessment, which used the school-based Test About Reading (STAR) tool, revealed that only 23% of grade 3 learners could read with comprehension. Several other studies have also reported poor literacy levels among Zambian learners (Jere-Folotiya et al., 2014; Matafwali, 2010; Matafwali & Bus, 2013; Mubanga, 2015; Mumba & Mkandawire, 2020; Mwanza-Kabaghe, 2015; Serpell, 2014; Tambulukani & Bus, 2012; McCoy et al., 2017; Zulu, 2019).

The problem of low literacy levels among children in Zambia has persisted despite the implementation of various initiatives aimed at improving literacy rates and the overall quality of education in the country (UNESCO, 2022). For instance, the government revised the National Curriculum Framework and formulated the National Literacy Framework (NLF) in 2013 (Ministry of Education, Science, Vocational Training, and Early Education, [MESVTEE], 2013). Following the formation of the NLF, a new literacy policy called the Primary Literacy Programme (PLP) came into effect in 2014. The NLF stipulated that teaching and learning in all subjects from early childhood education (ECE) to grade four was to take place in one of the seven indigenous official languages, namely, Nyanja, Lozi, Luvale, Kaonde, Lunda, Tonga, and Bemba. The framework further guided that English would only be taught as a subject from grade 2 to grade 4 and that from grade 5 to grade 7, content subjects would be taught in English, and only one official local

language approved for an area would be taught in a local language. The PLP increased the duration during which local languages were used for instructional purposes, in contrast to the previous Primary Reading Programme (PRP). The PRP limited the use of local languages for instruction to a single year, specifically in grade one.

With regards to ECE, the framework stated that ECE would receive consistent instruction and practice in the areas of listening, speaking, pre-reading, and pre-writing skills (MESVTEE, 2013). By the end of their ECE, children would have developed the necessary skills in sound, meaning, structure, and practical language application to engage in communication and achieve linguistic proficiency effectively (MESVTEE, 2013).

Literacy skills were expected to improve with the extended term of teaching and learning in a familiar language (from preschool to grade 4), as compared to the prior year in the PRP (Chibamba et al., 2018). However, despite the language policy change and years of research aimed at improving literacy levels, Zambia continues to record poor reading scores among early-grade students (PISA-D, 2018; USAID Education Data Activity, 2018, 2019, 2020; Zulu, 2019). It is evident, from these findings, that emphasising classroom pedagogy is inadequate for tackling the nation's low literacy rates, as these rates are also influenced by a range of societal factors. Therefore, researchers, educators, and policymakers need to pay attention to these factors that support or hinder the development of early literacy skills if literacy rates are to improve among young children in Zambia.

Various factors contribute to the low literacy rates in Zambia, such as poverty, limited access to educational materials and quality early childhood education (Serenje et al., 2023; Thomas & Thomas, 2009; UNESCO, 2016,

2021). Another important factor that stands out as a potential cause worthy of consideration is the inadequate development of emergent literacy skills among children entering grade one (Mumba & Mkandawire, 2020; Mwanza-Kabaghe et al., 2015; USAID Education Data Activity, 2020). Entering primary school with poor emergent literacy skills certainly has negative effects on how children learn to read when they are exposed to formal reading instructions (Septiani & Syaodih, 2020; Sulzby & Teale, 1991). Lack of adequately developed emergent literacy skills among most children from resource-constrained environments in Zambia may explain the low literacy levels observed among primary school children in Zambia (Matafwali & Bus, 2013; USAID Education Data Activity, 2018).

Challenges of Emergent Literacy Skills in the Zambian Environment

Several factors contribute to the low emergent literacy rates among Zambians. According to a study conducted by the USAID Education Data Activity (2020), which evaluated the school readiness of 511 preschool children from 52 government-funded preschools across five provinces of Zambia, it was discovered that the children's emergent literacy skills were not developing at the same pace as other skills that prepare learners for school entry. The study measured emergent literacy skills (i.e., expressive vocabulary, oral comprehension, phonemic awareness, print awareness, letter identification, and emergent writing), motor development, emergent numeracy, and socio-emotional development of preschoolers at the beginning of preschool, and the same skills were measured among grade one participants. At baseline, of all the four domains measured for school readiness, the mean group score on emergent literacy skills was the lowest at 36%, with phonemic awareness and letter knowledge identification being the most difficult tasks with 19% and 6% correct scores, respectively. At the end of grade

one, the mean score on literacy was again the lowest among the four domains for both children with early childhood education (ECE) experience (54%) and those without ECE experience (48%), while the highest was motor development with 81% and 71% for those with ECE and without ECE, respectively. These findings indicate that children's early reading skills are not adequately developed at school entry.

In addition, young children in Zambia may be having difficulties developing their emergent literacy skills because they are not getting enough practice through participation in emergent literacy-promoting activities owing to various constraints in the homes and preschools. For instance, studies have shown that exposure to reading materials and shared book reading support the development of emergent literacy skills in pre-literate children (Bus et al., 1995). In recent times, animated eBooks have also been employed to support the development of emergent literacy abilities in pre-reading children (Lopez-Escribano et al., 2021; Mayer, 2021; Smeets & Bus, 2015; Takacs & Bus, 2016, 2019).

However, the poor home literacy environment, especially in low-resourced homes, poses significant challenges for the development of early literacy skills among Zambian children. Most of these homes lack access to literacy materials and adult-led activities, such as shared book reading, to support the development of literacy skills in young children (Banda & Mwanza, 2020). Chansa-Kabali's (2017) research revealed inadequate availability of children's books and a lack of extensive implementation of reading activities in Zambian homes. Families often lack access to storybooks and other literacy materials in the language of instruction, limiting opportunities for literacy engagement (Chansa-Kabali, 2014, 2017; USAID Education Data Activity, 2020). Moreover, parents of children from low-income families may be illiterate and unable to read with them, thus lacking the capacity to

provide foundational literacy support (Lwanga, 2012). Also, parents from low-income households are usually preoccupied with meeting basic needs, leaving little time for literacy-related activities with their children. The poor reading culture among the Zambian population may also contribute to parents' reluctance to engage in literacy activities with their children (Lwangala, 2012). Without a strong emphasis on the value of reading in the broader community, parents may not prioritise literacy activities at home. This dearth of print materials and literacy-rich environments means that children have limited exposure to language outside of formal educational settings.

Also, government preschools in Zambia are poorly funded (UNESCO, 2022), which consequently impacts the availability and quality of educational resources for effective instruction. For instance, a study by USAID Education Activity Data (2020) on 511 preschool children from 52 government preschools in five provinces of Zambia revealed insufficient literacy materials and adequate access to literacy-promoting activities. The study found that 74% of the preschool classes surveyed did not teach oral storytelling. The study further reports that 90% of the 52 schools had no storybooks, and 46% of the children reported not having been read to at home. Another study by Lungu and Matafwali (2020) revealed that a good number of teachers (32 out of 40) at 10 preschools in Lusaka province reported a lack of toys in their classrooms. UNESCO (2022) points out that several teachers (46%) are not trained in early childhood education pedagogies, which compromises their teaching abilities. The various challenges mentioned have a notable impact on the educational experience of children enrolled in government-operated preschools. Most children who attend government preschools in Zambia typically come from low-income homes (Matafwali & Chansa-Kabali, 2017; World Bank, 2016). Lack of

age-appropriate reading materials and literacy activities that promote early literacy in these preschools deprives children of opportunities to develop emergent literacy skills essential for reading development.

Additionally, for some children living in a cosmopolitan environment, like Lusaka province, literacy acquisition is further complicated by a mismatch between the language of instruction (standard Nyanja) and non-standard Nyanja, which is the language of play and used widely in most homes (Kapenda, 2020; Matafwali & Bus, 2016; Mwanza, 2012; Mbewe et al., 2013; Tambulukani & Bus, 2012). A child or teacher who understands non-standard Nyanja may fail to understand standard Nyanja (Mwanza, 2012). This combination of factors results in a significant gap in emergent literacy opportunities for many children, especially those from low-resourced homes, further exacerbating disparities in early literacy development. If an effort is not made to improve the low emergent literacy skills before children enter grade one, Zambian children may continue to struggle to learn how to read as they go through school. This, in turn, may lead to reading problems, school dropouts, and a further decline in the quality of education (World Bank, 2016). Therefore, there is a need to implement interventions that guarantee children have the chance to develop the essential emergent literacy skills required for reading and academic success. Efforts to address these challenges should involve targeted interventions aimed at supporting parents and improving access to literacy materials. This is the situation that motivated the current study.

Efforts have been made by researchers and scholars to address the issue of low literacy skills among young children in Zambia. However, most past research studies have primarily focused on reading proficiency in grade school (Jere-Folotiya, 2014; Matafwali, 2010; Matafwali & Bus, 2012; Mubanga, 2015).

Relatively few studies have specifically examined emergent literacy skills in preschool settings (Matafwali & Chansa Kabali, 2017; USAID Education Data Activity, 2020; McCoy et al., 2017), despite the vital role these skills play in reading acquisition. Therefore, additional research in the Zambian context is necessary to address the problem of poor early literacy skills in young children.

In this digital era, animated literacy instructional materials offer promising avenues for addressing emergent literacy problems, especially in settings with limited access to traditional educational resources (Mayer, 2021; Smeets & Bus, 2015). The widespread availability of portable digital devices such as laptops, tablets, and smartphones has facilitated the use of digital instructional materials to support the development of emergent literacy skills (Ihmeideh, 2014; Kegel et al., 2009; Sari et al., 2019). These devices allow for the integration of diverse multimedia components into instructional materials, including interactive hypermedia elements, hotspots (Zang et al., 2020), animation, narration, music, and sound (Mayer, 2021; Sari et al., 2019). These multimedia elements have been reported to support the development of emergent literacy skills among children from diverse backgrounds (Smeets & Bus, 2015; Sari et al., 2019; Verhallen et al., 2006). Therefore, this study employed a practical digital intervention programme using digital animated stories and rhymes to support the development of emergent literacy skills in preschool children in Zambia.

Digital Educational materials and Emergent Literacy development

Several studies have shown the efficacy of digital instructional materials in fostering emergent literacy skills in young children (Dore et al., 2018; Korat & Shneor, 2019; Korat, 2010; Smeets & Bus, 2015; Sari et al., 2019; Verhallen et al., 2006). Research has also demonstrated that digital instructional materials are

effective in supporting specific emergent literacy skills, such as vocabulary, story comprehension, language acquisition, and phonological awareness (de Jong et al., 2004; Korat, 2010; Paciga, 2015; Sung & Chen, 2019).

Scholarly evidence suggests that children learn more from film-like digital instructional materials embedded with animated motion pictures and narrations than from static e-books and printed books (Li, 2020; Verhallen et al., 2006; Willoughby et al., 2015). For instance, digital animated books were reported to promote vocabulary growth more than eBooks with just static illustrations among 5 and 6-year-olds with a Dutch background (Kegel et al., 2009). Li (2020) conducted a study among 3- to 6-year-old children in the Southwest part of the United States and found similar results. The following paragraphs explore aspects that contribute to the efficacy of animated instructional materials as educational resources for young children.

Advantages of Animated Digital Instructional Materials

Verhallen and Bus (2010) explain that film-like animated materials are effective in supporting learning in young children as they help them grasp abstract concepts and make learning entertaining. They, further, point out that children at risk for language delays or learning complex material may not benefit from static eBooks as much as they would from film-like animated ones because children may not readily connect words read aloud to the pictures in the printed or static eBooks even if the image and words are presented simultaneously. However, making these connections is possible with digital animated storybooks. Their views are consistent with Mayer's (2021) modality principle, which suggests that children learn more from the information presented in both animation and narration. According to Mayer (2021), the animated format helps learners to process information more effectively

as they are exposed to the same information twice, which is processed into two separate channels. This reduces cognitive overload and improves learning outcomes.

Additionally, digital animated eBooks have been reported to enhance learners' attention and concentration on the presented materials (Mayor, 2021; Ritcher & Courage, 2017). In their study, Ritcher and Courage (2017) found that children read eBooks for a longer time and with higher attention than those who read printed books. Mayor (2021) points out that multimedia features like animation, sound, and music make digital materials more enjoyable as they arouse emotions and make one more attentive, which results in meaningful learning. Similarly, Verhallen and Bus (2009) found that children had higher levels of arousal when they listened to the animated e-book, as indicated by skin conductance, compared to when they listened to the static version of the e-book. Another advantage of animated materials is that they allow for repeated access to instructional materials, increasing the efficiency of the learning process (Smeets & Bus, 2014). As children listen to recorded materials repeatedly, they can memorise the materials, thereby enhancing learning.

Furthermore, in situations where adults are unable to engage in shared reading activities with children for various reasons, prior research shows that children who have not yet acquired reading skills can still independently benefit from digital animated eBooks (Dore et al., 2018; Furenes et al., 2021; Takacs et al., 2014). Takacs et al. (2014) illustrate how multimedia features in digital animated eBooks may provide scaffolding similar to that of an adult; hence, children can learn from them independently. However, some studies have demonstrated that children may not experience the same or greater benefits from using digital resources independently as they would when receiving guidance from adults (Neumann &

Neumann, 2017; Miller & Warschauer, 2014; Sega-Drori et al., 2010). For instance, Sega-Drori et al. (2010) discovered that shared reading of digital eBooks was more beneficial than children's independent reading of eBooks. In their study, Sega-Drori et al. (2010) compared word reading and the concept of print skills of children of low socioeconomic status who were exposed to four treatment conditions. They found that in children who read e-books with adult support, word reading, concepts about print, and phonological awareness skills improved more than those who read the e-book without adult support. Considering the empirical evidence presented in these studies, it can be inferred that children should only be encouraged to interact with digital instructional materials independently in circumstances where adult supervision is not feasible. The prevailing circumstances in Zambia, for instance, are such that most parents/caregivers seldom engage in reading activities with children due to factors such as parental illiteracy and poor reading culture (Kafusha et al., 2021; USAID Education Data Activity, 2020). Therefore, digital animated resources may serve as an effective instructional tool in facilitating the development of emergent literacy abilities among young children in Zambia, especially those who have not acquired the ability to read independently.

While numerous research studies have generally documented evidence that substantiates the favourable influence of multimedia features such as animation on the development of children's early literacy skills, other studies have found that certain multimedia features such as interactive hot spots, music, and sound may hinder learning if not used correctly (Reich et al., 2016; Sari et al., 2019; Takacs et al., 2015). A study by Sari et al. (2019) found that background music and sound had a negative effect on the receptive language of 4–6-year-old Turkish preschoolers. The researchers concluded that this negative effect on receptive language could have

been due to music and background sound interfering with spoken language as a result of auditory masking, which made it difficult for the children to learn the words in the story. Takacs et al. (2015) also found that some interactive features, such as hotspots, games, and dictionaries, had distracting effects on literacy acquisition in young children. Therefore, based on the findings of these studies, it is cardinal that educators and researchers exercise caution and careful judgement when integrating multimedia elements into digital teaching materials.

According to Mayer (2021), learning from digital materials is only possible if digital instructional materials align with how human beings learn. For instance, he suggests that if there is no congruency between the narration (what is said) and the animation (what is seen), if the digital tool contains details that are not essential to the story, distracting motions that have nothing to do with the story, or narrations that are not congruent with the animation, this may put too much strain on the children's working memory and may hinder learning (Mayer, 2021). This may explain why some studies have reported negative effects of multimedia materials on literacy development (Smeets & Bus, 2015). Henceforth, in order to facilitate learning in young children, scholars like Mayer (2021) and Sari et al. (2019) have emphasised the need to create digital instructional tools that take into consideration the unique ways that the science of how human beings learn.

Given the extensive integration of technology in both social and educational settings in modern society, coupled with the well-documented advantages of film-like animated resources in promoting early literacy skills in young children, the present study investigated the impact of a digital intervention programme on the emergent literacy skills of preschool school children in the Zambian context. Specifically, the study investigated the effects of digital animated stories and rhymes

on preschool children's phonological awareness skills (rhyme awareness), vocabulary, and story comprehension. The objective was to improve access to literacy resources in local languages and foster the development of emergent literacy skills in young children, empowering them to read independently and potentially easing the transition to formal reading instruction in primary school. By bolstering their early literacy abilities during the preschool years, Zambian children may be better equipped to overcome certain challenges encountered when they begin formal reading instruction. Intervention programmes that support the development of emergent literacy skills in preschool children in Zambia are limited (Jere-Folotiya, 2014). Additionally, although storytelling and rhyming have been used as teaching tools in Zambia for many years, especially in preschool classrooms, digital storytelling and rhyming are a more recent phenomenon. Consequently, there has not been much research done in Zambia on the impact of digital storytelling and rhyming on emergent literacy skills in early childhood settings.

Phonological Awareness, Vocabulary, Story Comprehension and Literacy Acquisition

Phonological Awareness. Prior to the introduction of the alphabetic principle, it may be crucial for children to have a firm grasp on the concept that words are made up of smaller components referred to as phonemes and that the combination of these phonemes results in the formation of words (Yopp & Yopp, 2009). This understanding improves the child's ability to read and construct words (Caravolas et al., 2013; Zugarramurdi et al., 2022). The ability to mentally categorise and rearrange the sounds (e.g., syllables, onsets, and rimes) that make up words is a key indicator of developing phonological awareness in a child. According to the findings of several studies, children of different linguistic backgrounds

acquire phonological awareness in more or less the same order, beginning with access to larger phonological units (e.g., rhyme awareness) and progressing down to smaller units of sound such as phonemes (Anthony & Francis, 2005; Kuppen & Bourke, 2017; Vloedgraven & Verhoeven, 2009; Ziegler & Goswami, 2005). One school of thought suggests starting with the most fundamental aspects of phonology and working your way to the more advanced ones (Turan & Gul, 2008). In line with this school of thought, this study focused on rhyme awareness skills, a component of phonological awareness skills, which is one of the earliest to develop in children as young as three (Bradley & Bryant, 1983; Kuppen & Bourke, 2017; Goswami & East, 2000).

Rhyme Awareness. Rhyme awareness is the understanding that words with identical end-sound segments (such as bat and rat) are pronounced similarly. It also involves identifying rhymes in spoken words and creating words that rhyme. Some researchers suggest that phonological awareness starts with the ability to identify and produce rhymes and that more advanced phonological skills, such as phonemic awareness, are built on this foundation (Anthony et al., 2003; Byrne & Fielding-Barnsley, 1991; Goswami, 1999; Kuppen & Bourke, 2017; Le Roux, 2016). Usually, children can identify rhyming words at a young age, sometimes as early as preschool, even before other phonological skills have fully developed (Adams et al., 2002; Heroman & Jones, 2011).

Rhyme awareness plays a vital role in literacy acquisition by enhancing phonological skills and fostering early literacy development (Gillon, 2018). The link between rhyme awareness and literacy development was first established in the 1980s by Bradley & Bryant (1983). Other studies conducted since then have also provided evidence that improving rhyming awareness skills translates to better

reading achievement (Dunst et al., 2011; Goswami, 1999; Høien et al., 1995; Harper, 2011; Singson & Mann, 1999; Wimmer et al., 1994). Furthermore, Anthony et al. (2003) and Dunst et al. (2011) suggest that rhyme awareness skills indirectly support reading development through the development of other advanced phonological skills such as segmentation and phonemic awareness, which in turn support the acquisition of reading skills. In a meta-analysis of 12 studies with a total of 5299 children aged 3 to 6, Dunst et al. (2011) found that measures of nursery rhymes (such as knowledge of, or experience with, specific nursery rhymes) were positively related to several phonological and pre-literacy skills, demonstrating that rhyme awareness skills support the development of other phonological and pre-literacy skills.

Nevertheless, the exact impact of rhyme awareness skills on reading development is a subject of ongoing debate. Some experts suggest that while rhyme awareness helps with early reading skills, it may not predict reading proficiency in later stages as effectively as segmentation and phonemic awareness, which are stronger predictors (Hatcher et al., 2004; Hulme et al., 2002; National Early Literacy Panel, 2008). Despite ongoing debate about its precise impact, researchers widely acknowledge the significant role of rhyming awareness abilities in fostering reading proficiency (e.g., Goswami, 1999; Hayes, 2001; Kuppen & Bourke, 2017). Additional research is required to enhance our understanding of the degree to which rhyming awareness skills influence reading development.

Vocabulary. Vocabulary is a key component of oral language that is crucial for reading development (Kamil & Hiebert, 2005; Suggate et al., 2017). Vocabulary has two types: expressive, which involves using words, and receptive, which involves understanding words (Rowe et al., 2012). Hart and Risley (2003)

highlighted the importance of early acquisition of vocabulary in predicting a child's language and literacy development. Hart and Risley (2003) demonstrated that the number of words a child hears and uses by age three reliably predicts their linguistic progress. Research also indicates that a child's vocabulary size at school entry strongly predicts their later language proficiency, literacy, and academic achievements (Storch & Whitehurst, 2002; Dickinson et al., 2003). Children can only comprehend what they read if they possess the necessary vocabulary, highlighting the essential role of developing oral language skills, including vocabulary, in early childhood (Senechal et al., 2006).

Story Comprehension. This study also investigated story comprehension as another aspect of developing reading skills. According to Dempsey and Skarakis-Doyle (2017), story comprehension is a vital component of effective oral language. Altun (2018) suggests that the story comprehension of pre-literate children may predict their reading proficiency in later years. Hence, it is imperative to nurture this skill in young children before they enter formal education.

Multiple resources are available to support the development of young children's phonological awareness, vocabulary, and story comprehension skills. This study proposes the use of digital animated stories and rhymes as a tool to facilitate the development of these skills in preschool children in the Zambian context. In the following subsection, traditional stories and rhymes are examined first for their role in promoting phonological awareness, vocabulary, and story comprehension. Subsequently, digital animated stories and rhymes are discussed as potential aids for fostering these emergent literacy abilities.

Stories, Rhymes, and Emergent Literacy Skills

Stories. Traditionally, parents and educators have commonly used storytelling to support children's emergent literacy skills because it can capture the interest and motivation of learners as they find it more fun and interesting (Bietti et al., 2019; Fernandez-Fei & Baker, 1997). Bus et al. (1995) and the National Reading Panel (2000) point out that children who listen and tell stories develop essential literacy skills such as phonological awareness, vocabulary, narratives, story comprehension, grammar, and written expressions, which are precursors to later reading. Logan et al. (2019) noted that storytelling allows children to hear the vocabulary and sounds of spoken words, and children learn new words that they would not otherwise hear in everyday discourse and story structures. The literature further suggests that young children learn a great deal about vocabulary and story language by repeatedly hearing the same stories (Kelley et al., 2015). Bietti et al. (2019) note that children can connect stories to their everyday lives and prior experiences, and this supports sense-making and improves early literacy skills. Hence, through activities such as the shared reading of stories, children's language and literacy development have been supported (Logan et al., 2019; USAID Data Education Activity, 2020).

Rhymes. The importance of rhymes in the acquisition of early literacy skills and reading is stressed by experts in the area of literacy and child development, who suggest that if a child knows eight rhymes by the age of four, they are among the best readers at the age of eight (Fox, 2001). Rhymes provide children with opportunities to engage in playful and developmentally appropriate ways that give them a chance to hear, identify, manipulate, and experiment with sounds in spoken words (Dayton et al., 2017; Harper, 2011), skills that are basic to learning how to

read. Kenny (2005) emphasised the significance of nursery rhymes in children's learning and development when he pointed out that “these bouncy, often nonsensical rhymes stimulate the social, emotional, physical, intellectual, and musical development of children in ways we may not realise” (p. 28). Arleo (2004) argues that the rhymes’ poetic texts work in a way that encourages children to play with language by using the same words and phrases repeatedly. Harper (2011) found that familiarity with nursery rhymes improved children’s phonological awareness and sensitivity to phonemes, which are stronger predictors of reading. Additionally, researchers Parlakian and Lerner (2010) discovered that, by singing nursery rhymes like “the wheels on the bus” and “twinkle, twinkle little star,” children were helped to understand the relationships between words and phrases, which serve as essential foundations for future literacy development. Several other studies have highlighted the importance of rhymes in children’s emergent literacy skills. Pre-schoolers’ (Lundberg et al., 1988; Read & Quirke, 2018) and four-year-olds’ (Lundberg et al., 1998) reading skills improved after being exposed to rhymes (Hatcher et al., 2004; Wimmer et al., 1994).

As evidence from research shows (Bus et al., 1995; Dickinson et al., 2012; Harper, 2011; Read & Quirke, 2018), using conventional stories and rhymes with young children may be an effective technique for fostering the development of emergent literacy skills. In recent times, there has been an increase in the use of digital animated stories and rhymes among young children as supplementary resources to conventional forms of stories and rhymes. The observed phenomenon may be attributed directly to the rapid advancements in technology that have occurred in the last few decades. Consequently, scholarly investigations have also

been undertaken to examine the influence of digital stories and rhymes on the development of emergent literacy abilities.

Digital Animated Stories, Rhymes, and Emergent Literacy

Digital animated stories and rhymes are short film-like multimodal stories and rhymes that are created by using digital technologies. Unlike traditional stories and rhymes, digital animated stories and rhymes may incorporate various multimedia elements, such as animations, narrations, sound, and music embedded in them. Other enhancements that can be added to digital stories and rhymes include interactive hypermedia elements or hotspots, such as animation that the child can activate on the touch screen (Mayer, 2021). Research has shown that children might learn more from digital stories with animation and sound effects than from static e-books and printed books (Dore et al., 2018; Verhallen et al., 2006; Willoughby et al., 2015). For instance, digital animated books were found to promote vocabulary growth more than books with just static illustrations among 5 and 6-year-olds with a Dutch background (Kegel et al., 2009).

Animated stories and rhymes have been found to be beneficial in helping preschool children develop different elements of emergent literacy skills such as phonological awareness skills (Shamir et al., 2012), vocabulary (Korat, 2009; Korat & Shamir, 2012; Roqueet et al., 2017; Segers et al., 2004), and story comprehension (de Jong and Bus, 2004; Doty et al., 2001; Ihmeideh, 2014; Korat, 2010; Lin & Li, 2018; Roque et al., 2017; Verhallen et al., 2006). Research has demonstrated that learners can grasp abstract concepts and find learning enjoyable through these film-like animated stories (Lin & Li, 2018). Incorporating audio and motion visual elements into children's stories has the potential to help children gain a deeper

understanding of the story independently and actively make meaning of the story content (Verhallen & Bus, 2010).

Additionally, multimedia features such as animations, narrations, and sounds in digital stories and rhymes can provide essential support for children's independent learning, similar to the guidance of an adult (Takacs et al., 2014). This can be particularly advantageous for children whose parents or caregivers are unable to read with them, such as due to parental illiteracy. Moreover, recent studies have demonstrated that digital animated stories and rhymes are effective in enhancing literacy skills, particularly in multilingual learners, children at risk of reading difficulties, and those from low socioeconomic backgrounds (Adams et al., 2002; Smeets & Bus, 2015; Sari et al., 2019; Takacs et al., 2015).

As the foregoing literature clearly illustrates, studies conducted in the Western (Europe and North America) and Eastern (Asia and the Middle East) worlds have demonstrated the potential of stories and rhymes in general, and digital animated stories and rhymes in particular, in supporting the development of early literacy skills (Ihmeideh 2014; Korat 2010; Lin & Li, 2018; Roque et al. 2017). Despite the increased use of digital instructional materials to support early literacy skills globally, little is known about their effectiveness in low-income countries like Zambia. Very few studies have been conducted in Africa and southern Africa (Klop et al., 2018). One may question if similar results would be found among Zambian early childhood learners due to the diverse environments in which previous studies were conducted, raising concerns about the generalisability of findings. In countries like Zambia, where teaching and learning materials are inadequate, parental illiteracy is high, and most parents/caregivers rarely read with children, digital animated stories and rhymes are crucial literacy resources that provide children with

opportunities to develop literacy skills independently. Hence, the significance of this current study.

While numerous studies have examined the impact of digital animated stories on emergent literacy, there is limited research on the influence of digital animated rhymes, especially on phonological awareness skills like rhyme awareness. The intervention was based on the premise that improving emergent literacy skills in preschool children would enhance eventual reading proficiency when children enter grade one. Specifically, the study focused on supporting phonological awareness, vocabulary, and story comprehension, as these emergent literacy skills have been shown to underpin the development of reading skills (Andersson et al., 2019; MESVTEE, 2013; Whitehurst & Lonigan, 2001; Zugarramurdi et al., 2022).

Theoretical Framework

This study examined the role of digital technology in supporting the acquisition of emergent literacy skills in preschool children from resource-constrained environments. Richard Mayer's (2005) Cognitive Theory of Multimedia Learning (CTML) serves as the theoretical framework in this research. The CTML theory explains how digital instructional tools support learning and how the design of these digital tools affects the learning process. The CTML provides a framework for using technology in the instruction of emergent literacy skills required for later reading success in formal education settings.

Cognitive Theory of Multimedia Learning

The CTML posits that people learn more effectively when information is presented using both auditory and visual formats rather than from information presented in a single medium (e.g., word only or graphic only). This is because of

the following three main assumptions on which the theory is grounded: (i) People have two separate information processing channels: visual and auditory. One channel processes auditorily presented information, and the other processes visually presented information. (ii) the two information-processing channels have limited cognitive capacity, and (iii) meaningful learning occurs when the learner processes the information presented in dual media and constructs it into knowledge. Hence, meaningful learning involves actively selecting, organising, and integrating information.

According to the CTML, the key to creating effective multimedia instructions that enhance learning is to design them to support how humans learn (Mayer, 2005, 2021). Moreno and Mayer (2010) indicate that this involves managing the complexity, volume, and order of multimedia inputs to avoid cognitive overload. By doing so, learners can better coordinate their cognitive processing and form long-term memory schemas. Ultimately, creating a multimedia message that avoids cognitive overload is crucial for successful learning. This study focused on five specific principles: multimedia, modality, redundancy, coherence, and temporal contiguity, to develop digital animated stories and rhymes to support the development of emergent literacy skills in Zambian preschool children.

Multimedia Principle. It stipulates that students learn better from materials presented in both Word and graphic formats (Mayer, 2005). The theory proposes that meaningful learning occurs when learners can make a clear connection between words and graphics. This aligns with the assumption that there are two separate information processing channels in which visual and auditory information are processed. The theory suggests that because of these two separate information processing channels, a person is likely to remember information presented in both

visual and audio formats more easily than information presented in one medium. Numerous studies (e.g., Altun, 2018; Korat & Shamir, 2008; Ricci & Beal, 2002; Sari et al., 2019; Takacs et al., 2015; Verhallen & Bus, 2010) have supported the validity of this cognitive paradigm. Ricci and Beal (2002) discovered that audio narrations without pictures resulted in poor narrative comprehension. Exposing them to the same information more than once enhances learning.

Modality Principle. The modality principle says students learn better from animation and narration than from narration and on-screen text. This is because presenting narration and on-screen text can create a split attention between animation and text, as both are first processed through the visual channel. But when words are presented as speech, they are processed in the auditory canal, freeing the visual channel for processing animation. Animated materials naturally adhere to this principle by incorporating both spoken language and visual elements. For preschool children who are still developing their language and literacy skills, this multimodal presentation can enhance comprehension and memory. Therefore, in accordance with this principle, it was hypothesised that incorporating animations and narration into stories and rhymes would assist preschool children in developing their rhyme awareness, vocabulary, and story comprehension skills. According to a study by Sari et al. (2019), using animation and narration in stories helped enhance preschool children's vocabulary and comprehension skills.

Redundancy Principle. According to the redundancy principle, it is not recommended to present the same information through both spoken words and written text. Presenting the same information through oral narration and text can distract learners and hinder their focus. To avoid redundancy and ensure effective

learning, the current study used animated stories and rhymes that only included animation and narration, without any on-screen text.

Coherence Principle. It states that learning is better when extraneous words, pictures, and sounds are excluded from the multimedia instructional materials rather than included because of the limited cognitive capacity. Sari et al. (2019) conducted a study that investigated the visual and auditory enhancements in multimedia books on story comprehension and word learning of 4-6-year-old Turkish preschoolers. Their findings show that music and background sound have a negative effect on receptive language. The researchers concluded that this negative effect on receptive language could have been caused by music and background sound interfering with spoken language due to auditory masking, which made it difficult for children to learn the words in the story. Therefore, multimedia materials must be concise to allow learners to focus on critical elements. The digital animated stories and rhymes for this current study were kept short and simple, and only relevant information was included.

Temporal Contiguity Principle. The temporal contiguity principle is another important principle to follow when designing digital educational tools. This principle suggests that learners learn better from multimedia instructional materials when corresponding words and pictures or animations are presented simultaneously rather than successively. When corresponding words and pictures are presented simultaneously, learners can hold both words and pictures in their working memory simultaneously, which is not possible when presented successively. This allows for better retention of information and enhances the learning experience. In designing materials for this study, care was taken to ensure that the visuals and narrations were presented simultaneously.

Application of the CTML Principles to the Current Study

The CTML theory was appropriate for guiding a study on the use of animated materials in educational tools for emergent literacy in preschool children. Animated materials combining spoken language with visual images are processed in two channels: visual and audio. Preschool children who are still developing their literacy skills can benefit from this dual representation, as it helps reinforce understanding and retention of information.

The study utilised educational tools that followed the CTML principles of multimedia, redundancy, coherence, and temporal contiguity to enhance children's rhyme awareness, vocabulary, and comprehension skills. Considering the assumption of the CTML theory and its principles for creating electronic books and previous studies, the multimedia elements included in the stories and rhymes were animations, narrations, music, and sound. Animated materials can be designed to manage cognitive load effectively, presenting information in a way that is not overwhelming for young learners. By controlling the complexity of animations and ensuring that they are congruent with the spoken content, educators can help children allocate their cognitive resources more efficiently, leading to better learning outcomes. The animated stories and rhymes for this study were kept simple, short, and with animations and narrations without competing text. So, in this research, the term “Nyanja digital animated stories and rhymes” is used to describe the soft copy of Nyanja stories and nursery rhymes presented on a tablet with animations, background music, sound, and narration as the only digital aspects that distinguish them from the conventional version of stories and rhymes.

Animated illustrations and oral narrations in Nyanja digital stories and rhymes

The Nyanja stories and rhymes used in this study were embedded with animated illustrations and oral narrations. The multimedia principle advocates for the presentation of digital materials in both audio and visual formats because it allows the presentation of the same information twice, which is processed in two different channels twice, enhancing learning. For instance, previous research shows that children are able to learn from independent access to animated stories (Sari et al., 2019). Animated storybooks allow children to connect the words being narrated with the corresponding images when shown together (Verhallen & Bus, 2010). However, children may not make these same connections when reading printed books, even if the image and words are presented simultaneously, especially when children are at risk for language delays, or the material is complex. To reduce the burden of decoding unknown Nyanja words and improve children's learning, the researcher presented information in both animation (visual) and narration. In doing so, the researchers expected that children's rhyming awareness, vocabulary, and comprehension skills would improve in accordance with multimedia and modality principles and previous research (Sari et al., 2019; Korat & Shamir, 2008; Takacs et al., 2015).

The animations in the stories and rhymes were highly congruent with the oral narratives, sounds, and music. For example, in the story of *the chick's feather*, the action of the eagle catching the chick appears simultaneously with the oral narration: *'An eagle caught the chick.'* As the temporal contiguity principle highlights, understanding is deeper when the verbal (in this case, narration) and non-verbal information (animation) are presented close to each other in time rather than further apart (Mayer, 2005, 2021). Research studies have provided evidence to

support this principle. For instance, a meta-analysis study conducted by Takacs et al. (2015) on the impact of technological advancements on children's vocabulary and story comprehension revealed that young children's learning improved when animation pictures were closely aligned with verbal narrations, while they struggled to learn when the animation pictures and verbal narrations were not in sync.

Sound and Background Music

The Nyanja stories and rhymes used sounds and music to illustrate feelings and moods that matched the events of the story. For instance, in the *frog and beetle* story, the sound of a frog snoring is heard when the picture of a frog sleeping appears. Previous research has indicated that music and background noise can sometimes hinder language learning by disrupting auditory processing and impeding the retention of new vocabulary (Sar et al., 2019). A study conducted by Sari et al. found that sound and background music had a negative effect on receptive language, likely due to auditory masking, which made it challenging for participants to learn the vocabulary. As a result, we have limited the use of sound and music in our current study to only the necessary instances.

Based on the difference principle, it was hypothesised that learners with low scores at baseline (who have low knowledge of the subject matter) would benefit more from listening to digital stories and rhymes than those who would score high at baseline. In accordance with the CTML, this study predicts that exposing children to animated digital stories and rhymes would enhance their vocabulary, rhyme awareness skills, and comprehension of the story. The combination of animation and narration, which are congruent in the Nyanja digital animated stories and rhymes, would boost learning. If proven effective, these materials could greatly benefit Zambian children who have limited access to adult-led literacy-promoting activities.

Statement of the Problem

Despite efforts by various stakeholders to improve literacy outcomes in Zambia, young learners continue to perform poorly on literacy tests at regional and national levels (PISA-D, 2015; 2018; USAID Education Data Activity, 2019; 2020). One key contributing factor is that many children commence grade one without well-developed emergent literacy skills due to limited exposure to materials and activities that promote emergent literacy skills in preschool years (Kafusha et al., 2021; Mwanza-Kabaghe, 2015; USAID Education Data Activity, 2020). This deficiency hampers their ability to acquire reading skills in grade school, leading to educational failure and other far-reaching consequences such as increased unemployment, poverty, and criminal behaviour (UNESCO, 2022). Thus, prioritising the development of early literacy skills during preschool is crucial for optimal literacy outcomes.

Digital instructional materials provide a promising solution to promoting early literacy skills in young children in this digital era, as several previous studies have demonstrated their effectiveness (Bus et al., 2018; Dore et al., 2018; Sari et al., 2019; Verhallen et al., 2006). However, the efficacy of these materials in the Zambian context remains largely underexplored. Given the differences in the language, technological, cultural, social, and economic contexts of earlier research, it is unclear whether digital instructional tools can be as effective in promoting emergent literacy skills in preschool children in Zambia. Therefore, the primary objective of the current study was to examine the impact of digital animated stories and nursery rhymes as educational tools for enhancing emergent literacy skills among preschool learners in Lusaka Province, Zambia. The ultimate goal was to

establish a contextual basis for advocating for digital technology to promote the development of emergent literacy skills in preschool children in a Zambian setting.

Purpose of the Study

This study investigated the potential role of digital technology in promoting emergent literacy skills in preschoolers from government preschools in the Lusaka province. Specifically, the current study aimed to record the impact of Nyanja animated digital stories and rhymes, presented through tablet technology, on preschoolers using three indicators: 1) impact on rhyme awareness, 2) impact on vocabulary, and 3) impact on story comprehension.

Objectives of the Study

The objectives of the study were as follows:

1. To investigate the effects of Nyanja digital animated stories and rhymes on the acquisition of rhyme awareness among Zambian preschoolers.
2. To determine the impact of Nyanja digital animated stories and rhymes on the acquisition of vocabulary skills in the language of instruction among preschool children in Zambia.
3. To investigate the effect of Nyanja digital animated stories and rhymes on the story comprehension skills of Zambian preschool children.
4. To determine the relationship between vocabulary pretest scores and the intervention's impact on story comprehension skills.

Research Questions

The following questions guided the study:

1. Can Nyanja digital animated stories and rhymes improve rhyme awareness skills among preschoolers in Zambia?

2. Does exposure to Nyanja digital animated stories and rhymes impact Zambian preschool children's vocabulary skills in the language?
3. Does exposure to Nyanja digital animated stories and rhymes enhance the story comprehension skills of Zambian preschoolers?
4. Is there a relationship between pretest vocabulary and the effect of the intervention on story comprehension?

Hypotheses

This research examined whether preschool children's emergent literacy skills would improve from exposure to Nyanja digital animated stories and rhymes. The intervention program (digital animated stories and rhymes) was an independent variable. The dependent variables included rhyme awareness skills, vocabulary, and story comprehension skills. The study hypotheses were formulated as follows:

1. Preschool children exposed to Nyanja digital animated stories and rhymes will show significant gains in rhyme awareness skills compared to their non-exposed peers.
2. There will be significant differences in vocabulary mean scores between preschool children exposed to Nyanja digital animated stories and rhymes as compared to those not exposed.
3. The story comprehension skills of preschoolers exposed to Nyanja digital animated stories and rhymes will be significantly higher than those of their peers who are not exposed.
4. Pretest vocabulary scores will moderate the effect of the intervention on story comprehension.

Null Hypotheses

1. Preschool children exposed to Nyanja digital animated stories and rhymes will show no significant gains in rhyme awareness skills compared to their non-exposed peers.
2. There will be no significant differences in vocabulary mean scores between preschool children exposed to Nyanja digital animated stories and rhymes as compared to those not exposed.
3. The story comprehension skills of preschoolers exposed to the Nyanja digital animated tales and rhymes will not be significantly higher than those of their peers who are not exposed.
4. Pretest vocabulary scores will not moderate the effect of the intervention on story comprehension.

Significance of the Study

This research study collected data on the impact of Nyanja digital animated stories and rhymes on the acquisition of emergent literacy skills in the language of instruction among preschool-aged children in Zambia from government-funded preschools. Government-run preschools in Zambia often face restricted access to essential educational resources such as books and other learning materials, primarily due to inadequate funding, and children who attend these schools often come from middle- to low-income families that also lack literacy materials (Chansa-Kabali, 2017). Hence, intervention studies like this one that seek to enhance the acquisition of early literacy skills among this group of children are always necessary and significant.

This study may contribute to our understanding of effective strategies for supporting early literacy development in a Zambian setting. Intervention studies

focusing on emergent literacy skills among preschool learners in Zambia are limited. Most previous studies have investigated reading skills at primary schools and the use of traditional methods of teaching. Regrettably, not much research in the country has focused on supporting emergent literacy skills in preschool, even though emergent literacy skills acquired prior to entering school have strongly been linked to later reading success (Whitehurst & Lonigan, 1998). Hopefully, the results of this study will serve as a catalyst for further research on this significant yet understudied subject in Zambia.

Furthermore, this research showcases a practical strategy (the use of digital animated stories and rhymes) that may be employed to support the emergent literacy skills of preschoolers. A study like this one that provides cutting-edge strategies for encouraging the development of early literacy skills is significant. Based on the findings of this study, parents may feel more confident in using digital animated stories and nursery rhymes with preschoolers in Zambia. The findings of this study may also encourage teachers, the Ministry of Education, (MoE) and other parties interested in early literacy in preschool settings to consider using digital instructional materials (e.g., animated stories and rhymes) as alternative supplementary resources to conventional literacy-promoting activities. Multimedia materials offer advantages in that, once produced, they can easily be shared and accessed, and as such, they tend to be cheaper in the long run. This is especially important for low-resourced countries like Zambia, where there are inadequate teaching and learning literacy materials, especially in the local language of instruction (Jere-Folotiya et al., 2014).

This study also contributes to the limited body of knowledge on using technology-enhanced instructions in general and digital stories and rhymes, in

particular, to support emergent literacy in Zambian preschool learners, which is very important for developing a curriculum for preschool and classroom practice. The results of this study can elicit additional discussion about improving the preschool curriculum in Zambia. Additionally, this study has the potential to contribute to the global conversation on the role of technology-enhanced instruction by adding literature from underexplored regions of Africa to this relatively new phenomenon. This research may inform the creation of similar digital instructional materials to support the development of emergent literacy skills in young children in Zambia and beyond. Studies like the one that investigates the effects of incorporating technology into the classroom are crucial in shaping the way we educate our young children in the twenty-first century.

Delimitation of the Study

This study examined the acquisition of emergent literacy skills in preschool children in three districts of Lusaka province. Government preschools were selected, and Nyanja was the language of instruction in all the schools. Children with special needs were not included. Multimedia elements incorporated in the intervention materials were animations, narration, sound, and background. Emergent literacy skills assessed were vocabulary, rhyme awareness, and story comprehension. The delimitations are important as they helped to narrow down the study's scope and ensure a thorough investigation of the emergent literacy skills in government-funded preschools in Lusaka province.

Limitations of the Study

For one, the nursery rhymes utilised in the study were made specifically for the study and had never been used in a preschool setting before. Thus, the results may not apply to the influence that more traditional nursery rhymes would have.

Nonetheless, the rhymes were appropriate for preschool children in this study, as they were made with the assistance of language experts and teachers who have spent many years working in preschools.

Another limitation of this study is the lack of representation of children with special education needs in the sample. This exclusion may limit the direct applicability of the study's findings to this specific group. However, this limitation also presents an opportunity for future research to expand on these findings by examining the population that was not included. By studying children with special education needs, future research has the potential to greatly contribute to our understanding of this population.

Due to the use of quantitative data collection methods, data on the participants' engagement in "on-task" activities was not collected. Collecting such data in future studies could establish a correlation between "on-task" behaviour and the learning outcomes achieved through the use of these educational materials. This could provide valuable insights into children's emotional experiences when engaging with digital stories and rhymes.

Definition of Key Terms

Emergent literacy skills. These are foundational skills that children are expected to develop before they enter school. The emergent literacy skills measured in this study were vocabulary, rhyme awareness, and story comprehension.

Multimedia. It refers to multiple forms of media that are integrated together. For instance, a combination of text, sound effects, light, animation, still images, videos, and interactive content forms (Shilpa and Sunita, 2013).

Multimedia materials. Tools that allow the combination of video and sound in

digital environments.

Digital animated stories and rhymes. In this current study, digital animated stories and rhymes refer to stories and rhymes accompanied by the following multimedia features: animation, audio narrations, background music, and sound.

Conventional literacy skills. These include advanced literacy skills such as decoding, reading fluency, reading comprehension, writing, and spelling.

Rhyme. Refers to a kind of poetry in which words with similar sounds are used in a repetitive pattern.

Literacy. A person's capacity for reading and writing. It is influenced by multiple actors, such as educational background, culture, environment, and social context (Snow, 1998).

Early childhood education. The MoE (2013) in Zambia has defined early childhood education as the education that children between the ages of 3 and 6 receive before they enrol in primary school at the age of seven. This study adopted the definition provided by the MoE (2013).

Dual-code theory. A memory and processing theory indicates that information can be stored in verbal and nonverbal forms (Paivio, 1991).

Home literacy environment. The kinds of reading-related activities and materials that are available within the context of the household, as well as the frequency with which they are used.

Resource-constrained environments. This study refers to environments that have inadequate literacy materials and literacy-promoting activities.

The Organisation of the Thesis

The first chapter of the thesis introduces the concept of emergent literacy and multimedia learning and explains the research background. The chapter also presents the statement of the problem, the purpose of the study, research questions and hypotheses, the significance of the study, limitations, and delimitation, and outlines the definition of key terms.

Chapter two presents a review of relevant literature on what is known about how multimedia-enhanced materials influence the acquisition of emergent literacy skills in young children. Specifically, the chapter describes emergent literacy skills and their role in reading acquisition. The role of traditional stories and rhymes in supporting emergent literacy skills, including vocabulary, rhyme awareness, and story comprehension, is discussed. It also looks at the potential benefits of multimedia elements in digital stories and rhymes in supporting emergent literacy. Furthermore, empirical research on the role of technology in supporting the development of different emergent literacy skills with specific references to digital stories and rhymes is discussed. Finally, the chapter summary is provided.

Chapter three outlines the methodology used to conduct this study. It describes the research design, the philosophical underpinnings on which this study was anchored, the population and study sample, sampling methods used to select the participants, data collection instruments, interventions, and general data collection procedures. The chapter also describes how the data collected for this study were analysed. The chapter ends with a description of the ethical issues considered when undertaking this study.

Chapter four provides a detailed account of the research findings. It includes descriptive statistics that offer insights into the participants' characteristics, such as

age, gender, and socio-economic status. The chapter also presents inferential statistics on the relationship between Nyanja's digitally animated stories and rhymes and emergent literacy abilities measured in the study.

In Chapter Five, the outcomes of the six-week intervention presented in Chapter Four are discussed. The discussion delves into how the findings of this study align with the literature and theoretical framework regarding the use of multimedia tools in the early years. This chapter also discusses the implications of the results and their potential influence on future research in the field.

Finally, chapter six presents a detailed conclusion of the research findings and analysis. The chapter also offers recommendations for policymakers and practitioners on using Nyanja digital stories and rhymes to improve emergent literacy skills. Additionally, the chapter discusses the limitations of the study and suggests ways in which future research can address them.

Chapter Summary

This chapter provides context for the current research as well as the motivation for conducting it. It discusses the relationship between emergent literacy skills gained prior to school entry and subsequent reading skill acquisition to illustrate the importance of promoting emergent literacy skills in preschool. The chapter also discusses low literacy skills among early-grade learners in Zambia and ties them to children's low emergent literacy at primary school entry. Zambian children's poor emergent literacy skills at school entry are explained, in part, by their home and school literacy environments, which are characterised by insufficient reading and learning resources in the language of instruction and little or no parental-child shared book reading. Digital animated stories and rhymes are proposed as viable strategies for boosting rhyme awareness, vocabulary, and story

comprehension skills among preschool children in Zambia. The multimedia elements in digital instructional materials and the cognitive theory of multimedia learning are discussed in order to demonstrate why digital animated stories and rhymes can potentially support the development of emergent literacy skills in Zambian preschoolers. The chapter also outlined the hypotheses and limitations of the study, as well as the organisation of the thesis.

CHAPTER TWO: LITERATURE REVIEW

Overview

This study investigated the impact of a digital technology intervention programme (Nyanja digital animated stories and rhymes) on the development of emergent literacy skills among preschoolers in the Zambian context. This second chapter of the thesis presents a review of relevant literature and situates the study within the existing body of knowledge about the connections between digital animated stories and rhymes and emergent literacy development. The review covers themes that are aligned with the study objectives. The chapter starts by examining the concept of emergent literacy in reading acquisition. It then discusses empirical evidence associated with using digital tools to support emergent literacy skills. Next, it reviews the literature on the effect of traditional stories and rhymes on emergent literacy development before discussing the effect of digital animated stories and rhymes on preschool children's phonological awareness (rhyme awareness skills), vocabulary, and story comprehension. The chapter also sheds light on gaps in the literature. Finally, the chapter concludes with a concise summary of the primary arguments and themes presented in the chapter.

Emergent Literacy

Emergent literacy comprises a set of fundamental skills that children acquire during the early phases of development before receiving formal instruction in reading and writing (Mkandawire, 2018; Whitehurst & Lonigan, 1998). The idea of emergent literacy is often credited to Marie Clay, a researcher from New Zealand, who initially presented it in her 1966 doctoral thesis titled "Emergent Reading Behavior." However, it was not until 1986 that the term "emergent literacy" was officially coined by William Teale and Elizabeth Sulzby (Teale & Sulzby, 1986).

The emergent literacy concept underscores the holistic development of literacy skills from infancy through early childhood and beyond (Mkandawire, 2018; Whitehurst & Lonigan, 1998). It emphasises that literacy acquisition is not confined to formal reading and writing instruction but begins as soon as a child is exposed to language and print in their environment (Pavelko et al., 2018; Teale & Sulzby, 1986). During the emergent literacy phase, children develop important emergent literacy skills, including letter knowledge, phonological awareness, vocabulary development, story comprehension, and concepts about print, which are cardinal in literacy development (NELP, 2008; Suggate, 2018).

Letter knowledge. Letter knowledge, which involves recognising and identifying individual letters of the alphabet, allows children to connect spoken language with written symbols, facilitating the transition to decoding and encoding written language (Adams, 1990; Ehri, 2013). Furthermore, letter knowledge supports quick identification and processing of letters within words, enhancing word recognition and reading fluency (Ehri, 2013).

Phonological awareness. Phonological awareness, another key component of emergent literacy, encompasses the ability to detect and manipulate the sounds of language, such as rhyming words, segmenting words into phonemes, and blending sounds to form words (Pinto et al., 2016). Robust phonological awareness skills are vital for successful reading acquisition as they establish the groundwork for grasping the alphabetic principle and decoding printed words (Adams, 1990).

Vocabulary. Vocabulary development is also critical during the emergent literacy phase, as it expands children's language comprehension and expression (Kamil & Hiebert, 2005). An extensive vocabulary empowers children to comprehend and communicate effectively, enhancing both oral and written

communication skills. Furthermore, vocabulary knowledge is closely linked to reading comprehension, as readers must comprehend the meanings of words encountered in text to understand what they are reading (Snow, 1991).

Story comprehension. Story comprehension is crucial in emergent literacy, requiring children to grasp narrative elements like plot, characters, and event sequences (Hamoud, 2022). By immersing themselves in stories and narratives, children enhance their predictive abilities, infer meanings, and grasp the structure of written texts, establishing essential comprehension skills for future reading success.

Concept about print. The print concept is critical for emergent readers as it imparts knowledge of how written language operates (Adams, 1990; Pavelko et al., 2018). These concepts include understanding that written language represents spoken language, recognising that words are made up of letters, and understanding the conventions of reading and writing, such as directionality and punctuation. All these skills are precursors to reading development (Pavelko et al., 2018).

Emergent literacy skills develop in the early years through activities like holding books, labelling images, and listening to stories (Saracho, 2017). Children's early literacy skills progress predictably through different developmental stages as they mature (Manosalba-Torres, 2023). As children grow older, they develop more advanced emergent literacy abilities, and their play often involves activities like pretending to read, drawing, and connecting stories to real-life events (Ehri, 2001, 2013; Manosalba-Torres, 2023). As children's emergent literacy abilities develop, they form perspectives, behaviours, and habits related to reading and books that affect their personal growth (Manosalba-Torres, 2023). For instance, print motivation can start with basic book interactions and evolve into a true love for reading, underscoring the critical need for early support in skill development.

The Importance of Emergent Literacy Skills

Since its inception, the concept of emergent literacy has gained significant importance in early childhood education, as both educators and researchers recognise the significance of supporting children's development in this field (Ehri, 2013; Pavelko et al., 2018; Scarborough, 1990). Prior research has elucidated the profound impact of emergent literacy skills on later reading proficiency and academic success (Bigozzi et al., 2016; Hannon et al., 2019; Piasta et al., 2018; Scarborough, 1990; Suggate et al., 2017). Longitudinal studies have shown that children who develop strong emergent literacy skills in preschool are more likely to excel in reading as they progress through school (Lonigan et al., 2000; Pinto et al., 2017; Scarborough, 1990; Suggate et al., 2017).

Suggate et al. (2017) conducted a longitudinal study that investigated the relationship between vocabulary, early literacy skills, oral narrative, and reading comprehension over a period of 15 years. The study involved a sample of 58 children from New Zealand who were assessed from 19 months of age until the age of 16. Of the original sample, 51 participants remained part of the study at 16 years of age. This unique dataset allowed for the examination of the connection between language and reading from infancy to adolescence by measuring children's vocabulary eight times and their oral narrative skills, letter identification, and word reading before and after school entry. Oral reading fluency and reading comprehension were measured when the children were 12 and 16 years old. The findings of the study suggest a significant correlation between specific early language and reading skills over time. Vocabulary at 19 months predicted early literacy skills before school entry and reading comprehension at 12 years old. School entry literacy skills were also found to predict reading comprehension at 12

years old. Moreover, children's oral narrative skills around school entry were uniquely related to reading comprehension ten years later, even when controlling for maternal and infant vocabulary. The study provides new evidence for the long-term interplay between early language, literacy, and later reading and vocabulary development. Earlier studies (i.e., Lonigan et al., 2000; Scarborough, 1990) reported similar results.

Lonigan et al. (2000) conducted a study that presented evidence supporting the association between emergent literacy skills acquired during the preschool years and subsequent reading proficiency in primary school. Their study examined the combined and distinct predictive importance of emergent literacy abilities on subsequent emergent skills and reading performance in two samples of preschool-aged children. The participants in the study were recruited from families with middle- to upper-income levels. The one group of participants consisted of 96 children with a mean age of 41 months, all in the early stages of preschool education. The second group comprised 97 preschool children in the late stage of preschool, with an average age of 60 months. Children in both groups were assessed on various aspects of emergent literacy skills, including letter knowledge and phonological awareness skills in preschool and grade one. The study's findings indicated a notable progression in acquiring emergent literacy skills, specifically in letter knowledge and phonological awareness, from the end of preschool to grade one. Letter knowledge and phonological awareness accounted for 54% of the variance in children's decoding abilities in grade one.

Scarborough (1990) followed 52 children living in New Jersey, aged 2 and 5, for two years. At the baseline, 34 out of 52 were found to be at risk of reading difficulties. Of these, 22 (65%) were found to have developed substantial reading

problems by the end of grade 2, showing that children's early reading difficulties tend to remain as they progress through school. In the absence of proficient reading abilities, children's academic performance is adversely impacted, leading to a higher likelihood of school disengagement and ultimate dropout. Hence, it is imperative to identify children who exhibit emergent literacy difficulties and provide appropriate support for cultivating these skills during the preschool period.

Some emergent literacy skills have been reported to possess greater predictive value for subsequent reading abilities than others (Lonigan et al., 2000; NELP, 2008). For instance, Lonigan et al. (2000) found that letter knowledge and phonological sensitivity (i.e., sensitivity to words, syllables, onset-rime, and phonemes) acquired at the end of preschool predicted reading in grade one more print concepts. Similarly, in 2008, the Nation Early Literacy Panel in the United States identified alphabet knowledge, phonological awareness, phonological memory, rapid automatic naming of letters and numbers, and rapid automatic naming of objects and colours as stronger predictors of later reading. The concepts of print, print knowledge, reading readiness, oral language, and visual processing were reported to have a moderate effect. Maurine et al. (2021) and Paris (2005) found that the acquisition of meaning-making skills, such as oral language proficiency, vocabulary knowledge, and story comprehension, moderately affected the development of reading abilities. According to Pavelko et al. (2018), these basic abilities not only build the platform for effective literacy acquisition but also develop a lifetime love of reading and learning.

Ultimately, fostering early literacy skills creates opportunities for children to become confident, articulate individuals who appreciate the power of language to connect and transform ideas into action. Therefore, all these skills need to be

enhanced for children to have a strong foundation for future reading acquisition. This study focused on supporting phonological awareness, vocabulary, and comprehension skills in preschool children.

Phonological Awareness

Phonological awareness has been identified as a reliable indicator of a child's early literacy development (Adams, 1990; Lonigan et al., 2000; Melby-Lervg et al., 2012; NRP, 2000). Adams (1990) identified five categories of phonological awareness skills, which include rhyming, alliteration, comparing and contrasting sounds, blending, and segmenting syllables, and manipulating phonemes. The NRP (2000) argues that to become a successful reader, one must first acquire a strong foundation in phonological and phonemic awareness. Previous studies (e.g., Correia, 2010; Zugarramurdi et al., 2022; Lonigan et al., 2000; Wagner et al., 1997) have demonstrated that children who possess the capacity to manipulate and reflect upon phonemes are likely to experience enhanced proficiency in reading. Additionally, studies have shown that when phonological awareness is promoted in the early years, it facilitates easier letter-phoneme connections, making the learning process of reading simpler. For instance, the study by Lonigan et al. (2000) found that the phonological awareness of children at the end of preschool contributed to a 25% variance in children's decoding skills in grade one.

Further, research has demonstrated that children from diverse linguistic backgrounds exhibit similar patterns of development in acquiring phonological awareness skills (Turan & Gul, 2008). This developmental sequence typically commences with the recognition of larger phonological units (rhyme awareness, syllables) and gradually progresses towards the smaller and more complex units, such as phonemes. According to research by Bradley and Bryant (1983), children as

young as 2 years old can already recognise syllables and rhymes in words. However, children aged 5 and 6 were the first to recognise phonemes, supporting the idea that larger phonological awareness skills, such as rhyming knowledge, precede smaller phonological units, such as phonemic knowledge. Similar results were observed in a study conducted by Byrne and Fielding-Barnsley (1991), who compared how well young children could recognise rhymes and starting phonemes. They discovered that 60% of the children (N = 128) passed the rhyme awareness questions, while only 29% passed the phoneme questions, further supporting the notion that rhyme awareness skills precede the development of higher phonological skills like phonemic awareness. Turan and Akolu (2008) have suggested that it would be beneficial for the development of phonology to begin with the most basic building blocks of the discipline before going into the more sophisticated ones. In line with this argument, this study targeted rhyme awareness skills, a subset of phonological awareness that has been shown to emerge as early as age three (Bradley & Bryant, 1983).

Rhyme Awareness. Wimmer et al. (1994) examined whether or not 6-7-year-old children's rhyming awareness was equally important for learning to read German as it was for learning to read English. They assessed the children's reading and spelling skills at the end of kindergarten and again when the children were 10 years old. By the end of first grade, rhyming knowledge was just a mild predictor of success in reading and spelling, but by the end of third and fourth grade, it was a strong predictor. The researchers argued that rhyming awareness was initially a weaker predictor of reading and spelling, as German children rely mostly on indirect word recognition via grapheme-phoneme translation and blending during the first phase of learning to read. They further speculated that rhyming awareness's

beneficial effect on forming mental representations of written words might account for its increased predictive effectiveness. Similarly, research conducted by Harper (2011) showed that being familiar with nursery rhymes helps to improve children's phonological awareness and sensitivity to specific phonemes, and it also accelerates the development of phonemic skills. According to the study conducted by Dunst et al. (2011), exposure to nursery rhymes has a positive impact on children's development, independent of their age or developmental state. This suggests that the introduction of nursery rhymes during the early years of preschool may have a lasting effect on the development of literacy-related skills in later stages.

Furthermore, some scholars suggest that rhyme awareness skills indirectly support reading development through the development of other advanced phonological skills such as segmentation and phonemic awareness, which in turn support the acquisition of reading skills (Anthony et al., 2003; Dunst et al., 2011; Ziegler & Goswami, 2005). In a meta-analysis of 12 studies with a total of 5299 children aged 3 to 6, Dunst et al. (2011) found that measures of nursery rhymes (such as knowledge of, or experience with, specific nursery rhymes) were positively related to several phonological and pre-literacy skills, demonstrating that rhyme awareness skills support the development of other phonological and pre-literacy skills.

Jing et al. (2019) conducted research that found a link between children's vocabulary development and their ability to recognise rhymes. The study involved 15 five-year-old children with normal hearing and showed that those with strong vocabulary skills also had better rhyme awareness than those with lower vocabulary skills. Other various studies have demonstrated a strong connection between phonological processing abilities and the size of one's vocabulary. For instance,

Edwards et al. (2004) and Munson et al. (2005) have highlighted this correlation. Metsala (1999) also discovered that one's proficiency in phonological awareness tasks was influenced by a combination of factors, including overall vocabulary size, age of word acquisition, and neighbourhood density. In Zambia, there are no known studies that have investigated rhyme awareness skills in preschool children, despite the role that rhyme awareness skills play in reading development. This underscores the importance of conducting the present study.

Vocabulary

Empirical research underscores the predictive nature of vocabulary acquisition for later language development, literacy, and academic performance (Senechal et al., 2006). Studies have shown that a child's vocabulary upon entering school is a significant predictor of their eventual language proficiency and literacy skills (Hart & Risley, 2003; Storch & Whitehurst, 2002; Dickinson et al., 2003). Marulis and Neuman (2013) stipulate that children's vocabularies start developing from a very young age, even before they can speak, and early acquisition of vocabulary correlates significantly with reading comprehension abilities, which persist throughout primary and secondary education. By the age of five, most children can comprehend over 10,000 words and use approximately 2,100 to 2,200 words themselves (Klarowska, 2011). As children learn new words, they become better equipped to comprehend and interpret written texts when they start reading. Additionally, their ability to create and develop oral and written stories also improves. There are two significant implications of vocabulary for aspects of literacy development, specifically in relation to phonological awareness and story comprehension.

Vocabulary and phonological awareness. A child's vocabulary size has been reported to influence their phonological awareness (Walley et al., 2003; Verhallen & Schoonen, 1993). As a child's vocabulary expands, they learn to deconstruct words into their individual phonemes, one of the stronger predictors of later reading (Walley et al., 2003). A study of typically developing 3-year-old children found that receptive and expressive language predicted concurrent scores on a composite phonological measure (Chaney 1992, 1994). In another study, kindergarten's general oral language skills (composed of receptive and expressive language, syntax, and morphology) predicted phonological awareness (Cooper et al., 2002). Therefore, helping a child build a large vocabulary throughout the preschool years is essential, as vocabulary also contributes to the development of other critical literacy skills, such as phonological awareness skills, as empirical research has shown.

Vocabulary and comprehension. Vocabulary is also related to story and reading comprehension (Collins, 2016; Senechal et al., 2006). Research indicates a positive correlation between vocabulary proficiency and reading comprehension skills, underscoring the significance of vocabulary instruction in enhancing overall literacy abilities (McKeown & Beck, 2017; National Reading Panel, 2000). Story comprehension necessitates a strong foundation in vocabulary knowledge, as individuals must grasp word meanings to comprehend narratives effectively (McKeown & Beck, 2017). Senechal et al. (2006) suggest that children can only make sense of the content they read if they have the vocabulary. Good vocabulary positively affects comprehension, which will, in turn, facilitate the acquisition of new vocabulary (Collins 2016). Therefore, supporting the development of oral language skills, such as vocabulary, in the early years is essential. To support

vocabulary development in young children, parents and educators can provide rich language experiences such as reading to them, engaging in conversation, exposing them to a variety of words in different contexts, teaching children how to use a dictionary, and encouraging them to ask questions. Repeated exposure to new words can also enhance children's vocabulary and language skills. When children encounter unfamiliar words multiple times, they are more likely to remember and understand them, which allows them to expand their knowledge and comprehension of language.

Story Comprehension

In addition to the above skills, story comprehension is another crucial component of emergent literacy. Story comprehension involves a child's ability to understand and make sense of the plot, characters, and sequence of events in a story (Hamoud, 2022). Furthermore, story comprehension, characterised by the ability to understand and analyse stories, is an essential component of emergent literacy (Altun, 2018). Proficiency in story comprehension requires various cognitive abilities, including character recognition, understanding of relationships, perspective-taking, inferencing, thematic analysis, and working memory (Chaturvedi, 2016; Tompkins et al., 2013). Research suggests that the capacity of preliterate children to engage with stories may serve as a precursor to their future reading abilities (Altun, 2018). Therefore, supporting the development of narrative comprehension skills in young children is paramount long before they enter formal schooling (Dempsey & Skarakis-Doyle, 2017). Research suggests that the capacity of preliterate children to engage with stories may serve as a precursor to their future reading abilities (Altun, 2018). Therefore, supporting the development of narrative

comprehension skills in young children is paramount long before they enter formal schooling (Dempsey & Skarakis-Doyle, 2017).

The process of story comprehension encompasses many cognitive tasks, such as character identification, understanding the connections between characters, monitoring the narrative, engaging in perspective-taking, forming inferences, extracting major concepts, and using one's working memory capacity (Dempsey & Sharakis-Dyle, 2017; Tompkins et al., 2013). Altun (2018) posits that pre-literate children's story comprehension skills may serve as an early sign of their eventual capacity for reading comprehension. Additionally, the ability of preliterate children to have a more in-depth grasp of stories may be an early sign of their subsequent reading proficiency (Altun, 2018; Collins, 2016; Martucci, 2016). Children with strong story comprehension skills can understand a story's plot, characters, and sequence of events. This skill is essential for developing reading comprehension skills, which are critical for success in school and later in life. Children who have trouble reading sometimes have trouble understanding what they read, which shows in their inability to recount stories they have read (Merritt & Liles, 1987; Naremore et al., 1995). Hence, it is essential to support the development of the story comprehension abilities of young children who have not yet acquired reading skills long before they start school.

The use of stories and rhymes has been employed to facilitate the development of several emergent literacy skills, including phonological awareness, vocabulary acquisition, and narrative comprehension, which are the emergent literacy skills of interest in this study. Shared reading of stories has been used to support children's language and literacy development (Logan et al., 2019; USAID Data Education Activity, 2020). Logan et al. (2019) posts that children who are

never read to at home are exposed to approximately 300,000 fewer words than those who are read to daily from infancy to age five. The importance of shared reading is also underscored by the USAID Data Education Activity (2020) study, which reported that Zambian preschool children whose parents or family members read to them performed approximately 4% higher compared to their counterparts who were not read to. In contemporary society, children are not only exposed to conventional stories and rhymes but also to digital ones (Smeets & Bus, 2015; Takacs & Bus, 2016, 2019).

Emergent Literacy in Zambian Children

The few studies that have looked at preschool children's emergent literacy skills in Zambia have revealed that most children don't have a solid foundation in the area (Kafusha et al., 2021; Mwanza-Kabaghe, 2015; USAID Education Activity, 2020; Zimba, 2011). A study conducted by Zimba (2011) investigated how ECE centres support the development of children from urban preschools in Kasempa and Solwezi districts. The study revealed that children had poor emergent literacy skills. The study also reported that it was uncommon for children to receive regular reading sessions, including shared reading experiences. Mwanza-Kabaghe et al. (2015) conducted a study in Zambia to determine whether preschool attendance had any impact on later reading success. The study involved 216 children, 118 of whom had attended preschool. The children were assessed at the beginning of grade one and eight months later. Surprisingly, the researchers found that preschool attendance had a negative impact on the development of reading skills by the end of first grade, even after accounting for the initial level of basic literacy skills. One explanation for this unexpected result is that the instructions in the preschools that these children attended were in English, while in grade one, the children were taught in a local

language. This language shift may have led to confusion, affecting how these children acquired reading skills. Fortunately, in 2013, the government introduced government preschools where instructions are given in a local language (MESVTEE, 2013). This development ensured that children learn in a local language from preschool to grade one, thus eliminating the problem of language shift from preschool to grade one.

Since the implementation of Zambia's literacy policy in 2013, which advocates for teaching in local languages from preschool to grade four (MESVTEE, 2013), studies have demonstrated the positive impact of preschool education taught in local languages on the early literacy skills of young children (Amber et al., 2018; Mofu et al., 2023; USAID Education Activity, 2020). However, these same studies have also brought to light significant areas for improvement, indicating that preschools are not fostering early literacy skills to the desired extent. Amber et al. (2018) examined preschool participation and letter learning across 16 countries, Zambia being among them. Findings in Zambia revealed statistically significant differences between children with preschool experience and those without preschool in lower-level literacy skills, but it wasn't statistically significant for higher-level reading skills. Learners who had been in pre-primary programmes were able to name an average of 1.99 more letter sounds correctly per minute in second grade than those who had not been in pre-primary programmes. Also, students who had been in pre-primary school correctly read an average of only 0.64 more words per minute in second grade than students who had not been in pre-primary school. However, the overall average score was low even among those with pre-primary experience (4.51 letter sounds total in second grade). According to the researchers, the measured improvement in performance is insufficient to qualify as either a statistically

significant or meaningful improvement. Nevertheless, the majority of the studies presented primarily concentrated on comparing outcomes among children who had completed preschool. There is a need for more research among Zambian preschool children to understand pre-literacy skills better and provide appropriate programmes that promote early literacy in these young children.

The studies explored within this thesis and several other studies have illustrated the importance of emergent literacy skills in promoting the development of reading skills (Septiani & Syaodih, 2020). Understanding the critical components of emergent literacy and their predictive validity for subsequent literacy attainment is crucial for informing educational practices and interventions to foster early literacy development. Educators and policymakers can lay a solid foundation for lifelong literacy success by addressing emergent literacy needs early on. This, in turn, can positively impact academic achievement, cognitive development, and overall well-being.

Early exposure to a literacy-rich environment and engagement in language-rich activities are paramount for nurturing emergent literacy skills (Suggate, 2018). By nurturing these skills during infancy and early childhood, caregivers and educators lay the foundation for a lifetime of learning and personal growth. In line with this, this study explored the use of digital animated stories and rhymes in supporting three key emergent literacy skills: phonological awareness (such as rhyme awareness), vocabulary development, and story comprehension, which have been linked to successful reading acquisition (Lonigan et al., 2000; Suggate, 2018).

Digital Technology in Early Childhood Education

For some time now, researchers have been exploring the potential of digital instructional materials like digital stories to enhance emergent literacy skills in

young children. These studies have examined different areas, such as the media types (e.g., static eBooks versus animated ones) that are most effective in supporting specific emergent literacy skills, such as vocabulary, story comprehension, language acquisition, and phonological awareness (de Jong et al., 2004; Paciga, 2015; Sung & Chen, 2019; Underwood & Underwood, 1998). These investigations have resulted in a number of important discoveries regarding the use of digital technology in promoting young children's emergent literacy skills. For instance, multiple studies have demonstrated that multimedia instructional tools have the potential to enhance early literacy skills in young children (Doty et al., 2001; Ihmeideh, 2014; Altun, 2018; Oakley et al., 2020; Segers et al., 2004; Shamir et al., 2012; Verhallen et al., 2006).

Furthermore, research has indicated that animated digital instructional materials have the potential to enhance emergent literacy skills to a greater extent than static eBooks in young children who have not yet developed independent reading abilities (Dore et al., 2018; Verhallen, Bus, & De Jong, 2006; Willoughby et al., 2015). Film-like animated stories have been shown to help learners grasp abstract concepts and make learning entertaining (Lin & Li, 2018; Verhallen et al., 2006). Verhallen et al. (2006) analysed the effect of book-based animated stories on narrative comprehension and linguistic abilities using a sample of sixty-five-year-olds studying Dutch as a second language. Participants were randomly allocated to one of four experimental conditions and two control conditions. The results showed that although the children benefited from repeated exposure to static eBooks, they benefited more from the animated version. Each version of the story (static and animated) was read out in the same voice and shown on a computer screen. The researchers concluded that the multimedia features in the animated story, which

included motion pictures, audio, and music, helped to increase the intensity of the portrayed events. The researchers further indicated that incorporating multimedia was very helpful in learning about the story's implicit parts, such as the goals or motives of the main characters, as well as expanding vocabulary and improving grammar. The superior value of multimedia books was emphasised in this study, showing that incorporating audio and motion visual elements into children's stories, for example, can help them understand the story independently and actively make meaning of the story content.

Other subsequent investigations have reported similar results to those of Verhallen et al. (2006). For instance, digital animated books were reported to promote vocabulary growth more than eBooks with just static illustrations among 5 and 6-year-olds with a Dutch background (Kegel et al., 2009). Roque et al. (2017) also obtained similar results when they studied Filipino preschoolers aged 4 years. The children in the study's experimental group, who listened to animated e-storybooks, outperformed their counterparts in the study's control group, who read printed storybooks. In a more recent study, Li (2020) found that enhanced stories (with animation, music, sound, and narrations) supported the vocabulary and story comprehension skills of 3- to 6-year-old children in the Southwest part of the United States. The studies further substantiate the effectiveness of digital animation multimedia learning resources. Several other studies have investigated the effect of these digital animated resources on emergent literacy skills such as phonological awareness skills, vocabulary, and story comprehension (Marsh et al. 2017).

Therefore, digital technology provides exciting prospects to support early literacy skills in the preschool years. Educational applications, digital storytelling tools, and other digital resources may help with emergent literacy development by

providing activities that increase language and literacy abilities (Marsh et al. 2017). However, successful incorporation of digital technology in preschool education requires careful consideration of contextual elements (Marsh et al., 2017). The study focused on the use of digital animated stories and rhymes to support emergent literacy skills in preschool children.

Stories, Rhymes and Acquisition of Emergent Literacy Skills

Stories and Emergent Literacy Skills

Extensive research has consistently demonstrated the beneficial impact of traditional storybooks on the enhancement of vocabulary, comprehension, and other crucial early literacy skills (Mol, Bus, de Jong, 2009; NLF, 2008). Bietti et al. (2019) note that connecting stories to everyday life and prior experiences helps children with sense-making and improves early literacy skills. According to Logan et al. (2019), children are exposed to new words through stories that they may not hear in everyday conversations. Additionally, Kelley et al. (2015) discovered that reading storybooks aided in the enhancement of vocabulary and comprehension skills. In their study of 18 four-year-old children, the experimental group was exposed to nine stories while the control group was not. The results indicated that the experimental group significantly outperformed the control group in vocabulary and comprehension skills, providing evidence that stories support the development of these abilities. The effect size on vocabulary was large, while that on story comprehension was moderate. Loftus et al. (2010) and other studies have similarly shown the positive effects of stories on emergent literacy. Therefore, stories can serve as effective tools to promote emergent literacy skills among young children.

Nursery Rhymes and Emergent Literacy Skills

Considerable research on the effectiveness of rhymes in fostering early literacy skills has reported a positive association between young children's knowledge of rhymes, phonological awareness, and emergent reading (Bradley & Bryant, 1983, 1985; Dunst et al., 2011; Goswami, 2019). Numerous scholarly investigations have explored the developmental process by which typically developing preschool-aged children acquire the capacity to perceive and identify rhymes (Bradley & Bryant, 1983; Fibriasari et al., 2021; Meadows, 2003). Arleo (2004) argues that the rhymes' poetic texts work in a way that encourages children to play with language by using the same words and phrases repeatedly. Rhymes allow children to participate in playful and developmentally appropriate ways, allowing them to hear, recognise, manipulate, and experiment with sounds in spoken words (Dayton et al., 2017; Harper, 2011), which are essential abilities for learning to read. Also, researchers Parlakian and Lerner (2010) discovered that by singing nursery rhymes, young children understood the relationships between words and phrases. According to Fox (2001), children who know eight rhymes by the age of four are among the best readers by the age of eight.

Several other studies have found a positive correlation between familiarity with nursery rhymes and reading proficiency among children of different ages (Bryant et al., 1989, 1990; Byrne & Fielding-Barnsley, 1991; Gathercole et al., 1991; Goswami, 1999; Jing et al., 2019; Kuppen & Bourke, 2017; MacLean et al., 1987; Le Roux, 2016; Read & Quirke, 2018). Kuppen and Bourke (2017) conducted a study that demonstrated a predictive relationship between children's acquisition of nursery rhymes at three years old and their ability to read words at six years old. Another study by Bryant et al. (1990) found that children's scores on rhyme and

alliteration tests taken when they were 3 and 4 years old were significantly correlated with their reading skills two years later. Additionally, the research conducted by Gathercole et al. (1991) unveiled a noteworthy association between the performance of preschool-aged children on a rhyme-oddity identification test and a multiple-choice evaluation of their reading proficiency. This finding remained consistent even after controlling for variables such as age, verbal memory, and IQ. Research has also shown that nursery rhymes support the development of certain emergent literacy skills that are fundamental to the process of reading acquisition, such as phonological awareness skills (Harper, 2011) and vocabulary (Horst et al., 2011).

Rhymes and Phonological Awareness. Exposure to nursery rhymes has been shown to improve phonological sensitivity (Goswami, 2019; Bryant et al., 1989; Harper, 2011). A study by Harper (2011) found that being familiar with nursery rhymes improved children's phonological awareness and sensitivity to phonemes, which are stronger predictors of reading. A seminal study by Bryant et al. (1989) examined the relationship between familiarity with nursery rhymes, phonological awareness, and reading proficiency among 64 children who spoke English at home. The participants in the study were within the age range of 2.9 to 3.9 years at the start of the research. The ability to repeat well-known nursery rhymes was used to measure rhyme awareness. Rhyme identification, word-initial phoneme identification, and word-final phoneme identification tests were used to assess phonological awareness. Object reading, spelling ability, intellect, and vocabulary competency were also included in the research. For four years, the abilities were evaluated annually. These skills were assessed annually for four years. The results of this study demonstrated a strong correlation between early exposure

to nursery rhymes and later phonological and reading skills. The researchers concluded that listening to rhymes had no direct impact on developing reading skills. Knowledge of nursery rhymes influenced phonological awareness levels, which in turn influenced the development of reading skills.

As shown by previous studies, exposure to nursery rhymes enhances phonological abilities, including rhyme awareness skills. Research has shown that children who possess familiarity with the sounds of a language tend to acquire reading skills at a faster pace and with less cognitive exertion (Goswami, 2019; NRP, 2000; Yopp, 1995). Therefore, exposure to nursery rhymes may be necessary for phonological awareness and reading skills.

Rhymes and vocabulary. Researchers have also found that nursery rhymes aid in the development of other early literacy abilities, such as vocabulary (Horst et al., 2011). Research indicates that using rhyme in text can enhance vocabulary retention, particularly when new words are presented at the end of rhyming stanzas (Horst et al., 2011; McLeod & McDade, 2011). Revisiting books can aid children in two ways: it enables them to encounter unfamiliar words repeatedly and has been found to aid in their retention of these new words (Horst et al., 2011; McLeod & McDade, 2011; Sénéchal, 1997). Prior studies on the impact of rhyme on vocabulary acquisition during group reading, however, have only focused on immediate recall after a single session rather than repeated exposure over several days.

The preceding discussion has shown empirical findings that provide credence to the idea that exposure to traditional stories and nursery rhymes may confer potential benefits in several emergent literacy areas, including phonological awareness, vocabulary acquisition, and story comprehension skills (Goswami, 1990; 2019; Horst et al., 2011; McLeod & McDade, 2011). Given the widespread use of

digital instructional tools among contemporary preschoolers, this study set out to examine the effect of digital versions of traditional stories and nursery rhymes on these skills. The following part is dedicated to research focused on the impact of digital stories and rhymes on emergent literacy development.

Digital Animated Stories, Rhymes, and Rhyme Awareness

Despite the existence of various studies examining digital animated stories and rhymes on emergent literacy skills, there is a scarcity of research investigating the impact of digital instructional materials and, specifically, digital animated stories and rhymes on phonological awareness skills. Nevertheless, few studies that have investigated this aspect have reported positive results (Segers & Verhoeven, 2015; Wood, 2005). For instance, a study by Wood (2005), which compared the effects of ebooks on the phonological awareness skills of 80 kindergarten children, revealed no significant differences between the traditional book condition and the electronic storybook condition on general phonological awareness skills. However, further evaluations revealed that the e-storybook condition led to much superior increases in rhyming awareness.

Additionally, Shamir and Lifshitz (2013) measured the effect of eBooks on the rhyming skills of 77 Hebrew-speaking kindergarteners aged 4.5–7.0 from Israel at risk of learning disabilities. Their results show that rhyming skills for both groups of respondents who used the e-book (eBook with metacognitive guidance and eBook without metacognitive guidance) improved significantly compared to the control group. Improvements in rhyming were most noticeable in the experimental group that got metacognitive assistance as part of their e-book experience. Similarly, Segers and Verhoeven (2015) conducted a study to determine if computer-based intervention could improve the phonological awareness of Dutch-speaking

kindergarteners in the Netherlands, both native and immigrant. The programme was administered once a week for 15 minutes throughout the school year, and the children's phonological awareness skills were tested before and after the intervention, as well as in first grade. The results indicated that the intervention significantly improved the children's ability to rhyme.

In another study, Schryer et al. (2015) examined how a reading intervention utilising animated books affected the early literacy development of 3–5-year-old children. The study used a pre- and post-test quasi-experimental design and implemented twenty 15-minute DVD video lessons on animated book reading in a centre-based childcare setting. The results showed that children who received the intervention improved in different aspects of emergent literacy, including rhyming. In this study, explicit methods were used to support rhyme awareness skills.

Given the paucity of studies that have focused on rhyme awareness skills, further studies are required to verify the effect that digital programmes have on phonological awareness abilities, particularly rhyme awareness. This study hopes to make a valuable contribution to the existing body of knowledge on this topic.

Vocabulary Acquisition through Digital Animated Stories and Rhymes

Multiple studies have shown that digital stories and rhymes can foster vocabulary learning in young children (Korat, 2010; Sari et al., 2019; Smeets & Bus, 2015; Zhou et al., 2017). It has been found that digital storybooks with video features are especially helpful in encouraging young students to expand their vocabularies (Korat & Shamir, 2008; Takacs et al., 2015; Verhallen et al., 2006; Verhallen & Bus, 2010). Takacs et al. (2015) studied the effect of technology-enhanced storytelling on children's literacy development compared to traditional storybook reading. The findings of the study indicated that the incorporation of

technology-enhanced multimedia components, such as animation, music, and sound effects, improved vocabulary. Sun et al. (2019) obtained similar results when they studied the effects of an “animated eBook” on the Mandarin language skills of 1024 Singaporean children aged four and five. The results indicated that in the narrative of one of the stories, the children in the animated condition outperformed those in the static e-book condition on vocabulary.

Zhou and Yadav (2017) conducted a study that compared the impact of multimedia story reading and questioning techniques on children's vocabulary acquisition and engagement with traditional paper book reading. The study included 72 participants who were randomly assigned to one of four conditions: paper book reading, paper book reading with questioning, multimedia story reading, and multimedia story reading with questioning. The findings revealed that multimedia storytelling was effective in improving children's vocabulary acquisition.

Smeets and Bus (2015) show that eBooks have the potential to support the development of vocabulary among children with advantaged backgrounds. Smeets and Bus (2015) investigated how various aspects of electronic storybooks influenced pre-primary children aged 4-5 years' vocabulary growth and story comprehension. The three types of electronic books investigated were: (a) static electronic books that included a reading-aloud feature but lacked visual or audio animations; (b) animated electronic books that included a reading-aloud feature as well as visual and audio animations; and (c) interactively animated electronic books that included a reading-aloud feature and integrated hotspots that displayed unfamiliar words upon activation. The results showed significant treatment effects on vocabulary. The vocabulary expansion from reading interactive animated e-books was the greatest, followed by (noninteractive) animated e-books and, finally, static e-books. Based on

the findings, the two researchers suggested that interactive animated e-books would be the most beneficial e-book to use in the classroom to support the development of early literacy skills. As children repeatedly listen to the same words in the digital animated stories and rhymes, they develop better word pronunciation and learning. In addition, when children repeatedly listen to the same stories and rhymes, their vocabulary is expanded, especially for second language learners and children from low socio-economic status. Multimedia elements in digital animated stories and rhymes assist children in connecting spoken words to image-enhancing vocabulary (Mayer, 2001, 2021).

Nonetheless, some other studies found no effect of digital books on vocabulary (Roque, 2017; Silverman, 2013). A study by Silverman (2013) explored the role of video in vocabulary learning among 78 kindergarten classrooms that included children from low-income and dual language learning backgrounds. The first study (n = 78) compared the effect of watching videos to that of reading books on vocabulary learning, while the second study (n = 89) compared the effect of repeatedly watching videos to that of watching them only once. The results indicated that there was no significant difference in vocabulary learning between the video viewing and book reading conditions. However, when it came to repeated viewing of videos, children displayed higher gains in vocabulary on the expressive measure, while no differences were found between children with higher and lower vocabulary knowledge in either study.

Also, Roque (2017) evaluated the effects of eBooks (containing animations as the only digital feature and presented on a laptop) on Filipino children's vocabulary and story comprehension. No statistically significant effects of eBooks on vocabulary or word memory were found in this study. Like Silverman (2013), the

researchers attribute this to children's limited exposure to print and electronic storybooks that children in their study experienced. In a study conducted by Silverman (2013), researchers found that children had limited exposure to print and electronic storybooks, which may explain why their results were not as positive. Previous studies that had more positive outcomes exposed children to a story four to five times (e.g., Korat, 2010; Sari et al., 2019), while this study only had two exposures. It appears that young children may require more than two exposures to digital eBooks in order to benefit from them. In light of these results, the present research exposed young children to the same digital animated stories and rhymes over the course of six weeks, for a total of twenty-four sessions, in an effort to boost vocabulary development. Smeets et al. (2010) observed that the presence of background music and sound effects had a detrimental impact on the acquisition of words.

As literature has shown, motion in digital instructional tools is essential when supporting the learning of vocabulary skills for young children. On the other hand, interactive components such as hotspots, games, and dictionaries would be distracting when not appropriately used (Korat, 2010). Mayer (2021) suggests that the addition of multimedia to instructional materials should be avoided. Notwithstanding the positive results, there remains a need for more investigations to substantiate the efficacy of digital interventions targeting vocabulary development in preschool-aged children, particularly in countries in the global south like Zambia, where few studies have been conducted before.

Impact of Digital Animated Stories and Rhymes on Story Comprehension

The ability of preliterate young children to have a more in-depth grasp of stories may be an early sign of their subsequent reading proficiency (Doty et al.,

2001). A positive effect has been found between digital animated stories and story comprehension (Altun, 2018; de Jong and Bus, 2004; Doty et al., 2001; Ihmeideh, 2014; Korat, 2010; Labbo & Kuhn, 2000; Sun et al., 2019; Verhallen et al., 2006; Zucker et al., 2009). A study by Verhallen et al. (2006) also found that animated eBooks enhanced story comprehension among kindergarten children speaking Dutch as their second language in the Netherlands. Similarly, an assessment of 27 research studies by Zucker et al. (2009) revealed that using digital books instead of conventional paper books has a small to moderate influence on student comprehension results.

According to research by Altun (2018), young children may benefit from digital animated storybooks because they provide close temporal contiguity between the text and the graphics, which aids in concretising the narrative and, as a result, helps them better grasp the story. Altun (2018) studied 72 Turkish preschool children aged five years old to examine whether or not the added multimedia aspects of digital storybooks would benefit their story comprehension. The findings showed that (a) children who were exposed to a multimedia-enhanced storybook performed better than those who were exposed to a print storybook in terms of both explicit and implicit story comprehension, (b) explicit story comprehension was higher than implicit story comprehension for both groups, and (c) children who were exposed to animated illustrations were able to recall significantly more story elements, and their retellings of the stories were longer. The research demonstrates that children's story understanding and ability to draw inferences about the story may be enhanced via multimedia storytelling. The study was conducted as a reading activity with a small group. The emphasis was placed on incorporating authentic classroom activities into artificially controlled laboratory conditions. Children in both the experimental group

and control group only listened to the story once. The repetition of story-reading passages has the potential to impact the comprehension of stories among young children (Takacs et al., 2014; Verhallen et al., 2006). Thus, in the current study, children were exposed to the materials twenty-four times over a period of six weeks.

Nonetheless, other research studies found that digital storybooks were not more successful than printed storybooks in boosting story comprehension (de Jong & Bus, 2004; Korat & Shamir, 2007; Silverman, 2013; Zhou & Yadav, 2017). A study by Zhou and Yadav (2017) that examined the impact of multimedia story reading on children's story comprehension skills revealed that multimedia storytelling did not enhance their ability to comprehend stories. Another study conducted by Smeets and Bus (2014) investigated how three types of electronic storybooks influenced children's vocabulary growth and story comprehension in preschool children aged 4-5 years. There were no significant differences observed in children's comprehension of the story across the various conditions. Similarly, a study by Silverman (2013) found no evidence that animated storytelling improved story comprehension or vocabulary. The materials used in these research studies were not structured, so non-verbal information guided the learner towards grasping the narration. The researcher concluded that in their study, digital stories did not significantly impact children's language skills or memory, as they were only exposed to a limited number of print and electronic storybooks. In contrast to previous studies that included four to five-story exposures, children in this study only had two encounters with the stories. In the case of Korat and Shamir (2007), the animations used were not designed to draw attention to the specific aspects that matched the story text. The motion was only added to the scene to make it appear more realistic (for example, trees swaying in the wind). However, this was not done

to draw children's attention to vital story elements depicted in the illustrations and maximise temporal congruence between the text and the illustrations.

Still, other studies have found a negative effect of digital stories on story comprehension (Smeets & Bus, 2015; Yokota & Teale, 2014). Some studies showed that children's story comprehension was lower for children who listened to digital storybooks as opposed to conventional storybooks (de Jong & Bus, 2002; Parish-Moris et al., 2013). The variety in format of multimedia eBooks, the broad range of diversity in the language used, and the different contexts in which these studies have been conducted might explain the inconsistent results on the influence of multimedia eBooks on story comprehension. Research shows that the inclusion of multimedia components that are irrelevant may have a detrimental effect on the process of learning (Mayer, 2005; Takacs et al., 2015). This could be because they may divert children's attention away from the plot, thereby hampering their story comprehension (Flack & Horst, 2017; Leu, 2000; Rideout, 2014). This is also consistent with Sweller's (1994) cognitive load theory, which explains that working memory can only hold one piece of information at a time. In a meta-analysis of 43 studies involving 2147 children, Takacs et al. (2015) found that some multimedia elements, like hotspots, games, and dictionaries, were less effective in supporting story comprehension. Additionally, in a study of 41 Dutch children with an average age of 64 months, Takacs, and Bus (2018) discovered that a picture that was congruent with the narration contributed much more to children's story retelling than a picture that was incongruent with the narration. Therefore, additional details that distract from the storyline should not be included in multimedia stories if they are to be beneficial to children.

As literature has shown, the design of multimedia materials impacts their effectiveness in facilitating story comprehension (Mayer, 2021; Mayer & Moreno, 2003; 2017; Takacs & Bus, 2018). Although there are conflicting results in studies that examine the relationship between animated instructional materials and story comprehension, a number of scholars argue in favour of incorporating multimedia elements such as animation into instructional materials designed to enhance story comprehension in young children (Altun, 2018; Ihmeideh, 2014; Mayer, 2021; Takacs et al., 2015). Children may need help understanding storybook narratives due to intricate words and complicated grammar (Takacs & Bus, 2018). Therefore, the integration of multimedia elements into instructional materials has the potential to enhance the story comprehension skills of young children, as long as they align with the main storyline. For instance, Takacs et al. (2015) suggest that using animated images, sound effects, and music congruent to the story may improve students' ability to understand the story and learn new vocabulary. But like in everyday conversations, animated stories may facilitate the understanding of the story, particularly if pictures and narrations are congruent. Takacs and Bus (2018) further state that animated pictures help a child make sense of a complicated plot by visually presenting ideas that would otherwise be hard to grasp in print materials. This is consistent with Mayer's (2005) multimedia learning theory and Paivio's (2007) dual coding theory, which proposes that when the same content is presented in multiple formats (pictorial and verbal), learning is enhanced because visual and verbal information is processed via two separate information processing channels. Consequently, a considerable number of academics have demonstrated a general inclination towards endorsing the incorporation of multimedia elements within digital storybooks.

Therefore, to enhance their effectiveness in promoting story comprehension in preschool children, digital instructional materials for this current study were designed in line with Mayer's (2009, 2021) multimedia principles and previous research in which story comprehension skills were supported (Sari et al., 2019; Takacs et al., 2015; Takacs & Bus, 2018). The multimedia elements included in the digital stories and rhymes were animations, narrations, music, and sound, which were kept simple and short. The animations in the stories and rhymes were highly congruent with the oral narratives, sounds, and music. Additionally, Sari et al. (2018) found that sound and background music had a negative effect on receptive language, likely due to auditory masking, which made it challenging for participants to learn the vocabulary. As a result, the use of sound and music in the current study was limited to only the necessary instances. By doing so, it was expected that children's rhyming awareness, vocabulary, and story comprehension skills would improve.

Summary of Literature

The preceding literature demonstrates the depth of research on the significance of digital instructional materials (such as digital animated stories and rhymes) in the development of early literacy skills among preschoolers. Several investigations have been undertaken to examine the influence of digital technology on facilitating the acquisition of emergent literacy skills among young children. These investigations have resulted in several important discoveries regarding the use of digital technology in promoting young children's emergent literacy skills. For instance, multiple studies have demonstrated that multimedia instructional tools have the potential to enhance early literacy skills in young children (Doty et al., 2001; Ihmeideh, 2014; Korat, 2010; Labbo & Kuhn, 2000; Oakley et al., 2020;

Segers et al., 2004; Shamir et al., 2012). Additionally, prior studies show that multimedia instructional materials may help to foster various components of emergent literacy skills, such as phonological awareness (Shamir et al., 2012), vocabulary (Korat, 2009; Korat and Shamir, 2012; Roque et al., 2017; Segers et al., 2004), and story comprehension (de Jong and Bus, 2004; Doty et al., 2001; Ihmeideh, 2014; Korat, 2010; Labbo & Kuhn 2000; Roque et al., 2017; Verhallen et al., 2006).

Furthermore, research has also shown that including multimedia elements like animations, music, and sound effects can help children better understand materials presented to them (Ihmeideh 2014; Korat 2010). This is because multimedia elements like animations provide visual and tactile representations of abstract language and highlight important details in the visuals (Mayer, 2021). Additionally, nonverbal cues can be especially helpful for children with language delays as they try to understand the vocabulary and plot of a story. Further, this approach can lead to increased motivation, independent learning, and better instructor support. However, the success of integrating technology into education depends on various factors.

Prior research has also demonstrated the significance of the format of multimedia messages or instructional materials. These studies have shown that the effectiveness of digital tools may depend on the activities and methods used (Takacs & Bus, 2018). For instance, they may be influenced by medium (static eBook versus animated), child (pre-schooler versus primary), language (transparent Hebrew vs. opaque English), the context in which it is used (classroom versus home), usage (independent access versus adult-guided), and several other factors (Mayer, 2014). The efficacy of digital multimedia instructional resources is supported by Mayer's

(2001, 2005, 2009) Cognitive Multimedia Theory of Learning and the dual coding theory developed by Paivio (2007), which posit that children will learn better from the information presented in both visual and verbal formats because the two types of information are processed by the brain through separate channels, thereby reducing cognitive overload. As such, several scholars in the field of education have continued to use multimedia components in literacy instruction for young children (e.g., Ihmeideh, 2014; Oakley et al., 2020; Takacs & Bus, 2018; Sari et al., 2019).

Gaps in Literature

This review of relevant literature emphasizes the importance of using digital instructional materials, such as digital animated stories and rhymes, to foster early literacy skills in young children. Several research studies have delved into the potential of digital instructional resources to enhance different emergent literacy skills, including phonological awareness (Shamir et al., 2012), vocabulary (Korat, 2009; Korat and Shamir, 2012; Roquet et al., 2017), and story comprehension (de Jong and Bus, 2004; Doty et al., 2001; Ihmeideh, 2014; Korat, 2010; Verhallen et al., 2006). However, additional studies are necessary to gain deeper insights into these teaching methods, especially regarding the influence of digital animated instruction on story comprehension, given that prior research has produced mixed outcomes in this domain of early literacy. Furthermore, there is scarce literature on the impact of digital animated stories and rhymes on the development of rhyme awareness skills.

Additionally, earlier research conducted on the relationship between digital instructional resources and early literacy has been from Western and Eastern countries. There have been very few studies that have explored the same topic in a setting like Zambia in terms of reading culture, technological advancements, socioeconomic level, and language. Moreover, previous studies that have examined

the relationship between digital instructional resources and early literacy have primarily focused on English, a language with an opaque orthography, with few studies focusing on transparent languages such as Mandarin and Chinese. Research on the effects of digital instructional materials on Bantu languages, like Nyanja, remains limited. It is important to note that language may impact how children benefit from literacy instructions, as demonstrated by Ehri et al.'s (2001) study on the impact and transferability of phonological awareness training on decoding skills in English and other languages. This study revealed that training in languages with a more transparent orthographic system resulted in less significant impacts and lower transferability than training in English. Therefore, what has been obtained in other languages might differ from the Zambian situation. To address this knowledge gap and expand upon the prior research, research aimed at exploring the most effective ways to employ multimedia tools to help Zambian preschoolers acquire emergent literacy skills was warranted. This underscores the importance of the current study.

Chapter Summary

This study aimed to test whether Nyanja digital animated stories and rhymes support the development of rhyme awareness, vocabulary, and story comprehension among preschool children in Zambia. The chapter presented theoretical arguments and empirical studies that have highlighted the importance of emergent literacy skills in learning how to read, as well as the role of digital animated instruction materials (e.g., digital stories and rhymes) in supporting the development of these skills. Research studies have demonstrated that if digital animated stories and rhymes align with human learning patterns, they can aid preschoolers in developing emergent literacy skills such as vocabulary, rhyme awareness, and story comprehension. Based on the principles of instructional theories, like the cognitive

theory of multimedia learning (Mayer, 2003), visuals and words, if congruent, may enhance learning. However, the efficacy of digital technology in developing emergent literacy skills remains relatively new, with only a few studies conducted under conditions like the *Zambian* environment. Hence, there is a need for more studies on the subject.

CHAPTER THREE: METHODOLOGY

Overview

This chapter outlines the methodology used to carry out the current study. It commences with a discussion on the research paradigm within which the study is situated, followed by an account of the research methodology, research design, study site, population, sample size, and sampling procedure. The chapter also details the intervention and assessment measures used in the study. Additionally, the chapter outlines the data collection procedures and the methods employed in data analysis. Furthermore, the chapter discusses the ethical considerations considered during the study focusing on young children. The chapter concludes with a chapter summary.

Research Paradigm

Research paradigms are crucial in shaping the direction and methodology of scientific inquiry, offering a foundational framework for researchers to explore and understand different phenomena. It is a set of beliefs, principles, and practices that serve as a framework for studying a particular phenomenon (Brown & Duenas, 2020). It shapes the design and methodology of scientific research, ensuring systematic and rigorous conduct. Key elements of a research paradigm include ontology, epistemology, and methodology.

Ontology refers to the philosophical study of the nature of being, existence, or reality. It involves delving into questions about the existence of a single objective reality that is independent of individual perceptions, the coexistence of multiple realities, and the concept of reality as a subjective construct that varies among individuals (Brown & Dueñas, 2020). Ontological considerations influence the researcher's approach to defining and conceptualising phenomena, as well as their

interpretations of research findings. Epistemology, on the other hand, refers to beliefs about how knowledge can be obtained and justified. It aims to elucidate the process of acquiring knowledge, distinguish truth from falsehood, and validate the authenticity of knowledge. It is concerned with how we can ensure that knowledge is both adequate and legitimate (Park, 2020). Epistemology examines sources of knowledge like perception, memory, reason, and testimony, as well as the methods used for knowledge acquisition such as observation, experimentation, and reasoning. Understanding epistemology is vital for developing grounded beliefs and making informed decisions in various aspects of our daily lives. A research methodology outlines the specific techniques, tools, and procedures that the researcher will use to collect and analyse data (Brown & Duenas, 2020). A well-developed methodology is essential for guaranteeing the accuracy and reliability of research outcomes and laying the groundwork for interpreting and generalising findings. These key elements (i.e., ontology, epistemology, and methodology) of a research paradigm shape the researcher's approach to understanding and investigating the research problem. This study utilised the positivist paradigm to investigate the relationships between digital animated stories, rhymes, and the development of emergent literacy skills in preschool children.

Underpinnings of the Positivist Paradigm

The positivist paradigm, introduced by Auguste Comte (1798–1857), emphasises that knowledge about the world should be based on observable facts and empirical evidence (Johnson, 2015). This paradigm asserts that scientific methods are the most reliable means of acquiring knowledge (Brown & Duenas, 2020). Ontologically, positivism assumes that there is a singular objective reality that exists independently of human perception (Miller, 2015; Smith, 2018). The paradigm

depends on objective or universal truth, viewing knowledge as a collection of objective concepts that need discovery instead of creation (Ryan, 2018). The positivist ontology asserts that reality is tangible and quantifiable, lending itself to empirical investigation through systematic observation and measurement. Epistemologically, positivism prioritises empirical evidence and scientific methods as the most reliable means to acquire knowledge about the universe (Taylor, 2021). It holds that the only legitimate way to understand human behavior and determine truth and nature of the world is through scientific experimentation, observation, and reason based on experience. Babones (2016) points out that positivism underscores the importance of objectivity, reliability, and replicability in scientific research that aims to produce findings that are grounded in empirical evidence and can withstand rigorous scrutiny. It includes formulating testable hypotheses, manipulating variables through controlled experiments, and using statistical techniques for data analysis. Brown and Duenas (2020) stipulate that by employing standardised procedures, objective measurements, and statistical inference, positivist research aims to generate reliable, generalisable knowledge that contributes to the understanding of the world in a systematic and replicable manner. The positivist methodological orientation involves the use of experimental designs, standardised assessments, and statistical analyses to systematically collect, analyse, and interpret quantitative data (Moniruzzaman et al., 2022). Through controlled experimentation and statistical inference, it seeks to establish causal relationships between variables, identify patterns and trends in the data, and draw reliable conclusions. In essence, the positivist paradigm is characterised by its ontological belief in an objective reality, its epistemological emphasis on empirical evidence and scientific methods, and its methodological preference for quantitative research approaches.

Critics of positivism in social research argue that its over-reliance on quantitative methods may fail to capture the complexity of human experiences (Corry et al., 2019). Smith (2018) asserts that positivism often overlooks contextual factors and subjective experiences, which can be crucial in comprehending social phenomena. For instance, by using positivism in this current study, contextual factors and subjective experiences that are important in understanding children's engagement with digital media may be overlooked. Further, other critics post that the positivist methodology's reliance on controlled environments and standardised measurements may not fully accommodate the dynamic and naturalistic settings inherent in studying human social problems (Brown, 2015). Despite its inherent weaknesses, the current study deemed the positivist quantitative methodology a suitable approach.

Relevance of Positivism to the Current Study

This current study aimed to establish causal links between exposure to digital animated stories and rhymes and changes in emergent literacy skills. The positivist paradigm is relevant to this study because it aligns with the goal of uncovering objective truths about the relationship between digital animated stories, rhymes, and emergent literacy skills. From a positivist perspective, digital animated stories and rhymes are external stimuli that have tangible effects on children's emergent literacy skills (Brown & Duenas, 2020).

Positivism emphasises the importance of empirical evidence, which is essential for establishing causal relationships. Therefore, the impact of digital tools on emergent literacy development can be understood through systematic observation, experimentation, and statistical analysis. This entails that, to investigate the impact of digital animated stories and rhymes on emergent literacy skills among

preschoolers, there would be a need to conduct controlled experiments, measuring the emergent literacy variables of interest (i.e., phonological awareness, vocabulary, and story comprehension) before and after exposure to digital media. Through the analysis of data from experimental and control groups, the researcher can assess how digital animated stories and rhymes influence emergent literacy skills in preschoolers, providing valuable insights that can benefit educators, parents, and policymakers. This approach enables a methodical assessment of how digital tools influence emergent literacy skills by focusing on observable phenomena and measurable results. This study aimed to produce dependable and transferable knowledge on the causal factors driving emergent literacy development in the digital era by adhering to standard procedures for hypothesis testing, experimentation, and statistical analysis. Through controlled experimentation and statistical inference, this study can establish causal relationships between digital animated stories and rhymes and the emergent literacy skills of preschool children under study and draw reliable conclusions.

Quantitative Research Methodology

This study aimed to evaluate the impact of digital animated stories and rhymes on preschool children's emergent literacy skills. To achieve this objective, a quantitative methodology was employed in line with the positivist paradigm. A quantitative methodology provides systematic, objective, and generalisable evidence and offers a structured approach to data collection and analysis, allowing for the precise measurement of variables (Park, 2020; Taherdoost, 2022). As a result, the quantitative methodology used in this study allowed for a thorough evaluation of the impact of digital animated stories and rhymes on emergent literacy, contributing to evidence-based practices in early childhood education. Employing a randomised

control trial design, this study used tightly controlled methods to isolate the effects of digital tools on emergent literacy skills from confounding variables. With these methods, it was possible to assess changes in children's emergent literacy skills before and after exposure to digital animated stories and rhymes. Using standardised instruments like standardised literacy assessments and maintaining measurement consistency, the study enables a rigorous analysis of the impacts of digital animated stories and rhymes on emergent literacy skills.

Moreover, quantitative methodology provides the statistical tools necessary to analyse large datasets and identify patterns or correlations within the data (Moniruzzaman et al., 2022). The relationship between exposure to digital animated stories and rhymes and preschool children's literacy outcomes could be determined through statistical analyses, including linear mixed effect analysis and correlation analysis (Brown & Duenas, 2020). The statistical tools allow for controlling for confounding variables, and by statistically controlling for potential confounding variables, the researcher can ascertain the unique contribution of digital interventions to rhyme awareness, vocabulary acquisition, and story comprehension.

Furthermore, quantitative research enables the replicability and generalisation of findings to broader populations (Creswell & Creswell, 2017; Taherdoost, 2022). In the positivist paradigm, the significance of generalisability lies in its ability to validate findings for informing educational practices and policies, showcasing the wider relevance and applicability of the study outcomes. This was important for a context like Zambia, where few studies have investigated the effectiveness of digital tools.

Thoroughly outlining all research elements, including sample selection, data-gathering methods, statistical analysis, and drawn conclusions, is essential for ensuring transparency and reproducibility in quantitative research. The next subsections outline clearly how the current study was conducted using a quantitative methodology.

Research Design

In accordance with the quantitative approach, a randomised control trial with a between-subject experimental design was employed to evaluate the effects of Nyanja digital animated stories and rhyme on young children's emergent literacy skills. Dollahite et al. (2014) point out that a randomised controlled trial permits researchers to draw causal inferences between variables, thereby allowing an effective assessment of the impact of the intervention. A central feature of this design is the random assignment of participants to intervention and control groups, which minimises potential selection bias (Wharrad & Silcocks, 2007).

Prior to the intervention, a pretest assessment was conducted, and participants were then randomly assigned to either the intervention group or one of the two control groups. Children in the intervention group watched digital animated stories and rhymes. Children in the control group I played a non-verbal video game (*Subway Runner*, downloaded from *Combine, Inc.*). The purpose of including this control group was to ensure that the effects observed in the study would be a result of the contents of the tablets (digital animated stories and rhymes) and not because of the tablet experience. Children in control group II continued with the usual classroom activities. All three conditions were present in each school and each classroom. After the intervention, a post-assessment was administered.

Research Site

This research study was conducted in Lusaka province, basically for two primary factors. Firstly, Lusaka province, as Zambia's provincial capital, boasts a diverse linguistic landscape due to the high influx of people from various provinces who speak different languages (USAID Education Data Activity, 2021). Furthermore, there exists a noticeable disparity between standard Nyanja, the language of instruction, and the non-standard Nyanja spoken in most households and playgrounds in Lusaka Province (Mwanza, 2012; Tambulukan & Bus, 2012). According to Mwanza (2012) and USAID Education Data Activity (2021), this has serious implications for children who do not speak Nyanja at all or who speak non-standard Nyanja. Children who do not use standard Nyanja may struggle to grasp and apply the standard Nyanja used for instruction in an educational setting. Therefore, it is essential to implement measures that promote oral language and literacy development for children in Lusaka Province, as some may be learning in an unfamiliar language. Secondly, during the fieldwork conducted for this study in 2018, Lusaka province had considerably more government-run preschools than other provinces, providing a larger pool of participants for randomisation.

Target Population

The target population for this study was typically developing preschool-aged children from government preschools in Lusaka, Kafue, and Chilanga districts of Lusaka province. According to the data provided by the Lusaka provincial education office, there were a total of 23 government preschool centres attached to primary schools within the three districts: Lusaka (10), Kafue (6), and Chilanga (7), with approximately 803 children at the time of this study in 2018. The government preschools in Zambia are considered to fall short of optimal standards due to

inadequate funding (USAID Education Data Activity, 2020). A study conducted by the USAID Education Data Activity (2020) discovered that a significant majority (88%) of the 55 preschools surveyed in five provinces of Zambia, specifically 88% out of 55, were found to be lacking crucial pedagogical and supplementary materials for effective teaching and learning. For instance, 90% of the preschools lacked storybooks. Additionally, the Zambia situation analysis (2021) reports that 40% of preschool teachers have no formal training, and this situation contributes to an unsuitable educational environment in these preschools. There is a possibility that children in government preschools in Zambia may be experiencing difficulties in acquiring emergent literacy skills due to a lack of or limited access to cognitively stimulating activities and educational resources. Thus, early intervention programmes that support the acquisition of emergent literacy skills in this population are eminent, as such a group of children is most at risk of developing reading problems. Hence, this population was deemed appropriate.

Sample Size

To obtain an adequate sample for this study, Yamane's (1967) formula was used with a confidence level of 95% and a sampling error of 5%. The resulting calculation determined that a minimum sample size of 267 was required from a population of 803 to maintain a 95% confidence interval.

Yamane formula

$$n = \frac{N}{K + N (e)^2}$$

Where:

N = Population of the study (803)

K= constant (1)

e = degree of error (0.5)

n = sample size

$n = 803 / 1 + 803 (0.05)^2$

n= 267

Initially, 375 children from 14 government preschool centres were selected to participate in the study. However, 22 children were excluded from the final study because they did not complete a post-test: 13 children had transferred to other schools during the intervention period, and 9 were absent during post-test data collection. The final sample did not differ extensively from the intended, as there was only a 5.9% attrition rate at the post-test.

Sample Characteristics

Preschoolers. The final sample comprised 353 typically developing preschool children, 169 boys and 184 girls ($M_{age}=81.09$ months; $SD = 15.69$). Most children (73.37%) said they spoke Nyanja as their primary language, while 94 (26.63%) spoke other languages like Bemba, Lozi, Tonga, and English.

Parents/Caregivers: Parents/caregivers participated in the study by virtue of their children being part of this study. A total of 316 (90%) parents/caregivers completed the questionnaire, which included items related to family demographics, parental educational level, employment status, income levels, and home possessions (see Appendix G for the different home possessions assessed).

Table 1 shows that 26.4% of the parents/caregivers were in formal employment, while 8.3% possessed post-secondary education. More than half (57.2%) reported a monthly household income below K1100, which is below the international poverty rate of \$2.25 per day (Multidimensional Poverty Index, 2023). Employment status, parental education level, and household income are useful measures of a family's socioeconomic position. Hence, it can be deduced from Table 1 that most of the children who participated in this study came from households situated within the lower-income bracket.

Table 1

Parental and Household Characteristics

<i>Item</i>	<i>Count (N)</i>	<i>Percent</i>
<i>Employment</i>		
No formal employment	229	(73.6%)
Formal Employment	82	(26.4%)
<i>Monthly Income</i>		
Below K1100*	99	(57.2%)
K1100-K2100	33	(19.1%)
K2200-K3200	20	(11.6%)
Above K3200	21	(12.1%)
<i>Education level</i>		
No education	16	(5.1%)
Primary	107	(34%)
Secondary	166	(5.7%)
Post-Secondary	26	(8.3%)

*At the time of data collection in May 2018, 1 US dollar was equal to 10.360 Zambian Kwacha (Exchange-rate.org, 2018)

Sampling Procedure

Recruitment of Preschools. A simple random sampling procedure was employed to select the preschools and participants. Recruitment of preschool centres was carried out in May 2018. At the time, there were 23 preschool centres annexed to primary schools in the targeted three districts: Lusaka (N = 10), Kafue (N = 6), and Chilanga (N = 7). A centre was excluded from the study if it was not located within 15 kilometres of the district's town centres. Since the study involved an intervention requiring researcher to visit the centres often, it was necessary to have centers located within distances that researcher and research assistants could access without much difficulty. A centre was also excluded if it had fewer than 18 eligible

children. It was necessary for each classroom to have a sizable number of children since all three conditions had to be present in each classroom. Thus, 14 out of the 23 centres met the inclusion criteria initially. However, one of the eligible centres was dropped when school authorities did not grant researcher permission to conduct the study in that particular centre. Therefore, due to the limited number of eligible preschool centres in the three districts, all 13 centres that had met the two criteria, plus the only centre that was initially excluded based on having less than 18 children (it had 16 children), were recruited to the study. Of the selected 14 centres, 8 were in Lusaka district, 2 in Chilanga district, and 4 in Kafue district.

Selection of Participants. Following the recruitment of preschool centres, a simple random sampling procedure, giving each participant an equal chance of being selected, was used to select participants. Ary (2006) emphasises that randomly assigning participants to groups in an experiment eliminates systematic bias by distributing extraneous variables equally among groups. When participants are randomly assigned to treatment groups, they are all subjected to identical testing conditions. Several possible dangers to internal validity are eliminated or considerably reduced as a result. A rotary method was used to select the participants, whereby the names of children were written on a separate piece of paper using a class list. The names were put in a non-transparent bag, and the researcher picked the papers out of the bag one by one. For centres with more than 30 children, 30 children were randomly selected from each centre, and only 15 children were selected from each centre with less than 30 children. However, in one preschool with three classrooms, 45 participants were selected, 15 learners from each of the three classes. Thus, 9 schools had 30 children each, 4 schools had 15 children each, and 1 school had 45 children.

Assigning Conditions. The selected children were randomly assigned to three conditions after the pre-test. This was done to remove or reduce the influence of confounding factors (Ary, 2006). Equal numbers of participants (n = 125) were randomly assigned to an intervention group and to each of the two control groups. To ensure that all three conditions were present in each classroom, the random assignment of participants to conditions was done at the classroom level. Each child's name was written on a separate piece of paper, put in a non-transparent bag, and shuffled. Each paper containing a child's name was picked and assigned to one of the conditions. The first name picked was assigned to the intervention group, the second name went to control group I, and the third name was allocated to control group II. This process was repeated until all participants had a group assigned to them. There was an average of 10 children in each group in most schools. However, 4 of the 14 schools with 15 participants had 5 children in each group.

Research Measures

Intervention materials consisting of 4 Nyanja digital animated stories and 7 Nyanja digital animated rhymes were used in this study. The goal of the digital stories and nursery rhymes was to teach children new words, rhyme awareness, and story comprehension in standard Nyanja (which is the language of instruction from preschool to grade four in Lusaka province). Various measures of rhyme awareness, vocabulary, and story comprehension were used to collect data.

Intervention Materials

Digital Animated Stories. Three stories from the Nyanja stories published by Cambridge University Press for the Zambia primary reading programme were adapted for this study. The stories were chosen because they were culturally and age-appropriate, short, had interesting storylines, and were already written in

standard Nyanja. To enhance the vocabulary of children, the three stories were enriched with words from the preschool books that are not commonly used by the children, such as "kamukunkhuniza-beetle," "dzenje-ditch," "ukonde-net," and "zipatso-fruits." One of the stories was created by the researcher using words from preschool books with the help of language experts and preschool teachers. The language experts and preschool teachers checked the structure and age-appropriateness of the language in the stories.

The stories were digitalised. In creating digital stories, principles of the cognitive theory of multimedia learning were applied (Mayer, 2005, 2021). The printed stories were converted into film-like stories by adding animated illustrations, oral narrations, background music, and sound. The stories were kept short, and only relevant information was added to prevent cognitive overload. Animated illustrations, oral narrations, background music, and sound were the only multimedia features added to the stories that distinguished them from the traditional stories.

Animated illustrations were added to the stories to complement verbal information, while background music and sound were added to illustrate feelings and moods that matched what was happening in the story. The animated illustrations in the stories were highly congruent with the oral narratives, sounds, and music, in line with the temporal contiguity principle of the CTML theory (Mayer, 2005). The animations corresponded well with what was explained in the narration. Sounds and music were added to illustrate feelings and moods that matched what was happening in the story. For instance, in the *frog and beetle* story, a sound of a frog snoring is heard when the picture of a frog sleeping appears on the screen. No print was added to the stories to prevent cognitive overload since text and animated illustrations are processed in the same channel (visual). There were variations in the length of the

stories. The shortest story was 48 seconds long, while the longest was 140 seconds long (see table 2). Figure 1 shows the screen dumps from one of the intervention stories (digital animated story of the frog and the beetle, *Cule ndi Kamukunkhuniza*) that the children watched.





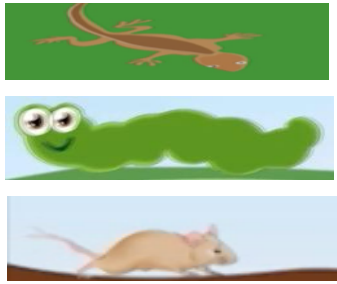



Table 2
Characteristics of Nyanja Digital Animated stories

<i>Story Title</i>	Unique words	Total words	Duration (seconds)
Cule ndi kamukunkhuniza	51	80	88
Ukonde	48	72	63
Piko	22	44	48
Zipatso ndi Zama samba	49	171	140

Figure 1

Screen dumps from the digital animated story of the frog and the beetle (Cule ndi Kamukunhunya)

A sleeping frog was awakened by a beetle. The angry frog threatened to eat the beetle, but the beetle pleaded with the frog to be let free. The frog obliged. One day, the frog fell into a ditch. Several animals did not help him. Finally, the beetle helped him by rolling dung into the ditch until the pile was high enough for the frog to jump out of the ditch. The frog thanked the beetle.

<p>1</p>  <p><i>Tsiku Lina Cule analikugona</i></p>	<p>2</p>  <p><i>kamukunhunya kanakwera pamusana pake ndipo kanamuutsa</i></p>	<p>3</p>  <p><i>Cule anagwira kamukunhunya ndi lilimi lake. Iye anati, “Codi, musandidye ai.”</i></p>
<p>4</p>  <p><i>Tsiku lotsatira, Cule anagwela mudzenje.</i></p>	<p>5</p>  <p><i>Buluzi sanatandize. Koswe sanatandize. Cinkuwala sicinatandize</i></p>	<p>6</p>  <p><i>kamukunhunya kanakunhunya mpaka pa dzenje.</i></p>
<p>7</p>  <p><i>Cule anakwanisa kulumpila ku bwalo kwa dzenje</i></p>	<p>7</p>  <p><i>Cule anati, “zikomo.”</i></p>	

Digital Animated Rhymes. All 7 rhymes for this study were created for the study because Nyanja nursery rhymes were non-existent when constructing materials for this study. Both familiar words (e.g., *Galu-dog*) and uncommon words (e.g., *cithunzi-tunzi-drawing*) from the preschool curriculum were included in the rhymes. All the rhymes had a storyline because the researcher’s intention in creating each rhyme was not only to enhance phonological awareness but also to facilitate vocabulary acquisition and story comprehension. The nursery rhymes varied in length. For instance, the shortest rhyme titled “fisi” [hyena] was 35 seconds long. It had three rhyming words—*chipupa*, *fupa*, and *onenepa*—10 unique words and 39 total words. The longest rhyme was *Tumbewa* [bush mice], which was 81 seconds long with 17 unique words, 78 total words, and 4 rhyming words (*tumbewa*, *auwa*, *kathawa*, *twathawa*), as shown in Table 3.

Table 3

Characteristics of Nyanja Digital Animated Rhymes

<i>Title</i>	Unique words	Total words	Duration (sec)	Rhyming words
Patu	23	35	36	<i>Nyumba-nkumba, nkunda-kumunda, zovola-covala</i>
Tumbewa	17	78	81	<i>auwa-kathawa-twathawa</i>
Amalume ndi mbalame	18	37	40	<i>Amalume-mbalame, mpando,-nyundo, thyoka-mbululuka</i>
Cithunzi-tunzi	28	69	68	<i>mudzi-mbudzi, moto-poto</i>
Cona	28	58	55	<i>ziwiri-kwambiri, zitatu-adyeratu, asanu-pacisanu</i>
Fisi	10	39	35	<i>chipupa-fupa-onenepa</i>
Kumunzi kuli agogo	18	47	63	<i>Mkango-mtengo-mikango, zifana-zimuna, cithunzi thunzi-alikhenzi</i>

Like the stories, the rhymes were digitalised by adding motion pictures, oral narrations, sound, and background music. For instance, in the *Tumbewa* rhyme, the sound of a dog barking is heard as the narrator mentions that the dog barks. Presented is an example of a rhyme the children listened to, and figure 2 displays the screen dumps from this rhyme

Amalume ndi Mbalame [my uncle and the bird]

Amalume ndi mbalame [my uncle and the bird]

Amalume ndi mbalame [my uncle and the bird]

Amalume akwera mpando [my uncle climbs on a chair]

Afunakugwira ka mbalame [he wants to catch a bird]

Amalume ethyola mpando [uncle broke the chair]

Amaluma atenga nyundo [uncle gets a hammer]

Alungisa mpando wo thyoka [he repairs the broken chair]





Adzicita mwendo ndi nyundo [he hurt his leg with a hammer]

Adzicita mwendo ndi nyundo [he hurt his leg with a hammer]

Mbalame ya mbululuka [the bird flies away]

Figure 2

Screen Dumps from the Digital Animated Rhyme called *Amalume Ndi Mbalame*

<p><i>Amalume ndi mbalame</i> rhyme roughly translated as “My uncle and the bird”.</p> <p>The rhyme had the following rhyming words: <i>mpando/nyundo</i> and <i>thyoka/mbululuka</i>. This rhyme is about an uncle who wanted to catch a bird but fell off a chair as he tried to do so. He got a hammer to repair the chair but hurt his leg with the hammer in the process. The bird flew away.</p>			
<p>1</p>  <p><i>Uncle climbed on a chair and tried to catch a bird</i></p>	<p>2</p>  <p><i>He fell off the chair and broke his leg</i></p>	<p>3</p>  <p><i>He tried to repair the broken chair with a hammer but hurt his leg in the process.</i></p>	<p>4</p>  <p><i>The bird flew away</i></p>

Data Collection Tools

This current study was part of a large research project that utilised various existing and researcher-developed assessment tools to gather data. This study collected data using various existing and researcher-constructed assessment measures. The existing measures used in this large study included: biographic information form, letter naming task, letter identification task, letter-sound task, letter-sound identification task, familiar language test, Rapid Automated Naming (RAN) test, Stroop-like (opposite) test, digit span test, pencil tapping test, Peabody Picture Vocabulary Test (PPVT), task orientation, parent/caregiver questionnaire that measured family literacy, home possessions, socio-emotional development, the Basic Assessment Tool (BASAT), and the media time use questionnaire. In addition, the following researcher-constructed tests formed part of the assessment instruments for the main study: picture rhyming test, rhyme production test, rhyme

recognition test, receptive one-word picture vocabulary test, expressive one-word picture vocabulary test, story retelling comprehension test, and question and answer comprehension test. To ensure contextual responsiveness, all the tools were translated into Nyanja, the local language of instruction in Lusaka Province.

For this specific study, the data was collected using the following assessment tools: a biographic information form, picture rhyming test, rhyme production test, rhyme recognition test, familiar language test, receptive one-word picture vocabulary test, expressive one-word picture vocabulary test, story retelling comprehension test, question and answer comprehension test, and parent/caregiver questionnaire.

Child Assessment measures

Demographic Data/Covariates. The biographic information forms collected data on children's demographic factors that may affect emergent literacy skills, namely, age, sex, school, district, and the primary language spoken by the child at home.

Rhyming Awareness Measures

Rhyme awareness skills were assessed using three measures developed by the researchers: rhyme recognition, rhyme prediction, and picture rhyming tests. However, the final analysis included only two of these tests, namely picture rhyming and rhyme prediction. The rhyme recognition test was dropped from the analysis because it had poor internal reliability ($\alpha < .3$ at the pretest and .542 at the post-test). Therefore, only the two rhyme awareness measures used in the final analysis are discussed.

Rhyme Production Test. This test measured a child's ability to produce rhyming words. During the test, the administrator would say a word, then ask the

child to say a word with the same ending sound as the one the administrator said. For example, if the administrator said "galu," the child would have to say words like "culu" or "malu." Both intervention and non-intervention words were used in this test. *Nonsense words* were accepted if they rhymed with the target word. On the scoring protocol, the child's response was marked as incorrect if they did not produce a word that rhymed with the target word and correct if they produced a rhyming word. The actual word produced by the child was written down, whether correct or incorrect. The researcher used this information to verify the scores (see Appendix A). The Cronbach alpha for this test was .849 at the pretest and .846 at the posttest.

Picture Rhyming Test. It examined children's ability to identify rhyming words from pictures. Four pictures were represented; two of the pictures had words that rhymed, while the other two pictures were distractors. The child was asked to point to a picture and say out loud the two words for the two pictures that rhymed. On the scoring protocol, the words representing the two pictures that a child had pointed at were circled. In constructing the test, efforts were made to include items familiar to children across a range of socio-economic and cultural backgrounds (refer to Appendix B). Researchers also used distractors that were phonologically similar and semantically related to the target pictures (e.g., *lima, cheka, sekula, and tema*). The tests had 20 items with a Cronbach's alpha of .786 at the pretest and .817 at the post-test.

Vocabulary Measures

Children's vocabulary skills were assessed using two researcher-developed tests (i.e., the receptive one-word picture vocabulary test and the expressive one-word picture vocabulary test) and an existing tool, the familiar language test adopted

from Tambulukani (2015). However, the familiar language test had low levels of internal consistency, with Cronbach's alpha of .558 at the pretest and .485 at the post-test, indicating that it may not accurately reflect each child's accurate linguistic skills. Therefore, it was not included in the final analysis. The two vocabulary tests (Expressive One-Word Picture Vocabulary and Receptive One-Word Picture Vocabulary tests) used in the final analysis are discussed in detail.

Expressive One-Word Picture Vocabulary Test (EOWPVT). This was a measure of children's expressive language. The test was constructed in line with Dunn and Dunn's (1997) Peabody Picture Vocabulary Test (PPVT). A child was presented with a picture on a computer tablet and was asked to name the picture shown to them in Nyanja. Zero was given for an incorrect response and one for the correct answer. All the target words in this test were also derived from the digital animated stories and rhymes administered to the children in the intervention group. In this test, the target words were the same as in the receptive vocabulary test. Therefore, the expressive test was always administered first before the receptive test. The test had 30 target words: 19 nouns, 7 verbs, and 4 adjectives. The reliability was .772 at the pretest and .775 at the post-test. (See Appendices C)

Receptive One-Word Picture Vocabulary Test (RPVT). This was a researcher-constructed test. The test measured children's receptive language. The target words were generated from the stories and rhymes given in the intervention. Each item had four pictures, one target picture, and three distractors. Children were asked to point at the picture that illustrated the target word. The test was scored as correct or incorrect. The test had 27 target words, and of these words, 18 were nouns, 7 were verbs, and 4 were adjectives. The scores of this test had a reliability of .609 at the pretest and .700 at the post-test (See Appendices D).

Story Comprehension Measures

These examined children's understanding of a digital animated story. This was only measured at the post-test. A child was given a digital animated story to watch. The story was adapted from the English *Crow* story created by Tamar Levy and Yaki Gani and downloaded from www.smarttoonz.tv. The story (translated as *Cikwalala* in Nyanja) was chosen because it had a simple storyline, was age-appropriate, and had good moral teaching. It was translated into Nyanja by one language expert, and it was back translated by another into English. The story was 2 minutes and 17 seconds long.

Story Retelling Test. After watching the story, children were asked to retell the story. A standard prompt (*what else was in the story?*) was used to encourage the child to continue retelling the story. Responses were audio-recorded. The responses were later transcribed and scored by the researcher. The scale had 9 items. For inter-rater reliability, 20 participants were scored by three researchers on the following elements: characters, setting, climax, resolution, and sequence. The total score on the retelling test was 22. Agreement on the elements was above 80%, demonstrating acceptable interrater reliability. Differences in scoring were resolved, and some details initially not stated in the scoring protocol were added. The test had a reliability of .842.

Question and Answer Story Comprehension Test. This test was administered as soon as the child finished the retelling test. A child was asked questions based on the *Cikwalala* story. Responses were audio-recorded. Appendix E shows the score sheet for this test. The recordings were used to verify the scores on the score sheet. The Cronbach alpha for this test was .670.

Scale Reliability

Cronbach's alpha was calculated to assess how consistently the measurements used in the current study were capturing the underlying construct being studied. Cronbach's alpha values range from 0 to 1. Typically, Cronbach's alpha of .7 and above is considered acceptable (Meschkow et al., 2018). The data presented in Table 4 shows the number of items in each test, the total number of children who took part in the assessment, and the Cronbach's alpha coefficients associated with the tests that were used in this study.

Table 4
Reliability of pretest and posttest data

<i>Measures</i>	Total items	N	Reliability (Cronbach Alpha)
Pretest			
Rhyme production	20	351	.849
Picture rhyme	20	351	.786
Receptive language	20	351	.609
Expressive language	30	353	.772
Post-test			
Rhyme production	20	339	.846
Picture rhyme	20	338	.817
Receptive vocab.	27	353	.700
Expressive vocab.	30	341	.775
Story retelling	22	181	.842
Q & A comp.*	12	219	.670

* Question & answer story comprehension

Pilot Study

A pilot study was conducted to determine the clarity and appropriateness of the study materials. In addition, the pilot study was meant to help researcher and

research assistants familiarise themselves with the intervention and assessment measures. The pilot study revealed that the intervention materials were too many (7 stories and 10 rhymes). Following the pilot trial, a decision was made to drop 2 stories and 3 rhymes from the final intervention materials.

Furthermore, the pilot research found that some assessment items were not clear. For instance, some pictures in the picture rhyming test, the receptive one-word picture vocabulary test, the expressive one-word picture vocabulary test, and the familiar were unclear and, therefore, had to be changed or dropped altogether. The pilot research also revealed that the assessment battery was too large and lengthy (took about 1 hour to complete), leaving the children exhausted. Consequently, it was decided to assess children in two sessions, with each session falling on a separate day. For instance, a child would be partly assessed on day 1, and the assessment of this child would be completed on day 2.

Procedure for Data Collection

After permission to conduct the study had been granted by the ethics committee at UNZA, the Provincial Education Officer (PEO) for Lusaka province, the District Education Board Secretaries (DEBS) for Lusaka, Kafue, and Chilanga districts, school authorities, and parents/caregivers, the collection of data for the study commenced in May 2018 by trained research assistants.

Training of Research Assistants

Prior to data collection, 18 undergraduate students were recruited and trained for five days. Of the five days, three were allocated for training on conducting assessments, research ethics, and other general guidelines of the project, while two days were for field practice.

Pre-test

Child Assessments. A pre-test was conducted in term two of the school calendar, from May 22nd to June 8th, 2018. All assessments were undertaken in the preschool setting, and each child was assessed individually. Data was collected by researchers and trained research assistants. The whole assessment battery took approximately 60 minutes to complete. Due to the length of the assessment battery and the age of participants, assessments were conducted in two sessions running on different days for each child. Each session took approximately 30 minutes. Children who were not available for the second session within a period of five days were substituted with other children. A total of 375 children were assessed at the pre-test: 225 from Lusaka, 105 from Kafue, and 45 from Chilanga districts. All assessments were conducted in a separate room. Upon completion of pretest data collection, children were randomly assigned to the intervention group and two control groups.

Parent/Caregiver Interviews. Parents/caregivers were interviewed at the pre-test using the parent/caregiver questionnaire. The interviews were conducted within the preschool centres after the assessment of the children was done. Teachers were very instrumental in ensuring that parents/caregivers came to the school for interviews. The teachers were provided with a schedule of the interviews and allocated time slots to arrange meetings with parents on behalf of the researchers. The interviews lasted approximately 35 minutes. Parents/caregivers who came to the school for interviews received reimbursement for travel expenses.

Intervention

The intervention started in June 2018, a week after the pretest data collection. All intervention sessions took place at the school in a separate room. Both the intervention and control group I (where children played a non-verbal video

game) were put in one room due to the limited number of free rooms. There was an average of 10 children in each group in most schools. However, four of the 14 schools with 15 participants had five children in each group. Children from the two groups were made to sit at the opposite end of the room to prevent those in control group I from being exposed to the intervention materials. Children in both groups wore headsets. Control group II children proceeded with their regular school activities.

On the first day of the intervention, researchers explained the contents of the tablets to each group. Children in the intervention group were given instructions on where to press to start watching the stories and rhymes and to signal to the research assistant when the stories and rhymes had stopped playing. The touch-based interface of the tablets does not require the use of complex fine motor skills, so it is easy to operate even for 0-2-year-old children (Marsh et al., 2015). Nonetheless, researchers always checked to ensure that all the children had successfully pressed the play button. Once the play icon was pressed, the stories and rhymes played automatically. Children first listened to the four stories and then the seven rhymes on 7" Samsung tablets for 11 minutes and 57 seconds per day, 4 times per week for six weeks. This translated into 24 sessions and a total time of 4 hours, 46 minutes, and 8 seconds at the end of the intervention. The children exhibited a genuine appreciation for the stories and nursery rhymes. The participants consistently maintained a high level of engagement and exhibited sustained interest throughout the whole of the intervention, even in the later stages of the intervention. There was never a case of a child refusing to watch digital animated stories and rhymes during the intervention. Even when the researchers revisited the schools nine months after

the intervention, most of the children asked if they might see the tales and rhymes again.

Children in the control group I were instructed on how to play the non-verbal video game (*Subway Runner*, downloaded from *Combine, Inc.*). They played the video game for the same amount of time that those in the intervention group watched the digital stories and rhymes. Children in both the intervention group and control group I wore headsets. Children in control group II continued with the usual tabled classroom activities.

Posttest

Posttest data collection was conducted one week after the end of the six-week intervention. Story comprehension tests, in addition to all the assessment measures used at the pretest stage, were used to collect data. All story comprehension tests were recorded. A total of 353 learners were assessed at the post-test stage.

Blinding. At the post-test stage, everyone who participated in data collection was blinded to the condition participants were in during the intervention to reduce researcher bias (Wharrad & Silcocks, 2007). Researchers and research assistants who worked in a particular district during the pretest and the intervention period collected post-test data in another district. For instance, research assistants and researchers who worked in the Lusaka district at the pre-test and intervention stages collected data in Kafue district at the post-test. Those assigned to Chilanga district at the pre-test and intervention stage, collected data in Kafue district at the post-test, while those who did the pre-test and intervention in Kafue did the post-test in Chilanga district.

Internal Validity

A simple random sampling method was used to choose the children who participated in the study, and this method ensured that every participant had an equal opportunity to be chosen. Another component that helped ensure the internal validity of the experiment was the random assignment of participants to the three different conditions. According to Campbell (1963), randomisation of the study's participants is one way in which high levels of internal validity might be accomplished.

Data Analysis

The data for this study was entered in SPSS version 26. Descriptive statistics were run to check the equivalence of the variables of interest in the three groups (intervention, control group I and control group II) at baseline and post-test. Before running inferential statistics, normality and homogeneity tests were conducted.

A linear mixed-model statistical analysis was employed to establish the effect of the intervention on preschool children's emergent literacy skills. According to the literature (e.g., Cleophas & Zwinderman, 2011; West et al., 2007), this method is more suitable for the analysis of data involving repeated measurements since it handles missing data in a more effective manner and allows the variance to be accounted for separately by fixed and random factors. Linear contrasts were created to compare the mean scores of three conditions: (i) intervention versus the two control groups (Helmet 1) and (ii) the non-verbal games group (control group I) versus the business-as-usual control group (Control group II-Helmet 2). The second contrast was created to estimate any effects of the tablet experience. The outcome variables (posttest rhyme awareness, vocabulary, and story comprehension) were regressed on the conditions. Pretest scores were adjusted for, as these have been

documented to be related to the child's achievement at the post-test (Keppel & Wickens, 2004). For instance, when analysing the effect of the intervention on post-test rhyme awareness skills, pretest rhyme awareness scores and the child's primary language were the covariates. The primary language spoken by the child at home was also controlled for because previous studies have suggested that it is related to child achievement (Whitehurst & Lonigan, 2001; Cassano & Schickedanz, 2015). Other covariates, such as age, gender, family socio-economic status, home literacy, and parental literacy, were included only if they had an effect on the outcome variables.

Where the intervention had a statistically significant effect, the effect size was computed by dividing the estimated marginal means of the intervention by the standard deviation of the outcome variable and multiplying the answer by 2, in line with the suggestion by Kugler et al. (2012). In this study, effect sizes were interpreted using both Cohen's *d* (1988) recommended scale: a 2-small effect, a 5-medium effect, and an 8-large effect, and using benchmarks suggested by Kraft (2019) for causal education intervention studies of pre-K–12 as follows: $< .05$ as small, 0.05 to < 0.2 as medium, and greater than 0.2 as large.

Ethical Considerations

This study was approved by the ethics committee of the University of Zambia. Permission to conduct the study was also granted by the Provincial Education Officer (PEO) for Lusaka province, District Education Board Secretaries (DEBS) for Lusaka, Kafue, and Chilanga districts, school authorities, and parents/caregivers. Parents were given a thorough explanation of the study's aims and procedures and were asked to sign a written permission for their children's

involvement in the study (see a appendix, H, I and J for documents of study approval).

Confidentiality was maintained at all times, and participants' identities and responses were kept confidential throughout the study. The research assistants signed a contract in which they pledged to uphold research ethics and abide by the research ethics outlined by the project. Since this research involved the use of audio recorders, parents were informed of this prior to signing the consent form. Children were notified of the recording right before it occurred. After data collection, only the researcher had access to the hard and soft copies of the data, which were securely stored. The data was solely used for academic purposes and has not been shared with any third parties.

Chapter Summary

This chapter outlines the methodology used to investigate the impact of Nyanja digital animated stories and rhymes on preschool children's rhyme awareness, vocabulary, and story comprehension skills. The study followed the positivism paradigm and utilised a quantitative methodology to generate data that could be analysed and interpreted statistically. The research design employed was a randomised controlled experiment, which included one intervention group and two control groups. The study was conducted across three districts of Lusaka province, Zambia, and data was collected from a total of 353 children using various assessment tools. The collected quantitative data was entered into SPSS, and both descriptive and inferential statistics were obtained. The chapter also discusses the research ethics that were followed during the study. The next chapter presents the results of the study.

CHAPTER FOUR: PRESENTATION OF RESULTS

Overview

This study investigated how digital animated stories and rhymes affect preschool children's rhyme awareness, vocabulary, and story comprehension skills. Data were collected at two points: the pretest (May 22nd to June 8th, 2018) and the posttest (July 27th to August 9th, 2018). The collected data were analysed in SPSS v26, and linear mixed model analyses were performed to determine whether there were significant differences in scores between the intervention and control groups and whether these differences were due to exposure to digital animated stories and rhymes.

This chapter presents the results of the study. This includes the attrition flow chart, background measures, descriptive statistics, and inferential statistics aligned to the following study hypotheses.

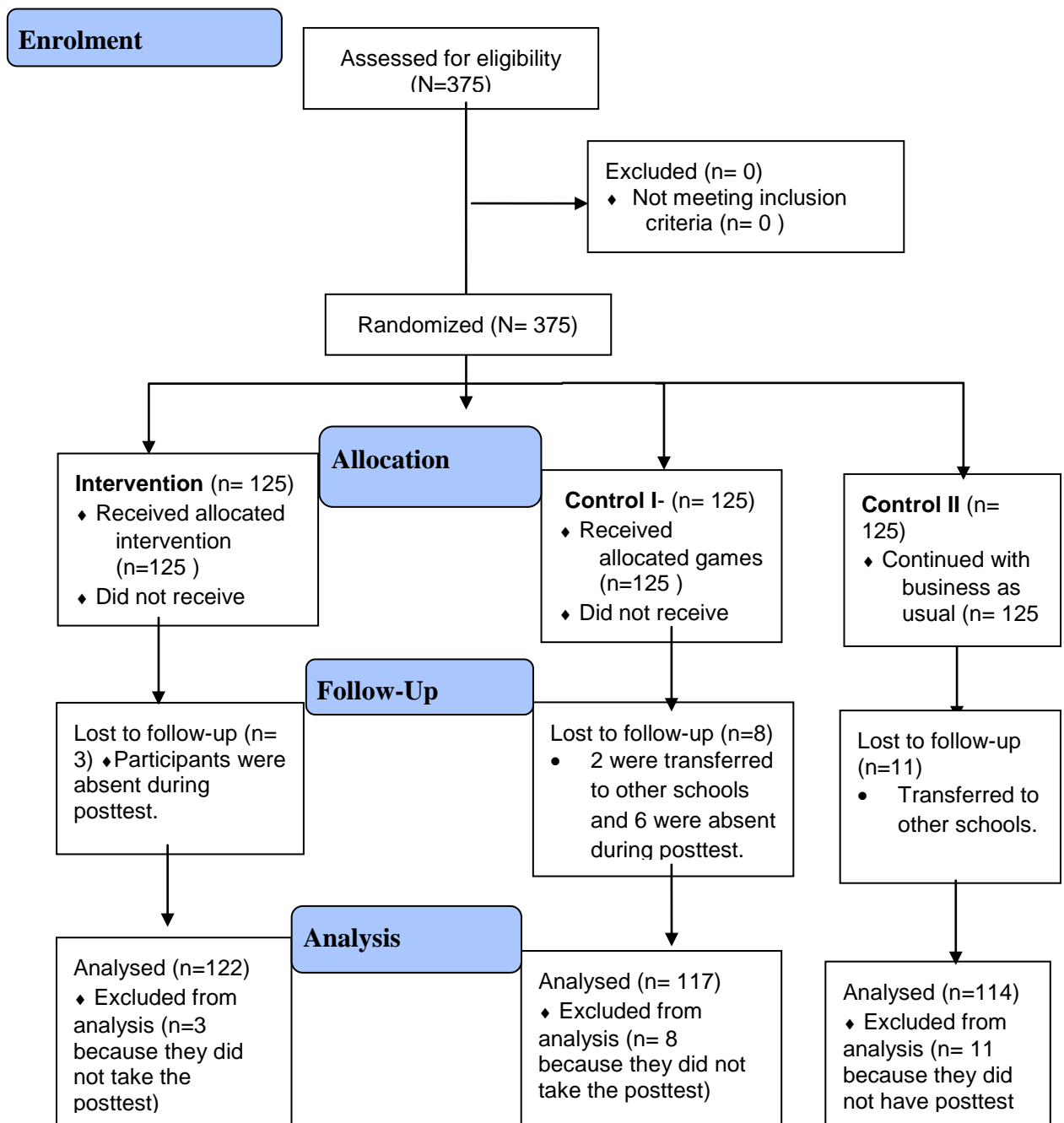
1. Preschool children exposed to Nyanja digital animated stories and rhymes will show significant gains in rhyme awareness skills compared to their non-exposed peers.
2. There will be significant differences in measures of vocabulary between preschool children exposed to Nyanja digital animated stories and rhymes as compared to those not exposed.
3. The story comprehension skills of preschoolers exposed to Nyanja digital animated stories and rhymes will be significantly higher than those of their peers who are not exposed.
4. Pretest vocabulary scores will moderate the effect of the intervention on story comprehension.

Attrition and Missing Data

At the pretest, 375 typically developing preschool children were recruited for the study. Equal numbers of participants ($n = 125$) were then assigned to three conditions. Of the 375, 22 participants were lost at the posttest, resulting in a final sample of 353 children and a total attrition rate of 5.8% (see Figure 3).

Figure 3

Participant Flow Diagram



Data Preparation

The dataset was initially examined to identify and address any missing values and outliers to ensure that the data was complete and ready for analysis. Missing data points were managed using strategies like imputation or deletion. Outliers were identified and winsorisation was applied where necessary (i.e., replacing extreme values with less extreme ones). Tests for normality, homogeneity of variance, and independence of observations were conducted.

Descriptive Statistics

Covariates: A series of descriptive tests found no statistically significant differences in covariates that may influence the intervention, such as age, gender, parental literacy, reading activities at home, and socioeconomic status. Therefore, the subsequent analysis did not include these covariates.

Baseline Equivalence

Descriptive analyses were performed on baseline scores to determine the equivalence across the three conditions (intervention, control group I, and control group II) before the intervention. An analysis of variance (ANOVA) was run on picture rhyming, expressive and receptive language pretest scores to determine if significant differences existed between the intervention and control groups before the intervention. Additionally, the Kruskal-Wallis's test was used on rhyme production scores, which were not normally distributed. As Table 5 shows, there were no statistically significant differences in pretest results across the three groups ($P > 0.5$). This demonstrates that all three groups were equivalent before the intervention was implemented.

Table 5

Baseline Mean Scores and Standard Deviations by Condition

Measures	Intervention		Control I		Control II		<i>p-v</i>
	<i>n</i>	<i>M(SD)</i>	<i>n</i>	<i>M(SD)</i>	<i>n</i>	<i>M(SD)</i>	
Picture rhyming	121	5.13(3.96)	117	5.27(3.58)	113	6.11(4.15)	.12
Rhyme production*	121	2.01(2.53)	117	2.29(3.09)	118	2.64(3.62)	.85
Receptive language	120	13.96(3.28)	117	13.56(3.51)	113	13.85(3.58)	.66
Expressive language	122	4.34(2.07)	116	3.87(2.18)	114	4.19(1.75)	.19

Note. P-values on all measures were $>.05$, indicating the equivalence across the three conditions before the intervention. *Calculated using the Kruskal Wallis test as scores were not normally distributed

Post-test Mean Scores

The ANOVA or Kruskal-Wallis tests were used to determine the means and standard deviations (SD) scores for the measures of interest. Except for Rhyme production, which was not normally distributed, all the other tests were analysed using ANOVA. Results in Table 6 show that, compared to the two control groups, children in the intervention group showed statistically significant gains in their expressive and receptive language skills at post ($p < .01$).

Table 6

Mean scores, Standard deviations, and P-values by condition

Measures	max	Intervention		Control I		Control II		p-v
		n	M(SD)	n	M(SD)	n	M(SD)	
Picture	16	116	6.09(4.53)	112	6.29(4.09)	110	6.19(4.08)	.78
Rhyme								
Rhyme production*	16	118	2.09(2.72)	112	2.26(3.15)	110	2.29(2.91)	.78
Receptive Language	29	117	19.38(3.80)	112	15.83(4.00)	110	14.91(3.38)	.000
Expressive Language	18	119	6.14(2.91)	113	4.72(1.97)	110	5.11(2.30)	.000
Story Retelling	19	70	6.00(4.53)	64	5.50(4.79)	46	5.94(4.96)	.81
Q&A**	11	80	4.60(2.57)	76	4.21(2.11)	70	4.21(2.37)	.49

*Calculated using the Kruskal Wallis test as scores were not normally distributed.

**Question and Answer story comprehension

Normality tests were conducted on variables to verify the normality of the data, analysing the Kurtosis and Shapiro-Wilks tests and visually inspecting histograms and Q-Q plots. Where results showed that the data was not normally distributed, it was normalised using a square root transformation. Additionally, homogeneity of variance was assessed using the Analysis of Variance (ANOVA), specifically Laverne's test. The results for the variables of interest were non-significant ($p > 0.05$), indicating that the assumption of homogeneity of variance was met.

Factor Analysis

Before inferential statistics could be conducted, variables that measured similar constructs were combined into composite scores using factor analysis. Raw

rhyme awareness, vocabulary and story comprehension scores were subjected to principal component analysis (EFA) using Varimax (orthogonal) rotation to create composite scores. The varimax rotation method was selected because it produces factor loadings that are either very high or low, making it easier to match each item with a single factor (Tabachnick & Fidell, 2013). All factors loaded on one component, meaning that the items in each subscale measured similar things. Most elements, except pretest receptive language loaded above the acceptable limit of $>.4$. Table 7 summarises the items included in the subscales and the component loadings of the items in the subscales.

Table 7

Factor loadings for exploratory factor analysis with varimax rotation

Subscale	Component		
	1	2	3
<i>Pretest rhyming</i>			
Pretest Rhyme Production	.778		
Pretest Picture Rhyming	.696		
<i>Pretest Vocabulary</i>			
Pretest Expressive language	.808		
Pretest Receptive language	.317*		
<i>Posttest rhyming</i>			
Rhyme Production	.676		
Picture Rhyming	.680		
<i>Posttest Vocabulary</i>			
Expressive language	.823		
Receptive language	.630		
<i>Story Comprehension</i>			
Story Retelling	.879		
Question and Answer	.879		

*Pretest Receptive language was the only individual measure with a factor loading of $<.4$. It was analysed separately.

Bivariant Correlations

Pearson's correlation coefficients were calculated to examine the relationships between various variables. The results, presented in Table 8, revealed several significant correlations between various covariates and outcome variables. There was a significant positive correlation between post-test rhyming and pretest rhyming ($r = .329$, $p < .05$). This indicates that children who had better rhyme awareness skills at the pretest tended to have higher scores on post-test rhyme awareness assessments. Additionally, post-test vocabulary showed significant positive correlations pretest vocabulary ($r = .366$, $p < .01$) showing that children with higher pretest vocabulary tended to achieve better scores on post-test vocabulary assessments. Additionally, posttest vocabulary negatively correlated with age ($r = -.117$, $p < .01$) and school ($r = -.112$, $p < .05$)

Further, pretest vocabulary was positively correlated with story comprehension abilities ($r = .283$, $p < .01$), implying that children with stronger vocabulary skills at pretest also had better comprehension skills at post-test.

Table 8

Summary of intercorrelations for covariates and outcome variables

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Covariates														
1 Age	1													
2 School	-.671	1												
3 Sex	.008	.007	1											
4 Parental Education	-.027	.015	.010	1										
5 Parental literacy	-.082	.052	-.002	.397	1									
6 Primary Language	.056	-.059	-.077	.033	.052	1								
7 Literacy Materials	-.016	-.100	.008	.165**	.256**	.130*	1							
8 Home Literacy	-.026	.084	.029	.112	.279**	.085	.253**	1						
9 Home possessions	-.196	.072	-.017	.317**	.245**	.104	.172	.085	1					
Pretest Measures														
10 Vocabulary	.337**	-.295**	-.58	.059	-.017	.067	-.011	-.120	.018	1				
11 Rhyming	-.064	.099	-.021	.017	.104	-.121	-.074	-.002	.015	.030	1			
Post-test Measures														
12 Vocabulary	-.174**	-.168**	-.112*	.037	.047	.096	-.040	.009	.098	.366**	-.029	1		
13 Rhyming	0.19	.081	-.064	.030	.006	.117*	.018	.18	.070	.142**	.329*	.072	1	
14 Comprehension	.041	-.014	-.121	-.049	.134	.136	.115	.051	.067	.283**	.029	.117*	.183*	1
Mean	81.08	7.18	.52	1.57	.75	.73	2.44	3.83	8.54	.00	.000	.00	.00	.00
S.D	15.676	4.372	.5	.611	.457	.443	1.275	1.708	2.21	1	1.00	1.00	1.0	1.0

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed).

The Influence of Digital Animated Stories and Rhymes on Rhyme Awareness

Skills

A linear mixed model was used to test the hypothesis that children's rhyme awareness skills would significantly improve after being exposed to digital animated stories and rhymes as compared to children in the two control groups. First, an interclass correlation coefficient (ICC) was calculated to check for school effects. The intraclass correlation coefficient (ICC) equalled $(0.069/0.069+0.782= 0.081)$. Therefore, the school explained an 8% variance in post-test rhyme awareness scores. Next, post-test rhyme awareness scores were regressed on contrast conditions, pretest rhyming scores, and primary language spoken by the child as fixed effects. The intervention had no significant main effect on post-test rhyming outcomes ($\beta=.13$, $SE=.09$, $p=.173$). Consequently, the hypothesis that children exposed to digital animated stories and rhymes would have better rhyme awareness skills compared to those in the two control groups not exposed was rejected, and the null hypothesis was accepted.

Impact of Nyanja Digital Animated Stories and Rhymes on Vocabulary

Acquisition

The effect of the intervention on vocabulary was assessed after adjusting for baseline vocabulary scores and children's primary language spoken at home. The interclass correlation was first calculated and revealed that the school explained 4% of the variance in vocabulary scores. ICC equalled $(0.01817/0.01817+0.323= 0.0525)$. When posttest vocabulary was regressed on 'contrasted condition,' pretest vocabulary scores and the child's primary language, results revealed a significant linear increase in vocabulary scores for participants in the intervention group ($\beta = 0.19$, $SE= .02$, $p<.001$, 95% CI [0.16, 0.23]) as Table 9 shows. Therefore, the

hypothesis that vocabulary scores of children in the intervention group will significantly be higher than those of preschool children not exposed to Nyanja digital animated stories and rhymes was accepted.

Table 9

Estimates of fixed effect^a for vocabulary post-test scores as a function of intervention

Parameter	Est.	SE	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	-.16	.100	57.62	-1.63	.109	-.367	.04
Intervention vs control condition*	.30	.03	322.65	9.58	.000	.24	.36
Contrasts between Control conditions**	.08	.05	326.27	1.23	.220	-.04	.18
Primary Language	.20	.11	335.80	1.91	.058	-.01	.40
Pretest Vocabulary	.29	.05	261.31	6.10	.000	.20	.38

a. Dependent Variable: Vocabulary

Effect size. As table 9 shows, participants' vocabulary improved after listening to digital animated stories and rhymes. The calculated effect size was (ES=0.30). This could be interpreted as a small effect size, according to Cohen's criteria based on laboratory studies (1988). Nonetheless, according to benchmarks by Kraft (2019), for causal educational intervention studies of pre-K children in their natural environment like in this study, an effect size of 0.30 is large.

Digital Animated Storis and Rhymes and Story Comprehension

The effect of digital stories and rhymes was evaluated in the study, which was measured through story retelling and question-and-answer tests. The effect of the intervention on story comprehension was assessed by regressing story

comprehension on contrasts between intervention and control conditions, and between control conditions and the child’s primary language. The intervention had a significant main effect on story comprehension ($\beta = .20$, $SE = .10$, $p = .043$) when the child’s primary language was controlled for, as shown in table 10. The calculated effect size equalled ($ES = .40$), which is a large effect, according to Kraft’s standards (2019). However, the study did not find any statistically significant interactions between the intervention and the child’s primary language. This means that, within the group receiving the intervention, the primary language of the children did not influence the development of their story comprehension skills. The hypothesis stating that preschool children who are exposed to Nyanja digital stories and rhymes will exhibit significantly higher story comprehension skills compared to their peers who are not exposed has been supported by the findings. Consequently, the null hypothesis was rejected.

Table 10

Estimates of fixed effect for story comprehension, adjusting for primary language

Parameter	Est	SE	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	-.26	.14	180	-1.84	.068	-.55	.02
Intervention vs control condition	.20	.10	180	2.02	.043	.00	.39
Contrasts between Control condition	-.07	.19	180	-.38	.708	-.43	.30
Primary language	.35	.17	180	2.06	.040	.02	.68
Intervention * primary language	-.19	.11	180	-1.67	.095	-.41	.03
Control * primary language	.040	.22	180	.19	.851	-.38	.46

Dependent variable: story comprehension

Moderating Effect of Pretest Vocabulary Scores on Story Comprehension

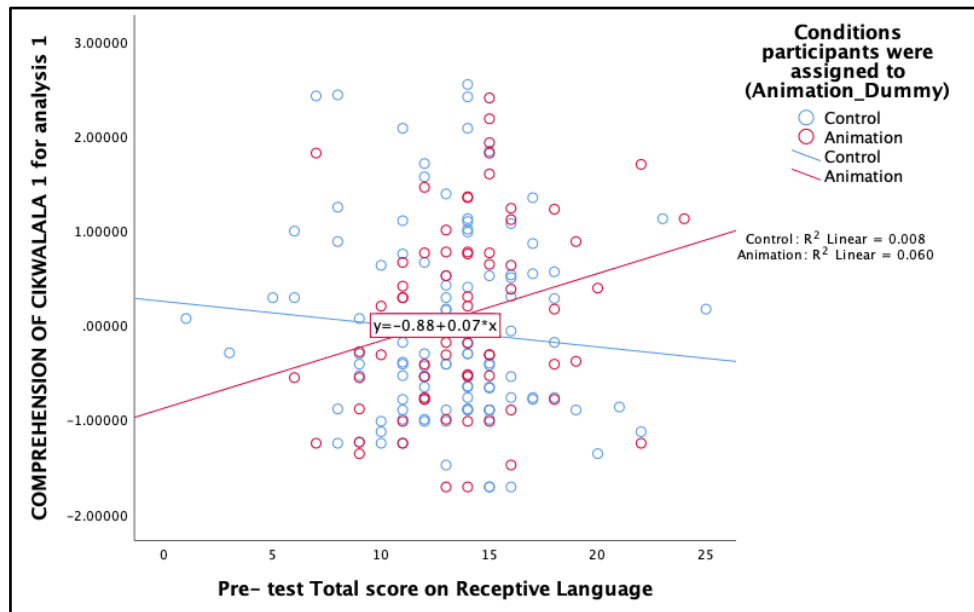
The potential moderating effects of baseline vocabulary scores on the relationship between the intervention and story comprehension scores were also examined in this study. The researcher hypothesised that the effectiveness of the interventions in enhancing story comprehension skills would be contingent upon the participant's vocabulary skills as measured during the pretest phase. The results indicated that expressive vocabulary scores did not moderate the effect of the intervention on story comprehension. There was no statistically significant interaction between pretest expressive language scores and the intervention ($p > .05$). However, there was a statistically significant interaction observed between the intervention and the baseline receptive language scores ($\beta = .032$, $SE = .032$, $p = .024$), as indicated in Table 10. The findings indicate that the baseline receptive language scores of children had an impact on the rate of improvement in story comprehension skills among participants in the intervention group. Thus, the hypothesis stating that pretest vocabulary scores would serve as a moderating factor in the relationship between the intervention and story comprehension has been confirmed.

Interaction between the Intervention and Pretest Receptive Vocabulary Scores

Analysis of the interaction plots for the intervention and receptive vocabulary showed that children in the intervention group who started out with high receptive vocabulary scores at baseline had better comprehension scores than those with low baseline scores in receptive vocabulary (see figure 4). Children in the intervention who started out with lower receptive vocabulary skills also demonstrated lower story comprehension skills at the post-test.

Figure 4

Mean Story Comprehension by Pretest Receptive Vocabulary



Chapter Summary

This chapter presented the results of the study. Linear Mixed model analysis shows that digital stories and rhymes (intervention) significantly improved vocabulary and story comprehension skills. Baseline receptive language scores are the only vocabulary scores that moderated the intervention's effect on story comprehension. There were no statistically significant differences between the intervention and the two control groups and the intervention with regard to rhyme awareness skills. These results are discussed in the next chapter.

CHAPTER FIVE: DISCUSSION

Overview

The current study's primary goal was to examine whether digital animated stories and rhymes might be effective in assisting Zambian preschool children to acquire emergent literacy skills. Based on previous studies, the current study hypothesised that: a) the intervention (digital animated stories and rhymes) would enhance rhyme awareness, vocabulary, and story comprehension skills of preschool children; and b) baseline performance vocabulary scores would moderate the effect of the digital stories and rhymes on story comprehension. This chapter discusses the various results obtained in this study.

The Influence of Digital Animated Stories and Rhymes on Rhyme Awareness

Skills

The first objective of this study was to assess the impact of digital animated stories and rhymes on preschool children's rhyme awareness skills. The hypothesis was that children exposed to digital animated stories and rhymes would show a significant improvement in their rhyme awareness as compared to those who were not exposed. The intervention implemented in this study lasted for 6 weeks, consisting of 24 sessions. This timeframe was selected based on previous research indicating that significant improvements can be achieved with relatively short interventions (Shamir & Lifshitz, 2013). Statistical analysis showed no significant difference in rhyme awareness skills between the intervention group and the two control groups. These results are not consistent with the previous research that found that digital instructional materials enhance rhyme awareness skills. For example, Segers and Verhoeven (2005) reported a significant improvement in rhyme awareness among Dutch-speaking children following computer-based intervention,

while Shamir and Lifshitz (2013) observed similar outcomes among Hebrew-speaking children with learning disabilities exposed to electronic storybooks.

The lack of statistical significance in this study may have resulted from the children's limited comprehension of the concept of rhyming. To recognise and produce rhymes, a developed understanding of this concept is required, which may not have been fully developed by the children involved in the study. The primary goal of the study was to determine whether children could develop their rhyme awareness skills without adult assistance. The study sought to address the issue of insufficient adult supervision in promoting literacy. In Zambia, many low-socioeconomic households do not engage children in literacy-promoting activities, and some preschools have classes that are too large for teachers to provide individual attention to each child, which adversely affects literacy acquisition. However, implicit teaching of rhyme awareness skills through exposure to digital animated stories and rhymes may not have provided sufficient support for children, especially those without prior exposure to rhyme awareness instruction. Previous studies that explicitly taught these skills have reported positive results (Shamir & Lifshitz, 2013). The departure from direct instruction in this current study may have been less suitable, particularly for children from disadvantaged backgrounds who may lack prior exposure to rhymes. Interactive and scaffolded approaches that teach rhyming concepts directly could potentially improve children's skills more effectively.

Additionally, it is possible that the limited diversity of rhyming words in digital animated stories and rhymes may have made it challenging for children to fully comprehend the idea of rhyming, particularly without explicit instruction. However, it's important to note that some words had similar phonetic qualities, such

as "agogo" and "agona," which could have enhanced children's awareness of sounds. This sensitivity might have helped them develop other phonological awareness abilities. Unfortunately, the study did not evaluate sound sensitivity, which limits our ability to understand the impact of digital resources on phonological awareness skills. The lack of a comprehensive assessment makes it difficult to determine the overall effectiveness of digital animated stories and rhymes in developing phonological awareness skills in preschool children. The study may have employed a test too sophisticated for children unfamiliar with the concept of rhyming, potentially influencing the outcomes.

These findings have implications for the broader context of literacy promotion in Zambia. With limited adult engagement in literacy activities at home and large preschool class sizes, relying solely on implicit learning from digital rhymes may not be sufficient to enhance rhyme awareness skills among Zambian preschoolers. Zambian preschool children might benefit from digital nursery rhymes in which rhyming skills are explicitly taught, and more studies may determine this. Therefore, we need to conduct further research to identify strategies that can enhance the rhyming abilities of preschoolers in Zambia, given their crucial role in later reading success (Harper, 2011).

The Impact of Digital Animated Stories and Rhymes on Vocabulary

Acquisition

This study also hypothesised that children exposed to animated digital stories and rhymes would demonstrate significant improvements in their vocabulary skills compared to those who were not. The study's results revealed a statistically significant improvement in vocabulary skills among children exposed to digital animated narratives and rhymes, compared to those not exposed to these materials.

The effect size of the improvement was measured at 0.48, which is considered a large effect size (Kraft, 2019). Therefore, the null hypothesis that no significant difference in vocabulary scores would be observed between children exposed to digital animated stories and those not exposed was refuted. These results provide evidence that digital animated narratives and rhymes have the potential to significantly enhance the vocabulary skills of preschool children in resource-constrained environments. This conclusion is consistent with previous studies (such as those by Bus et al. 2020, Maureen, van der Meij, & de Jong, 2018, 2020, and Sari et al., 2019), which also confirm the potential of digital animated narratives and rhymes in enhancing the vocabulary skills of children in resource-constrained environments.

The results of this current study also align with the Cognitive Theory of Multimedia Learning (Mayer, 2005; 2021), which emphasises the effectiveness of combining visual and auditory teaching methods to enhance learning. According to this theory, presenting information through multiple sensory channels can improve learning outcomes by engaging different cognitive processes simultaneously. In the context of the study, the combination of digital animated stories and rhymes provided a multisensory learning experience for the children. The animations' visual component provided vivid depictions of vocabulary words in context, while the auditory element provided oral narration and reinforcement of the presented words (Mayer, 2021). This integration of visual and auditory stimuli allowed the children to make connections between what they saw and heard, facilitating deeper understanding and retention of the vocabulary. By leveraging both visual and auditory cues, children are better able to encode, process, and retrieve new information, leading to more robust learning outcomes.

The digital animated stories and rhymes create an immersive learning environment that captures children's attention and sustains their interest through captivating visuals and audio elements. This dynamic context presents vocabulary in meaningful contexts, enabling children to naturally understand the usage and nuances of words. Moreover, the repetitive patterns and rhymes commonly found in animated stories serve as powerful mnemonic devices, reinforcing vocabulary learning through multiple exposures.

Additionally, digital animated narratives' emotional resonance and cultural relevance foster a deeper connection to the vocabulary learners. By evoking emotions and depicting familiar cultural contexts, these stories and rhymes not only enhance motivation but also reinforce the relevance and significance of vocabulary in children's lives. This research, building on the groundwork of previous studies, highlights the transformative potential of multimedia resources in shaping children's language development.

Digital Animated Stories, Rhymes, and Story Comprehension Skills

The third objective of this study was to examine whether exposing preschool children to digital animated stories and nursery rhymes could enhance their story comprehension skills in the language of instruction. It was hypothesised that preschool children exposed to digital animated stories and rhyme would outperform those not exposed to these multimedia materials. Story comprehension scores did not correlate with any of the following covariates: age, gender, socio-economic status, and parental education. Hence, these were not included in further analysis and are not discussed here. Descriptive statistics showed that the mean scores for both the retelling and question-and-answer story comprehension measures were slightly higher for children in the intervention group than for those in the control

groups. However, these differences were not statistically significant, according to the ANOVA.

Nonetheless, results of the linear mixed model analysis revealed a statistically significant improvement in the performance of children who were exposed to digital animated stories and rhymes compared to those who were not exposed, after accounting for the child's primary language spoken at home ($p = 0.043$, with an effect size of 0.39). By the standards set by Kraft (2019) for educational studies for prekindergarten, like the current study, this is considered to be a large effect size. Therefore, the study's hypothesis that story comprehension skills among children who were exposed to digital animated stories and rhymes would significantly be higher post-intervention than for children who were not exposed was supported by the findings of this study. These findings are consistent with previous studies, specifically one by Altun (2018) and Smeets and Bus (2015), who found that animated e-stories promoted the development of story comprehension skills in children from disadvantaged backgrounds. From the results of this study, it becomes clear that film-like multimedia instructional materials, which incorporate animations, narrations, sound, and background music, can be effective in facilitating the development of story comprehension, one of the emergent literacy skills that this study set out to explore.

The design of the digital intervention materials explains the positive outcomes obtained. The digital intervention materials were formatted in a film-like manner, including motion images, narrations that were coherent with the animations, background music, and sound effects that were used only when necessary. The animations were carefully synchronised with the spoken narratives, sounds, and music. The CTML asserts that congruent presentation of materials in animation and

narrations leads to meaningful learning (Mayer, 2001, 2021). In this study, the use of animation and oral narration helped children connect spoken words with visual representations presented simultaneously, making it easier for them to grasp the material. According to Verhallen and Bus (2011), animations are particularly useful for helping children learn about implicit aspects of stories, like the characters' aims or intentions, and to actively generate a sense of the story. Therefore, the animations and rhymes used in this context may have helped children understand the implicit aspects of the stories, which in turn improved their story comprehension skills.

Additionally, the digital animation and rhymes included sounds and background music, but this research did not examine whether or not they contributed to the participant's ability to grasp the stories. Previous studies have reported mixed effects of these multimedia elements on story comprehension (Ritcher & Courage; Sari et al., 2019). In their study, Sari et al. (2019) observed that background music had a negative impact on narrative comprehension as a result of audio masking. On the contrary, the background music and sound included in the digital animated stories and rhymes did not appear to have a negative effect on story comprehension. Based on our study's findings, it's possible that including these elements in digital animated instructional materials that are kept to a minimum may not negatively impact the growth of story comprehension skills.

Moderating Effects of Vocabulary on Story Comprehension

The last objective of this study was to assess whether the children's baseline vocabulary scores moderated the effect of the intervention on story comprehension. Research has established a link between an individual's vocabulary skills and their comprehension abilities (Senechal et al., 2006). Research has been able to demonstrate that vocabulary enhances comprehension, which in turn facilitates the

process of acquiring new vocabulary (Senechal et al., 2006). Based on this literature, this study embarked on exploring whether vocabulary would influence the acquisition of story comprehension from digital animated stories and rhymes. It was hypothesised that baseline vocabulary scores would moderate the impact of the intervention on story comprehension. The study found that, of the two vocabulary measures (expressive and receptive language), only baseline receptive language scores significantly influenced the effectiveness of the intervention in enhancing story comprehension. The results suggest that children in the intervention group who exhibited better receptive language proficiency prior to the intervention also demonstrated superior story comprehension abilities following the intervention in comparison to children with lower receptive language scores at baseline. The results of this study align with prior research indicating that the use of animated stories has a positive impact on the acquisition of vocabulary and story comprehension skills, thereby enhancing overall story comprehension skills (Reade, 2017; Shwetha & Phil, 2013). Given the role of vocabulary in facilitating the acquisition of story comprehension through the use of digital technology, it is necessary to introduce interventions that specifically target the enhancement of both vocabulary and story comprehension, as was the case in this current study. This will improve children's story comprehension, resulting in additional benefits from these educational resources.

The findings of this research, together with those of previous studies, provide more evidence that animated digital materials are an important tool for enhancing readers' ability to comprehend stories. The study provides a better understanding of how digital technology can be used to help support the development of story comprehension in preschool children in a Zambian setting. Therefore, these

resources can serve as effective tools for enhancing the development of story comprehension abilities in early childhood.

Implications for Policy and Practice

Preschoolers exposed to digital animated stories and rhymes through tablets demonstrated significant improvements in vocabulary and story comprehension, according to this research. The study provides evidence that children's vocabulary and story comprehension can be improved through exposure to digital animated stories and rhymes without the assistance of adults. These findings have several positive implications for preschool children in Zambia.

Children can learn from digital animated stories and rhymes on technological devices like smartphones, tablets, and laptop computers without adult assistance. Digital animated stories and rhymes can still promote children's emergent literacy skills in Zambian homes, where access to adult-led literacy-promoting activities like shared book reading is limited. Digital animated stories and rhymes can be useful tools in such situations, especially for preschool children who cannot read printed materials on their own.

Preschool children whose mother tongue or the language of play differs from the language of instruction should also benefit from the use of digital animated stories and rhymes to support their oral language skills. In this study, children's vocabulary skills (expressive and receptive language) significantly improved in the language of instructions after exposure to just 24 sessions of 15 minutes each to Nyanja digital animated stories. Lusaka province, the capital city of Zambia, has people who speak diverse languages such as Bemba, Tonga, Lozi, English, and Nsenga in their homes (USAID Education Data Activity, 2020; Mwanza, 2012). Hence, for some children, the instruction language at school may differ from the

primary language they speak at home. Such situations make it difficult for children to acquire early literacy skills. Matafwali and Bus (2013) found that oral language affected grade 1 and 2 pupils' acquisition of literacy skills in Lusaka province.

Additionally, digital animated stories and rhymes could be used to enhance vocabulary skills in the language of instruction in Lusaka province. A mismatch has been reported between standard Nyanja, which is used in schools for instructions in Lusaka province, and the 'nonstandard', which is preferred and used by children during play (Mwanza, 2012; Tambulukani, 2012). Therefore, even if schools offer instructions in one of the seven official local languages, some learners may not be learning in their most familiar language. This situation may pose a challenge to children's acquisition of oral language and literacy skills. Digital animated stories and rhymes, proven effective in fostering vocabulary skills, could serve as remedial materials to enhance oral language in standard Nyanja. Children could listen to digital animated stories and rhymes repeatedly, which could improve their vocabulary in the language of instruction.

Digital animated stories and rhymes can also help reduce the problem of inadequate literacy resources in the language of instructions in homes and preschools. USAID Education Data Activity (2020) found that 80% of the 52 public preschools surveyed did not have storybooks in the local language in which initial literacy from preschool to grade 4 is taught or in English. While the production of digital animated instructional materials may seem expensive compared to print materials, they become cheaper in the long run. Once produced, digital animated stories and rhymes can easily be shared with many people and used on various devices such as laptops, tablets, televisions, and smartphones. According to Bankmycell (2022), there has been a significant increase in the proportion of the

global population using smartphones, with estimates rising from 49% in 2016 to 83% in 2022. Therefore, children can access these digital instructional materials from their parents' phones. Statistics show that the number of households with cell phones is growing. In Zambia, it was about 53% in 2018 (ZICTA, 2018).

Further, digital animated stories and rhymes could be used by teachers as supplementary material, especially in large classrooms, which characterise most government preschool centres in Zambia. By government regulations, 25 to 30 learners between the ages between the ages of five and six are expected in the preschool classroom. However, some government centres have as many as 50 learners (USAID, 2020). Such numbers may overwhelm some teachers, potentially hindering their performance. Teachers could supplement their efforts with digital animated stories and rhymes. In such large classes, learners could independently learn from digital animated stories and rhymes, allowing the teacher to devote more time to educational activities that digital technology cannot meet.

Moreover, in classrooms where the teacher is not a native speaker of the language of instruction, digital animated stories and rhymes should be used to teach the correct pronunciation of words. Zambia deploys many teachers without considering their proficiency in the language of instruction. Hence, it is possible that some teachers may be teaching in a language with which they are not familiar. For instance, a survey by Mwanza (2012) revealed that some teachers in Lusaka province were not conversant in standard Nyanja. They found it challenging to understand and use standard Nyanja and therefore resorted to using non-standard Nyanja as an alternative. Therefore, families, teachers, and the preschool curriculum should implement digital animated stories and rhymes to promote young children's vocabulary and story comprehension skills.

Chapter Summary

The results of the effect of digital animated stories and rhymes on rhyme awareness, vocabulary, and story comprehension skills were discussed in this chapter. Results for the rhyme awareness skills showed that the intervention did not significantly impact children's rhyme awareness skills, which was attributed to a lack of explicit instructions and children's unfamiliarity with the concept of rhyming. Digital animated stories and rhymes enhanced vocabulary and story comprehension skills in preschool children, which was consistent with what most previous research studies found. These positive outcomes were attributed to the multimedia elements embedded in the digital animated stories and rhymes (i.e., animated illustrations with oral narrations, background music, and sound). These multimedia tools provide engaging experiences that effectively facilitate and enhance overall learning for young learners.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

Overview

The final chapter of the thesis first presents conclusions drawn from the study's results and discussion. The chapter then outlines recommendations made based on the results of this study. The chapter ends with suggestions for future research.

Conclusions

The efficacy of digital animated tools that support the independent acquisition of emergent literacy skills among preschool children had not been widely investigated in Zambia, a gap that this study has since filled. This study showed that digital instructional materials enhanced with animations, oral narrations, background music, and sound fostered the development of vocabulary and story comprehension skills in preschool children. The findings of this study give credence to the assumptions of the CMTL theory, which stipulates that presenting materials in both animation and narrations supports learning as it affords children a chance to make the connection between what they see and what they hear, especially if these two are presented simultaneously. In this study, rhyme awareness skills did not improve after exposure to digital stories and rhymes. The limited number of unique rhyming words in the digital stories and rhymes and children's lack of knowledge of the rhyming concept might have affected the results. Simply exposing children to digital animated nursery rhymes without explicitly teaching of these rhymes might not be beneficial for Zambian preschoolers.

All in all, this study uncovers the contribution of technology-enhanced instructions (digital animated stories and rhymes) to the vocabulary and story comprehension proficiency of preschool children. The multimedia elements in the

new media made it possible for children to learn literacy materials without the assistance of an adult, which might not be possible with print stories and rhymes. Even though we do not deny that children may benefit more from accessing digital animated stories with adults, many Zambian children do not get such an opportunity. Given that adult-led activities such as shared book reading are not common, especially in resource-constrained homes in Zambia, digital animated stories, and rhymes could be used to support the emergent literacy skills of children not yet reading print. A digital programme seems advantageous for an environment characterised by low parental literacy levels, a lack of shared reading, insufficient literacy instructions and materials, and learning in overcrowded classrooms.

Furthermore, this study has established that technology-enhanced instructions produce positive results despite the many different contextual differences. In this study, the digital animated stories and rhymes produced positive results among children from resource-constrained homes and preschools. Therefore, the use of these tools should be promoted among children from different contexts and languages. However, this should not make parents and teachers choose them over printed books, especially among children who are able to read print. Printed books still remain the best way to cultivate a lifelong love of reading, and digital reading resources are simply one way to supplement the traditional reading experience. It is hoped that digital books will be used as a supplement to, rather than a substitute for, conventional print books in homes and classrooms.

Recommendations

This current study has found that exposing preschool children to digital animated stories and rhymes had a positive impact on children's vocabulary and story comprehension skills. However, there is no significant difference between the

intervention group and the control group. The study's results lead to several recommendations for policy and practice.

Policy Recommendations

1. Results of this study have shown that digital animated stories and rhymes were effective in supporting the development of vocabulary and story comprehension skills in preschool children in a resource-constrained environment. As a result, the study recommends using these materials as supplementary materials for preschools' limited print resources. Providing digital resources, such as digital animated stories and nursery rhymes, alongside printed teaching materials for preschool children can help address the country's limited availability of printed resources.
2. Once produced, a large audience, including families and teachers, can easily share and access digital tools. This strategy would help to address the issue of the limited printed teaching and learning materials that exist in the country. The Ministry of Education in Zambia should provide digital resources, such as animated storybooks and nursery rhymes, to supplement printed teaching and learning materials for preschool children.

Practice Recommendations

1. This current study has found that exposing preschool children to digital animated stories and rhymes had a positive impact on children's vocabulary and story comprehension skills. This study recommends using digital animated stories and rhymes as teaching and learning tools with preschool children to enhance their emergent literacy abilities, including vocabulary and story comprehension skills.

2. Nyanja digital animated stories and rhymes helped preschool children develop vocabulary and story comprehension in the language of instruction. This study recommends that digital animated stories and rhymes can be used to support the development of emergent literacy skills at home and in preschool, especially in Lusaka province, where there is a mismatch between the standard Nyanja used as a language of instruction and the non-standard Nyanja used by most children during play. These digital resources can assist in bridging the gap between the home language and the school language of instruction. By exposing children to stories and rhymes in the language of instruction, their vocabulary and language skills can be strengthened.
1. The results have shown that children can learn vocabulary and story comprehension from digital animated stories and rhymes even without the assistance of adults. This is particularly beneficial in homes where access to adult-led literacy activities may be limited. These materials are recommended to be incorporated in home literacy programmes, especially in low-resourced homes in Zambia, where adults do not usually engage in literacy-promoting activities with children.
2. Since digital animated stories and rhymes can support vocabulary and story comprehension skills even without the support of adults in young children, they can be used by teachers in large classroom settings, where teachers face challenges in providing individualised attention. This can alleviate the burden on teachers and provide additional learning opportunities for students.

Future Research Directions

The results of this intervention study have made a valuable contribution to our understanding of how digital animated stories and rhymes can enhance emergent literacy skills in preschool children, particularly in the Zambian setting. It is important to note that the study has some limitations, and there are opportunities for further research.

1. Since implicit exposure to animated stories and rhymes did not yield positive results, further studies can explore the effectiveness of digital animated stories and rhymes in explicitly teaching rhyme awareness skills. Understanding the best methods for teaching such skills can provide valuable insights for improving early literacy skills in preschool settings.
2. Furthermore, this research has not established the correlation between rhyming awareness and the development of other phonological awareness abilities, despite reports to the contrary. In future studies, it would be beneficial to investigate whether the influence of digital animated stories and rhymes on the enhancement of other phonological skills, such as blending, segmentation, iteration, and onset rhymes, is mediated by rhyme awareness skills. Additionally, evaluating children's auditory sensitivity after exposure to digital animated rhymes would be valuable. This approach would allow us to gain a more comprehensive understanding of how Nyanja digital animated stories and rhymes promote phonological awareness skills.
3. In view of the positive short-term effects of exposure to digital animated stories and rhymes on preschool children's vocabulary and story comprehension skills, as demonstrated in the current study, it might be useful to investigate whether these benefits endure over time. Longitudinal studies

tracking children's literacy development would provide valuable insights into the sustained impact of digital literacy resources on later academic achievement.

4. While the current study found beneficial effects of digital animated stories and rhymes on emergent literacy skills, it is crucial to explore how these effects vary across diverse populations and contexts. For example, understanding how factors such as context, disabilities, and linguistic background influence learning outcomes can inform the development of more inclusive and culturally relevant digital literacy interventions for preschool children in Zambia.
5. The current study has highlighted the potential of digital animated stories and rhymes as effective tools for promoting emergent literacy skills in preschool education. However, optimal integration strategies for incorporating these resources into curricula remain unclear. Experimental studies exploring variations in instructional practices, such as the duration and frequency of exposure to digital media, can help identify strategies that maximise educational benefits while minimising potential challenges and distractions in the classroom.

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APPENDICES

Appendix A

Cinyanja Rhyme Production Test

Materials; test template/score sheet and pencil

Say; *Ndidzakamba mau ndipo ndifuna kuti undiuze liu limene lipalana nalo kamvekelo ku last kwake. Tiye tiyeseko.*

Example 1

Basi na Delesi; Mau aya yapalana kamvekelo kulast kwake. Yonse yali ndi kamvekelo ka 'si' kulast kwake.

Ask the Child; *Ndiuze liu lina limeme lipalana kamvekelo kulast kwake ndi Basi.*

If the child gets example 1 correct say;

eye basi na (any word child produces ending in si) aya mau yapalana kamvekelo kulast kwake. Yonse yali ndi kamvekelo ka 'si' kulast kwake.

If the child fails to produce a rhyming word say;

wayesako liu lina lamene lipalana kamvekelo kulast kwake ndi basi ni Sutukesi. Aya mau basi-sutukesi yapalana kamvekelo kulast kwake. Yonse yali ndi kamvekelo ka 'si' kulast kwake.

Example 2

Say; *Ndiuze liu lina limeme lipalana kamvekelo kulast kwake ndi nyumba.*

If child fails to produce a rhyming word use *Nyumba-Nsomba* to teach them.

Say; *Wayesako. Liu lamene lipalana kamvekelo kulast kwake ndi nyumba, ni nsomba.*

Aya mau Nyumba-Nsomba yapalana kamvekelo kulast kwake. Yonse yali ndi kamvekelo ka 'mba' kulast kwake.

If child does not produce a rhyming word in both examples then proceed to the test.

S/N	Words	Child's Response	Correct (√)	Incorrect (√)
1	Gona			
2	Supuni			
3	Mbuzi			
4	Lima			
5	Lemba			
6	Zitatu			
7	Chimanga			
8	Mutolilo			
9	Mbululuka			
10	Moto			
11	Culu			
12	Sopo			
13	Coko			
14	N'gombe			
15	Kakowa			
16	Sisi			
17	Dzinja			
18	Kapokola			
19	Mbale			
20	Windo			

Appendix B

Cinyanja Picture Rhyming Test

Say;*Ndidzakuonesa zithunzi-tunzi zosiyana siyana. Ndifuna uniwuze zili pa zithunzi-tunzi izi. (Turn to Sample picture 1)*

Example 1

Say;*Kodi wazona zithunzi-tunzi izi? Point to sample picture 1.*

Sewenzetsa mau amodzi ndiuze cabe zimene ukuonapo. (Expected responses;

N’gombe, Matepo, Chimanga, Sopo).

NB: If the child does not successfully name the four items tell the child the names of the items.

If the child successfully names the four items, say to the child;

wacita bwino. Ndi zasonta ndikukamba maina awiri ya zithunzi-tunzi yali ndi kamvekelo kopalana kulast kwake.

Say; Sopo, Matepo (pointing at items)

Maina awa yapalana kamvekelo kulast kwake. Yonse yali ndi kamvekelo ka ‘po’ kulast kwake.

Say; Lomba ndidzakulangiza zithunzi-tunzi zina. Go to picture sample 2.

Example 2

Say;*Kodi wazona zithunzi-tunzi izi? Point to sample picture 2.*

Sewenzetsa liu limodzi ndiuze cabe zimene ukuonapo. (Expected responses; **Njinga,**

Bola, Minga, Shati.)

NB: If the child does not successfully name the four items tell the child the names of the items.

If the child successfully names the four items, say to the child; *wacita bwino.*

Ask the Child: *Ndi zithunzi-tunzi ziti zimene zipalana kamvekelo kulast kwake.*

(Expected responses; **Minga, Njinga**)

If the child does not get the concept of the test, correct the child, and move to example 3.

Assessor say; *Lomba ndidzakulangisa zithunzi-tunzi zina.* **Go to sample picture 3.**

Example 3

Say; *Kodi waziona zithunzi-tunzi izi?* **Point to sample picture 3.**

These are verbs say; *Sewenzetsa liu limodzi ndiuze zinthu zomwe anthu awa alikucita.* (Expected responses; **Phempera, Tilira, Tyola, Yimba**)

NB: If the child does not successfully name the four actions tell the child the actions.

If the child successfully names the four actions, say to the child; *wacita bwino.*

Ask the Child:

Ndi zithunzi thunzi ziti zimene zipalana kamvekedwe kulast kwake. (Expected responses; **Pempera, Tilira**)

If the child does not get the concept of the test, correct the child, and go through example 1 again. Then proceed to the test.

Test Instructions

Says; *kodi waziona zithunzi-tunzi izi apa? Kusewenzetsa liu limodzi ndiuzeko zinthu kapena zocitika zamene ulikuona.*

After the child has successfully named the items, ask the child; *Kodi ndi zithunzi-tunzi ziti zimene zipalana kamvekelo kulast kwake?*

NB: Incorrect response: if the child does not successfully name the four pictures of either the nouns or verbs, tell the child the names. If the child does not get the rhyming words correct, move to the next item.

Scoring Sheet

S/N	Child's Response	Incorrect (√)	Correct (√)
E1	N'gombe Matepo Cimanga Sopo		
E2	Njinga Bola Minga Shati		
E3	Phempera alira Tyola Yimba		
1	Windo Moto Bedi Poto		
2	Loko Nsapato Chona Nkoloko		
3	Nyundo Tebulo Foni Mpando		
4	Myala Kamwibili Tapu Chola		
5	Galu Kapokola Kwanja Fulu		
6	Wailesi Mbalame Mtengo Chipyango		
7	Delesi Mugomo Nkuku Basi		
8	Supuni Buku Peni Maso		
9	Ndevu Nsimbi Koswe Njobvu		
10	Lima Cheka Sakula Tema		
11	Jumpa Gwada Kumwa Kwempa		
12	Belenga Gona Tyola Pyanga		
13	Phika Taya Gela Peluka		
14	Gulugufe Mbuzi Bhaka Buluzi		

15	Nshawa	Mbale	Nkonono	Cule		
16	Nyumba	Motoka	Muthu	Nkumba		
17	Cithunzi	Ntochi	Kendulo	Botolo		
18	Capa	Nkala	Kudya	Vala		
19	Samba	Donsa	Posha	Lemba		
20	Siketi	Kapu	Nsomba	Basiketi		

Appendix C

CiNyanja Expressive One-Word-Picture Vocabulary Test

Materials: Tablet with animations, pencil and score sheet.

Example 1

Say; *Ndifuna kuti uyangane cithunzi-tunzi niri naco.* (**Turn to sample picture 1 - Cule**)

Waciona cithunzi-tunzi ici? (**Point to sample picture 1-Cule**)

Ask the Child: *Ici ndi ciani?*

If the child gives the correct answer say: *Wacita bwino!*

Proceed to Example 2.

If the child gives an incorrect answer correct the child saying:

Wacita bwino kuyesako, koma uyu ndi Cule.

Proceed to Example 2

Example 2

Show the child sample picture 2-**alu phempera.**

Point to the Picture and Say: *Kodi ulu cita ciani?*

If the child gives the correct answer say: *Wacita bwino!*

Proceed to Sample Picture 3.

If the child gives an incorrect answer correct the child saying:

Wacita bwino kuyesako, koma uyu alu phempera.

Proceed to Sample Picture 3.

Example 3

Show the child sample picture 3-**Nyama**.

Point to the Picture and say: *Kodiizi nizi ciani?*

If the child gives the correct answer say: *Wacita bwino!*

Proceed to the test.

If the child gives an incorrect answer correct the child saying:

Wacita bwino kuyesako, koma izi ninyama.

Proceed to the test.

Test Instructions

Say;*Cabwino. Lomba ndidzakuonetsa zithunzi-thunzi zosiyana siyana. Ndifuna uniwuze zili pa zithunzi-thunzi izi.*

Prompts

You may only use the prompt provided in the score sheet, please do not use any other wordings.

Score Sheet

***NR-no response; DK-Do not know**

S/N	Word	Prompts	Correct	Incorrect	NR	DK	Child's
-----	------	---------	---------	-----------	----	----	---------

			(√)	(√)			Incorrect Response
1.	Gulugufe	Ici ndi ciani?					
2.	Maluwa	Ici ndi ciani?					
3.	Piko	Ici ndi ciani?					
4.	Sowera	<i>alu kucita ciani?</i>					
5.	Cinkuwala	Ici ndi ciani?					
6.	Capa	<i>alu kucita ciani?</i>					
7.	Cona	Ici ndi ciani?					
8.	Zinai	<i>Yali yangati magalu?</i>					
9.	Kugwa	<i>alu kucita ciani?</i>					
10.	Gwira	<i>alu kucita ciani?</i>					
11.	Cithunzi tunzi	Ici ndi ciani?					

12.	Zipatso	<i>ndi liu liti</i> <i>limodzi</i> <i>lomwe</i> <i>lingakambe</i> <i>izi zonse ?</i>					
13.	Fisi	<i>Ici ndi</i> <i>ciani?</i>					
14.	Kutawa	<i>alu kucita</i> <i>ciani?</i>					
15.	Mkango	<i>Ici ndi</i> <i>ciani?</i>					
16.	Lalanje	<i>Ici ndi</i> <i>ciani?</i>					
17.	Onenepa	<i>Iluwoneka</i> <i>bwanji</i>					
18.	Cidiza	<i>Ici ndi</i> <i>ciani?</i>					
19.	Kwela	<i>alu cita</i> <i>ciani?</i>					
20.	Nyundo	<i>Ici ndi</i> <i>ciani?</i>					
21.	Oyopa	<i>Aluwoneka</i> <i>bwanji</i>					
22.	Mvuu	<i>Ici ndi</i> <i>ciani?</i>					

23.	Cothyoka	<i>Cili bwanji?</i>					
24.	Ukonde	<i>Ici ndi ciani?</i>					
25.	Mphungu	<i>Ici ndi ciani?</i>					
26.	Munyansi	<i>Galu alikuti?</i>					
27.	Nthoci	<i>Ici ndi ciani?</i>					
28.	Kamunkunk uniza	<i>Ici ndi ciani?</i>					
29.	Zamamsam ba	<i>ndi liu liti limodzi lomwe lingakambe izi zonse ?</i>					
30.	Mbululuka	<i>Alu kucita ciani?</i>					

Appendix D

Receptive One-Word Picture Vocabulary Test Score Sheet

Item	Word	Key	Correct (√)	Incorrect (√)	Child's Incorrect Response (Number)
1.	Cona/Cat	2			
2.	Gulugufe/Butterfly	2			
3.	Maluwa/Flowers	1			
4.	Piko/Feather	1			
5.	Gwira/catching	4			
6.	Lalanje/Orange	3			
7.	Cithunzi-tunzi/Picture	1			
8.	Capa/Washing	4			
9.	Onenepa/Fat	4			
10.	Cinkuwala/Caterpillar	4			
11.	Mkango/Lion	4			
13.	Zinai/Four	2			
14.	Mbululuka/flying	1			
15.	Zipatso/Fruits	2			
16.	Nyundo/Hammer	2			
17.	Fisi/Hyena	4			
18.	Kutawa/Running	1			

19.	Mvuu /Hippo	2			
20.	Kwela /Climb	2			
21.	Ukonde /Net	4			
22.	Mphungu /Eagle	1			
23.	Cotyoka /Broken	2			
24.	Munyansi /Under	3			
25.	Sowera /Playing	2			
26.	Nthoci /Banana	4			
27.	Kamunkunkuniza /Beetle	3			
28.	Oyopa /Terrified	4			
29.	Kugwa /Falling	3			
30.	Zamasamba /Vegetables	4			

Appendix E

Story Comprehension Question and Answer Score

	Story: <i>The Thirsty Crow</i>	Score	Code
Setting	<p>1. Who were the main characters in the story/ who was in the story? Mwenzeli vinyama bwanji mu story</p> <p>Correct Answer: two Crows</p> <p>Child's Answer:</p> <p>_____</p>	<p>1 Correct</p> <p>0 Incorrect</p>	
Main Character/s	<p>2. Where did this story take place? <i>Kodi nkhanayi/story inachitikira kuti? Kodi vikwalala vinali Kuti?</i></p> <p>Correct Answer: Outside/daytime</p> <p>3. What time of the day did the story happen? Ndi nthawi bwanji yomwe nkhanayi inkachitika</p> <p>Child's Answer:</p> <p>_____</p>	<p>1 Correct</p> <p>0 Incorrect</p>	
Climax/ Problem	<p>3. What was the problem of the crow? Chikwalakwala cenzeli na vuto/problem ya bwanji?</p> <p><i>Kodi vuto wa chikwalakwala yenzeli ciani?</i></p> <p>Correct answer: <i>The crow could not drink water because his beak could not touch the water, as the level of the water was low OR because his beak got stuck.</i></p> <p>Child's answer:</p> <p>_____</p>	<p>1 Correct</p> <p>0 Incorrect</p>	

Resolution	<p>4. There came another crow who helped. How?</p> <p>Kunabwela chikwalakwala camene cinatandiza, cinatandiza bwanji?</p> <p><i>Correct answer: He threw stones into the water until the water rose to a level the crow could reach.</i></p> <p><i>Child's answer:</i></p>	<p>1 Correct</p> <p>0 Incorrect</p>	
Moral	<p>5. Would you do the same? Why?</p> <p>Kodi ungachite chimodzimodzi? cifukwa?</p> <p><i>Correct answer: With a little thought, a bit of determination</i></p> <p><i>and some patience you can achieve almost anything.</i></p> <p><i>Child answer:</i></p> <p>_____</p> <p>_____</p>	<p>1 Correct</p> <p>0 Incorrect</p>	
	Total score	/6	

Appendix F

Home Possessions Measure

HP1	Do you have a television in your home?	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP2	Do you have a stove at home?	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP3	Do you have electricity at home? <i>Including solar electricity.</i>	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP4	Do you have running water from any source at home?	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP5	Do you have a toilet in the home? <i>If no, skip to HL6</i>	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP5a	If YES, what type of toilet?	<input type="checkbox"/> Flush to sewer/septic. <input type="checkbox"/> Pit latrine. <input type="checkbox"/> Other: _____ <input type="checkbox"/> Refused
HP6	Does your family own any vehicles, including bicycles, motorbikes, etc.?	<input type="checkbox"/> No <input type="checkbox"/> Yes

	<i>If no, skip to HP7.</i>	<input type="checkbox"/> Refused
HP6a	Number of bicycles:#_____	
HP6b	Number of motorbikes:#_____	
HP6c	Number of cars:#_____	
HP7	Does the child have at least two sets of clothes?	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP8	Does the child have at least one pair of shoes?	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP9	Does the household own a radio?	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP10	Does the child have a mat or bed to sleep on?	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP11	What type of floors do you have in your home?	<input type="checkbox"/> Cement/tiled. <input type="checkbox"/> Mud <input type="checkbox"/> Other: _____ <input type="checkbox"/> Refused

HP12	What type of roofing does your home have?	<input type="checkbox"/> Iron sheets. <input type="checkbox"/> Grass-thatched <input type="checkbox"/> Other
HP13	Does your family own any animals? <i>If no, skip to HP14</i>	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP13a	Number of goats/sheep: #_____	
HP13b	Number of cattle:#_____	
HP14	Does your family own land?	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> Refused
HP14a	If YES, how many acres:	

Appendix G
Consent Form

UNZAREC FORM



1b

THE UNIVERSITY OF ZAMBIA
DIRECTORATE OF RESEARCH AND GRADUATE STUDIES
HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS
COMMITTEE

Telephone: +260-211-290258/293937

P. O. Box 32379

Fax: +260-211-290258/293937

Lusaka, Zambia

E-mail drgs@unza.zm

HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS
COMMITTEE

CONSENT FORM

(Translated into vernacular if necessary) Fomu yo longoza kubvomera
kutengako mbali.

TITLE OF RESEARCH: Mutu wa kafufuzidwe

REFERENCE TO PARTICIPANT INFORMATION SHEET:

1. Make sure that you read the Information Sheet carefully, or that it has been explained to you to your satisfaction.

Onani kuti mwawelenga pepala lomwe lili ndi unthenga moikako nzeru, kapenanso kuti mwafotokozeledwa mokutira.

2. Your permission is required if tape or audio recording is being used.

Cilolezo canu cifunika ngati tepu kapena coteping'ira mau cili kusewenzetsedwa

3. Your participation in this research is entirely voluntary, i.e. you do not have to participate if you do not wish to.

Kutengako mbali mu kafufuzidwe aka ndi modzipeleka cabe , macistanzo ngati simufuna simungatengeko mbali

4. Refusal to take part will involve no penalty or loss of services to which you are otherwise entitled.

Ngati mwakana kutenga mbali simudzapatsidwa cilango ciliconse kapena kukucotsani mu ufulu omwe anzanu alinao ku zinthu

5. If you decide to take part, you are still free to withdraw at any time without penalty or loss of services and without giving a reason for your withdrawal.

Ngati mwaganizira kutengako mbali , muli nawo ufulu wolekeza kutengako mbali nthawi iliyonse kombula kukupatsani cilango ciliconse kapena kukucotsanu mu ufulu uliwonse ndiponso mungaleke kopanda kunena cifukwa comwe mwalekera kutengako mbali

6. You may choose not to answer particular questions that are asked in the study. If there is anything that you would prefer not to discuss, please feel free to say so.

Mungasankhe kusankha mafunso ena yomwe yafunsidwa mukafufuzidweka . Ngati pali zina zomwe muganiza kuti sizingafotokozeledwe, khalani omasuka pa kukamba tero.

7. The information collected in this interview will be kept strictly confidential Uthenga /zokambilana zonse zimene zatengedwa mukukambilana ku (kafufuzidwe aka) zidzasungidwa mwa cisinsi.

8. If you choose to participate in this research study, your signed consent is required below before I proceed with the interview with you.

Ngati mwasankha kutengako mbali mu kafufuzidwe aka, cibvomelezo canu colongozedwa mkusina cifunika pansipa sindinapilize mukukambilana ndi inu.

VOLUNTARY CONSENT

I have read (or have had explained to me) the information about this research as contained in the Participant Information Sheet. I have had the opportunity to ask questions about it and any questions I have asked, have been answered to my satisfaction.

Kulola kutengako Mbali

Ndawelenga (andimasulira zonse, fotokozero zonse) uthenga wonse wa kafufuzidwe aka monga momwe zilili pa pepela la uthenga kwa wotengako mbali. Ndinali nawo mpata wofunsa mafunso pa kafufuzidwe aka ndipo funso lililonse lomwe ndinafunsa linayankhidwa mokhutila.

I now consent voluntarily to be a participant in this project and understand that I have the right to end the interview at any time, and to choose not to answer particular questions that are asked in the study.

Ine ndibvomera kutengako mbali mu kafufuzidwe aka ndipo ndamvetsa kuti ndingalekeze kutengako mbali mkafufuzidweka nthawi iliyonse, ndiponso ndilinalo danga losayankha mafunso ena ofunsiwa mukafufuzidweka.

My signature below says that I am willing to participate in this research:

Kusaina kwanga pansipa kulongoza kutindili obvomera kutengako mbali
mkafufuzidweka:

Participant's name (Printed):

.....

Dzina la otengako mbali

Participant's signature: Consent Date:

Kusaina kwa otengako mbali.....Tsiku

lobvomelera.....

Researcher Conducting Informed Consent (Printed) Ofunsa mafunso/Ocititsa
kafufuzidwe

.....

Signature of Researcher: Date:

Kusaina kwa Ofufuza/.....Date.....

Signature of parent/guardian: Date:

Kuisaina kwa makolo/Osunga mwana.....Date.....

Appendix H

Permission Letter

All communications should be addressed to the Provincial Education Officer and not to any individual by name

Telephone: +260-211-238855 / 231720
Fax: +260-2112009

In Reply please quote:
No.
PEO/LR/101/28/2



REPUBLIC OF ZAMBIA

MINISTRY OF GENERAL EDUCATION

OFFICE OF THE PROVINCIAL EDUCATION OFFICER
LUSAKA REGIONAL HEADQUARTERS
PRIVATE BG RW 21E
LUSAKA

12th October, 2017

The University of Zambia
School of Education
P.O. Box 32379
LUSAKA

**RE: REQUEST TO CONDUCT RESEARCH IN EARLY CHILDHOOD SCHOOLS
IN LUSAKA PROVINCE**

Reference is made to the above subject matter.

This office is in receipt of your letter dated 8th October, 2017 in which you were seeking permission to conduct a research in Early Child Schools in Lusaka Province.

I write to inform you that permission has been granted for you to carry on the research in Lusaka Province.



Paul. Ngoma
PROVINCIAL EDUCATION OFFICER
LUSAKA PROVINCE
/s/

Appendix I

Ethical Clearance Letter



**THE UNIVERSITY OF ZAMBIA
DIRECTORATE OF RESEARCH AND GRADUATE STUDIES
HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE**

Telephone: +260-211-290258/293937
Fax: +260-211-290258/293937
Zambia
E-mail drgs@unza.zm

P O Box 32379
Lusaka.

Approval of Study

15th February, 2018

The Principal Investigator

Dear Madam,

RE: "Effects of Stories and Rhymes Presented through electronic media on Language and Literacy Skills among Pre-school and First Grade Learners in Zambia"

Reference is made to your resubmission. The University Of Zambia Humanities And Social Sciences Research Ethics Committee IRB resolved to approve this study and your participation as Principal Investigator for a period of one year.

Review Type	Expedited Review	Approval No. 2018-Feb-001
Approval and Expiry Date	Approval Date: 15 th January, 2018	Expiry Date: 14 th January, 2019
Protocol Version and Date	Version-Nil	

Information Sheet, Consent Forms and Dates	<ul style="list-style-type: none"> English. 	To be provided
Consent form ID and Date	Version	To be provided
Recruitment Materials	Nil	Nil

There are specific conditions that will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

Conditions of Approval

- Provide information sheets and consent letters as these were not attached. The information sheets should have had the essential features included. Please use the WHO templates which you could download at www.who.int/rpc/research_ethics/informed_consent/en/). REC would appreciate if the PI could customise the WHO templates and include the domains of what the submitted protocol is positing on tools and the sampling units (people who have been or shall be participating in this study).
- No participant may be involved in any study procedure prior to the study approval or after the expiration date.
- All unanticipated or Serious Adverse Events (SAEs) must be reported to the IRB within 5 days.
- All protocol modifications must be IRB approved by an application for an amendment prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address or methodology and methods. Many modifications entail minimal risk adjustments to a protocol and/or consent form and can be made on an Expedited basis (via the IRB Chair). Some examples are: format changes, correcting spelling errors, adding key personnel, minor changes to questionnaires, recruiting and changes, and so forth. Other, more substantive changes, especially those that may alter the risk-benefit ratio, may require Full Board review and approval. In all cases, except where noted above regarding subject safety, any changes to any protocol document or procedure must first be approved by the IRB before they can be implemented.
- All protocol deviations must be reported to the IRB within 5 working days.
- All recruitment materials must be approved by the IRB prior to being used.