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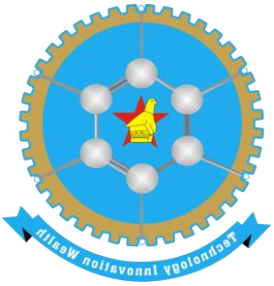

RESEARCH GRADUATE STUDIES

DESIGNING TRANSFORMATIONAL MULTIMEDIA CONTENT FOR ZIMBABWE'S PRIMARY SCHOOL DIGITAL LEARNERS

BY

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C23155084P

A THESIS SUBMITTED IN FULFILMENT FOR THE MASTER OF PHILOSPHY DEGREE IN VISUAL COMMUNICATION AND MULTIMEDIA DESIGN

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APRIL 2025

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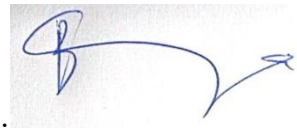
Signature ……..……  …….

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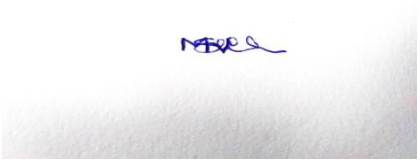
Signature ……  ……

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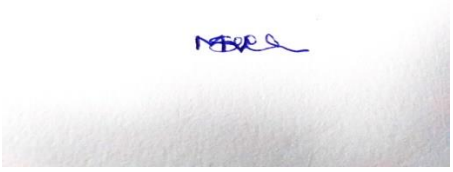
Signature ……  …….

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DEDICATION

This thesis is dedicated to my beloved husband, Loveday Ngulube, whose unwavering love, patience, and encouragement were my anchor throughout this journey. Your belief in me has been my greatest strength.

To my daughters, who inspire me every day to balance passion with purpose. You are the light that brightens every step I take.

To my parents, whose sacrifices, wisdom, and endless support laid the foundation for everything I have achieved. Your faith in me has shaped the person I am today.

And to my brothers, whose presence and encouragement have been a constant source of motivation. Thank you for always being there, no matter the distance.

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Abstract

Traditional educational systems have been severely affected by the COVID-19 pandemic in many countries, including Zimbabwe, where schools had to close for extended periods of time. The adoption of e-learning as a crucial substitute for traditional classroom learning was expedited by this crisis which exposed the challenges in utilizing digital technologies to enhance learning results in Zimbabwe's primary education. The effectiveness of e-learning in Zimbabwean primary schools is hindered by lack of relevant and localized content, inadequate teacher training, and limited consideration of cultural values and indigenous languages. Current digital content falls short of meeting the cognitive, emotional, and cultural demands of young learners, as it is text-based content. A qualitative study approach was used, incorporating ethnographic observations on two digital classes and twelve key informant interviews with grade four teachers as well as two focus group discussions with thirty, grade four digital learners from six primary schools in the categories of Government and private schools were conducted respectively. The findings generated themes on access to digital resources and infrastructure, student's engagement with digital content, cultural and contextual relevance, and inclusivity in digital learning and teacher's role in digital content development. Being guided by the theoretical framework and the findings of the study, the researcher designed a prototype of digital learning content that is inclusive and relevant to local cultures. The major recommendations from the study were improving teacher preparedness, developing content that is appropriate for local cultures with relevance as well as increasing accessibility of infrastructure with suggestions of solar powered gadgets for digital classes to optimize potential of digital learning with content that is interactive and engaging, multilingual to promote understanding.

Keywords: Digital learning, Multimedia, Digital literacy, Dependency and Self- sustaining.

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CHAPTER ONE

1.0 INTRODUCTION

Schools worldwide function as cultural Centre's where students from many communities converge to live and learn. In recent years, this distinctive ecosystem has faced notable disruptions due to natural disasters including the recentCovid-19 outbreak, leading to uncertainties surrounding education. The pandemic compelled schools to transition from traditional physical classroom teaching to digital learning. With the increasing prevalence of online education, optimizing the delivery of learning content to primary school learners became a pressing concern.

Throughout the pandemic in 2020, the Zimbabwean government worked on creating new methods to maintain continuous learning. Initially, lessons were broadcast on the radio in response to the crisis. While this approach was successful, the absence of a digital library hindered students from accessing the radio lessons at a later time (Rwezuva et al, 2022). As the Ministry of Primary and Secondary Education continued to look for alternatives to provide education for Zimbabwean learners, platforms such as WhatsApp, Study application, Google Class, and Microsoft Teams became the trend for online learning. The communication done during digital learning was mostly text-heavy (text-only environment) with a few additions of graphics and images. This study aimed to give a detailed account of the content used for digital learning by primary school learners in Zimbabwe to find out if online learning would promote engagement as well as establish ways to deliver online learning content that is not text-based through transformational multimedia designs for primary school learners.

1.1 Background of the Study

Schooling is considered a necessity for individuals, enabling them to prepare for and navigate through life. In many countries, education typically commences in early childhood and extends into adulthood, serving as a customary practice for a majority of the global population. However,

the traditional educational landscape has recently faced significant disruptions brought by natural disasters such as the Covid-19 pandemic. This unforeseen crisis caused widespread uncertainty surrounding the realm of education, with nation's worldwide facing challenges imposed by the global lockdowns. Zimbabwe was no exception to this phenomenon and yet lockdowns breathed a new life style which included working and learning online, therefore, this era brought focus to new systems such as Digital learning, a system that has been there before but never fully utilized especially in Zimbabwe.

The introduction of e-learning in Zimbabwe has been a part of the country's broader effort to modernize education and improve access to learning materials, particularly in light of challenges such as inadequate physical resources, teacher shortages, and the growing demand for education in the digital age (Zimbabwe Ministry of Primary and Secondary Education, 2019). According to the Zimbabwe National Education Policy (2019), the government has made strides incorporating digital technology into education by promoting the use of computers and the internet. However, the extent to which online platforms are utilized in primary education remains under-researched (Mujeyi, 2021). In Zimbabwe, a clear digital divide exist, particularly between Private schools and Government schools. Private schools tend to have better infrastructure, including access to stable electricity and internet connections, while marginalized schools lack basic technological resources (ZIMSTAT, 2020). This inequality in access to digital resources hampers the full integration of e-learning systems in primary education (Chavura & Munemo, 2021). More so, while various online learning platforms and educational content are available, the quality of these resources and the ability of teachers to effectively deliver content through these platforms have not been systematically assessed (Mujeyi & Ndamba, 2020). This additionally highlighted the need for accessible online learning tools in Zimbabwe, as schools were forced to adopt digital learning methods to continue education during lockdowns. Despite this push for digital inclusion, many students still face significant challenges accessing online education and also teachers are not correctly managing virtual classrooms (Munyoro & Kudzai, 2021).

Re-imagining education is all about ensuring that education is accessible, flexible, inclusive and sustainable, but also innovative. Adam, 2022 commended that we need to ensure that every

child, including those in marginalized communities have access to education. As the system of e-learning had to be functional, it was a trial for many educational institutions including primary schools; however the targeted audience had to determine the results of the system. According to Dumford and Miller, the students taking greater numbers of digital lessons were more likely to engage in quantitative reasoning as it is enhanced learning and innovative teaching, therefore, the researcher became interested in the type of content that is used for e-learning for primary school learners considering the following factors;

1. Primary school learners have low concentration span because of age hence they lose focus easily.
2. Primary school learners rarely get motivated to study all by themselves without supervision.
3. And the learners' security in this age of cyber-attacks, risks and distractions on the internet as they further study online without supervision.

Looking at primary school learners especially those in the junior level category, text-based learning has negative resentments with students as it lacks sufficient motivation. The researcher focused the study on grade four learners considering that, it is the beginning of the critical junior stage in education according to International standard classification of education, (UNESCO, 2011). According to the Ministry of Primary and Secondary education in Zimbabwe, the pass rate of the students who sat for their examinations during the Covid pandemic was low compared to that of the pre and post Covid era. This prompted the research to investigate on the teaching methods that were used during such a time with the aim of evaluating them and see if they were educative enough for the learners. The researcher found out that one of the effects of digital learning was a decrease in the pass rate and then focused on the type of content that is being used for these students in the digital classroom. Children in junior levels who are at the development stage lack the ability to organize work load. Considering the fact that students hardly get motivated to study on their own without supervision, it is of concern on what measures that can be taken to bring motivation to these young learners to develop a learning culture without supervision or scheduled lessons. More so, the digital era has some risks of cyber-attacks as well as danger posed from pop up advertisements of different categories, such as gaming, lottery

games, applications and different websites offering different products and services which might distract the learner as they will be studying digitally with connected internet with the risk of following those advertisement links due to curiosity forgetting that they are studying.

Considering all these factors, the researcher conducted a pilot project on urban primary schools under the Private School and Government school categories in Mashonaland West province, as it was convenient and accessible for her, with the aim of transforming the E-learning system using multimedia designs after gathering data that exposed the research gap. The chart attached below on figure 1.1 shows the number of schools and their categories that were interviewed by the researcher.

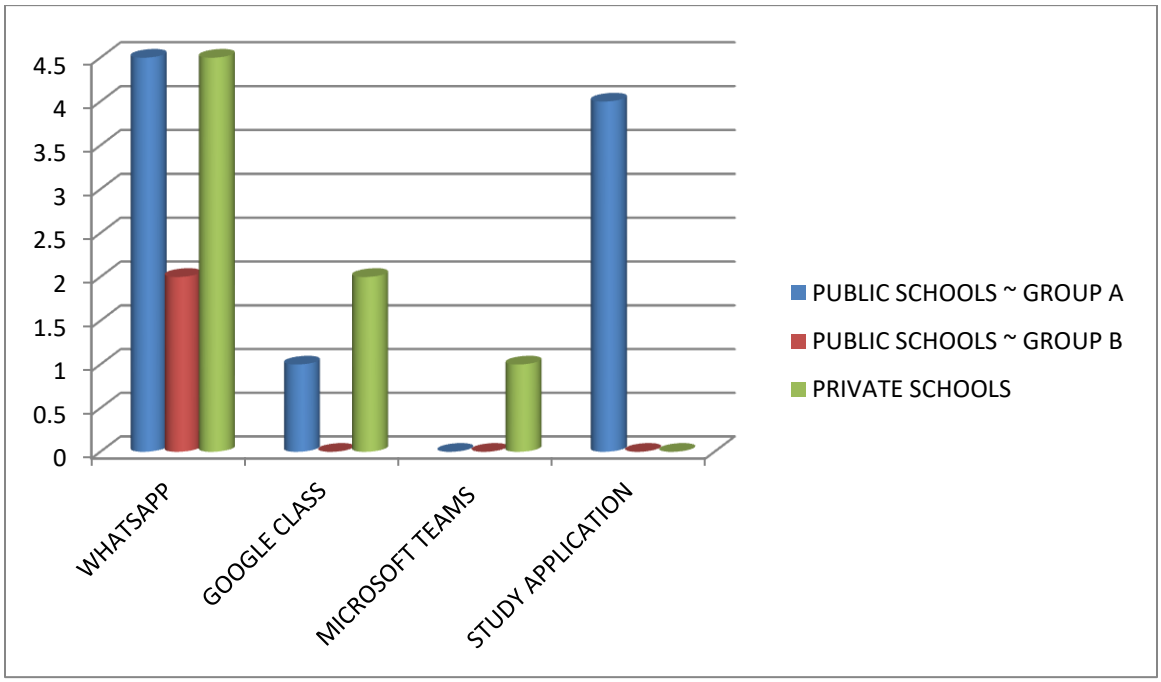


Figure 1.1 *Pilot project schools, application and software results.*

Currently in Zimbabwe, digital learning content for primary school learners has been coming in the form of text with the aid of images/pictures were there is a diagram, charts or graphs. Applications such as Radio Broadcasting lessons, Ruzivo, Zimbabwe Learning Passport, WhatsApp, Study App, Google class and Microsoft teams were used by teachers and learners to conduct E-Learning in five different schools the researcher studied depending with their digital

literacy capabilities. The text-based content was aligned with the National Curriculum, but it was lagging behind on the practical part as it is theoretical. Considering the age of primary school learners, who hardly get the motivation to sit on their own and try to bridge the gap between the theoretical and practicality of the knowledge and concepts they are getting. Attached on figure 1.2 are images containing multimedia content that is currently used for digital learning within the schools investigated and how the learning content is presented on digital learning platforms.

Figure 1.2 *Multimedia content currently used in Zimbabwean primary schools for digital learning. Accessed from https://ruzivo,2025*

As the researcher went on further to enquire on the current E-learning practices, she found out that, the current content used is being taken as it is straight from the text books in Jpeg and portable document formats at times with the teacher's voice note to accompany it giving the leaners an instruction on what to do. The teachers whom were interviewed mentioned that as much as they want to explain the text written concepts to the learners, they will be limited by the resources such as internet connectivity and the technical ability to create multimedia content that is suitable for primary school learner's digital learning. The researcher realized that, the content drawn straight from the text book is meant to be further elaborated by the teacher as it is teacher led and yet it is now being given out without further elaboration of the concept from the teacher, meaning the learners are chewing the bone on their own, making it difficult for them to grasp the concepts.

The researcher then concluded that the current educational content used for digital primary school learners has been designed harp hazard, either with less user interaction or there hasn't

been enough consultation on Curriculum hence this project seeks to improve the presentation of online learning content. There is a glaring lack of relevant multimedia educational content targeting primary school learners and teachers are finding it increasingly difficult to source the kind of content that is ideal which they can use as there is scarcity of digital learning materials fine-tuned to support primary school learners.

1.2 Statement of the problem

The primary education system in Zimbabwe has challenges in utilizing digital technologies to enhance learning results. Current digital content falls short of meeting the cognitive, emotional, and cultural demands of young learners, as it is text-based content. More so, students find it difficult to interact with digital content in a meaningful way, particularly in schools with limited resources. This makes the disparities between the private schools and marginalized schools more pronounced. There is a dearth of locally relevant, pedagogically sound, and captivating multimedia content that complements Zimbabwe's national curriculum. Teachers and curriculum designers frequently lack the skills and resources necessary to create instructionally sound and culturally appropriate content while content developers lack the pedagogical capabilities of infusing concepts in the educational content currently available leading to a disconnection between the content that is provided and the actual demands of students in the digital learning environment of the twenty-first century.

1.3 Aim

The aim of this research was to create transformative multimedia learning content for Zimbabwean primary school students in order to improve their engagement, understanding, and digital literacy through pedagogically sound, culturally appropriate, and easily accessible digital learning content.

1.4 Objectives

This study sought to:

1. Evaluate the accessibility, engagement, and curriculum alignment of the digital learning materials currently utilized in Zimbabwean primary schools.
2. Determine primary school students' and teachers' pedagogical and technological requirements for efficient digital content delivery.
3. Create transformative multimedia content that is based on accepted multimedia learning concepts, culturally appropriate, and curriculum aligned.

1.5 Research Questions

1. What are the key factors influencing accessibility of digital learning content in Zimbabwean primary schools?
2. How effective is the e-learning content currently used in Zimbabwean primary schools in enhancing learner's academic performance and engagement?
3. How can the integration of technology and pedagogy contribute to the effective design of digital learning content for primary school learners?

1.6 Significance of the study

This study holds significant value for several key stakeholders within Zimbabwe's educational landscape, as well as the broader field of educational technology.

Contributing to Global discussions on digital learning

The research would contribute to the global discourse on the effective use of multimedia in education, particularly in marginalized settings. It could serve as a model for other countries facing similar challenges in integrating digital content in their educational systems.

Advancing digital learning in Zimbabwean primary schools

Designing multimedia learning content tailored to the needs of primary school learners could contribute to the modernization of Zimbabwe's education system. It addresses the gap in effective and engaging digital learning content that is culturally relevant, accessible, and aligned with the national curriculum. The findings from this study would also offer valuable insights into

the practical challenges and solutions related to integrating digital technologies into primary school education, therefore policymakers and curriculum developers could benefit from evidence-based recommendations for designing and scaling digital learning initiatives across the country. The study may enable the Zimbabwean Education system to create its own digital learning content that is specifically tailor made to suit the Zimbabwean context, to harness the thrust of Education 5.0, which is Heritage-based education, considering that most of the content that is currently used for e-learning especially in primary schools is designed out of Zimbabwe.

Fostering teacher professional development

The design and evaluation phases of this study could offer opportunities for teacher professional development. Equipping teachers with multimedia learning tools in pedagogical strategies might enhance their ability to integrate digital resources into their teaching practices, ultimately enriching the quality of content.

Improve student engagement and learning outcomes

Utilizing multimedia strategies grounded in proven pedagogical theories, the study enhances student engagement and learning outcomes. This transformation in learning experiences is expected to improve students' understanding, critical thinking, and problem-solving skills, ultimately fostering digital literacy. It would also bridge the digital divide between private schools and marginalized schools in Zimbabwe by developing digital content that can be accessed by students regardless of their geographical location. This contributes to educational opportunities for students from diverse socioeconomic backgrounds.

1.7 Scope of the study

The scope of any study is defined as the boundaries of the research project which specifies what will be covered in the study, including time frame of the study, geographical area and variables that the research will explore. Therefore, this research’s targeted variables was grade four primary school learners considering the fact that, the critical junior stage of primary education begins then. At this stage, advanced concepts of primary education commence which then feeds

into senior primary education. If one does not get these concepts clearly, it means the later education is compromised as it will not have a basis. This age group would have surpassed the infant level but not yet grown or developed enough to be compared to the senior levels that are expected to reason well. The research was conducted within three years as stipulated by the regulations of Research Graduate Studies at the Chinhoyi University of Technology. The geographical area which the research was conducted was limited to Makonde District in Mashonaland West province considering that the primary school Education curriculum is the same at National level, hence the results that comes from these schools would be the same as those in any region or province nationwide.

1.8 Limitations of the study

Technological Access Variability

The study was limited by differences in access to digital devices, electricity, and internet connectivity between Private and Government schools, which could affect both implementation and evaluation of the multimedia content.

Sample Size and Generalizability

Due to time and resource constraints, the research focused on a small number of schools, which may limit the generalizability of the findings to all Zimbabwean primary schools.

Training and Teacher Readiness

The effectiveness of the multimedia content was influenced by teachers' digital literacy and willingness to adopt new digital learning content, which may vary across contexts.

Time Constraints for Evaluation

The study could not allow for long term tracking of learning outcomes, thus limiting the ability to assess sustained impact over time.

1.9 Definition of key terms

Multimedia

In the context of media studies, multimedia is the convergence of various media formats such as text, graphics, video, and sound, into an interactive or combined format that creates richer complex forms of media consumption. Multimedia has fundamentally transformed how information is communicated, blending text, video, images, and sound into new, interactive formats" (Manovich, 2001).

In communication and technology, multimedia is the integration of multiple forms of media such as text, images, audio, video, and animations coming up with a single interactive or non-interactive system. It is defined as an integration of different forms of media, such as text, audio, graphics, animation, and video, in a unified presentation to create dynamic, interactive content" (Laurel, 1993).

In educational contexts, multimedia is often used to enhance learning by providing multiple sensory channels through which learners can engage with content, hence it is defined as the use of a combination of text, audio, images, video, and interactive content to enhance teaching and learning experiences, making them more engaging and effective, (Mayer, 2001).

Content

According to Jackendoff, 2002, content refers to the informational substance or meaning conveyed by a message, text, or expression, distinct from its form or structure. It represents the ideas, facts, or concepts that are communicated.

In the context of digital media and communication, content refers to the information or creative material presented through various digital platforms, such as text, images, video, or audio.

Content is created to engage, inform, and attract audiences, typically in the form of articles, blog posts, videos, and social media posts" (Järvinen & Taiminen, 2016).

Digital learning

According to Hastie, 2013, digital learning is an educational process that integrates digital tools and technologies such as computers, tablets, smartphones, internet resources, educational applications and interactive media, into a learning experience with the aim of enhancing or transforming the way students' access information, collaborate, and engage with learning materials.

Ghaleb, 2006 also defined digital learning as a means of education that incorporate self-motivation, communication, efficiency, and technology.

Transformational

In the context of education, transformational refers to teaching strategies or educational frameworks that aim to bring about significant changes in students' ways of thinking, learning, and perceiving the world. Transformational learning in educational theory involves a shift in a learner's worldview, where deep, meaningful changes in their beliefs and perspectives occur due to new experiences or critical reflection. Transformational learning theory emphasize that learning is not just the acquisition of knowledge, but a change in the learner's worldview" (Mezirow, 1991).

Transformational multimedia content is defined as digital content that has been combined using various media types to enhance the user experience and effectively convey the messages. Hence, it encompasses a wide range of formats including text, images, audio, video, and interactive elements. The aim is to create engaging and impactful content that resonates with the audience (Joise Luis Orihuela, 2017).

In summary, transformational signifies a profound or fundamental change in a process, system, or individual, whether in the context of leadership, linguistics, mathematics, education, or

business. It implies significant change that produces new ways of understanding or interacting with the world.

1.10 Structure of the Study

This research is organised into six sections. Chapter one puts the problem into perspective by mainly establishing the study's background, the research problem as well as the research objectives and questions. Chapter Two reviews literature related to this study guided by the research questions of the study. This chapter likewise provides the theoretical framework of the research and justifies its adoption. Chapter Three focuses on the selected research methodology and justifies the specific methodological aspects. These methodological aspects include research philosophy and approach, research design, population and sampling technique, data collection instruments namely Focus Group Discussions, key informant interviews as well as ethnographic observations of the participants, data collection and analysis, ethical considerations. Chapter four presents, analyse and discusses the data using the embedded format. Chapter five carries the design process of the prototype being guided by the theoretical framework and the findings from the data analysed in the previous chapter. The last chapter, Chapter six, summarises the findings with conclusions drawn and recommendations prepared.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

A literature review is an evaluation of earlier research. In order to lay the groundwork for future research, it draws attention to significant findings, contentions, and gaps in the field. It is a crucial part of scholarly research that summarizes previous studies to give a broad picture of the current level of knowledge in a particular field, claim Rowley and Slack (2020). According to Booth et al. (2021), a literature review is a tool that aids in the establishment of a theoretical framework for the study by both summarizing and critically assessing the contributions of earlier research. The chapter's goal is to review the body of research on digital learning in primary schools, starting with a global perspective and working down to a national one. A theoretical framework has been presented in this chapter as a guide to this study.

2.2 Concepts in the study

In today's changing educational environment, integrating digital technology has become critical to improving learning experiences for young learners. Zimbabwe's primary education system is on the verge of transformation, necessitating the creation of multimedia content that is not only interesting, but also pedagogically sound and culturally appropriate. As digital literacy becomes increasingly important in the twenty-first century, creating effective multimedia content designed specifically for Zimbabwean primary school pupils offers a unique chance to overcome educational inequities and promote a more participatory, learner-centered environment. The importance of this endeavor is highlighted by the necessity to bridge the gap between traditional teaching techniques and modern technology breakthroughs, ensuring that students are well-prepared to meet the demands of a digital world. This literature review investigates existing

studies on multimedia learning resources, best practices in content design, and the potential effects of innovative digital solutions on primary education from global context to Zimbabwean context.

With digital content being crucial for enhancing information access and establishing dynamic learning environments, the rapid globalization of digital learning has fundamentally altered the nature of education (Anderson, 2008). The quality of digital learning content, including instructional materials disseminated through various digital platforms, is crucial to ensuring successful learning experiences for primary scholars. Getting top-notch content not only makes learning easier, but it also boosts learner motivation, engagement, and retention (Clark & Mayer, 2016). Despite all of the benefits of digital learning, concerns remain regarding the design, accessibility, and pedagogical efficacy of the content. Thus, a variety of factors, including how well the content fits with learner needs, educational objectives, and technological concerns, determine the quality of digital learning content and how it is created.

2.2.1 Digital learning in primary schools in America and Europe

Due to pedagogical reforms, government regulations, and technological advancements, digital learning has emerged as a critical element of primary education worldwide (Voogt et al., 2018). Selwyn (2020) asserts that countries in the American and European regions have made large investments in digital infrastructure, teacher training, and e-learning platforms, leading to innovative and cutting-edge learning environments. With a focus on the challenges and best practices that affect education in different regions, the adoption of digital learning in North American and European primary schools has been studied. By implementing digital learning policies, European countries have integrated information and communication technology (ICT) into primary education.

In order to improve primary education, the European Commission's Digital Education Action Plan (2021–2027) has emphasized the use of artificial intelligence, digital literacy programs, and information and communication technology enhanced learning (European Commission, 2021).

Countries like Finland, Estonia, and Denmark are leading the way in the adoption of digital classrooms by leveraging smart boards, tablets, and online learning platforms (Ilomäki et al., 2016). The UK's EdTech policy has promoted the use of virtual learning environments and learning aids driven by artificial intelligence (Department for Education, 2019). Teachers can facilitate blended and interactive learning by using online learning platforms like Google Classroom, Edmodo, and Moodle (Redecker, 2017). In countries like Estonia, the Proge Tiiger program teaches elementary school pupils computational thinking and coding through game-based learning (Vinter et al., 2021). Through digital textbooks and e-libraries, students can access open educational resources (OERs) (European Commission, 2021).

According to Redecker (2017), the European Framework for the Digital Competence of Educators (DigCompEdu) guarantees that educators acquire the digital literacy necessary to utilize technology in the classroom. Countries such as Sweden and Germany provide teachers' digital pedagogy-related continuous professional development (CPD) programs as explained by Voogt et al., 2018). Strong regulations for digital learning in the United States of America and Canada encourage STEM integration, online education, and personalized learning (Molnar, 2021). EdTech financing is supported and technology-enhanced learning is encouraged in the United States by the Every Student Succeeds Act (ESSA) based on the U.S. Department of Education, in 2020.According to Barbour and LaBonte (2019), Canada's K-12 Digital Learning Strategy placed a strong emphasis on fairness in online education and the promotion of digital literacy.

Learning Management Systems (LMS) such as Schoology, Blackboard, and Canvas are used by schools to support hybrid and online learning (Molnar, 2021). Every student gets access to laptops or tablets on the authority of one is one device initiatives conducted by the U.S. Department of Education in 2020. Flipped classrooms are now common, with students applying what they have learned in class to exercises while watching instructional videos at home (Bergmann & Sams, 2012). Coding, robotics, and artificial intelligence e-learning resources are all incorporated into primary school curricula under the U.S. K-12 Computer Science Framework (ISTE, 2019), which has increased digital literacy and education on Science, Technology,

Engineering and Mathematics. Early coding e-learning content in primary schools is encouraged by Canada's Code.org project (Barbour & LaBonte, 2019), as well as tools for virtual reality (VR) and augmented reality (AR) as it improve hands-on learning in disciplines like history and science (Molnar, 2021).

2.2.2 Primary school digital learning in African region

In Africa, digital learning is revolutionizing primary education by providing creative answers to conventional learning obstacles such as scarce resources and lack of teachers, and accessibility problems (UNESCO, 2021). Despite these advantages, a lack of digital infrastructure, exorbitant expenses, and disparities in digital literacy plague many African nations (Chigona et al., 2020). A number of African governments have included ICT policies into their educational programs, emphasizing digital literacy, e-learning, and technology-enhanced resources (Mwangi et al., 2022). Digital textbooks and tablets have been made available to primary school students through one is to one device programs in nations including South Africa, Rwanda, and Kenya (World Bank, 2021). Affordable EdTech solutions are becoming more accessible to schools as private sectors such as Google, Microsoft, and Huawei are partnering for better education accessibility (Wanjala, 2020). Affordable and easily available digital content is being offered via e-learning platforms such as Kolibri which is an open-source in Nigeria, ULesson in South Africa and Eneza Education in Kenya (Karsenti, 2021). The digital literacy program in Kenya introduced in 2016 gave tablets loaded with educational materials to primary school pupils (Otto et al., 2021), were more than 1.2 million gadgets have been provided, together with teacher training programs (World Bank, 2021).

In Rwanda's Intelligent Classrooms were established in a collaboration between Microsoft and the government with efforts to create ICT-enabled primary education classrooms (Trucano, 2021), which emphasizes in teaching young students to code and become proficient in digital abilities. In South Africa, a curriculum aligned video courses, tests, and Artificial Intelligence powered learning analytics are all available on a mobile learning platform called ULesson

(Karsenti, 2021), which permits offline downloading in order to reach students with spotty internet connections. To standardize and raise the standard of basic education, Bridge International Academies in Kenya, Uganda, Nigeria, and Liberia teach lessons on tablets (Wanjala, 2020). Student results have been demonstrated to improve with evidence-based teaching strategies. Many nations are now using mobile-based learning, television, and radio to reach pupils in remote locations (UNICEF, 2020). The lack of locally relevant digital content is filled in part by open educational resources (OERs), as the African Storybook Project has been doing its best to bridge the gap (Otto et al., 2021).

The Teacher Professional Development in Africa project is one example of how governments' and non-governmental organizations are encouraging teacher training in digital literacy (Trucano, 2021). According to Maringe and Prew (2020), the E-Schools Initiative in South Africa guarantees that primary school teachers receive training on ICT integration. However, many schools, especially those in rural and low-income areas, lack computers, energy, and reliable internet (Chigona et al., 2020). Africa's low internet penetration rate limits access to digital learning resources (ITU, 2021). Increasing the availability of affordable internet options like satellite internet and mobile broadband, as well as investing in solar-powered digital classrooms would help bridge the gap and aid on the integration of digital learning (GSMA, 2022).

Although some governments offer gadgets at a reduced cost for instance, the Kenya's Digital Literacy Program, sustainability is still a problem as many families and schools cannot afford the expensive digital devices and data packages as they are still beyond the reach of many (Wanjala, 2020 and Otto et al., 2021). In 2021, World Bank suggested that the use of zero-rated educational websites for free learning access and local manufacturing of inexpensive educational equipment should be done in Africa. Within the African curriculum, a large number of digital learning resources are not adapted (Karsenti, 2021), and encouragement of EdTech companies and African governments to create locally relevant digital learning materials could be a solution. According to Chigona et al. (2020), some schools obtain technology but lack adequate teacher training, which limits its successful deployment. A number of non-governmental organizations

have been introducing initiatives on teacher training; however there is need for mandatory continuing professional development for digital skills amongst the education sector.

2.2.3 Primary school digital learning in Zimbabwe

As digital learning offers innovative tools and resources to improve teaching and learning, it has become a crucial part of contemporary education. The use of digital learning by Zimbabwean primary school pupils has been impacted by a number of factors, including government regulations, infrastructure problems, socioeconomic concerns, and a lack of teacher training, claim Mhlanga and Moloi (2020). In this section, the current state of digital learning in Zimbabwean primary schools is examined, along with significant challenges and successful initiatives.

Improving teacher and student access to and training in ICT is one of the policies that the Zimbabwean government has put in place to encourage the integration of ICT in education. This is part of the National E-Learning Strategy for Schools (2021–2025) (Ministry of ICT, 2021).
Digital change in education was emphasized in the 2016 Zimbabwe National ICT Policy (Mutisya & Makokha, 2022). Some schools received ICT infrastructure through the Smart Classroom Initiative, which was partnered with Huawei (UNESCO, 2022). To facilitate interactive, curriculum-aligned content, several elementary schools have embraced e-learning platforms such as Moodle and Ruzivo Digital Learning (Mushure, 2021). Particularly during the COVID-19 pandemic, mobile-based learning through SMS and WhatsApp has been used to maintain learning continuity (Mhlanga, 2020). The Zimbabwe Broadcasting Corporation (ZBC) offered teaching radio and television programming to students in areas that lack ICT infrastructure as well as those that have limited internet connectivity (Nyagura, 2021).

Programs for digital literacy have been implemented, but access to technology and teacher preparation are still unequal (Maringe & Prew, 2020). While low-income families and rural schools find it difficult to buy ICT resources, urban schools have more access to digital technologies (Nyagura, 2021). However, accessing digital education is more difficult for girls

and children with disabilities as there is impartiality on students varying from gender to special needs (UNICEF, 2021). There is need for the government to come up with policies that support digital inclusion, and digital skills initiatives for underprivileged children and the girl child as these policies can assist girls, students with impairments, and rural schools.

2.3 Heritage-based curriculum in Zimbabwe

As a component of the 2015 competency-based curriculum (CBC) reform, Zimbabwe's Heritage-Based Curriculum (HBC) was first presented and formally put into effect in 2017. The goal of this curriculum was to match education with Zimbabwe's national identity, indigenous knowledge systems (IKS), history, culture, and tradition (Muzvidziwa & Seotsanyana, 2021). In order to decolonize the educational system and advance indigenous knowledge, practical skills and national awareness, the Ministry of Primary and Secondary Education (MoPSE) spearheaded the effort (Nziramasanga, 1999). One of the objectives of the heritage-based education is ensuring students comprehend and value their national heritage, customs, and values as a key component in promoting Zimbabwean identity and culture (Chakanyuka & Mavunga, 2020).

The inclusion of local history, traditional sciences, and African ways of knowledge in regular classroom teaching is known as integrating indigenous knowledge systems (IKS) (Marungudzi, 2022). Competence-based learning is moving away from rote memorizing and heading toward experiential, hands-on learning that gives students the ability to solve problems (Chisaka, 2020). Another objective of the heritage-based curriculum is to strengthen Science, Technology, Engineering and Mathematics (STEM) subjects and programs. To achieve economic self-sufficiency, STEM education should be promoted in conjunction with entrepreneurship capabilities (Mhlanga, 2021). In order to guarantee linguistic and cultural relevance, it is important to promote the use of Shona, Ndebele, and other indigenous languages in education (Chivore, 2021).

2.3.1 A competency-based Approach to Education

The competency-based approach emphasizes on creativity, critical thinking, problem solving, and hands on learning for instance, lessons incorporate indigenous science, agriculture, and the performing arts (Ministry of Primary and Secondary Education, 2017). An educational strategy known as competency-based learning (CBL) places more emphasis on problem solving, skill development, and practical application than rote memorization (Chisaka, 2020). In order to provide students in Zimbabwe with marketable skills, critical thinking abilities, and practical knowledge, competency-based learning was integrated into the heritage-based curriculum, which was first introduced in 2015 and completely implemented in 2017 (Ministry of Primary and Secondary Education, 2017). CBL moves the emphasis from knowledge-based learning, which focuses on what students already know, to skills-based learning, which focuses on what students can accomplish with that information (Chakanyuka & Mavunga, 2020).

The curriculum was implemented with one of its main goals being to promote the Zimbabwean identity and culture via education. According to Chakanyuka and Mavunga 2020, the aim of this curriculum was to decolonize the educational system by teaching pupils about their indigenous knowledge systems (IKS), national history, customs, and values, for instance, current scientific methods are taught alongside traditional healthcare, organic farming, and Zimbabwean architectural designs such as the Great Zimbabwe ruins (Chisaka, 2020). According to Chisaka (2020), indigenous Knowledge Systems" (IKS) describes the customs, knowledge, and cultural practices that have been cultivated over many generations by local groups including traditional medicine, agriculture practices, environmental protection, storytelling, music, language, and governance systems. Supporting Indigenous Knowledge Systems (IKS) and Ubuntu, social studies and civic education are infused in supporting indigenous knowledge systems with the Ubuntu principle, which states, “I am because we are”. Traditional practices such as dance, poetry, music, and visual arts are all part of the performing arts curriculum, with traditional dances like Isitshikitsha, Muchongoyo, and Jerusarema being taught and performed in schools to enable pupils to cultivate their creative abilities while promoting an awareness of Zimbabwe's artistic legacy (Marungudzi, 2022). According to Muzvidziwa and Seotsanyana (2021),

Zimbabwean history, especially the pre-colonial period, the liberation war, as well as the post-independence growth, is given priority in the curriculum to allow knowledge on the Zimbabwean history and heritage studies. In addition to the studies of important historical individuals like Nehanda and King Lobengula, students study Great Zimbabwe, the Ndebele monarchy, and the Chimurenga battles. This promotes an awareness of Zimbabwe's historical roots and a sense of national pride. In addition to preparing students for both contemporary and traditional economic systems, the method fosters social cohesiveness, pride in Zimbabwe's cultural legacy, and national consciousness.

Another strategy for advancing the Zimbabwean culture and identity is the use of native languages in the Classroom. The significance of indigenous languages in education is emphasized by Zimbabwe's Constitution, which recognizes 16 official languages such as
Shona, Ndebele, Tonga, Venda, Kalanga, Chichewa, Nambya, Sotho, Xhosa, Tswana, Shangani, Koisan, Ndau, and Chibarwe, (Government of Zimbabwe, 2013). Along with promoting other indigenous languages, Shona and Ndebele are required subjects in primary and secondary education where indigenous knowledge and moral values are preserved through the teaching of ancient proverbs, idioms, and folklore (Marungudzi, 2022).

2.4 Accessibility of digital learning resources in Zimbabwean primary schools.

In Zimbabwe, initiatives like Wi-Fi hotspots and e-learning bundles for schools have been introduced by companies like Econet wireless to allow the expansion of smart classroom activities (Mhlanga, 2020). Suggestions and strategies to improve the Nation’s digital education were employed which spent much of the finances on ICT infrastructure. As digital learning platforms are essential for expanding educational opportunities, especially in primary and secondary schools, the systems facilitate both in-person and remote learning by offering curriculum-aligned content, interactive lessons, and evaluations. The main digital learning platforms utilized in Zimbabwe are listed below, along with some of their features

Ruzivo

It is an e-learning platform in Zimbabwe that offers interactive classes for primary and secondary pupils that are in line with the curriculum (Mushure, 2021). Higher life foundation in Zimbabwe trading as Econet wireless created an e-learning platform that is in line with the Zimbabwean curriculum which provides interactive courses, tests, and evaluations for students in primary and secondary education. Subjects in both primary and secondary education such as English, social studies, science, geography, history and mathematics are provided on the platform which can be accessed using computers, tablets, and smartphones. This platform was created to facilitate access to high-quality education for both children in urban and remote areas, but internet connectivity is necessary for its functionality. The pros of this platform and its content is that, it is locally designed and in line with the National curriculum as well as reasonably priced for a large number of students. However, it has limited offline accessibility hence it needs reliable internet, which many people cannot afford. Another weakness of this platform is that, the educational content is taken straight from the text book as it is hence it is text-based content with the aid of visuals extracted as they are from the text books, which minimizes students grasping concepts without the aid of a teacher, hence removing the essence of digital learning.

Learning Passport

United Nations International CE Fund created a mobile friendly digital learning portal to help students by providing them with free instructional materials. The platform offers quizzes, digital textbooks, and interactive lessons as it incorporates offline learning features that let students save content for later usage. The platform was created with underprivileged students in mind including those in remote areas, to give access to digital learning tools and assist marginalized students with free educational materials which are compatible with mobile devices learning (UNICEF, 2021). However, the platform has limited local material in indigenous languages and downloading the resources requires initial internet access.

Akello smart Learning

Akello smart learning was developed by Econet Wireless subsidiary, Cassava Smartech. It offers pupils digital textbooks, interactive tests, and video training as it covers the fundamentals for students in primary and secondary education. The platform is accessible on portable computers and mobile devices. The greatest strength of this platform is that it contains multimedia instructional videos that cover a variety of topics. However these have been specifically designed for American students, meaning that they lack local contextualization and it is a subscription based model and it requires consistent access to the internet.

E-Learning Solutions Zimbabwe

It is a locally created online learning environment that features instructional videos, games, and tests. It emphasizes on areas related to science, technology, engineering, and mathematics (STEM). The platform offers digital literacy training resources for teachers and encourages STEM education in accordance with Zimbabwe's educational policies. However, the adoption is scarce in rural schools and for efficient utilization, digital literacy is necessary.

School based WhatsApp Groups

WhatsApp is a platform widely used as a digital learning tool by Zimbabwean educators and educational institutions, particularly in places where access to official e-learning platforms is restricted. Teachers set up parent and student WhatsApp groups where they exchange notes on lessons, voice notes, brief video explanations, tasks and marking guides for evaluations. This platform has been helpful and accessible to many, as it is also easy to use for parents and students as well as being compatible with low-end cellphones with minimal data usage. However, the lack of a formal learning platform's framework presents challenges considering the fewer interactive features than comprehensive e-learning systems.

Digital learning application for the Shona and Ndebele languages

The application has been designed for smartphones to aid in the learning of native languages like Ndebele and Shona. It consists of engaging vocabulary drills, local language storybooks, guides to pronunciation which aids in the preservation of Zimbabwean languages and increases the accessibility of digital learning for students in the early grades. The pros of this application are facilitating learning in the mother tongue and it is simple to utilize for young students. However, there is limited access to excellent content extensively included into the system of formal education. Zimbabwe has shown a dedication to modernizing education and expanding accessibility through its attempts to incorporate digital learning tools. Maximizing the advantages of e-learning, however, requires resolving infrastructure issues, enhancing digital literacy among teachers, reducing cost barriers for students, and ensuring that digital content conforms with standards. By tackling these problems, Zimbabwe might create an ecosystem for digital education that is more inclusive and successful.

2.5 Effectiveness of multimedia in digital learning

Increasing educational standards worldwide, particularly in developing countries like Zimbabwe, is largely dependent on the integration of multimedia into digital learning settings. Because it can accommodate a range of learning preferences and boost student engagement, multimedia—which combines text, images, music, and video—is especially helpful in primary education (Mayer, 2005). With limited educational resources, multimedia provides a means of augmenting traditional teaching methods and fostering the development of critical thinking skills in Zimbabwean primary school pupils. Because multimedia can adjust to various cognitive abilities and learning styles, it is particularly effective for elementary school pupils, according to studies (Mayer, 2005). Information presented verbally and visually aids in faster assimilation, enhancing

retention and comprehension, according to the Cognitive Theory of Multimedia Learning (Mayer, 2005).

In Zimbabwean primary schools, where teachers inevitably contend with large class sizes and limited resources, multimedia tools such as interactive educational videos, educational games, and animations can offer a variety of representational formats that facilitate a deeper comprehension of complex concepts, especially in subjects like science and mathematics (Chikunda, 2019). A study by Munatsi and Mupa (2016) found that Zimbabwean primary school students showed better comprehension and memory of mathematical concepts when multimedia resources, such as instructional videos, were utilized in the classroom.

Multimedia can also increase student interest and engagement, which is a big problem in many Zimbabwean classrooms where students might not have enough resources or face language barriers. According to Plass, Homer, and Kinzer (2015), multimedia provides an interactive learning environment that allows students to actively engage with the content. In Zimbabwe, where English may not always be the students' vernacular language, multimedia resources that combine audio and images can help break down the language barrier and make learning easier and more fun (Chikunda, 2019). By offering an interactive experience, multimedia can support various learning styles, such as auditory and visual. This encourages a welcoming classroom atmosphere. However, a variety of factors must come together for multimedia to be successfully incorporated into Zimbabwean primary schools.

A significant issue is the lack of adequate infrastructure and reliable electricity in many rural schools (Musonda, 2018). Although some urban schools may have access to digital resources, the widespread use of multimedia in rural areas is still limited by a lack of proper technological infrastructure. Additionally, teachers must receive adequate training and professional development in digital literacy in order to successfully integrate multimedia; however, Zimbabwe's educational system does not always provide easy access to these resources (Mupa & Chikunda, 2018). Teachers who are not adequately prepared may use multimedia ineffectively, which can result in missed opportunities to enhance learning outcomes.

Research indicates that multimedia is still a valuable tool for improving primary education in Zimbabwe in spite of these challenges. Multimedia has been shown to improve student motivation, creativity, and learning outcomes when appropriately incorporated into the curriculum (Chikunda, 2019). Furthermore, national and international organizations are increasingly acknowledging the significance of digital learning in Zimbabwe. The Zimbabwean government has initiated programs in collaboration with foreign partners to expand access to digital learning resources, especially in rural areas (UNICEF, 2020). Even though these initiatives are still in their infancy, they offer hope for the continued use of multimedia in Zimbabwean classrooms, particularly in primary education.

2.6 Major factors impacting primary schools' access to digital learning content

Technology plays a major role in modern education by enhancing learning through multimedia resources like interactive apps, digital textbooks, and animations. However, a number of barriers stand in the way of Zimbabwean primary schools' efficient use of digitally modifiable multimedia content. Socioeconomic, cost-effective, and infrastructure-related factors are the primary causes of these challenges (Mutemeri & Mugani, 2021). The main determinants of the availability of multimedia-based learning materials for a successful integration will be investigated in this study.

2.6.1 Accessibility of Infrastructure

Infrastructure availability refers to the availability, usability, and accessibility of essential physical and technological resources required to support a particular system or service. According to Unwin (2008), infrastructure availability in the context of education includes ICT facilities, electrical supplies, internet connectivity, and digital devices necessary for effective teaching and learning. Trucano (2015) argues that the availability of infrastructure in digital education includes both "hardware infrastructure" (computers, projectors, smartboards, and internet connections) and "soft infrastructure" (training facilities, technical support, and

maintenance). The absence of stable infrastructure is a significant barrier to digital learning, particularly in settings with limited resources.

Socioeconomic factors like income disparity, poverty, and unequal access to resources have a significant impact on primary school education in Zimbabwe (Musingafi & Zebron, 2019). Many kids in low-income and rural areas lack access to computers, internet connectivity, and digital learning materials, which leads to educational disparities. Another issue with limited Internet connectivity is that, as a result of high costs and inadequate network coverage, Internet perceptiveness is still low, particularly in remote areas. In Zimbabwe, 39% of rural schools have dependable internet access (Makombe & Kudzai, 2020). Additionally, research shows that many schools that receive ICT donations have inadequate maintenance because they lack technical support for updates and repairs, which causes rapid deterioration and underutilization (Moyo & Hadebe, 2020).

2.6.2 Expensive internet access and ICT equipment

It is very challenging for Zimbabwean primary schools to integrate ICT because of the high cost of ICT equipment and internet connectivity. Many schools, particularly those in rural areas, struggle to buy the digital equipment they need because of financial constraints, high taxes on ICT imports, and a lack of government funding (Musingafi & Zebron, 2019). The cost of internet access exacerbates the digital divide by restricting access to online educational resources and e-learning platforms. One of the numerous factors raising the price of ICT equipment in Zimbabwe is import taxes and duties. Due to Zimbabwe's high import taxes on ICT, educational institutions cannot afford devices like laptops, tablets, and projectors (Makombe & Kudzai, 2020).

The issue of limited local production is made worse by the necessity of relying on pricey imported digital devices because there aren't enough local producers. One of the ongoing economic issues in Zimbabwe that drives up the cost of ICT equipment is currency instability (Chigona et al., 2020). There are insufficient government subsidies in Zimbabwe. In contrast to a

number of countries where governments offer educational ICT subsidies, Zimbabwean schools regularly purchase digital devices at market rates (Ndlovu & Sithole, 2021). The high student-to-device ratio is a result of many schools operating with antiquated or inadequate ICT resources due to a lack of computers and digital tools (Moyo & Hadebe, 2020). Schools without projectors, smart boards, or tablets find it difficult to incorporate multimedia-based instruction, which has resulted in an inability to adapt multimedia learning.

Additionally, teachers do not have access to computers, which makes it challenging for them to take advantage of opportunities for digital literacy training. Most schools cannot afford to use online learning because data rates in Zimbabwe are among the highest in Africa, costing more than $10 per 10GB (Musingafi & Zebron, 2019). Schools in rural areas are forced to rely on expensive mobile data due to poor broadband connectivity. Poor service quality and high costs are caused by a shortage of service providers. Limited access to online learning resources has been observed because schools find it challenging to use e-learning platforms like Google Classroom due to students' limited exposure to digital tools. As a result, students miss out on the global educational content and essential ICT skills when they are unable to pay for internet access.

2.6.3 Lack of Teacher Training and Digital Literacy

Teachers' competency with digital technologies is vital to the proper integration of information and communication technology (ICT) in the classroom. Implementing digital learning practices is challenging in Zimbabwe, as many primary school teachers lack sufficient ICT training and digital literacy (Musingafi & Zebron, 2019). Many teachers lack exposure to contemporary teaching tools, lack training opportunities, and also lack of government assistance being the major causes of the digital skills gap (Chigona et al., 2020). The ability of teachers in using digital tools, platforms, and pedagogical practices to improve teaching and learning is known as teacher digital literacy (Trucano, 2015). It encompasses fundamental computer abilities, such as word processing, spreadsheets, and presentations, research and internet navigation abilities, incorporating multimedia into teaching, online interaction and cooperation, understanding cyber security and practicing good digital citizenship (Moyo & Hadebe, 2020).

According to Makombe and Kudzai (2020), traditional teaching methods continue to be given priority over digital education in several Zimbabwean teacher training colleges; hence teachers have little exposure to the digital world since current ICT training programs are scarce and inadequately supported. Instead of emphasizing practical application, the majority of professional development seminars concentrate on theoretical ICT knowledge (Musingafi & Zebron, 2019). For teachers to practice and refine their digital abilities, many schools lack adequate computers and internet connectivity (Ndlovu & Sithole, 2021). More so, digital training sessions are challenging to undertake in remote schools due to significant electricity shortages (Chigona et al., 2020). Some teachers, particularly those who are older, are reluctant to embrace digital tools because they are insecure or afraid of technology (Moyo & Hadebe, 2020). The shift to digital teaching methods can be difficult for teachers who have never had ICT training.

Makombe and Kudzai (2020), point out that, because ICT training for teachers is not required by the Zimbabwean government, digital literacy levels vary throughout schools. Teachers find it challenging to obtain assistance when they encounter technical difficulties since many schools lack ICT support personnel (Musingafi & Zebron, 2019), therefore digital exams, e-learning platforms, and multimedia information are difficult for teachers to incorporate into their classes (Chigona et al., 2020). Many teachers still employ the antiquated chalk-and-talk method even in the face of digital technology (Ndlovu & Sithole, 2021). The digital divide between Zimbabwe and other countries widens when teachers lack the necessary digital literacy to provide students with an adequate ICT education. Students miss out on chances to learn skills like coding, digital research, and online collaboration—all of which are essential for the modern workforce, claim Moyo and Hadebe (2020). Government attempts to introduce e-learning programs are being hampered by teachers' resistance and lack of digital readiness, claim Makombe and Kudzai (2020).

2.6.4 Parental and Community Support in Primary School Digital Learning

For digital learning to be successfully adopted, community and parent support is crucial for primary school students. Parents and community members have an impact on children's access to, motivation for, and participation in digital education (Epstein, 2018). Financial constraints, a lack of digital competency, and poor parental involvement all hinder Zimbabwe's elementary schools' ability to effectively employ ICT (Chigona et al., 2020). More parental and community involvement is necessary to close the digital divide and improve children's educational experiences. When it comes to providing access to devices such as computers, tablets, and smartphones for online learning, parents are crucial (Hargittai & Dobransky, 2017). As parents actively monitor homework and support digital learning activities, promoting pupils' digital education enhances academic success (Epstein, 2018).

However, many parents in Zimbabwe are not digitally literate enough to help their children in the primary school levels to use educational platforms and apps as stated by Moyo & Hadebe in 2020. Children's use of technology for learning is more likely to be supported and encouraged by parents who are more digitally literate (Livingstone & Helsper, 2007).It is challenging for many Zimbabwean parents to support digital learning since they lack sufficient ICT skills, especially in rural areas (Chigona et al., 2020). Parents who participate in digital literacy programs will feel more confident while guiding their children in ICT-based schooling.

According to Ndlovu and Sithole (2021), community-based ICT centers help close the digital divide by giving pupils shared access to computers and internet services as few rural communities in Zimbabwe have access to these facilities, underprivileged children find it challenging to learn digitally (Makombe & Kudzai, 2020). By increasing awareness and assisting in the construction of ICT infrastructure, local organizations like churches and community leaders may promote digital learning, according to Musingafi & Zebron's 2019 perspective. Strong teacher-parent communication helps parents support their children's digital learning, and public-private partnerships (PPPs) can fund ICT projects that provide free Wi-Fi wireless networks and educational devices to underprivileged children (Chigona et al., 2020). According to Moyo and Hadebe (2020), schools can hold community workshops to inform guardians and

parents about digital safety, e-learning platforms, and online learning tools. This way, pupils can receive support from both their home and school.

2.6.5 Curriculum Alignment and Localized Content Development

According to Kirkpatrick & Zang (2020), digital learning resources must be culturally and educationally appropriate and adhere to national education standards, which call for curriculum alignment and the production of locally relevant content. According to Moyo and Hadebe (2021), integrating information and communication technology (ICT) into Zimbabwean primary education requires curriculum content that is in line with the national curriculum as well as local cultural, linguistic, and socioeconomic contexts. Digital resources are hard to successfully integrate into the educational system, though, due to issues like inadequate funding, inadequate teacher training, and a dearth of local content development initiatives (Ndlovu & Sithole, 2021).

Zimbabwean primary school curricula promote digital literacy, critical thinking, and problem-solving skills, in accordance with the Competence-Based Curriculum (CBC), which was put into place by the Ministry of Primary and Secondary Education (MoPSE) (MoPSE, 2017). In order to enhance learning outcomes and assist students in acquiring 21st-century skills, digital content should incorporate the CBC (Musingafi & Zebron, 2019). In order to ensure consistent learning opportunities across different geographical areas, including rural areas, digital resources must be in line with national curricula, according to Chigona et al. (2020). Standardization helps to prevent the use of foreign or unnecessary resources that don't fit Zimbabwe's educational needs (Makombe & Kudzai, 2020). Teachers ought to receive training on how to incorporate ICT into regular classes in a way that improves student understanding and engagement as stated by Ndlovu & Sithole, (2021), therefore, good digital materials should support blended learning strategies and be used in conjunction with conventional teaching techniques (Moyo & Hadebe, 2021).

According to the Ministry of Primary and Secondary Education in 2017, Zimbabwe is a multilingual country where the primary languages of education are English, Ndebele, and Shona. However the majority of digital learning resources are in English and learners who are more fluent in indigenous languages face obstacles (Musingafi & Zebron, 2019). In order to improve comprehension, localized digital material that uses Shona, Ndebele, and other indigenous languages must be created stated Ndlovu & Sithole, (2021) as it allows real-world examples, historical occurrences, and socioeconomic concerns pertinent to Zimbabwe, which can be easily comprehended by the students. Learners' participation and appreciation of culture is enhanced by content that incorporates regional traditions, practices, and values (Makombe & Kudzai, 2020) but in the context of Zimbabwe, education relies heavily on digital learning resources created abroad, some of which might not be entirely in line with the country's curriculum (Moyo & Hadebe, 2021). Materials are guaranteed to be culturally appropriate and in line with regional learning requirements when local developers, educators, and education professionals are encouraged to produce in-house digital content (Ndlovu & Sithole, 2021).

Financial investment, which is frequently absent in Zimbabwe's education sector, is necessary for the creation of high-quality digital learning resources (Musingafi & Zebron, 2019). Currently, Schools are forced to use out-of-date or foreign curriculum that falls short of meeting local learning demands due to a lack of funding (Makombe & Kudzai, 2020). More so, many educators lack ICT proficiency and have insufficient training in incorporating digital resources into their classes stated Moyo & Hadebe, (2021). The impact of digital information decreases when teachers lack the necessary training to integrate it with the national curriculum (Chigona et al., 2020). Few local projects are devoted to developing digital learning resources tailored to Zimbabwean students (Ndlovu & Sithole, 2021). Musingafi and Zebron (2019) claim that the lack of collaboration between government agencies, content creators, and academic institutions slows down the production of locally relevant content. The government should invest in online education and create policies that promote the creation of digital content that is appropriate to the region (MoPSE, 2017). According to Chigona et al. (2020), the development of public-private partnerships can aid in funding the development of digital curriculum. Additionally, conducting training programs for teachers on how to properly incorporate digital content into the curriculum

(Moyo & Hadebe, 2021) will encourage local educators and software developers to create culturally relevant digital learning materials (Ndlovu & Sithole, 2021).

As a country, we should support open-source digital learning platforms to lower the cost and increase the accessibility of localized material (Musingafi & Zebron, 2019). Academic institutions and the government should provide funding for the development of interactive learning materials, movies, and digital textbooks that are specific to Zimbabwe (Makombe & Kudzai, 2020). By involving educators, parents, and community leaders in the content creation process, digital resources are certain to represent regional cultural and linguistic variance (Chigona et al., 2020). Schools ought to collaborate with local research institutes and universities to offer top-notch locally relevant digital content (Ndlovu & Sithole, 2021).

2.7 Combining pedagogy and technology to improve the layout and applicability of digital learning materials

The successful integration of pedagogy and technology has a significant impact on the design and usability of digital learning resources, ensuring that these resources serve both effective instructional goals and student engagement. As educational technology advances, its potential to enhance teaching and learning approaches becomes more apparent; nevertheless, merely integrating technology into the classroom is insufficient. To have the greatest impact, digital learning materials must adhere to sound pedagogical principles that promote critical thinking, active learning, and student involvement (Mishra & Koehler, 2006). This conversation highlights the importance of effectively integrating technology and pedagogy to enhance the creation, dissemination, and applicability of digital learning materials.

In order to understand how technology, pedagogy, and subject knowledge interact in educational settings, Mishra and Koehler (2006) developed the technical pedagogical content knowledge (TPACK) framework. According to TPACK, teachers must understand how to use technology

into specific subject areas in order to enhance and support pedagogy. This paradigm suggests that while designing digital learning resources, it is important to consider technology tools and focus on how they might support instructional practices that promote deeper learning.
For example, interactive simulations or gamified learning can be effectively implemented in scientific lectures to assist students in visualizing complex phenomena and actively engaging with the material, hence enhancing their understanding of the subject matter (Garris et al. 2002).

Furthermore, pedagogical integration of technology inspires students to take an active role in their education and supports student-centered learning environments. Approaches of education that stress problem-solving and active learning, such as constructivism, could be significantly enhanced by technology. According to Jonassen (2000), students are encouraged to explore, research, and collaborate with their peers through digital tools such as educational games, multimedia presentations, and interactive online platforms. This helps them develop their critical thinking and problem-solving techniques.

When these technologies are developed with pedagogical principles in mind, students stand to gain more from them. This guarantees that learning is engaging, meaningful, and effective. Additional elements that add to the relevance of digital learning tools are their flexibility and responsiveness to a variety of learner needs. Adaptive learning technologies, which use algorithms to customize learning experiences based on individual progress, are an example of how technology may enhance the design and utility of digital learning materials. Siemens (2005) asserts that by continuously assessing students' abilities and providing customized information, adaptive technologies ensure that each learner is challenged at their level of competency. This improves outcomes and encourages customized learning.

This will be especially beneficial for students in varied classrooms with varying learning styles and degrees of prior knowledge. Additionally, the structure and applicability of digital learning content are influenced by the ongoing development of instructional design concepts. As technology advances, instructional designers must constantly adapt their approaches to ensure that digital learning materials meet both current educational demands and future technological

advancements. Teachers, subject matter experts, and content designers must collaborate to ensure that resources are not only pedagogically sound but also incorporate cutting-edge technology that enhances learning (Clark & Mayer, 2016). The incorporation of technology such as virtual reality (VR) and artificial intelligence (AI) into educational settings is a symbol of the future of digital learning materials.

Apart from enhancing understanding of complex concepts, these technologies provide dynamic and captivating educational opportunities that can increase student enthusiasm and involvement (Zhu, 2019). However, integrating technology with instruction presents certain challenges. The lack of adequate professional development for educators in the utilization of educational technology is a significant barrier. Teachers need to have both the technical know-how to use digital tools and the pedagogical skills to design effective learning experiences. Professional development programs that prioritize the advancement of pedagogy and technology are necessary for teachers to be proficient in using digital learning resources (Ertmer & Ottenbreit-Leftwich, 2010). Issues like restricted access to technology, especially in environments with low resources, are additional barriers to the broad adoption of digitally enhanced teaching approaches. This integration depends on the availability of suitable technology tools and the capacity to use them effectively. Lack of the necessary software and digital literacy makes it very difficult to integrate pedagogy and technology in the classroom. Pedagogy is the foundation of instructional design in digital learning environments, however in order to promote meaningful learning experiences, educators must align pedagogical ideas with technology in order to achieve a balance between both components (Mishra & Koehler, 2006). Therefore, rather of using technology as an add-on, educators must ensure that it is included into the learning process. The proper technological software must be available in order to generate digital learning content effectively.

In order to provide interesting and dynamic material, learning management systems (LMS), authoring tools, video editing software, and interactive simulation platforms are essential (Kurt, 2018). Teachers' ability to create varied learning materials that accommodate various learning styles is constrained in the absence of such tools. Furthermore, technical innovations like virtual

reality (VR) and artificial intelligence (AI) are becoming essential to digital learning, which emphasizes the need for appropriate software for pedagogical integration. Effective integration requires more than just having the appropriate software; educators also need to know how to use these tools. Koehler, Mishra, and Cain (2013) assert that teachers' digital literacy is essential to ensuring that technology is used to improve learning. To gain the digital competencies necessary to successfully use educational technologies, teachers must participate in professional development. Without the right instruction, technology runs the risk of being more of a distraction than a tool to improve teaching.

2.8 Comparing and contrasting teacher led content and self-paced content

Teacher led and self-paced approaches are two of the many ways that digital learning has revolutionized traditional education. Each strategy has unique benefits and drawbacks that affect flexibility, information retention, and learner engagement. Self-paced content encourages students' independence and flexibility, whereas teacher led content offers structure and direct contact. A comparison between these two approaches reveals how they affect the effectiveness of digital learning. Teachers have to facilitate learning through live or recorded sessions in teacher led content, which adheres to an organized learning approach. With the teacher facilitating debates, giving clarifications, and providing immediate feedback, this method is similar to traditional classroom learning (Bonk & Graham, 2012). Teacher led digital learning includes synchronous online courses, webinars, and virtual lectures, which are being conducted on goggle class, goggle meet and Microsoft teams amongst other digital learning platforms in Zimbabwe.

Instant communication between teachers and students is the greatest benefit of teacher led strategy of learning since it enables concept clarification, discussion participation, and tailored feedback (Means, Toyama, Murphy, & Baki, 2013). This model works especially well for complicated topics that need supervised explanations. Additionally, because teacher led content allows students to interact with classmates through group projects and conversations, it promotes collaborative learning. However, teacher led content have drawbacks, the greatest among them being its lack of flexibility. Students have to follow a set timetable, which could not work for

those with different learning styles, infrastructural problems such as electricity availability or time constraints. Furthermore, accessibility may be impeded by technological obstacles such as inadequate internet connectivity (Hodges, Moore, Lockee, Trust, & Bond, 2020).

With self-paced learning, students can access and interact with the educational content whenever it is most convenient for them. According to Hrastinski (2019), this strategy usually consists of interactive simulations, reading materials, quizzes, and pre-recorded video lectures. One of the biggest benefits of self-paced learning is that it allows students to set their own pace and go back over the subject whenever they need to. Additionally, because self-paced learning allows people to learn new abilities without being constrained by set schedules, it promotes lifelong learning. Professionals and adult learners who must balance employment, personal obligations, and education will find it very helpful (Pappas, 2015). Furthermore, by meeting each learner's unique needs, artificial intelligence tailored learning paths and adaptive learning technologies increase the effectiveness of self-paced content. Regardless of its' advantages, self-paced learning presents many difficulties, the greatest being the motivation and involvement of learners. Some students may find it difficult to maintain discipline in the absence of real time teacher engagement, necessitating the use of extra support systems like discussion boards or frequent checkups with teachers (Sun & Rueda, 2012). Furthermore, self-paced learning might not be the best option for complicated concepts that call for guided problem-solving and practical experience.

Both teacher-led and self-paced digital learning strategies have advantages, but how well they work depends on the learning environment. Self-paced content offers freedom and independence, while teacher-led content is ideal for group and supervised learning activities. In order to maximize learning outcomes, a mixed strategy that combines both approaches is frequently advised. Flipped classroom formats, for example, combine teacher-led conversations with self-paced pre-learning to improve student engagement and comprehension (Bishop & Verleger, 2013). When creating digital learning materials, educators and designers must consider the complexity of the subject matter, learner preferences, and technological infrastructure.

2.9 Communication and local languages in digital learning materials

In the era of digital learning, the use of indigenous languages is crucial for fostering inclusive education and effective communication. Language plays a major role in learning, and because global languages like English are so common in digital learning, learners usually encounter difficulties. To maximize the benefits of multilingual digital education, local languages are integrated into digital learning materials to enhance learning outcomes, accessibility, and cultural relevance. However, problems like lack of digital resources in indigenous languages, technological constraints, and content localization need to be fixed.

Since local languages foster cognitive development and knowledge retention, they are essential for equitable access to education, particularly in multilingual societies. Research indicates that when instruction is given in their mother tongue, students comprehend subjects more thoroughly (Benson, 2013). By integrating local languages into digital learning platforms, students can engage with content more effectively and achieve better academic results. Furthermore, digital content in local languages helps bridge the digital divide by providing access to education for underserved communities. Language barriers in widely used digital content limit educational access in many developing countries (UNESCO, 2019). If learning materials are offered in their native tongues, learners from diverse linguistic backgrounds can utilize digital education without encountering language barriers. For communication to be effective, languages must be accessible.

When the content is presented in their native tongues, learners are more likely to collaborate effectively, engage completely, and voice their opinions with confidence (Odera, 2020). This is particularly crucial in online debates, forums, and virtual classrooms where language is crucial to knowledge sharing. Additionally, integrating local languages into digital learning promotes the preservation of cultural identity and legacy. Words usually lose their cultural distinction and context when translated into the most widely used languages in the world (Bamgbose, 2011). Local languages increase the significance and engagement of digital learning materials by making them more relevant to students' real-world experiences. Notwithstanding its advantages,

challenges must be overcome before learning local languages. One major issue is the lack of digital resources and content in native languages.

Localized learning resources are scarce since the majority of educational software and online learning platforms support widely spoken languages (Kamwangamalu, 2016). Because many language processing tools, speech to text applications, and translation software are still not suited for less widely spoken languages, technological limitations also present a problem. More so, substantial investments in infrastructure development, teacher training, and localization are necessary to produce high quality digital content in numerous languages (UNESCO, 2019).
Language inclusion must be given top priority by legislators, educators, and tech developers in order to improve the integration of regional languages in digital education.

Learning materials should be translated and modified into local languages by educational institutions and content creators. Also, voice recognition, automated translation, and linguistic accessibility features in digital education should be supported by developments in artificial intelligence and natural language processing. If designers and teachers work together with local communities, schools, and native speakers, assistance can be guaranteed that digital information is linguistically and culturally appropriate. To facilitate the integration of local languages in e-learning, policies that encourage multilingual education and digital inclusion must to be put into place. When it comes to improving accessibility and communication in digital learning content, local languages are essential. Their integration improves understanding, fosters inclusive education, and fortifies cultural identity. However, problems like limited digital resources and technological constraints need to be fixed in order to fully reap the benefits of multilingual digital education. Teachers, lawmakers, and tech developers must collaborate if digital learning is to be available to all students, regardless of language proficiency.

2.10 Theoretical Framework

A theoretical framework explains and bolsters the research problem in a manner similar to a road map. By connecting the research to accepted theories, concepts, or models, it creates a foundation for understanding and assessing data. The identification of research questions, theories, and methodologies is aided by theoretical frameworks. It also highlights the research's significance to the field by relating it to accepted theories. Richard Mayer's Multimedia theory (2001) was used in this study since a theoretical framework guarantees that the research is based on scholarly principles, which increases its credibility.

The theory of multimedia learning, developed by Richard Mayer, focuses on how people learn from words and images. According to the Cognitive Load theory, when information is presented both orally and visually, rather than just through text, people learn more effectively. Mayer's research demonstrates how multimedia instruction can enhance memory and comprehension when the material is delivered in a way that reduces cognitive overload and fits the way the brain absorbs information. A vital part of contemporary education, particularly for younger pupils, is multimedia learning. Suppose, for instance, that you click on the "pumps" entry in an online multimedia handbook. After that, a video with animation with narration that explains how a pump works is played on the computer. Or, in a computer game that teaches science, picture yourself traveling to a new planet and having to make a plant that can survive there. An on-screen character explains how the characteristics of the roots, stem, and leaves relate to various environmental circumstances. Agent-based simulation games and multimedia classes are two instances of computer-based multimedia learning environments. Because they include written and spoken words along with visuals like animation, video, illustrations, or photographs, these learning environments are categorized as multimedia.

Richard Mayer's Multimedia Learning Theory (2001), which makes use of both visual and verbal information processing channels, offers a strong basis for comprehending how multimedia content may enhance learning outcomes. This strategy highlights the importance of carefully crafted multimedia materials that maximize cognitive load, improving students' capacity to assimilate and retain information (Mayer, 2009). The application of multimedia learning theory is particularly pertinent to Zimbabwean and international primary school pupils since it offers

suggestions for creating interesting and instructive digital content that satisfies their cognitive and developmental requirements.

2.10.1 Cognitive theory of Multimedia Learning

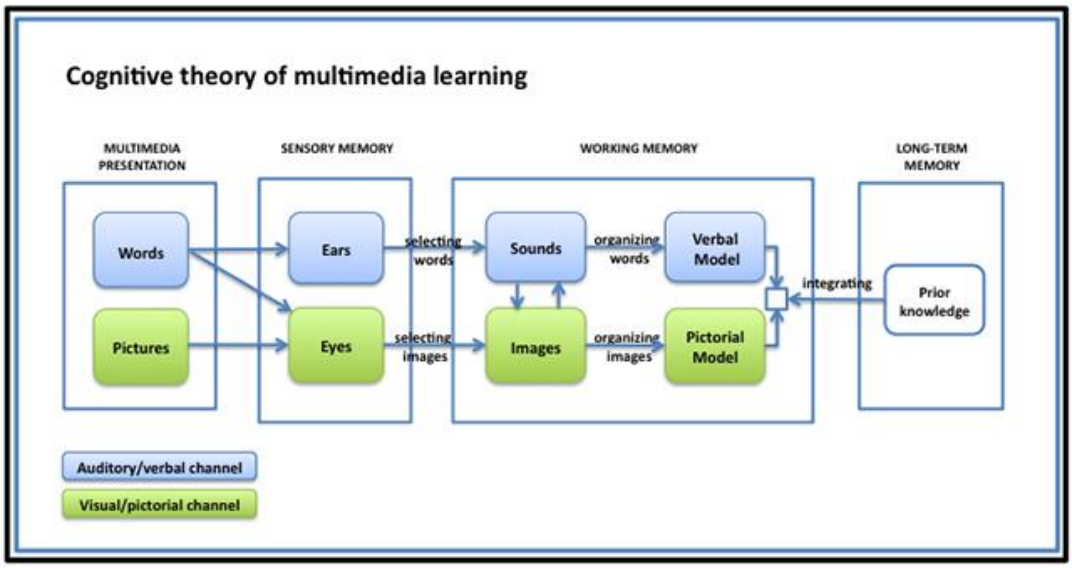


Figure 2.1 ***Cognitive theory of multimedia learning*** *(Adapted from Mayer 2001.)*

Mayer (2001) states that effective multimedia learning happens when instructional materials follow a number of essential concepts, including the dual-channel assumption, limited capacity assumption, and active processing assumption. According to these principles, multimedia content should be created to use both visual and auditory channels without overpowering either, allowing students to actively analyze and integrate knowledge (Mayer & Moreno, 2003). Using these

concepts to construct transformative multimedia content for Zimbabwe's primary school digital learners, educators and content creators may create materials that not only capture students' interest but also improve their learning experiences and outcomes. This theoretical framework emphasizes the role of multimedia learning in bridging the gap between traditional teaching approaches and the demands of the digital world.

When a student constructs a mental image using presented words and images, multimedia learning takes place. The scope of this concept is sufficiently broad to encompass computer-based environments with narration and animation, book-based environments with text and graphics, and virtual game environments with interactive speech and animated micro worlds. Since its origin, the psychology of learning has prioritized verbal learning over visual learning, going all the way back to Ebbinghaus's seminal research on learning and recalling lists of meaningless syllables in 1885. But with the development of computer graphics and visualization technologies, it is important to consider whether adding visual content to spoken content can affect learning a well-known subject that is being posed more and more frequently, (Williams & Houghton, 1987; Schnotz & Kulhavy, 1994; Mandal & Levin, 1989).

2.10.2 Principles of Cognitive Multimedia Learning Theory

Words and visuals work better together to help people learn than just words alone, according to Richard Mayer's Cognitive Theory of Multimedia Learning (2001). The idea, which is based on dual-channel processing and cognitive load theory, suggests that the human brain interprets visual and linguistic information through distinct but related channels (Mayer, 2009). The Fundamentals of cognitive multimedia learning theory suggests three main principles that form the foundation of the theory (Mayer, 2001). These concepts are based on the dual channel assumption where it suggests that people process verbal and visual information through two distinct cognitive channels (Paivio, 1986). The limited capacity assumption also states that too much information can overwhelm working memory since each channel has a restricted cognitive

capacity (Sweller, 1994). Mayer put out ten principles that aid in the efficient creation of multimedia learning environments and resources. These principles seek to improve learning by taking into account the way that human cognition functions.

Multimedia Principle

People learn more effectively when presented with both words and images according to the multimedia principle (Mayer, 2009). This concept is fundamental to Mayer's Cognitive theory of multimedia learning which describes how people absorb and remembers information through both spoken and visual means. It is widely believed that it is simpler for individuals to comprehend and learn when words are accompanied by images rather than just text. This concept is widely accepted, as evidenced by the saying that 'a picture is worth a thousand words'. According to Mayer (2001), this concept states that people learn more effectively when words and pictures are combined than when words are used alone. More precisely, individuals learn more thoroughly when relevant visuals are included with text. Dual channel processing states that people learn through different cognitive channels which are the visual channel and the verbal channel. The visual also known as the pictorial channel handles, diagrams, films and photos, while the verbal channel which is also known as the auditory channel interprets written or spoken words. Learning is more efficient when both channels are used because cognitive resources are shared rather than overwhelmed (Mayer and Moreno, 2003). According to cognitive load theory, each channel has a certain capacity, which means that students can only take in so much information at once (Sweller, 1994; Mayer, 2014). A well-designed multimedia resource should blend verbal and visual content without overloading the student. Active learning requires choosing pertinent material and arranging it in logical mental models as well as incorporating it with what has already been taught (Mayer, 2005). Multimedia presentations are beneficial because they provide both visual and spoken representations, strengthening ideas through a variety of communication channels. The multimedia concept is supported by research in a variety of educational contexts such as Science education where Mayer et al. (1996) discovered that students who watched narrated animations explained the generation of lightning outperforming those who were given only written explanations on assessments of problem-solving skills. According to research, online courses that include explanations and images

improve the transmission and retention of knowledge in digital learning environments (Mayer, 2017). According to research, students are better able to remember the content when teachers incorporate relevant diagrams, drawings, or animations into their lessons rather than relying solely on text or lectures (Clark & Mayer, 2016). The importance of including both spoken and visual elements in instructional design is emphasized by the Multimedia Principle. Supported by cognitive science and empirical research, this idea is widely applied in training, education, and e-learning to enhance comprehension and retention. However, multimedia content must be relevant and organized to maximize learning benefits.

Coherence Principle

According to the coherence principle, learning is enhanced when unnecessary information is removed from multimedia presentations, such as excessive words, sounds, or visuals (Mayer, 2009). This idea stems from the cognitive load theory, which contends that because students have a certain amount of cognitive capacity, introducing unrelated information might overload working memory, impairing understanding and memory (Sweller, 2010). Due to the limited processing capacity of human cognition, a learner's working memory may become overloaded with information (Sweller, 1994). Making sure that only pertinent information is presented, consists with the coherence principle which reinforces on minimizing unnecessary cognitive burden (Mayer & Moreno, 2003). Three primary categories of unnecessary content that should be avoided, according Mayer (2014) are, unnecessary audios such as unnecessary narration, background music, or ambience sounds which may divert students' attention from the main point. Unnecessary graphics were also stated by Mayer such as ornamental pictures that does not swiftly aid in learning which may draw away the focus from important information. Unnecessary words may overwhelm students which might result from using unnecessarily elaborating explanations, descriptive material, or repetitive speech. Learner's capacity to concentrate on the main instructional content ends up decreasing when they are presented with unnecessary material, which causes the brain to digest irrelevant information (Mayer, 2009). In multimedia learning contexts, where too much music, animation, or drawn-out explanations might reduce learning effectiveness, this impact is especially noticeable (Clark & Mayer, 2016).

Using animated graphics with and without background music, Mayer & Moreno (1998) conducted an experiment in which students learnt about lightning creation. It was confirmed that background sound can hinder learning because the group without it did noticeably better. In an eye anatomy class, for example, students who were shown visually appealing images such as a picture of an eye did worse on problem solving tests than students who were only shown essential visuals, according to research by Harp & Mayer (1997). This proves that unnecessary visuals does not help with understanding and might even make learning more difficult. In their 2001 study, Mayer et al. contrasted students who were given long, repetitious explanations with those who were given brief on screen text and narration. Concise narrative and text were found to improve problem solving skills and increase retention. Designers should not include irrelevant animations, graphics or background music in digital learning resources, according to Mayer. Employing brief storytelling instead of overloading students with lengthy text passages is recommended. Textbooks and Presentations designs should cut down on needless distractions and make use of simple slide designs in PowerPoint presentations to practice the coherence principle. Repetitive explanations or too much text should not be given to students so as to keep the layout minimal and tidy, containing only the most important information. According to Mayer and Fiorella (2022), some students may find background music enjoyable but studies indicate that it has no positive effects on learning results (Mayer, 2017).

Signaling Principle

According to the Signaling Principle, when visual and audible cues emphasize important information, people learn multimedia more successfully (Mayer, 2009). Through the use of text formatting, colors, arrows, outlines, highlights, narration emphasis, and other cues, signaling which is also referred to as cueing, assists students in concentrating on important information (Mayer, 2014). According to cognitive load theory, learners have a limited amount of working memory, which is consistent with this principle (Sweller, 2010). Hence, good signaling ensures that learners can focus their mental energies on learning that is relevant by reducing unnecessary cognitive load. As the ability of humans to process information is restricted, focusing students' attention on crucial components and avoiding distractions and signaling lowers the risk of cognitive overload (Mayer & Moreno, 2003).As people process information in two ways,

according to Mayer's cognitive theory of multimedia learning dual channels, signaling improves learning by arranging content to maximize both channels (Mayer, 2005). Information selection, organization, and integration are necessary for effective learning (Mayer, 2017), hence cues from signaling strategies improve retention and understanding by assisting students in organizing new information into meaningful schemes (Fiorella & Mayer, 2021).

According to research by Mayer and Jackson (2005), students who studied science texts with key phrases bolded and highlighted outperformed those who did not on assessments of recall and problem-solving skills. This implied that signaling enhances understanding by highlighting important ideas. According to Jamet (2014), instructional videos that include outlines, colors, and arrows greatly improved students' ability to recall knowledge and solve problems. On comprehension tests, learners with signaled content outperformed those without signaled content by 23%. Stull and Mayer (2007) showed that learners' retention and comprehension were enhanced by spoken emphasis, such as emphasizing important terms in narration. Narrative signaling, such as vocal emphasis and pauses before important ideas, improved learning outcomes for students compared to those who heard monotonous narration. However, split attention effects might result from overemphasizing or providing too many cues (De Koning et al., 2009). At the same time, explicit signaling is more beneficial for new students whereas it may not be as important for seasoned students according to Mayer (2017).

Types of Signaling Techniques

Table 2.2 Types of signaling Techniques

Type of Signaling	**Example**	**Effect on Learning**
Visual Cues	Arrows, bold text, color	Directs attention to key points, reducing visual

Type of Signaling	Example	Effect on Learning
	contrast	search effort (Jamet, 2014).
Textual Cues	Headings, bullet points, bolding key terms	Helps structure information, making it easier to process (Mayer, 2009).
Auditory Cues	Pauses, tone changes, emphasis on key words	Highlights important information in spoken content (Stull & Mayer, 2007).
Structural Cues	Concept maps, outlines, summaries	Organizes information for better retention (Fiorella & Mayer, 2021).

Redundancy Principle

According to the redundancy principle, a fundamental idea in Mayer's cognitive theory of multimedia learning, adding redundant information such as, presenting the same content in multiple formats like subtitles along with voice over narration can hinder rather than improve learning (Mayer, 2021). When educational resources are in alignment with how people process information, multimedia learning works well (Mayer, 2021). According to Sweller 2011 cognitive load theory, students' working memory capacity is limited hence learners may become overwhelmed and experience less learning efficiency if they are given repetitive material. According to the redundancy principle, learning might be hindered if the same information is provided in several ways without need. For instance, learner's visual and auditory channels may become overloaded if text is displayed on the screen and narrated at the same time. Cognitive overload may result from forcing students to divide their attention between verbal and written explanations of complicated visuals. Redundancies take place when digital learning resources have, voice over narration and subtitles talking about the same concept at the same time (Mayer, 2021). Redundancy may occur when self-explanatory graphics contain extra written explanations (Sweller, 2011).

Nevertheless, redundancy might not be harmful always. It may be useful when learners require more assistance because they don't have any past knowledge. Technical or difficult information is easier to understand when presented in a variety of ways. Repetition serves to reinforce important information. Studies have proven that, students that received both sub title text and voice over narration of the same information at once did worse than those who only got narration, according to Mayer and Moreno's (2003) research. According to Kalyuga et al. (2004), learning was greatly affected by duplicated text when students were already familiar with the material. The redundancy principle emphasizes how crucial it is to clearly guide learners by avoiding duplication of resources in multimedia learning. In order to minimize cognitive overload and improve learning effectiveness, educational designers should blend visual and auditory information.

Segmenting principle

The segmenting principle, states that learning is more successful when educational resources are delivered in brief, meaningful chunks as opposed to an unending chain of information (Mayer, 2021). Instead of presenting new information all at once, the human brain absorbs it more effectively when it is divided into smaller and digestible pieces. Long and complicated classes without breaks or division can cause cognitive overload in students, which weakens the learning process (Mayer, 2021). By segmenting instructional content, learners can proceed to the next section after processing the material at their own time. They can also arrange and incorporate new information into existing knowledge in their minds as well as reduce unnecessary cognitive load to facilitate concentration on important information. The segmenting idea can be applied in a variety of ways in multimedia learning including creating short clips from videos to provide a series of short educational videos with distinct breaks in between, rather than a long one (Mayer & Pilegard, 2014). Self-paced educational content allows students to set their own learning speed by letting them click "Next" when they're ready to move on (Clark & Mayer, 2016). According to Mayer and Chandler (2001), students who received segmented multimedia resources performed better on assessments of problem-solving than those who received continuous lessons, demonstrating the effectiveness of the segmenting principle. Students who could control the pace of the materials learned more effectively and retained the information longer, according to a

different study by Mayer and Pilegard (2014). Hasler and Kersten (2007) found that self-paced video lectures significantly improved understanding and recall when compared to continuous video presentations. The segmenting principle enhances learning and facilitates students' processing and retention of information by breaking down complex material into manageable chunks. Teachers and educational professionals should employ segmentation techniques like self-paced learning and detailed instructions to optimize multimedia learning experiences.

Pre training principle

Pre-training is a key idea in Mayer's Cognitive Theory of Multimedia Learning, which holds that students benefit from having a foundational understanding of key concepts and elements before starting challenging learning tasks (Mayer, 2021). Being exposed to important terms, concepts, or frameworks in advance may help learners avoid cognitive overload and assimilate new information more quickly. According to the pre-training principle, learners who are exposed to too much new information at once may experience working memory overload since it is limited (Sweller, 2011). Unproductive learning may result from students' inability to process new information when they lack prior knowledge (Mayer & Pilegard, 2014). To assist students develop a theoretical base, pre-training exposes them to important ideas prior to the main course. When students interact with the essential teaching content, this enables them to concentrate on deeper comprehension as opposed to simple comprehension. The activation of preliminary knowledge is the process by which learners who possess some prior knowledge organize and refer incoming material more easily (Mayer, 2021). According to Paas and Sweller (2014), learners can develop mental structures that facilitate the acceptance of new information more effectively, by receiving pre-training. The pre-training principle in multimedia can be applied in a number of efficient ways such as the provision of brief description of key words which might be provided to students prior to the introduction of complicated subjects (Mayer, 2021). Labeling important diagram elements before getting into a system's functions will help students in technical or scientific subjects as they will be introduced to the system's essential elements (Mayer & Pilegard, 2014). Initial videos and animations with brief introduction can also be used before receiving in-depth knowledge to give a general understanding of the subject (Clark & Mayer, 2016). Another pre-training way that can be uses is that of giving students a step-by-step

tutorial where students can receive instructions on basic concepts prior to working on more complicated activities (Fiorella & Mayer, 2018). By teaching key ideas and words prior to difficult instruction, the pre-training approach improves learning and facilitates learners' faster processing of new information. In technical or scientific areas, where mastery of essential elements enhances comprehension, it is especially useful.

Modality Principle

According to the modality principle, people learn better when information is delivered in spoken words which are the narration rather than written text, especially when paired with pictures or animations (Mayer, 2021). According to this theory, learning is improved when students are exposed to knowledge using both visual and audible means. The human mind processes information through two distinct channels, according to Mayer's cognitive theory. These channels collaborate to handle different types of incoming data despite their limited capacity. The theoretical underpinning is cognitive load theory, which studies how cognitive load may affect learning. Maximizing the cognitive load through the effective use of both channels while avoiding overloading one is the aim of multimedia learning. According to the modality principle, learning is more impactful when information is presented in both spoken words and visuals like pictures, diagrams, and graphs than when it is presented in just one modality. This theory is derived from the dual-channel structure of human cognition, which postulates that the brain uses distinct channels to process auditory and visual information. Students can gain from both channels and prevent cognitive overload that can occur when information is presented in a single format by having access to both types of content.

Mayer's research indicates that when students are shown narrated animations or diagrams rather than just text and still images, their comprehension and retention improve. This is due to the fact that more efficient cognitive processing occurs when the visual channel processes the imagery while the auditory channel focuses on the explanation. The theory states that by distributing the information across both channels, students can more effectively integrate verbal and visual representations, improving comprehension and memory retention. Mayer and his colleagues have conducted a number of studies to support the modality principle. In one of Mayer's studies.

Mayer's research shows that students' comprehension and retention improve when they are shown narrated animations or diagrams instead of just text and still images. The reason for this is that when the visual channel processes the imagery and the auditory channel concentrates on the explanation, cognitive processing is more effective. Students can more successfully integrate verbal and visual representations by distributing the information across both channels, according to the theory, which enhances comprehension and memory retention. The modality principle has been supported by a number of studies carried out by Mayer and his colleagues.

Mayer's research indicates that students frequently receive visual information in the form of diagrams and auditory information such as spoken words in various cognitive channels. Multimedia presentations that utilize both channels enable a more efficient and successful learning experience. This is because, instead of overtaxing one system, the different channels work together to support cognitive processing. The modality principle significantly influences the creation of instructional materials. For instance, the visual channel may become overloaded with text and images, leaving little space for the cognitive processing of the content. The student can use both cognitive channels by combining narration with images or animations, which reduces cognitive overload in either one and enhances comprehension and retention. To better convey complex information, educators and creators of multimedia content are advised to use narration, sound, or spoken explanations in addition to images and animations rather than merely text. This concept can assist educators and instructional designers in creating more effective multimedia learning experiences that enhance students' understanding and memory of the material.

Personalization Principle

According to the Personalization Principle, people learn better when multimedia content is delivered in a conversational style as opposed to a formal one. Learners benefit most from conversational content that uses casual language and promotes participation. When instructions are written to mimic a one-on-one conversation between the teacher and the student, for example, comprehension, engagement, and retention are frequently improved. The personalization principle has its basis in interaction and cognitive processing research. Learners

are more motivated and engaged when learning content is written in a conversational style because it makes the learning process feel more participatory. According to the principle, students are more likely to engage with content that feels personal, relatable, and approachable. Mayer and his associates have conducted a number of studies to examine the impact of the personalization principle on learning outcomes. Mayer and his coworker Moreno conducted a significant study in 2005 that contrasted multimedia instruction given in a formal and conversational setting. According to the results, students who received instruction in a conversational tone outperformed those who received the same subject presented in a more formal, impersonal manner on tests of retention and transfer. In a different study, Mayer et al. (2003) found that students expressed higher levels of engagement and were better able to retain and apply the information when they responded to educational content that used personal pronouns like "you" and "we" rather than more formal terms like "students" or "learners."

Several researches have been carried out by Mayer and his colleagues to look into how the personalization principle affects learning outcomes. In a key study, Mayer and his colleague Moreno in 2005 compared multimedia teachings delivered in a conversational and formal manner. Compared to the students who received the same subject presented in a more formal, impersonal manner, the results demonstrated that students who received instruction delivered in a conversational tone performed better on assessments of retention and transfer. In a different study, Mayer et al. (2003) discovered that students who engaged with educational content that used personal pronouns like "you" and "we" instead of more formal terms like "students" or "learners" expressed greater engagement and were better able to remember and apply the information. This supports the notion that customizing the delivery of multimedia lessons may enhance learning efficacy by promoting deeper cognitive engagement.

Instructional designers are encouraged to employ a conversational approach that makes use of pleasant language in order to create a more engaging learning environment. Instead of using rigid, formal language, they should address the student directly, for example, by saying, "Now let's look at how this works." Students may be better able to relate to the material and feel more engaged in the learning process if personal pronouns like "you," "we," and "let's" are used. Audio or video narrations should be engaging and conversational rather than dry or overly

formal. Narrators should sound approachable and conversational, as if they were having a face-to-face conversation with the student. Instructors can increase students' motivation and reduce their anxiety by personalizing and making educational content feel more engaging. This creates an environment where students are more likely to persevere through challenging material. Designers may incorporate interactive elements that simulate a conversation with the learner, such as dialogues, tests, and feedback, to promote active engagement.

Contiguity Principle

The contiguity principle improves multimedia learning by addressing the ways in which verbal and visual information presentation can impact cognitive processing. According to the theory, related text and images should be displayed near to one another (spatial contiguity) and corresponding text and narration should be delivered simultaneously (temporal contiguity).

By personalizing and making instructional materials feel more engaging, teachers can boost students' motivation and lower their anxiety. This fosters an atmosphere that increases the likelihood that students will stick with difficult material. To encourage active engagement, designers can include interactive components like dialogues, tests, and feedback that mimic a conversation with the learner. According to the idea of spatial contiguity, related visual and verbal information should be shown on the screen near each other. For example, when describing an image, the caption or accompanying text should be placed next to the image, not at a different location. By reducing the amount of effort students must put in to locate related pieces of information, the goal is to lessen cognitive load. Temporal contiguity refers to the presentation of similar visual and auditory information simultaneously or in a brief period of time, as opposed to one after the other.

Instead of waiting until the animation is finished, the narration should begin at the same time as the relevant images if it shows how a machine works. Presenting related information at the same time helps students connect spoken and visual representations in their working memory, which improves comprehension and retention. In a series of experiments, Mayer and his colleagues evaluated the efficacy of the contiguity principle. In a seminal study, Mayer and colleagues (2001) compared two situations in which the text describing an animation was placed near the

image and another in which it was placed far away in order to investigate the spatial contiguity effect. The results showed that students who watched the version with spatially continuous text and images performed better on comprehension and retention tests. According to this study, learners are better equipped to process information when it is presented in a cohesive manner. In a different study, Mayer and Moreno (2003) examined temporal contiguity by comparing the learning outcomes of learners who viewed a narrated animation with the narration either simultaneously with the visuals or provided after the animation. They found that students listening to synchronous narration performed better on tests of retention and transfer, suggesting that temporal contiguity enhances learners' ability to integrate information from different modalities. The Contiguity Principle has important ramifications for multimedia learning design, including the following:

Contiguity in Space:

Designers ought to position relevant labels, captions, or text next to the appropriate pictures. When utilizing diagrams or images in teaching content, designers need to make sure that any comments or explanatory text appear close to the image so that students don't have to look far away. Text should not be placed in footnotes, endnotes, or distinct sections because this forces students to divide their focus between the text and the image.

Temporal coherence:

Animations, info-graphics, or video clips should be timed to the audio or narration. When describing a procedure or series of events for instance, designers should make sure that the spoken explanation corresponds with the appropriate graphic representations' timing. This facilitates students' development of cohesive mental models of the material being covered. Designers also need to avoid presenting text or narrative after the visual element has been exhibited while producing multimedia material. As a result, there is a lag in time between the spoken and visual information, which may make it more difficult for working memory to process it.

Cutting Down on Cognitive burden:

By following the Contiguity Principle, educational content designers can assist cut down on needless cognitive burden so that students can concentrate their cognitive energies on comprehending the material rather than juggling verbal and visual instructions.

Optimizing Learning Efficiency:

Grouping related material together, both physically and chronologically, learners can more readily connect spoken and visual representations, which enhance learning efficiency, knowledge transfer, and engagement.

Interactive Principle

The foundation of the interactive principle is the notion that learning outcomes can be greatly improved through interactivity in multimedia learning environments. This principle highlights those active learning activities, such as problem solving, decision making, and interaction with the content. These are more likely to result in higher learning outcomes for students than passive information reception. The dual channel theory, which holds that people have distinct cognitive channels for processing visual and verbal data, forms the basis of the theory. Effective use of both channels maximizes learning and minimizes needless cognitive effort. Multimedia learning is most effective when learners are provided with verbal and visual information combinations that align with the cognitive architecture of the brain, according to empirical research. Mayer's fundamental ideas, such as the coherence, modality, and contiguity principles, are supported by this. These foundations are expanded upon by the interactive principle, which emphasizes the importance of actively engaging students with multimedia content and transforming them into active participants in their education. The interactive principle states that interactivity is the opportunity for students to actively engage with the course material, which enhances learning by encouraging more in-depth thought processes and heightened interest in the material.

When both channels are utilized efficiently, learning is maximized and unnecessary cognitive load is reduced. Multimedia learning can be interactive in a variety of ways, such as: Students are encouraged to actively alter or research the material through changing visual elements, experimenting with factors or using simulations to observe different outcomes. This is known as

"active exploration." Students who learn at their own pace are in control of how quickly they engage with the material. By allowing students to pause, replay, or skip content as needed, this enhances comprehension and recall. Making judgments and solving problems: In this phase, students must use the multimedia data to solve issues or reach conclusions. Critical thinking and knowledge retention can both be enhanced by this type of interaction.

Feedback and reflection:
Providing students with immediate feedback on their work, for instance through interactive exercises, tests, or simulations, encourages them to learn more efficiently and consider their mistakes, which improves their comprehension of the material.

The Interactive Principle is supported by research in the fields of cognitive psychology and educational technology that shows active interaction improves learning outcomes by encouraging students to apply and integrate new information rather than just absorb it. Research in the field of multimedia learning consistently supports the idea that active participation improves learning.
Mayer et al. (2005) found that students who had the chance to participate in simulations and problem-solving exercises demonstrated enhanced problem-solving skills and increased information retention compared to those who were only exposed to passive learning resources like lectures or text-based content. Additionally, Mayer's research on self-explanation supports the significance of interactivity in multimedia learning (Mayer & Johnson, 2008). Their findings showed that students who were asked to describe the material they had just encountered were better able to transfer and retain the information than those who were only asked to look at it. It was found that this kind of interaction significantly enhances comprehension by motivating students to actively engage with and think about the subject matter.

By promoting constructivist learning approaches, where students actively create their own understanding through interaction with the content, interactive multimedia environments, such as those that include interactive tutorials, learning games, and simulations, can enhance learning, according to a related study on educational technology. The interactive principle has a major influence on multimedia learning content design in several ways:

1. Educational designers should create multimedia environments that encourage students to interact with the content. This could include interactive tests and simulations.

2. Providing experiential learning opportunities can improve information transfer and retention by allowing students to apply what they have learned in simulated or real-world scenarios

3. Students can navigate multimedia content at their own pace with self-paced learning, which can reduce cognitive overload and enhance comprehension. According to designers, learners should be able to pause, playback, and skip content.

4. Interactive timelines, decision trees, and clickable interfaces are examples of digital learning resources that provide navigation control. These help students explore the material in a way that best fits their individual learning preferences, including problem-solving and critical thinking.

5. Decision-making scenarios and problem-solving activities ought to be incorporated into multimedia learning materials. For example, incorporating scenarios that require the student to apply their knowledge to solve problems or make decisions encourages deep learning and critical thinking.

6. Students who receive immediate feedback are better able to identify their mistakes and make necessary corrections. Interactive tests and fixes for mistakes made during a simulation are two examples of this. This feedback loop may be crucial for enhancing recall and reinforcing precise comprehension.

7. In order to encourage students to reflect on their learning, interactive exercises must also be developed. One example of this would be reflective questions or prompts that challenge students to think critically about how the material they are learning connects to their prior knowledge or to real-world applications.

2.11. Justified gap

Content Quality

The absence of locally relevant digital learning materials that complement Zimbabwe's primary school curriculum, cultural background, and native tongues is one of the main issues affecting digital learning in Zimbabwe (Maringe & Prew, 2020). For digital learning projects to be successful, high-quality, culturally appropriate, and pedagogically sound digital learning resources must be developed. Curriculum alignment and student learning needs must be taken into consideration while creating digital content (Castro, 2020). Digital content that is locally produced and represents Zimbabwe's cultural background and educational objectives is needed there. To improve student engagement and comprehension, Marongwe and Chikasha's (2019) study stressed the value of using local languages, customs, and examples in digital content. Furthermore, collaborations with tech firms and instructional content creators can help provide top-notch digital resources. Achieving meaningful learning outcomes requires making sure that a variety of contextually relevant digital content is available. The lack of local African languages in favor of European ones limits inclusion (UNESCO, 2021). The effectiveness of many e-learning tools is limited for young learners, particularly those in remote regions who speak primarily Shona or Ndebele, because they are either developed abroad, are not appropriate for the local educational system, or are only available in English (UNESCO, 2022).

Despite English being the official medium of teaching, many Zimbabwean primary school students, especially those in rural regions, struggle with the language (UNICEF, 2021). Early-grade students' access to online education is restricted by the lack of digital learning materials available in Shona, Ndebele, and other indigenous languages (Maringe, 2020). For instance, the efficiency of the few localized digital learning resources that are now available, like Ruzivo Digital Learning, is limited for certain students due to their predominance of English usage (Mushure, 2021). Students may find digital information created for other regions less interesting because it may not accurately represent Zimbabwean history, culture, or real-world circumstances (Chigona et al., 2020). For instance, examples from Western contexts such as snowfall, skyscrapers, and dollars are frequently used in science and math problems in foreign content instead of Zimbabwean contexts such as agriculture, Zimbabwe gold backed currency, or wildlife conservation (Nyagura, 2021). Because the materials do not mirror familiar experiences, this disconnect has an impact on students' comprehension and engagement.

Teacher Training

The effective implementation of digital learning content is strongly reliant on teachers' abilities to incorporate technology into their teaching methods. Professional development programs that provide instructors with the necessary skills and knowledge to use digital tools are critical for the successful adoption of digital learning (Olson, 2019). In Zimbabwe, there is a need for comprehensive training programs that address the specific problems instructors experience while using digital information. For example, a survey done by Mupa and Chinooneka (2015) discovered that many teachers lacked confidence in using technology and needed additional training in digital teaching. To address this issue, efforts such as the Ministry of Education-supported Teacher Capacity Development Programme have been implemented to offer teachers with ongoing professional development (Mutsvangwa, 2021). Such programs concentrate on improving instructors' pedagogical approaches and technological proficiency so they can use digital content to improve student learning.

Access and Resources

For digital learning initiatives to be successful, digital learning resources like e-books, instructional software, and online platforms must be readily available. Having access to a large number of excellent digital materials can improve the educational process and give students a variety of learning options (Gomez, 2017). The goal of programs like Zimbabwe's Digital Literacy Programme has been to give pupils access to digital libraries and online learning environments (Ministry of Primary and Secondary Education, 2020). The accessibility of digital resources is frequently restricted by elements including content localization, licensing fees, and internet connectivity. In order to increase access to digital resources and make sure they are in line with the local curriculum, partnerships with foreign organizations and content providers can be beneficial. The African Storybook Initiative and the Ministry of Education, for instance, have partnered to make a large collection of open-source, free digital storybooks in regional languages

available (African Storybook Initiative, 2021). Improving access to a wide range of excellent digital resources is crucial to developing a successful and inclusive online learning environment.

2.12 Chapter summary

This chapter reviewed literature that currently exists from the Global context, African region coming down to Zimbabwe. The review provided a comprehensive understanding of the current state of digital learning in Zimbabwe, identifying key challenges and opportunities, and offer insights into how transformational multimedia content can improve primary school students' learning experiences. Furthermore, it explored the role of stakeholders, such as teachers and technology developers, in developing and implementing effective digital learning practices that are consistent with Zimbabwe's educational goals and cultural context. More so, this review added to the continuing discussion about the integration of technology in education and its potential to improve young students' learning results.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

The major goal of this chapter is to give a summary of the methodology used in this study, taking into consideration the research problem at hand. This includes the research philosophy, research approach, research design, target population, sampling technique as well as the sample size, data collection procedure, instruments used and the ethical considerations that were implemented. . Research methodology is the process of conducting a series of investigations into a particular topic in order to gather information and develop a plan of action based on the results. This chapter provides a thorough explanation and rationale of the study's philosophy, methodology, design, target population, sample size, sampling technique, tools, data collection processes, analysis, and ethical considerations.

3.2 Research Philosophy

A study philosophy known as interpretivism emphasizes the importance of understanding human experiences in their natural context as well as the subjective significance of social events. Interpretivism is based on the notion that reality is socially constructed and cannot be fully understood through rigorous, quantitative methods alone (Bryman, 2016). Constructivism, which maintains that individuals create meanings from their interactions with the outside world, is commonly linked to interpretivism (Guba & Lincoln, 1994). Researchers interpret what they

find, which will be an interpretation shaped by the researcher's own experiences and background. Those who embrace this philosophy frequently employ techniques such as ethnography, phenomenology, and hermeneutics to explore the intricacies of social relationships and human behavior. Considering that this study had to interpret and understand the digital learning environment and make sense out of the problem understudy as well as construct a solution for the study with the help of the participants in their environment, the researcher had to employ the interpretivism philosophy.

3.3 Research Approach

In order to accurately ascertain the effects of utilizing multimedia when creating transformative digital learning content for Zimbabwean primary school learners, qualitative research was employed for the study.. According to Nicholls (2015), qualitative research techniques enable a far more thorough examination of problems, providing answers to meaning-related queries from the impacted population, taking into account the contributing causes, and providing a far more comprehensive picture. Qualitative research aims to explore what is believed to be a dynamic reality. It does not claim that the results are replicable because they are not universal (Whitney, 2015).

Instead of concentrating on what people do or believe on a broad scale, the goal, which falls under the category of discovery rather than verification, is to learn how and why individuals behave, think, and interpret the world in the ways that they do. Usually, the participants' environment which is the field were they encountered the issue under investigation is where data was gathered. The qualitative data collected by the researcher was then analyzed and processed the information which helped the researcher to come up with a design process which later assisted in producing a prototype design so as to solve the problem at hand with the help of the participants’ contributions and recommendations.

3.4 Research Design

As Creswell (2007b) emphasized on making use of the natural environment while collecting data, the study employed an ethnographic research design, which is an approach to inquiry whereby the researcher gathers data primarily through observation of an intact digital learning classroom in their natural setting with participants in their environment in this case, the digital learning environment of grade four primary scholars in Zimbabwe. Interviews where then conducted to the teachers and students who use digital learning platforms so as to understand the traits and behaviors conducted during digital learning classes as well as find out their preferred solutions to the problem under study which is causing these traits. LeCompte and Schensul (1991) state that the research method is adaptable and usually changes contextually in response to the lived realities experienced in the field. The researcher kept in mind that she will incorporate action research as it serves as a tool for education and conscious development, as well as mobilizing action and practice for underprivileged groups, in addition to being a means of producing information. In this research design, participants took charge of defining their issues, outlining the necessary solutions, and creating the possible outcomes that will help them achieve their goals.

3.5 TARGET POPULATION

A population is characterized as any collection of people who share one or more traits that the researcher finds interesting (Best and Khan, 2013). The study's targeted audience was the primary school learners, particularly those enrolled in the fourth grade in Makonde District Mashonaland West Province, since they are the group most impacted by the problem under study. The researcher made sure that, this group of key informants is pursuing grade four studies within the period the data was collected considering that the target group has difficulties in focusing during digital learning environments. This specified group also lacks focus on the ultimatum goal as they study using text-based content as well as failing to organize their work load considering their age. The researcher made sure that there was an equal gender balance on

the learners selected so that the findings would not be biased to gender considering that education in Zimbabwe is inclusive despite being physical or digital.

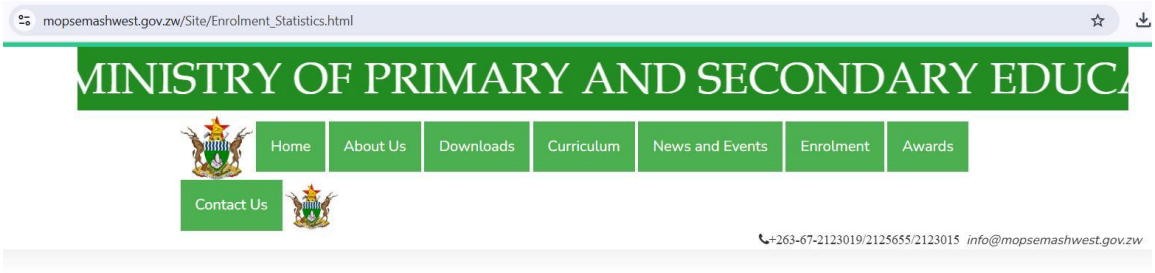
Another group of key informants was the population of grade four teachers from different schools with the students under study. The teachers were interviewed individually as key participants of the study as they experience the problem at hand during the time they conduct lessons on digital learning platforms with the students. The teachers also played a crucial role in guiding the researcher on what to consider and how to create digital learning content prototype as they have guiding theories in pedagogy such as constructivism and behaviorism theories which provides insight on what to put and what not to put during the construction of the prototype. The researcher made sure that there was an inclusion of both genders of the qualified teachers selected considering that all will aid to the problem under study with their experience and expertise as well as the development of the prototype at the end of the research using their knowledge and experience in the teaching field of Zimbabwean primary scholars. Furthermore, the teachers whom were selected were characterized by a minimum qualification of a Diploma in Education as well as two years' experience in teaching primary scholars in the fourth grade in Zimbabwe.

3.6 SAMPLE AND SAMPLING TECHNIQUES

According to Bhojanna (2017), a sample is a subset of the target population that has been carefully chosen to reflect the entire population. The study included non-probability sampling methods as the researcher chose convenient and judgmental sampling techniques. A suitably representative sample of respondents was selected from the alluded population for the research project. Selecting variables who are most positioned or in the greatest position to supply the necessary information is known as judgmental sampling where participants are specifically chosen according to predetermined standards or traits that support the goals of the study. This enabled the researcher to gather detailed information, rich in data from study's participants who are most pertinent.

Figure 3.1 The Zimbabwean Map with Makonde District, the area under study, dated in red. *Sourced from https://googlemap.com,2025*

The map of Zimbabwe captured above shows the marked region were the research study was conducted. Given that the national education curriculum is the same in all primary schools in Zimbabwe and that resources are what set them apart depending with the status of the school, the researcher only used data from Makonde District, were she employed convenient sampling technique. This method is frequently employed in exploratory research or when resources are limited, hence the researcher used this technique.



The table below shows schools in the province by distict.

DISTRICT	PRIMARY	SECONDARY	TOTAL
KARIBA	44	15	59
CHEGUTU	131	70	201
HURUNGWE	174	100	274
MHONDORO NGEZI	65	30	95
SANYATI	76	32	108
ZVIMBA	136	66	202
MAKONDE	117	56	173
TOTAL	743	369	1112

Figure 3.3 Ministry of Primary and Secondary Education in Zimbabwe, Mashonaland West Province Schools. *Extracted from https://info@mopsemashwest.gov.zw*

Mashonaland West has seven districts namely Chegutu district, Hurungwe district, Kariba district, Makonde district, Mhondoro Ngezi district, Sanyati district and Zvimba district. Narrowing down to Makonde district, which is the area under study, the Ministry of Primary and Secondary Education in Zimbabwe, has 117 primary schools as of January 2025 as illustrated on figure 3.3 captured above. Amongst these 117 primary schools the researcher conveniently and judgmentally selected six schools in the categories of Group A which was consisted of 3 private schools. Group B category consisted of 3 Government schools, bringing our total to 6 primary schools. The researcher approached respondents who she believed they possessed the necessary information and where willing to share it following Ranjit and Kumar, (2014) contention. This ensured that the respondents were judged to be a true representative of the population and that the respondents were sampled with the right data. Participants were chosen through convenient sampling according to their accessibility and availability to the researcher with the help of the school headmasters and head of departments at the selected primary schools.

As for teachers' sample size, 2 qualified participants were selected from each school, giving us a total number of 12 teachers for all the 6 schools that were selected. Coming down to the students, a sample size of 5 students were drawn from each of the 6 schools selected, giving us a total of 30 learners who participated in the focus group discussions. The focus group discussions of the 3 Private schools were held separately from the focus group discussion of Government Schools to make sure that the learners has a common ground. An ethnographic observation was done at one selected private school as well as one selected government school as the researcher took part in the digital class exercises of the 2 schools.

The characteristics that the researcher used to determine the selection of the participants to this study was:

1. Education level of the focus group key participants which were grade four pupils The level was fundamental in the selection of the participants as students in that age group fail to organize their work load, have a limited cognitive load as well as the inability to focus while learning from text-based content provided for digital learning in different school set ups.
2. Another characteristic was that the students should be frequently studying online, either during school holidays, weekends or school days on any digital learning platform. This was done so that it assures the participants under study were familiar with digital learning whether they have been learning asynchronously or not.
3. In the same category of primary data, teachers or facilitators of grade four classes in both private and government schools in Makonde district in Mashonaland West Province were engaged.
4. Another characteristic that the researcher considered was that the teachers or facilitators conducted lessons on digital learning platforms for not less than a year to allow them to be familiar with the digital learning environment so as to understand and contribute soundly to the problem under study.
5. The teachers or facilitators afore mentioned had a minimum qualification of a Diploma in education for middle aged primary scholars and possess teaching experience of the mentioned group for a minimum of two years to allow familiarity with the content used when teaching the selected group.

3.7 Data collection method and Research Instruments

Table 3.1 Research instruments and data collection methods used for this study.

Data Collection Methods	**Research Instruments**
1. Interviews	1. Key informant Interview Guide
2. Observations	2. Observation Checklist
3. Focus Group Discussions	3. Focus group Interview Guide

The table above consists of data collection methods that the researcher used with the research instruments against each method. The study made use of emerging methods that generally involves listening to the participants' voice and prescribing the data subjecting it to analytic induction. This study conducted two focus group discussions with fifteen (15) participants in grade four classes from six (6) different schools in Makonde district, under Mashonaland West province. Five (5) students were recruited from the six (6) schools in two categories of Private schools and Government schools. The students whom were selected had been learning online for not less than twelve months during their primary school education. Focus group discussions are useful to examine how social knowledge is produced and the researcher stimulated the discussion in order to examine the impact of the E-learning content that had been presented to them before. The researcher used an interview guide to formally and informally interview the grade four teachers, facilitators and the grade four digital learners. An observation checklist was utilized during ethnography exercise on digital classroom. The researcher needed to examine if

there were benefits and or effects from any transformational learning content presented to the students as well as confirming the theory with the primary school teachers and facilitators.

Key informant interview guide – See appendix D attached on page 141.

A key informant interview guide is an instrument used when conducting in depth interviews with people who possess specialized expertise or experience relating to a research topic, utilizing a standardized framework as a manual. This manual guaranteed uniformity in inquiry while allowing adaptability for exploring further into the relevant subjects. In qualitative research, it is frequently employed to collect rich, detailed data from key informants, such as experts, decision-makers, or people with firsthand knowledge.

An interview guide maintains consistency as it aids in keeping a systematic but adaptable approach even if it is to be used on different interviewees (Patton, 2015). It also permits interviewers to delve deeper into responses while encouraging participants to offer comprehensive views (Kvale & Brinkmann, 2009). Cresswell, (2003) contends that standardized questioning increases the reliability of the data which will then help the researcher when comparing participant responses. A key informant interview guide makes certain that ethical factors such as getting informed consent and maintaining confidentiality are taken into account (Silverman, 2016), hence the data collection procedure is done ethically. The researcher used the key informant interview guide so that she could get a deeper understanding of what transpires in a digital classroom, the advantages and disadvantages of a digital classroom, its limitations and possible solutions to address the problems at hand for a better learning experience to benefit both the teacher and the digital learners. Attached is a copy of the interview guide the researcher developed.

Observation checklist – See appendix F attached on page 143.

According to Angrosino, (2007), an observation checklist is a methodical technique for documenting occurrences, behaviors, or actions in a specific context. It offers a predetermined set of standards that let researcher's record observations in a consistent and impartial manner. In

ethnographic research, an observation checklist ensures thorough and organized data gathering when researchers engage themselves in a community or setting to investigate cultural or social practices.

In ethnographic research, using an observation checklist is advantageous as it improves the gathering of systematic data making sure that every pertinent detail of a society or environment is observed (Spradley, 2016). When documenting interactions and behaviors, standardized standards reduce subjectivity of the researcher when utilizing an observation checklist (Bernard, 2011). This instrument makes comparability easy as it enables researchers to compare findings from various participants, time periods, and contexts (Flick, 2018). Hammersley and Atkinson, (2007) contends that, an observation checklist can improve the validity of research when used with other ethnographic techniques like document analysis and interviews. The researcher used an observation checklist for her ethnographic observation so that she would know the most important things to look for in the setting. The observation checklist also served as a guide to investigate what the researcher had been reading and hearing but without firsthand experience of what really transpires in a digital classroom of primary school learners. The experienced helped the researcher in understanding some of the traits that have been done in a digital classroom and gave her an insight of how the Zimbabwean digital classroom conducts its sessions. Attached is the observation checklist the researcher developed to use for collection of data during a digital learning session.

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Focus group discussion interview guide – see appendix E attached on page 142.

Krueger and Casey, (2015) defines a focus group discussion interview guide as an organized framework for focus group interviews which is used to help a group of people talk about a specific subject. It is made up of important questions, topics, and probes that assist the facilitator or researcher in directing the discussion while guaranteeing that every relevant element of the

study issue is addressed. This instrument is crucial for qualitative research, which aims to investigate shared experiences, group dynamics, and collective points of view. According to Creswell (2013), a focus group interview guide upholds ethical principles including informed consent and confidentiality, as these are the initial stages taken when the researcher is mobilizing the group for the interview. A focus group discussion captures a variety of viewpoints, group dynamics, and experiences (Morgan, 1997). It also probes for deeper insights resulting from participants building on one another's responses (Krueger & Casey, 2015). Attached is a copy of the focus group discussion interview guide made by the researcher to aid to her data collection.

3.8 Data Collection Procedure

This study collected primary source of data from two ethnographic investigations of digital classroom which consisted of grade four primary school digital learners together with their teachers. Within that same category of data, 12 different primary school teachers and facilitators were also considered as key informants for interviews as they had the opportunity to impart knowledge to the school children using different mediums. The other source of data was provided by two focus group discussion from different school setups composed of grade four learners who have been studying online in private and government schools as they also have contributions to the study based on what they have been experiencing and observing in their digital learning sessions.

The collection of the data was done through the procedure listed below:

1. The researcher formed a sample using the judgmental sampling technique with the sample comprising the above stated characteristics.
2. Having obtained the required sample, the researcher had to seek permission from participants as well as getting consent for the children who participated on the Focus Group Discussion from the parents and guardians through the school authorities considering that they are under the age of individually consenting. See appendices B and C on pages 139 and 140 respectively.
3. After getting the approval, the researcher joined two digital learning sessions, one at a government school with a combination of 15 students from different government schools

in schools selected for the study. A similar focus group discussion was also held with the students from private schools with each sch ool sending 5 participants. Thereafter, she set appointment dates and time to conduct the interviews as well as the focus group discussions at a place that is convenient for the participants which was their respective schools. See the observation checklist and focus group discussion interview guide attached on the appendices section page 142 and 143 respectively.

4. The researcher then facilitated the focus group discussions, audio being recorded using a smart phone, and data prescribed by the researcher. On the interviews, the researcher conducted the interviews with the teachers, prescribing the data provided in the interview guide whom she was using to conduct the interview. See appendix D, the teachers' interview guide attached on page 141.

3.9 Data presentation and analysis.

The data collected was then analyzed with the researcher sung thematic analysis. The researcher closely examined the data, identified codes and then generated common themes or topics, ideas and patterns of meaning that came up repeatedly. An inductive approach was taken, which allowed the data to determine the studies theme and patterns. The method follows a six-step process which is listed below:

1. Familiarization

   This involved generally looking through the data to get familiar with it.

2. Coding

   The process was of identifying specific textual elements, typically phrases or sentences, and developing abbreviations or "codes" to denote their meaning. Following the text's review, the researcher compiled all of the data into code-designated groupings. With the help of these codes, one can quickly get a summary of the key ideas and recurring themes in the data.

3. Generating themes

During this phase, the researcher reviewed the codes generated, found trends within them, and begun to develop themes. Some of the codes were deleted as they were irrelevant for instance, if they are not frequently used in the data.

4. Reviewing themes

   The researcher then ensured that the themes accurately and usefully reflect the facts. Returning to the data, themes were contrasting. If there were issues with the themes, the researcher would have divided, merged, removed, or come up with new ones, to make it more accurate and useful.

5. Defining and naming themes

   When defining themes, the researcher precisely defined each one and determined how it contributes to the comprehension of the data.

6. Writing up

   In this phase, the outcomes or findings pertaining to each theme were presented in turn. Examples were provided from the data to support their explanation of the themes' meaning and frequency of occurrence. Conclusions outlined the key lessons learnt and demonstrate how the study addressed the research topic.

3.10 ETHICAL CONSIDERATIONS

Research ethics primarily deals with the interaction between researchers and the people they study; therefore, the following ethical considerations were adhered to during the course of this research – see appendix B and C attached on the appendices section on page 139 and page 140.

1. Seeking permission

In research, obtaining consent from subjects and relevant authorities is a basic ethical necessity. Informed consent is an important aspect of the process to ensure that participants are aware of the nature of the study, its aim, any potential risks, and their rights. Institutional review boards,

or ethics committees, must grant ethical permission in order to safeguard participants (Wiles et al., 2017). Institutional bodies must grant clearance for research involving vulnerable populations, health data, or educational settings, in addition to participants. Given that it protects the participant's identity and ensures their right to make an informed decision about their participation, informed consent is a crucial feature of ethical behavior. During this process, participants were given comprehensive information about the study's methods, potential risks, and expected outcomes. Participants were informed that they might stop taking part at any time without suffering any consequences.

2. Anonymity

Data collection must be anonymous to ensure that participants' identities are not connected to their data, protecting their privacy. Anonymity requires that no identifying information be used to identify specific persons, not even by the researcher. According to Tromp and Meijers (2021), contemporary research emphasizes the importance of anonymity in delicate research areas such as mental health or personal conduct, where revealing personal information may result in harm or social shame. In certain qualitative studies, maintaining the ethical principle of anonymity might be difficult, particularly when using open-ended questionnaires or interviews. Consequently, the researcher meticulously organized their investigations and used techniques like data coding and the removal of personal information in order to maintain participant anonymity.

3. Confidentiality

Confidentiality maintenance entails protecting participant responses and private information from unauthorized access. While confidentiality allows researchers to know the identify of participants, it also secures the data by not sharing it with any third party without authorization, in contrast to anonymity (Lamb, 2018). Confidentiality is particularly important when researchers are working with sensitive data, such as financial, medical, or personal information. For the purpose of maintaining confidentiality, the researcher put security measures in place to guard the data. These techniques included encrypted storage systems, safe access procedures,

and ensuring that identifiable information could only be accessed by authorized personnel (Sweeney, 2019). The researcher adhered to stringent ethical standards because breaches of confidentiality could be interpreted as a betrayal of confidence and could cause harm to participants.

4. *Voluntary participation*

Voluntary participation is crucial in ethical research. It suggests that people are free to choose whether or not to participate and that external forces cannot compel, govern, or sway them, claims Babbie (2020). Voluntary participation gives people control over their involvement in research, which is consistent with respecting people's concepts. This is especially important when working with vulnerable populations because too much influence could lead to exploitation or harm (Bradbury-Jones & Taylor, 2019). Participants should also be informed that they are free to withdraw from the study at any moment without facing any consequences. The APA Code of Ethics states that providing participants with sufficient information to allow them to make an informed choice about their participation is crucial to ensuring voluntary. The researcher made sure that all participants are aware of this consideration.

5. *Presenting data as grouped data*

Researchers can use the ethical practice of combining data so that no individual participant can be identified in order to present findings in a summary. This approach is especially important for sensitive data management or situations where participant identification is possible because of small sample sizes or distinguishing features (Kaiser, 2018). Data grouping can still yield insightful analysis for the research without inadvertently revealing personal information. This strategy ensures that the researcher respects people's privacy while maintaining the integrity of the analysis. Researchers should be careful when using small data sets or discrete demographic categories to avoid situations where grouping could lead to indirect identification, according to Sivapalan and Lee (2020). For this reason, the researcher presented some of the data as grouped.

3.11 Chapter Summary

In conclusion, this chapter provided a detailed methodology employed by the researcher as she was qualitatively collecting data with the aim of feeding the data into an action research. The chapter gave detailed explanation and justification on the philosophy, approach, design, targeted population, sample size, sampling methods, instruments, data collection procedures, analysis and the ethical considerations used for this study.

CHAPTER FOUR

4.0 Findings and analysis

4.1 Introduction

While the study examined research methodology and data collection methods to address research questions in the previous chapter, this chapter focuses on and discusses pertinent research findings. It presents the study's findings, analysis and discussions of the data collected from field respondents from 6 schools that were selected out of the 117 primary schools in Makonde district.

4.2 Response rate

Table 4.1 represents the response rate of grade four primary school learners who participated on two focus group discussions that where conducted.

Table 4.1: Grade four learners' response rate

	Private Schools				**Government Schools**			
Gender	School A	School B	School C	Total	School A	School B	School C	Total
Male	**3**	**4**	**1**	**8**	**2**	**1**	**4**	**7**
Female	**2**	**1**	**4**	**7**	**3**	**4**	**1**	**8**
Total	**5**	**5**	**5**	**15**	**5**	**5**	**5**	**15**

A sample size of 30, grade four learners was drawn from six schools in two different categories of Private schools and Government schools for focus group discussions with each group having fifteen participants. 5 learners were picked from each school in each category to have a fair representation of every school's experiences in digital learning, giving us a total of 15 learners for each category. Amongst the 15 participants drawn for each category, private schools had a total of 8 boys and 7 girls who participated. Government schools category had 7 boys and 8 girls giving us a total of 15 male participants and 15 female participants in the focus group discussions held respectively. The gender distribution was influenced by the selection of the sample size as the researcher purposively selected those to remove any biasness. For the purpose of anonymity,

the researcher de-identified participants' information and titled the learners from Private schools as PS L1, PS L2, PS L3… up to PS L15. The researcher did the very same with the Government school participants and titled them GS L1, GS L2, GS L3… up to GS L15. A total of 28 students participated until the end of the discussion while 2 students, from the Government schools category withdrew the discussions midway citing issues to do with not knowing the rightful answers to give as they were not familiar with ICT devices and experience of e-learning because of religious beliefs which does not allow them to make use of devices.

Table 4.2: Grade four primary school teachers' response rate

	Private Schools				**Government Schools**			
Gender	School A	School B	School C	Total	School A	School B	School C	Total
Male	**0**	**1**	**1**	**2**	**1**	**0**	**1**	**2**
Female	**2**	**1**	**1**	**4**	**1**	**2**	**1**	**4**
Total	**2**	**2**	**2**	**6**	**2**	**2**	**2**	**6**

A sample size of 12 teachers' was selected from a total of 6 schools in Makonde district, comprised of 3 private schools and 3 government schools. Two grade four teachers were selected from each school and the response rate of the teachers interviewed was 100%. On gender distribution, the information entails a total of 4 male teachers participated and 8 female teachers participated. Teachers had a fair distribution of gender with the greater population being females. This was influenced by the selection of the sample with male teachers having a lesser number in grade four classes compared to female teachers. For anonymity purposes, the researcher de-identified the participants' information in this category and titled the teachers from Private schools as PS T1, PS T2, PS T3… up to PS T6. The researcher did the very same with the Government school teachers and titled them GS T1, GS T2, GS T3… up to GS T6. Private schools were given the abbreviation PS and government schools were given the abbreviation GS.

4.3 Demographic information

This entails the general information that is related to the general demographical structure such as age, qualifications, experience and socio-economic backgrounds of the sample selected to conduct this research.

4.3.1 Age groups

Table 4.3 Age groups of the participants.

Age group range	**Frequency**	**Percentage**
9 and 10 years	9	30
10 and 11 years	21	70
	30 learners	**100**
25 to 30 years	4	33.3
31 to 45 years	6	50
46years and above	2	16.7
	12 Teachers	**100.0**

The information entails that there were two learner age group ranges that came up from the findings with a group of 9 to 10 years occupying 30% of the learners sample size. This age range is critical as children are typically in the early stages of formal education, where foundational skills in digital literacy are developed (Hague & Payton, 2010). Another group of 10 to 11 years had a 70% representation of the learners and the group is likely to have more exposure to digital learning environments. Bennett & Maton (2010) indicates that children in this age group are increasingly using technology for educational purposes, which can enhance their learning experiences. The dominance of learners aged 10 to 11 years suggests that digital learning content should be tailored to engage this age group effectively. As they are more likely to utilize

technology, educational content should incorporate interactive and multimedia elements to enhance engagement and retention (Gee, 2003).

Amongst teachers in the education sector, three age groups were defined comprising of 25 to 30 years category, 31 to 45 years category and 46 years and above category. The 25 to 30 years category which occupied 33.3% of the sample size may be more familiar with integrating technology into their teaching practices, as they are likely to have grown up during the rise of digital technology (Ertmer & Ottenbreit-Leftwich, 2010). The 31 to 45 years category occupies 50% of the sample size and may possess a balanced perspective on traditional and digital teaching methods, allowing them to effectively bridge the gap between conventional pedagogy and modern digital tools. The 46 years and above category represented by 2 teachers occupied 16.7% of the sample size. This group has possibilities of facing challenges in adapting to new technologies, which can impact their teaching effectiveness in a digital learning context (Mishra & Koehler, 2006). The varied age distribution among teachers indicates a potential need for professional development focused on digital literacy and technology integration in the classroom. This is crucial for ensuring that all educators, regardless of age, can effectively support their students in a digital learning environment (Ertmer & Ottenbreit-Leftwich, 2010).

4.3.2 Qualifications and experience

Table 4.4 illustrates the academic qualifications and experience of the teachers as key informant participant.

Table 4.4: Teachers academic qualifications and experience

Academic Qualification	Frequency	Percentage	Range of Experience	Frequency	Percentage
Diploma	5	41.7	<5 years	3	25
Degree	3	25	>5 years but <10 years	5	41.7

Post Graduate Diploma	1	8.3	>10 years but <15 years	2	16.7
Masters	3	25	>15 years	2	16.7
Total	**12**	**100**	**-**	**12**	**100.1**

The information provided from the research entails that, majority of the teachers hold a diploma as their highest qualification, making it the most common qualification among the group as they have 41.7% of the sample size**.** Equal representation of bachelor's degree and master's degree holders with 3 participants on each category was fairly represented as they each have the quarter percentage of the sample size**.** Only one participant reported having a post graduate diploma, occupying 8.3% of the sample size. Most teachers in the sample hold basic teaching qualification which is a diploma, with possible limits to their exposure to advanced pedagogical approaches, including digital learning. The presence of master's degree holders (25%) suggests that some teachers have pursued advanced studies, potentially equipping them with better skills in areas such as curriculum development and educational technology. However, the low representation of Post Graduate Diploma holders may indicate that this qualification is not a common pathway for professional development among educators in the sample. The high percentage of diploma holders indicates that a significant portion of teachers may lack formal exposure to advanced educational theories or digital pedagogy. This underscores the need for targeted professional development programs to bridge gaps in digital teaching skills. Teachers with higher qualifications such as post graduate diploma and master's degrees may serve as mentors or facilitators in guiding their peers toward adopting digital learning practices.

In view of experience, most teachers have mid-level experience were 5 participants occupied 41.7% of the sample size. This category has between 5 and 10 years of teaching experience, making it the largest group. 3 participants have less than 5 years of experience occupying 25% of the sample size with the possibility of being relatively new to the profession. Equal representation of 10 to 15 years' experience as well those with more than 15 years experienced teachers was part of the sample with each category occupying 16.7% of the sample size. This

reflects a diverse range of experience levels, from early career teachers to highly experienced ones suggests that most respondents are familiar with classroom dynamics and student needs. Teachers with more than 15 years of experience contribute institutional knowledge and traditional teaching methods, which may affect their adaptability to digital learning as they might be more comfortable with traditional methods of teaching. The representation of newer teachers suggests a growing workforce that may be more open to adopting innovative teaching strategies, including digital learning tools. These teachers are likely to be in a position where they are open to learning new teaching methods while still drawing on practical classroom experience due to their proximity to modern teacher training programs, which are more likely to include ICT integration.

4.3.3 Device accessibility

Figure 4.1 below provides information on the accessibility of devices amongst the selected sample size.

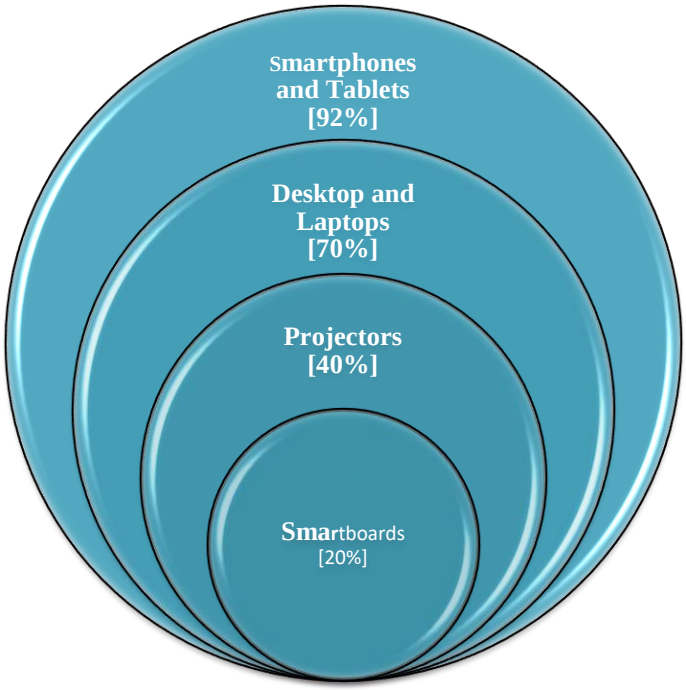

Figure 4.1: Device accessibility in Makonde district

The diagram illustrates the differences in the availability and accessibility of digital devices amongst the sample size drawn from both private and government schools. The most widely available devices are smartphones and tablets with 92% of the sample size having access to these. PS T1 said:

> *Although we are not provided with devices to use for digital learning, we use our very own phones and data, though it will not be enough for us according to budgets.*

Additionally, GS L3 said:

> *Although I do not have a personal phone, when I want to do my studies I always use my mother's phone. When she returns from work she then gives me her phone so that I could see what the teacher has sent for us and I do my work. Even in the absence of my mother, she can leave her phone behind with me and I do my work and return it when done.*

Another leaner in PS T1 highlighted that he can easily get any device for the use of digital learning as his parents know that it is now part of their learning exercises.

> *I have a smartphone, a laptop as well as a tablet for me to use for my studies and communication with the teacher he said.*

The high accessibility of smartphones and tablets highlights their portability and affordability in the targeted group, which makes them appropriate for environments with limited resources. Due to their accessibility and affordability, smartphone devices are becoming more and more common in African schools, according to a study by Mtebe and Raisamo (2014). In a similar context, Unwin et al. (2018) contends that in areas with inadequate infrastructure, mobile technology has emerged as the primary component of digital learning.

The findings also entails that 70% of schools that participated in the study have access to desktops and laptops, making them reasonably accessible. Although they are less accessible than smartphones and tablets, desktops and laptops are still widely used with some of the schools benefiting from government interventions of equipping schools with ICT infrastructure as a way of embracing digital technologies in learning. PS T3 said:

> *I cannot access a laptop or desktop even if I want to try and use it since we do not have those facilities. Given a chance to digitally use a laptop or desktop, I do not even know what I am supposed to teach and how to teach the students. When it comes to digital learning, I just have to use my smartphone which does not have data most of the times*

due to restricted budgets, hence I'm forced to stick to the physical way of teaching methods.

GS T3 elaborated that a school laboratory has been built and equipped with desktops by the SDC committee of the school to allow the students and teachers to embrace digital technologies:

> *A functional computer lab has been built an equipped for us by the SDC committee, however there is no one to repair the machine when they are malfunctioning and most of the times; this would have been caused by the teachers' incapacitation as they are not aware of how to use these devices. If only we could have a proper training on how to use these devices, probably they will be working very well as we speak.*

This is in line with research by Isaacs (2015), who found that although desktops and laptops are common in African educational systems, obstacles like maintenance expenses and power outages prevent their full use.

According to the study, projector use in the schools that took part in the study was limited as the availability is moderate, with less than half of the schools having access to them which is 40% of the sample size. Projectors seem to be reasonably accessible, although infrastructure issues frequently limit their use. PS1 and PS2 had projectors which they use sometimes to deliver lessons, however PTS3 does not fully utilize theirs as they sited electricity back up issues during the time of the classes. Chigona et al. (2010) pointed out that although projectors are useful for improving learning in the classroom, they need a steady power source and technical knowledge, of which both of these aspects are not always available in Zimbabwean schools.

20% of sample size had smart boards, making them the least accessible. PS2 and PS3 only had smart boards, however PS T5 said:

> *It is good to have interactive boards in class and we intend to fully utilize them, however we do not have much to share with the students using these. Most of the times we want to turn it on and learn differently especially during holidays but at times the parents of the learners fail to help them connect. As a teacher upon seeing this and fully aware that all I*

wanted to do in that lesson was to teach with a power point, I just turn it into a portable document format and then send it on the most common platforms like WhatsApp.

The high expenses and infrastructure needed to install and maintain interactive boards are reflected in their low accessibility. Hennessy et al. (2010) stated that due to training and financial limitations, smart boards are frequently unaffordable for schools in developing nations. According to this analysis, there is a discrepancy in the accessibility of devices, with mobile devices serving as the primary digital learning tools and smart boards having a lower uptake rate.

4.4 Access to Digital Resources and Infrastructure

According to the participants, an obstacle to digital learning has been identified as the absence of dependable internet connectivity and access to digital devices. Most participants complained about poor internet access and electricity shortages for them to make use of digital learning:

My phone's battery will be dead and would need electricity to charge it up so that I can join the lesson online," said learner 15. Additionally, another learner said, "Internet connectivity is my greatest problem as I try to download some tutorials on YouTube. I end up going on social media so that I can buy time as the network will be going on and off, taking so much time for me to download a selected tutorial.

The success of digital learning initiatives depends on dependable infrastructure, like internet access and electricity, according to Hennessy et al. (2010). Differences in access to digital resources indicate the necessity of focused investments in ICT infrastructure, especially in marginalized regions. Access to digital learning materials is limited by systemic and economic factors in addition to infrastructure. Instructors and students are unable to fully utilize online learning resources due to the high cost of internet data, bandwidth limitations, and a dearth of local digital education platforms (Mapolisa & Tshabalala, 2013). Most public schools lack enough digital equipment like projectors, desktops, laptops, and tablets. When these gadgets are

available, many students share them, which reduce the number of chances for customized learning. GS T6 highlighted that:

> *Sometimes we have to sit the learners in groups of tens on one desktop so that they both have equal chances to learn at the same time, however when it comes to navigation and technicality, chances are that only a few of them will have access to it. At times it will be a scramble for the front sit for the students with the hope of navigating the machine.* He went on to say,*" it is difficult for us to schedule different sessions for the learners to allow them to come through in smaller numbers as it is more work for us as teachers. It also poses the challenges of lagging behind in other subjects as well as we would have spent more time on one thing for long periods of time with the intention of helping every student grasp it. Besides it is tiring to continue with the very same lesson throughout the day. As the students exchange classes, the energy levels will be also decreasing; hence we end up disadvantaging the last groups.*

Obtaining digital resources for lesson planning and delivery presents additional difficulties for educators. Many teachers struggle to successfully incorporate available content into their lessons without the right guidance and assistance, which further reduces the potential advantages of digital education (Chigona, 2015). A PS T4 said:

> *The majority of digital content lacks local language support and is not adapted to the Zimbabwean curriculum, which lessens its usefulness and relevance for elementary school students. For all students to have fair access to digital learning opportunities, infrastructure gaps must be filled including local languages content*.

Some students reported using digital tools frequently in spite of these difficulties; 10 said they use devices daily, and 12 said they use them weekly. This supports the findings of Cheung and Slavin's (2013) study, which showed that students who regularly use digital resources develop stronger digital literacy abilities and achieve better academic results. The findings showed that students' access to digital devices varied, with a lot of students mentioning difficulties such as the issue of sharing. "*I have to share with my brother and we don't always have Wi-Fi,"* a learner

said during a focus group discussion with the students in government schools. These findings concur with a research by Selwyn (2011) and Warschauer (2004) that highlights the digital divide, or disparities in access to technology and the internet that disproportionately impact young students from lower-income families.

A major obstacle is the lack of electricity in marginalized schools, which prevents digital devices from being powered and internet services from being available. There are notable differences in Zimbabwe's digital infrastructure between private schools and government schools. According to Maringe and Sing (2014), a large number of private schools, have access to computers, reliable electricity, and internet connectivity. However marginalized schools in the same regions lack basic digital infrastructure, which makes it hard to successfully implement digital learning programs. The objectives of equitable access to high-quality education via digital means are compromised by the unequal distribution of resources, which also maintains educational inequality (Chikuni, 2020). Participants suggested that community ICT hubs and solar-powered gadgets could help with some of these issues.

Through the Ministry of Primary and Secondary Education (MoPSE), the Zimbabwean government has recognized the value of ICTs in education and has started programs like the e-Learning Strategy and the National ICT Policy. These regulations seek to integrate ICTs into the curriculum, expand access to digital devices, and enhance infrastructure (MoPSE, 2015). However, due to a lack of funding, inadequate monitoring systems, and a lack of coordination among stakeholders, implementation has been uneven, with many schools still falling behind. By giving schools access to digital resources and training courses, non-governmental organizations and international organizations like UNICEF and UNESCO have complemented government efforts. These initiatives however, frequently focus on a small number of schools and are unsustainable in the absence of sustained community ownership and government commitment (UNESCO, 2018).

4.5 Student engagement with digital content

The level of participation, interest, and drive that students show in educational activities is referred to as student engagement. Engagement in digital learning takes many forms, including behavioral, emotional, and cognitive components. Students' investment in their education, such as the time and effort they devote to comprehending the subject matter, is a component of cognitive engagement. While behavioral engagement focuses on students' active participation, such as interacting with digital tools and content, emotional engagement refers to how students feel about the learning process (Fredricks, Blumenfeld, & Paris, 2004). The findings highlighted how crucial it is to create interactive, visually appealing multimedia content. During an ethnographic observation, the researcher saw that most of the learners would rush to the quizzes section while they were learning digitally using the study application customarily developed for a private school. Digital content needs to draw in students, hold their interest, and promote participation in order to be successful. This is particularly crucial for primary school students, who need engaging and interactive experiences to stay motivated and focused.

In Zimbabwe's primary schools, a number of obstacles prevent students from participating in class, even though digital learning has the potential to be beneficial. There is frequently a lack of digital literacy among teachers and learners. Many teachers lack the necessary training to effectively use digital tools in the classroom, which hinders their ability to interact with students through digital content. According to Chikuni (2020), teachers who lack confidence in their ability to use technology may employ it passively, using it only as a tool for presentations rather than as an interactive learning tool. A PS T6 concurred with this saying:

> *Here we have all the resources we need to use for digital learning from the laptops to smart boards and interactive screen, however I have nothing interactive to share with the students except from seeing the students live on screen, sharing a power point a couple of images and a PDF. At the end of the day, I know I will have to repeat what I have done in digital classroom in a physical classroom. Digital learning, hardly allow me to elaborate further as time is limited non platforms like Google classroom. Sometimes I see the enthusiasm of the students, however with no interactivity, I end up conducting discussions and question and answer segments with the students though I know that the difference*

with a physical lecture should be slim with greater chances of engagement being found on digital classrooms.

Teachers have noted that students typically find digital learning interesting, especially when interactive materials like games, videos, and narratives are incorporated. A number of female teachers highlighted the appealing nature of storytelling and e-books, while male teachers pointed out that students preferred interactive exercises and videos. These results are consistent with the multimedia learning theory of Mayer (2005), which contends that integrating audio and visuals improves student comprehension and involvement. Zhang et al. (2006) also discovered that learners are more motivated and retain information better when they are exposed to interactive digital content.

Due to the interactive and enjoyable nature of digital learning, the majority of students especially female students expressed satisfaction with it. During focus group discussions, comments such as: "*Yes, it's enjoyable since it feels like playing games!"* and *"I enjoy it because it's vibrant and engaging"* demonstrate how digital tools enhance the appeal of learning. Boys also mentioned the interesting features, saying things like, "*I like digital learning because it's cool!*" and "*I like playing games that involve codin*g." These findings are consistent with the Cognitive theory of multimedia learning by Mayer (2005), which contends that well-designed interactive digital tools improve comprehension and engagement by fusing textual, visual, and auditory components. Comparably, a study on the SAMR Model by Puentedura (2013) emphasizes how digital technologies change education by producing dynamic and captivating experiences that inspire students to take an active role in their education. Some students, however, claimed that digital learning was less interesting because they had trouble concentrating or using the apps especially while using You Tube. GS L10 said:

> *I don't like it because it's hard to focus on a small screen. At times while I am searching for specific tutorials, advertisements of games and other things pop up and I end up playing a game with unfinished school work." This supports the findings of Kiger et al. (2012), who points out that although gamified content increases engagement, user experience may be hampered by poorly designed interfaces or technical issues. Language barriers and the relevance of the content are other issues that hinder student engagement. Zimbabwe's digital content is less accessible and engaging for students in*

primary schools, because it is either not in line with the local curriculum or is not available in the local languages (Maringe & Sing, 2014). The disconnection between content and context can reduce students' interest in digital learning activities. Teachers can enhance learning outcomes and student engagement by utilizing these formats, especially for younger students.

4.6 Cultural and Contextual Relevance

One important consideration in the design of digital content is cultural relevance. Teachers stressed how important it is that the content represents local contexts, Zimbabwean customs, and languages. Some participants emphasized the significance of avoiding foreign examples in the content and using local imagery. Others recommended incorporating cultural themes and traditional stories. These results support those of Chigona et al. (2010), who contend that for digital learning content in African schools to be successful, it must be relevant to the cultural backgrounds of the students. Likewise, Mavhunga (2020) emphasizes how crucial culturally sensitive content is in Zimbabwean primary schools. An observation was noted by the researcher during her ethnographic exercise, when learners where trying to access Ruzivo application which linked the learners to Akello Application. On Akello application, the United States of America flag came up on the home page and as the students were proceeding with their lesson on line, the content they used had examples of sky scrapers and snow flacks amongst other things. The extent to which educational content reflects the learners' values, customs, language, and life experiences is referred to as cultural and contextual relevance. In the context of digital learning, this means making sure that the content is relevant to the local context, which includes the socioeconomic realities, the students' languages, and their cultural practices, in addition to being in line with national curricula (UNESCO, 2018). Cultural relevance is especially significant for Zimbabwean primary school students since it affects their engagement and learning outcomes by influencing their capacity to relate to the material.

Adapting digital learning content to suit the needs of students in various geographic locations including marginalized areas is known as contextual relevance. Students from rural areas may have different educational needs and access to resources than their urban counterparts due to

Zimbabwe's pronounced urban rural divide. Digital learning content must therefore be created to close these gaps and guarantee that all students, regardless of where they are in the world, can take advantage of the content. There are sixteen officially recognized languages in Zimbabwe, including Shona, Ndebele, Tonga, Ndau and a number of minority languages. Nevertheless, a large portion of the digital content accessible to elementary school students is in English, which is not the majority of students' first language (Maringe & Sing, 2014). When English is used as the main language of instruction in digital content, it may make it harder for students who are more fluent in local languages to understand and participate. The efficiency of digital learning materials is restricted by this language barrier, which may also lead to student disengagement. A majority of Zimbabwe's digital learning content is either created with Western contexts in mind or is sourced from global platforms. The content might therefore not accurately represent the historical experiences, cultural norms, and values of Zimbabwean students. Students from Zimbabwe's distinct cultural context may not connect with digital lessons that emphasize Western holidays, characters, and social structures, which can make it difficult for them to interact with the content in a meaningful way (Chikuni, 2020). The socioeconomic differences in Zimbabwe also have a big impact on how relevant digital learning materials are. Both cultural norms and the realities of poverty, where resources like electricity and internet connectivity are scarce, must be taken into consideration when adapting the content, (Zhou and Zvoushe 2012).

Teachers can produce learning resources that are relevant and relatable to students by incorporating cultural components into digital content. This method increases student engagement and comprehension while fostering a sense of identity and belonging. Teachers may lack the training necessary to evaluate or modify digital content for the local context, which is why many educators use generic digital resources that are inappropriate for their context or culture. According to Chigona (2015), professional development programs in Zimbabwe frequently do not concentrate on giving teachers the tools they need to choose and modify digital resources that would improve local relevance in the classroom.

4.7 Inclusivity in Digital Learning

One of the main themes that came up was inclusivity. In education, inclusivity refers to establishing a setting where all students, irrespective of their socioeconomic status, physical capabilities, gender, or language, are afforded equal opportunities to participate, engage, and achieve. This involves making sure that all learners can access and use digital tools, platforms, and content in the context of digital learning. UNESCO (2018) states that in order to guarantee that vulnerable and marginalized groups do not lose out on the advantages of the digital transformation in education; inclusive digital education must address issues of representation, participation, and access. Bridging the digital divide requires inclusive strategies. All students, regardless of socioeconomic status, can have access to digital learning if marginalized students are given priority and context-specific solutions are developed.

An issue of gender differences in access to online education also came up from the teachers interviews findings. Boys' education is frequently given precedence over girls' due to cultural norms and financial limitations, particularly in rural areas. Additional obstacles that may prevent girls from participating fully in digital education programs include early marriage, domestic duties, and gender-based violence (UNICEF, 2020). Digital learning platforms and content run the risk of sustaining exclusion when they fail to consciously address gender biases or represent diverse identities. In another context, although there are 16 officially recognized languages in Zimbabwe, the majority of digital content is created in English or the country's most common languages, such as Shona and Ndebele in one specific area like the digital application that teaches Shona language. Minority language speakers are excluded by this linguistic restriction, especially during the early educational phases when mother tongue instruction is most successful (Chikuni, 2020). More so, because students find it difficult to relate to examples or contexts from other cultures, culturally irrelevant content can alienate students and reduce engagement (UNESCO, 2018). Students with disabilities must be accommodated in inclusive digital learning. Accessing traditional learning materials is difficult for students with visual, auditory, and mobility impairments in Zimbabwe, and digital content is frequently no better. The majority of digital resources and e-learning platforms are not made with accessibility features or assistive technologies like screen readers, captions, or keyboard navigation in mind (Chigona, 2015).

Digital learning has the potential to further marginalize children with disabilities if intentional inclusion is not implemented.

4.8 Teacher Training and Professional Development

Globally, as educational systems work to meet the demands of the twenty-first century, the incorporation of digital learning materials into primary education is increasing. The use of digital learning resources in Zimbabwean primary schools has brought attention to how crucial it is to give teachers the digital skills they need. The findings exposed the limited trainings; teachers have received in digital learning and educational technology. Amongst the participants, only five teachers out of twelve had formal training on Technological teaching, while the majority expressed a lack of confidence in integrating digital tools into their teaching. This aligns with Unwin (2005), who highlights that teachers in developing countries often lack professional development opportunities for ICT integration. Similarly, Kirkwood and Price (2014) argue that professional development is critical for equipping teachers with the confidence and competence to effectively use digital tools in the classroom. The degree of professional development and training provided to teachers has a big impact on how well digital learning is implemented in primary schools. In primary education, digital learning mainly depends on teachers' proficiency and self-assurance in using technology. Success in education depends on teachers' ability to successfully incorporate digital tools into the classroom, as they are the main facilitators of learning (UNESCO, 2018). Even though the importance of digital education is becoming more widely recognized in Zimbabwe, many primary school teachers are not properly trained in using educational technology (Chikuni, 2020).

Beyond basic computer literacy, effective teacher preparation must emphasize the pedagogical use of technology, including how to choose, modify, and produce digital learning materials that complement the curriculum and cater to the various needs of students (Chigona, 2015). Even well-resourced schools may find it difficult to fully utilize the potential of digital education without this training. The overall quality of students' digital learning experiences is impacted by the lack of professional training as teachers find it difficult to choose, modify, and use digital

resources efficiently if they are not properly trained. To improve teachers' ability to use digital tools, organized professional development programs emphasizing pedagogical integration and practical ICT skills are crucial.

4.9 Teachers' Role in Digital Content Development

Involving teachers in the creation of content guarantees that digital resources meet curriculum objectives and take into account each student's particular needs. The efficiency and relevance of digital learning resources are improved by this cooperative approach. Teachers are uniquely positioned to create relevant and easily accessible digital learning materials because they have firsthand knowledge of the needs, linguistic preferences, and cultural contexts of their students. Teacher participation in content development is essential to ensuring cultural and contextual relevance in Zimbabwe, where a large number of primary school students speak indigenous languages and reside in a variety of socioeconomic contexts. In order to match digital learning materials with the national curriculum, teachers are also needed. The Zimbabwe Curriculum Framework (2015–2022), which prioritizes competence-based learning, serves as the foundation for Zimbabwe's educational system. Digital content must be created to enhance students' social, practical, and cognitive abilities in order to achieve these curriculum objectives. Teachers can make sure that the digital content being created satisfies age-appropriate pedagogical standards and prescribed learning outcomes by working in conjunction with curriculum specialists, software developers, and educational publishers (Mapolisa & Tshabalala, 2013). Their advice increases the efficiency of such interventions by preventing a mismatch between digital tools and classroom teaching requirements. According to the participants, teacher led content was preferred, especially when students were having problems. PS L14 said:

> *Teacher explains better than a computer, learning with a teacher feels easier because they can help when you are stuck or when you do not understand." These sentiments are consistent with Vygotsky's Social Constructivist Theory (1978), which highlights the value of peers and teachers in scaffolding learning and giving prompt feedback.*

Another learner said, "*A device is faster, but a teacher makes it more interesting,*" responding to the question, what if artificial intelligence was incorporated in their digital learning. Students

also valued the independence and speed of digital learning. This is consistent with research by Clark and Mayer (2016) that indicates that although digital tools offer flexibility, they are not a complete substitute for the direction and individualized help that teachers provide. The findings emphasize the necessity of a strategy for online education. Although digital tools provide flexibility and engagement, they must be carefully incorporated into the curriculum, with teachers serving as the primary mentors and support system for students. This is consistent with the TPACK framework (Mishra & Koehler, 2006), which highlights how crucial it is to integrate pedagogical, content, and technological knowledge for successful digital learning. Chikuni (2020) claims that imported digital learning resources frequently don't represent local realities or fit the curriculum of Zimbabwe's primary schools. In order to make learning more relatable and meaningful for young students, teachers can develop or modify digital resources that incorporate local examples, folk tales, and real life scenarios based on their knowledge of the curriculum and community. Facilitating the creation of content in native tongues and localization also aids in removing language barriers such as Shona, Ndebele and Tonga. Teachers emphasized the value of giving feedback and customizing materials for local contexts, viewing themselves as collaborators in the creation of digital content. This supports Laurillard's (2012) contention that educators play a key role in creating successful online learning content. In a similar vein, Mishra and Koehler (2006) stress that teacher participation is essential for successful ICT integration in the Technological Pedagogical Content Knowledge (TPACK) framework.

4.10 Chapter Summary

The thematic analysis identified key areas, such as infrastructure development, inclusivity, cultural relevance, and teacher training, for enhancing digital learning in Zimbabwean primary schools. Although it encourages participation and independence, issues like accessibility and the requirement for teacher assistance still exist. Content developers and educators must work together to address these problems. To ensure that all students have meaningful learning experiences, the integration of digital tools must prioritize equity, usability, and alignment with pedagogical goals as they continue to evolve. Zimbabwe can improve educational outcomes for

every student by investing in these areas and utilizing the transformative potential of digital learning.

CHAPTER FIVE

5.0 DESIGN PROCESS

5.1 Introduction

As highlighted in the methodology chapter, this study intended to produce a prototype with the data which was fed from qualitative research methods. The researcher came up with this chapter to present the design process she went through as she was coming up with the prototype. A design process is the description of the stages that the designer took as she was trying to come up with a prototype. This chapter gives an overview of the problem identified by the designer, the objective that the researcher has. This research collected data in a real life setting using the qualitative research approach, through ethnography research and conducting interviews and focus group discussions with the teachers and students respectively, hence there will not be any need to present empathy maps as they have been presented before in the findings. This chapter will detail the concept development and the journey map of the prototype design giving details and clear illustrations on the processes taken by the designer as she was coming up with the prototype focusing on the functionality and innovativeness of the design with the provision of illustrations from stage to stage. The chapter concludes with a prototype ready to be tested for evaluation.

5.2 Problem identification

The integration of digital learning in primary education has gained popularity globally including developing countries such as Zimbabwe. In Zimbabwe, digital learning platforms used often offer content on a wide range of subjects, including languages, social sciences, mathematics amongst others. Nonetheless, the content quality is still uneven and lagging behind, as it is text-based and lacking in interaction (Chikumbu, 2019). Considering the fact that foundations of education begins in primary level with students in the fourth grade being the targeted group as

they beginning the fundamental primary education, there is a need for multimedia-rich learning content.

5.3 Goal Statement

According to Chikumbe (2019), many digital learning platforms in Zimbabwe are still in the early phases of content development, with little funding available to create rich multimedia educational content that is engaging. The designer aimed to create multimedia educational content using elements of multimedia which are audio-visual element, graphics, animation, typography and gamification to encourage engagement and focus in self-paced learning considering that children in the fourth grade can be easily lose concentration when studying with text based content. The very same ages can be lured and diverted from learning by any other content that pops as adverts the likes of social media platforms and different games, in the course of digital learning increasing the risks of personal information distribution, cyber bullying and most importantly, losing the purpose of engaging on digital learning platforms.

5.4 Concept development

Product

The researcher transformed the currently existing content for grade four learners in Zimbabwe using the Ministry of primary and secondary education curriculum. The designer only took one topic from two subjects which are Science and Technology as well as Agriculture just to demonstrate the concept, being hindered by the availability of resources and time as the project was been guided by the period of the study. The name for the product the researcher came up with was Knowledge Hub as it gives the impression of a central, well-organized area where users can access a variety of educational content. The name implies that it is a center for education, giving the impression that it is the place to go for anything related to learning.

Theme colours

The researcher decided to use the colors green and yellow which she drew inspiration from the Zimbabwean flag where green is a symbol of development, vegetation, and wealth. Yellow symbolizes wisdom, knowledge, and minerals. The combination of these two colors can arouse feelings of accomplishment and success, which is consistent with learning objectives. Psychologically, green and yellow motivates and reinforces focus while being optimistic.

Targeted population

The targeted population for the project is grade four learners in Zimbabwe's primary schools.

Objective

The objective is to design educational content that is engaging and contextually relevant for grade four learners in Zimbabwe using local languages including sign language to accommodate the learners with special needs. Another objective of the researcher is to make sure that the content is accessible to everyone; hence it should be downloadable and easy to share. The content should serve the purpose of engagement and it should be used as a tool of assessing the student's retention to the concepts learnt.

Design Process

The designer first gave a brand name to the product for identification purposes and created an interface that would allow her to load the content so that it can be accessible on different platforms and devices. The designer used the following listed software's in the creation and accessing of the content and the prototype.

Adobe Illustrator. The designer used this software to create a brand and backgrounds for the design project. Figure 5.1 below shows a mock up design of the brand the designer came up with.

Adobe Character Animator. The designer used this software to create characters that she could use for here product. The designer chose animated characters considering that the children at the ages of 9 to 11 can easily relate to them than a physical person. Also the designer was considering that animated character can fit in any cultural background unlike real life people whom might dress in appropriately in other cultures even though they might be alright in their own culture.

Adobe After Effects. The designer used this software to bring motion to the character created above. This software was also used to come up with subtitles to assist.

Sign Translate. The designer used this one to translate the content she had crafted to deliver a lesson for the students into sign language. Figure 5.2 shows a part of the lesson being converted from verbal language to sign language.

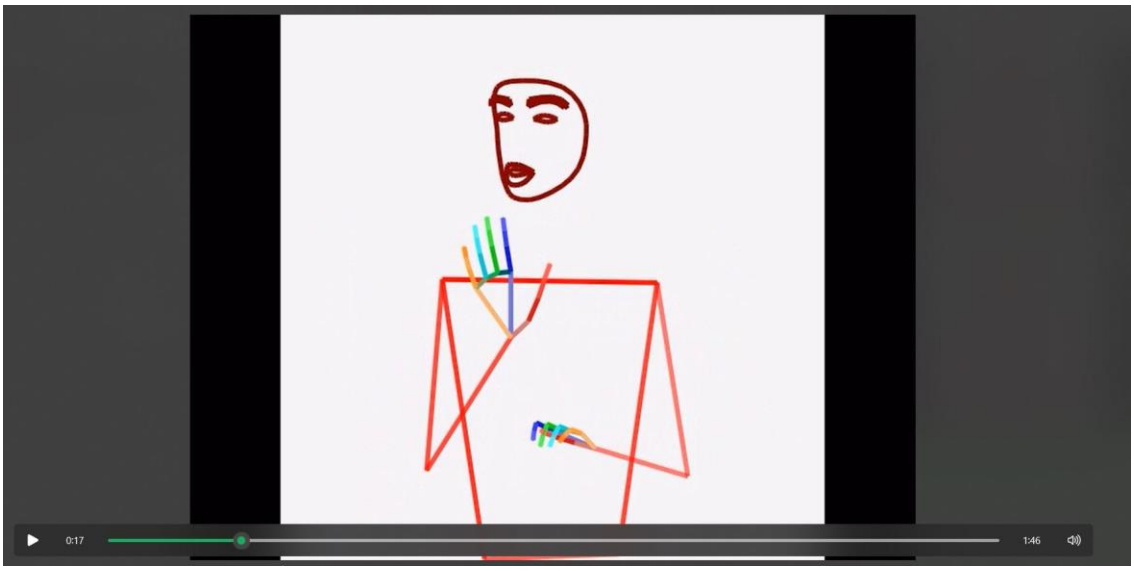

Figure 5.2 Character translating into sign language.

Adobe Premier Pro. The designer used this software to combine the visuals and audios so that the product comes as one in sequence.

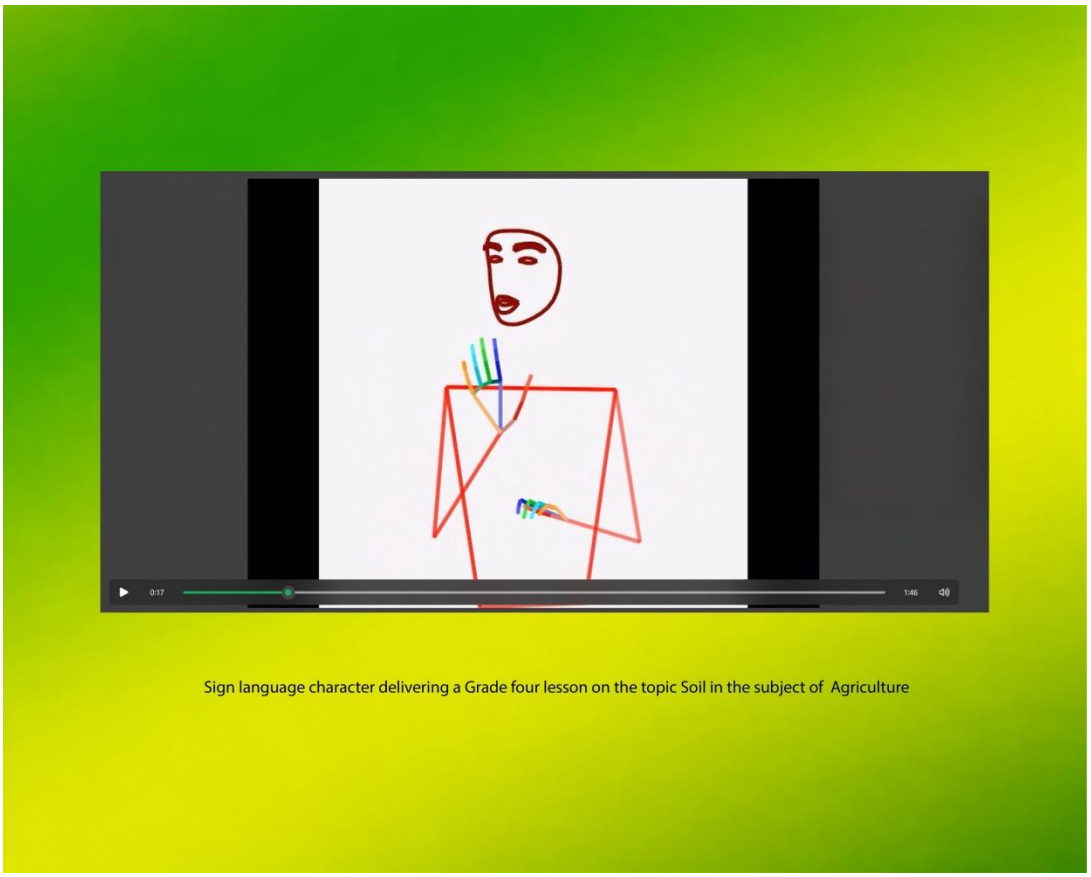

Figure 5.3 Sign language character delivering a lesson

Adobe XD. The designer then used this software to draw the wire frames to illustrate the journey map and navigation of the project. Figure 5.3 shows the wireframes of the project.

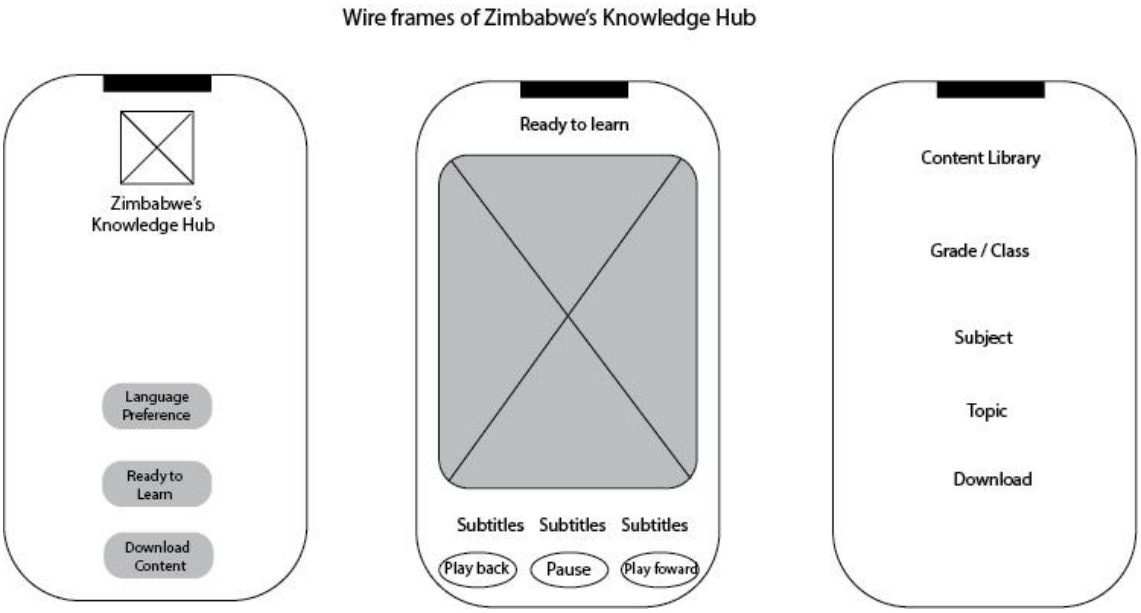

Figure 5.4 Wireframes.

5.5 Description of the prototype.

The prototype was developed with the intention to suit Zimbabwean children of different cultural contexts. This influenced the development of an animated character instead of having a human being in the prototype. The reason for this was that animation is easily acceptable to children despite different cultural contexts compared with human beings who have high chances of discrimination from dressing, presentation or even hair styles hence the use of animation would rule out different cultural relevance.

The prototype was developed with examples that are contextually relevant to avoid examples such as human robots and sky scrapers that are far-fetched from our own Zimbabwean environment hence, examples of clay pots amongst others were infused in the prototype. The idea was implemented with the aim of fostering the Zimbabwean culture and this can be better implemented across all subjects in the Zimbabwean curricula.

The researcher developed the prototype with the thought of inclusivity in digital learning hence she incorporated a character that was communicating in sign language to carter for those children living with physical disability. The intention is to also include the visually impaired who need brail l amongst others when creating digital learning content. Translators

of different languages that are found in Zimbabwe can also be utilized to strengthen the aspect of understanding on the learners as they utilize self-paced learning.

5.6 Significance of the theoretical framework in the prototype.

The cognitive multimedia learning theory by Richard Mayer in 2001, influenced the development of the prototype as the researcher utilized the principles found in the theory such as the redundancy principle, signalling principle, multimedia principle, coherence principle, segmenting principle, modality principle as well as personalization principle. The very same principles could be taken note of in the development of content In different subjects with guide from pedagogically trained teachers to come up with sound, pedagogically grounded and relevant digital learning content.

5.7 Conclusion

The action research conducted in collaboration with the design process can address the challenges of digital learning and create transformational multimedia content that is engaging, inclusive, and relevant. The design process emphasizes collaboration with stakeholders, including learners, teachers, and policymakers, to ensure that solutions meet the unique needs of the local context. Prototyping and testing allow for continuous improvement, ensuring that the final solutions are both practical and effective.

This approach not only bridges the digital divide between private and government schools but also empowers teachers and learners with the tools they need to thrive in a digital age. Through thoughtful design and implementation, Zimbabwe can create a sustainable digital learning environment that supports equitable access to quality education for all primary school learners.

CHAPTER SIX

6.0 CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS

6.1 Introduction

In a time when digital learning is becoming more important in education, the purpose of this study was to investigate the current status of digital learning materials among Zimbabwean instructors and students in grade four. The results showed important information about the cultural relevance, accessibility, and engagement of digital resources, as well as the need for more infrastructure development and teacher training.

6.2 Summary of the study

A total of 30 students and 12 teachers from both private and public schools participated in the study, which started with an emphasis on response rates. As seen by the gender balanced involvement, both male and female students were actively participating in conversations on digital learning. According to demographic study, teachers were primarily between the ages of 31 and 45, while the majority of grade four students were between the ages of 10 and 11. Given the necessary preparation, this age range of teachers highlighted the possibility of combining conventional teaching techniques with technological innovations.

Digital device accessibility became a key subject, with 92% of students able to use smartphones and tablets, which were found to be the most accessible tools. However, smart boards were much less common than desktops and laptops, which were found in almost 70% of schools. This disparity in technology resources created clear distinctions between the experiences of learners attending government and private schools, which may have contributed to educational disparities. In addition to the availability of devices, internet connectivity problems were a significant obstacle that hindered the use of digital learning resources by both teachers and students. A lot of participants expressed how their digital learning experiences were hampered by inadequate internet access. A variety of educational elements, including the relevancy and

interactivity of digital content, affected student involvement. Although some students expressed excitement in digital tools, especially those that included games and videos, their learning was frequently hampered by distractions and technological issues.

Another important conclusion was the digital content's cultural and contextual relevance. Teachers emphasized the value of digital resources that are connected to Zimbabwean students' cultural experiences that utilize indigenous languages, and reflect on local situations. There was a clear lack of these resources, which frequently caused pupils to become disinterested in digital learning content that seemed unfamiliar or unrelated. The topic of inclusion also gained significant attention with discussions focusing on language challenges, gender inequality, and the requirement for consideration for students with disabilities. These issues showed that digital learning programs could further marginalize some communities, if ignored. Teachers' lack of training in digital learning and educational technology was another important discovery. There is a lack of trust in using technology amongst teachers into their practices because just a small percentage of teachers reported having received formal training. Many experts believe that teacher expertise is a crucial component of successful digital learning integration, and this discrepancy reflects a concern that has been expressed in the literature.

6.3 Conclusions

In summary, the results of this study highlight the significance of creating transformative multimedia content that is easy for Zimbabwean primary school students to access, interesting, and relevant. Although integrating digital technologies offers special chances to improve education, there are also major obstacles that need to be addressed in a thorough manner. By giving educators' professional development first priority, encouraging content that is culturally and contextually appropriate, and enhancing necessary infrastructure, stakeholders can foster an atmosphere that makes it easier for digital tools to be used to enhance learning. To ensure that no learner is left behind, especially among marginalized groups, it is crucial to ensure inclusivity in

digital education. Additionally, in order to match educational content with students' socioeconomic and cultural circumstances, teachers must work together to create locally relevant digital resources. The potential of digital education in Zimbabwe may be fully realized with these revolutionary approaches to multimedia content design, equipping a new generation of students to succeed in an increasingly digital environment. In order to create an atmosphere that encourages participation, empowerment, and success in digital learning environments, the proposed educational framework must thus take into account the varied identities and experiences of students.

6.4 Recommendations

Improving teacher preparedness and professional growth should come first. It is necessary to provide thorough training programs that give educators the digital literacy and pedagogical know how they need to successfully incorporate technology into their teaching. These courses ought to address both creative methods of using multimedia in the classroom as well as fundamental ICT skills. Working together with academic institutions and non-governmental organizations can help to create chances for ongoing professional development that are explicitly focused on creating digital material and using digital tools in the classroom. By giving teachers more authority, we can make sure they are comfortable using technology to improve instruction.

Additionally, creating educational content that is appropriate for local cultures needs to be a top concern. Designing multimedia educational content with local learners in mind can result in content that represent Zimbabwean socioeconomic situations, languages, and culture. Developing a platform for collaboration where educators may exchange ideas and materials can improve content localization even more. Collaborating with content creators and regional educational publishers is crucial to producing products that complement Zimbabwe's curriculum and speak to students' real-world experiences. This strategy will guarantee that students may interact with content that represents their everyday lives, improving their educational experiences.

Accessibility to infrastructure and digital gadgets is yet another important issue that needs to be resolved. The successful execution of digital learning programs depends on support for better digital infrastructure, such as dependable internet access and power supplies in both public and private schools. Collaboration with community stakeholders, NGOs, and local government should be a part of these initiatives in order to assist the creation of ICT centers and sustainability strategies for infrastructure maintenance. To guarantee that all students have access to digital learning platforms, it may also be possible to overcome electricity shortages in marginalized schools by investigating options like solar powered gadgets.

Additionally, inclusivity is a key component of digital education that calls for coordinated effort. For students with impairments, it is crucial to create digital information that is accessible. Including assistive tools in digital learning platforms, such as sign language and subtitles, is part of this. Additionally, promoting gender parity in digital education by means of targeted programs and assistance for girls can combat cultural biasness that might prevent their full involvement. Taking care of these problems will guarantee that every student has an equal chance to participate in digital education.

Another crucial suggestion is the creation of locally relevant digital learning platforms. Investments in digital platforms that offer curriculum aligned content in indigenous languages will aid in overcoming language obstacles, which frequently impede primary school students' understanding and involvement. Organizing seminars on the creation of digital content will give educators and other stakeholders the know-how to produce relevant and locally relevant learning materials, increasing student engagement and retention.

Just as crucial to creating a successful digital learning environment is putting in place strong feedback systems. Prioritizing systems that collect teacher and student input on digital learning experiences will enable ongoing enhancements to digital content. A flexible and dynamic educational framework will be ensured by regularly evaluating the usefulness and relevance of

digital resources through focus groups and surveys, which will allow educational stakeholders to adjust to learners' changing demands.

6.5 Implications

Policy development

The results make it clear that Zimbabwean education policymakers must give digital literacy top priority as a fundamental skill for all primary school curricula. By guaranteeing that every learner has the necessary digital skills from a young age, this has the potential to change educational standards.

Enhancement of the curriculum

The study emphasizes the significance of incorporating digital content that is contextual and culturally relevant into the curriculum. This suggests a change in the way educational resources are developed, with learning materials reflecting cultural characteristics and local circumstances to improve learning results and engagement.

Programs for teacher training

The study's results emphasize how important it is for teachers to be proficient in using digital tools. Ongoing professional development that prioritizes practical content in both technology and pedagogy is vital for instructors who struggle with digital literacy, as this can have a big impact on student engagement and academic success.

Equity in access

It is important to address the difference between private and public schools' access to digital tools and resources. To close the digital divide, this necessitates making investments in ICT

infrastructure to guarantee that all schools, particularly those in marginalized regions, have access to the tools they need.

6.6 Recommendations for further study

The study identified a number of areas for further research.

Long term studies: Upcoming investigation may examine how integrating digital learning affects student performance over the long run in Zimbabwe across various demographic groupings. Long term research could shed light on how students' digital literacy changes as they move through different educational phases.

Extensive content evaluations: Additional research is required to determine whether particular digital learning platforms and resources are beneficial in improving educational results. Future content development could be informed by the thorough assessments of usability, cultural relevance, and engagement that such research could offer.

Effects of teacher training programs: It would be beneficial to conduct research on how particular teacher training interventions affect students' involvement and digital literacy. Assessing different training methods may help identify best practices and guide the creation of scalable solutions for the professional development of educators.

Investigation of parental involvement: More research might look into how parents can help their children learn digitally at home, especially in situations when access to gadgets is restricted. Strategies to strengthen home schooling can be informed by an understanding of the attitudes and difficulties faced by parents.

Emphasis on language and cultural sensitivity: More study is required to examine how student engagement and comprehension are affected by educational content that is culturally appropriate. Research could examine the effects on student performance and general involvement of using indigenous languages in digital learning.

Alternative forms of technology use: Examining different forms of technological integration, like flipped classrooms or blended learning, may offer different approaches to improving digital learning. Research can concentrate on how these models can enhance student achievements in diverse educational contexts and supplement conventional teaching techniques.

In conclusion, although Zimbabwean primary schools' current digital learning environment presents many difficulties, a dedication to resolving these issues through well informed policy, calculated training expenditures, and culturally sensitive content has enormous potential to revolutionize education in the digital era.

References List

American Psychological Association. (2017). *Ethical principles of psychologists and code of conduct*. https://doi.org/10.1037/0003-066X.59.1.44

Anderson, T. (2008). *The theory and practice of online learning* (2nd ed.). Athabasca University Press.

Angrosino, M. (2007). *Doing ethnographic and observational research*. Sage.

Ayres, P., & Sweller, J. (2005). The split-attention principle in multimedia learning. In Mayer, R. E. (Ed.), Cambridge handbook of multimedia learning (pp. 135–146). New York: Cambridge University Press.CrossRefGoogle Scholar

Babbie, E. (2020). *The practice of social research* (14th ed.). Cengage Learning.

Baddeley, A. D. (1999). Human memory. Boston: Allyn & Bacon.Google Scholar

Bamgbose, A. (2011). *Language and the nation: The language question in sub-Saharan Africa*. Edinburgh, UK: Edinburgh University Press.

Barbour, M. K., & LaBonte, R. (2019). *State of the nation: K-12 e-learning in Canada*. Canadian eLearning Network.

Benson, C. (2013). The importance of mother tongue-based schooling for educational quality. *Background paper for EFA Global Monitoring Report 2013/14*. Paris: UNESCO.

Bergmann, J., & Sams, A. (2012). *Flip Your Classroom: Reach Every Student in Every Class Every Day*. ISTE.

Bernard, H. R. (2011). *Research methods in anthropology: Qualitative and quantitative approaches* (5th ed.). AltaMira Press.

Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. *ASEE National Conference Proceedings*, 30(9), 1-18.

Bonk, C. J., & Graham, C. R. (2012). *The handbook of blended learning: Global perspectives, local designs*. San Francisco, CA: Pfeiffer.

Bradbury-Jones, C., & Taylor, J. (2019). Ethical issues in the voluntary participation of children and vulnerable adults in research. *Journal of Nursing Ethics, 26*(4), 124-136. https://doi.org/10.1177/0969733019826035

Brown, C. (2018). Sustaining digital learning: Maintenance and support strategies. *Journal of Educational Technology*, 14(2), 45-57.

Brünken, R., Plass, J. L., & Leutner, D. (2004). Assessment of cognitive load in multimedia learning with dual-task methodology: Auditory load and modality effects. Instructional Science, 32, 115–132.

Bryman, A. (2016). *Social research methods* (5th ed.). Oxford University Press.

Castro, D. (2020). Designing culturally relevant digital learning content. *Educational Research and Reviews*, 15(7), 359-367.

Chakanyuka, S., & Mavunga, G. (2020). Zimbabwe's education reforms: A heritage-based curriculum in the 21st century. *African Education Review, 17*(3), 155-171.
Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. Cognition and Instruction, 8, 293–332.CrossRefGoogle Scholar

Cheung, A. C., & Slavin, R. E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review, 9*, 88-113. https://doi.org/10.1016/j.edurev.2013.01.001

Chigona, A. (2015). Pedagogical shift in the 21st century in sub-Saharan Africa: The challenge of ICT integration in teaching and learning. *The Turkish Online Journal of Educational Technology, 14*(4), 66–74.

Chigona, A., Chigona, W., & Davids, Z. (2010). Educators' motivation on integration of ICTs into pedagogy: Case of disadvantaged areas. *South African Journal of Education, 30*(2), 235–250.

Chigona, A., Chigona, W., & Davids, Z. (2014). Educators' use of ICTs in teaching and learning in disadvantaged schools: Issues and challenges. *International Journal of Education and Development using Information and Communication Technology*, 10(2), 53-66.

Chigona, A., Chigona, W., & Davis, Z. (2010). Levels of readiness in integrating ICTs into teaching and learning in Western Cape schools. *Education as Change, 14*(2), 335-347.
Chigona, W., Chigona, A., & Davids, Z. (2020). The digital divide in African schools: Barriers to ICT integration. *African Journal of Education, 16*(2), 45-62.

Chikunda, C. (2019). *The role of multimedia in enhancing the quality of education in Zimbabwe's primary schools*. Zimbabwe Journal of Education, 45(2), 45-60.

Chikuni, E. (2020). The integration of ICT in teaching and learning in Zimbabwean primary schools: An assessment. *International Journal of Education and Development Using ICT, 16*(2), 45–59.

Chinyama, T., Mafunga, P., & Sibanda, N. (2019). ICT infrastructure in rural Zimbabwean schools: Challenges and opportunities. *Zimbabwe Journal of Educational Research*, 31(3), 457-478.

Chisaka, B. C. (2020). Challenges of implementing competency-based learning in Zimbabwe. *International Journal of African Education, 12*(2), 89-102.
Chivore, B. R. (2021). Parental attitudes towards competency-based learning: A case study in Harare. *Zimbabwean Journal of Education Research, 29*(1), 77-91.

Clark, R. C., & Mayer, R. E. (2016). *E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning* (4th ed.). Wiley.

Craig, S. D., Gholson, B., & Driscoll, D. M. (2002). Animated pedagogical agents in multimedia educational environments: Effects of agent properties, picture features, and redundancy. Journal of Educational Psychology, 94, 428–434.CrossRefGoogle Scholar

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Sage.

De Koning, B. B., Tabbers, H. K., Rikers, R. M., & Paas, F. (2009). Towards a framework for attention cueing in instructional animations: Guidelines for research and design. *Educational Psychology Review, 21*(2), 113–140. https://doi.org/10.1007/s10648-009-9098-7

Department for Education (UK). (2019). *Realising the potential of technology in education: A strategy for education providers and the technology industry*.

Epstein, J. L. (2018). *School, family, and community partnerships: Your handbook for action*. Corwin Press.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47-61. https://doi.org/10.1007/BF02299597

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255-284. https://doi.org/10.1080/15391523.2010.10782551

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*(2), 423-435. https://doi.org/10.1016/j.compedu.2012.02.001

European Commission. (2021). *Digital Education Action Plan (2021-2027): Resetting education and training for the digital age*.

Farrell, G., & Isaacs, S. (2007). Survey of ICT and education in Africa: A summary report. Washington DC: World Bank.

Fiorella, L., & Mayer, R. E. (2018). Effects of observing the instructor draw diagrams on learning from multimedia messages. *Journal of Educational Psychology*, *110*(4), 561–577. https://doi.org/10.1037/edu0000237

Fiorella, L., & Mayer, R. E. (2021). *The science of learning and development: Multimodal learning principles*. Routledge.

Flick, U. (2018). *An introduction to qualitative research* (6th ed.). Sage.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*(1), 59–109. https://doi.org/10.3102/00346543074001059

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming, 33*(4), 441-467. https://doi.org/10.1177/1046878102238657

Gomez, R. (2017). Access to digital learning resources in developing countries. *International Journal of Educational Technology*, 12(4), 293-307.

Government of Zimbabwe. (2013). *Constitution of Zimbabwe*. Harare: Government Printers.

Government of Zimbabwe. (2016). National ICT Policy. Harare: Ministry of Information Communication Technology, Postal and Courier Services.

Hammersley, M., & Atkinson, P. (2007). *Ethnography: Principles in practice* (3rd ed.). Routledge.

Hargittai, E., & Dobransky, K. (2017). Digital inequality: Differences in young adults' use of the Internet. *Communication Research, 44*(4), 556-582.

Harp, S. F., & Mayer, R. E. (1997). The role of interest in learning from scientific text and illustrations: On the distinction between emotional interest and cognitive interest. *Journal of Educational Psychology, 89*(1), 92–102. https://doi.org/10.1037/0022-0663.89.1.92

Harp, S. F., & Mayer, R. E. (1998). How seductive details do their damage: A theory of cognitive interest in science learning. Journal of Educational Psychology, 90, 414–434.CrossRefGoogle Scholar

Hasler, B. S., Kersten, B., & Sweller, J. (2007). Learner control, cognitive load, and instructional animation. *Applied Cognitive Psychology*, *21*(6), 713–729. https://doi.org/10.1002/acp.1345

Heeks, R. (2002). Information systems and developing countries: Failure, success, and local improvisations. *The Information Society*, *18*(2), 101–112.
Hennessy, S., Harrison, D., & Wamakote, L. (2010). Teacher factors influencing classroom use of ICT in Sub-Saharan Africa. *Itupale Online Journal of African Studies, 2*, 39–54.
Hennessy, S., Onguko, B., Harrison, D., & Ang'ondi, E. K. (2010). Developing the use of information and communication technology to enhance teaching and learning in East African schools: Review of the literature. *Centre for Commonwealth Education, University of Cambridge*.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause Review*, 27(1), 1-12.

Hrastinski, S. (2019). What do we mean by blended learning? *TechTrends*, *63*(5), 564-569.

Ilomäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence – A key component for 21st century skills. *European Journal of Education, 51*(1), 1-21.
Isaacs, S. (2015). The role of ICTs in education in Africa. *World Education Forum Report*.
ISTE (International Society for Technology in Education). (2019). *ISTE Standards for Educators*.
ITU. (2021). *Measuring Digital Development: Facts and Figures 2021*.

Jamet, E. (2014). An eye-tracking study of cueing effects in multimedia learning. *Computers in Human Behavior, 32*, 47–53. https://doi.org/10.1016/j.chb.2013.11.013

Jeung, H., Chandler, P., & Sweller, J. (1997). The role of visual indicators in dual sensory mode instruction. Educational Psychology, 17, 329–343.CrossRefGoogle Scholar

Jonassen, D. H. (2000). Computers as mindtools for schools: Engaging critical thinking. *Prentice Hall*.

Kaiser, M. (2018). *Ethics in research: Presenting data responsibly*. *Journal of Research Ethics, 16*(2), 142-154. https://doi.org/10.1177/2158244017732115

Kalyuga, S., Chandler, P., & Sweller, J. (2004). When redundant on-screen text in multimedia technical instruction can interfere with learning. *Human Factors*, *46*(3), 567–581. https://doi.org/10.1518/hfes.46.3.567.50405

Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia instruction. Applied Cognitive Psychology, 13, 351–371.3.0.CO;2-6>CrossRefGoogle Scholar
Kalyuga, S., Chandler, P., & Sweller, J. (2000). Incorporating learner experience into the design of multimedia instruction. Journal of Educational Psychology, 92, 126–136.CrossRefGoogle Scholar

Kamwangamalu, N. (2016). *Language policy and economics: The language question in Africa*. Cham, Switzerland: Springer.

Karsenti, T. (2021). *The impact of digital education initiatives in Africa: Successes and challenges*. International Journal of Educational Technology.
Khan, S., Hasan, M., & Clement, C. K. (2012). Barriers to the introduction of ICT into education in developing countries: The example of Bangladesh. *International Journal of Instruction, 5*(2), 61–80.

Kiger, D., Herro, D., & Prunty, D. (2012). Examining the influence of a mobile learning intervention on third grade math achievement. *Journal of Research on Technology in Education, 45*(1), 61-82. https://doi.org/10.1080/15391523.2012.10782613

Kimathi, F., & Rusznyak, L. (2018). Community engagement in promoting digital learning

Kirkwood, A., & Price, L. (2014). Technology-enhanced learning and teaching in higher education: What is "enhanced" and how do we know? *Learning, Media and Technology, 39*(1), 6–36.

Kivunja C. Distinguishing between theory, theoretical framework, and conceptual framework: A systematic review of lessons from the field. Accessed August 8, 2023. https://files.eric.ed.gov/fulltext/EJ1198682.pdf

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education, 193*(3), 13-19.

Krueger, R. A., & Casey, M. A. (2015). *Focus groups: A practical guide for applied research* (5th ed.). Sage.

Kurt, S. (2018). Educational technology: An overview. *Educational Technology Journal, 35*(2), 45-59.

Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing* (2nd ed.). Sage.

Lamb, C. (2018). *Protecting confidentiality in qualitative research: An overview of methods and considerations*. *Journal of Applied Social Science, 12*(1), 34-45. https://doi.org/10.1177/2158244017752782

Laurillard, D. (2012). Teaching as a design science: Building pedagogical patterns for learning and technology. New York: Routledge.
Lee, H., Plass, J. L., & Homer, B. D. (2006). Optimizing cognitive load for learning from computer-based science simulations. Journal of Educational Psychology, 98, 902–913.CrossRefGoogle Scholar

Livingstone, S., & Helsper, E. J. (2007). Gradations in digital inclusion: Children, young people, and the digital divide. *New Media & Society, 9*(4), 671-696.

Low, R., & Sweller, J. (2005). The modality principle in multimedia learning. In Mayer, R. E. (Ed.), The Cambridge handbook of multimedia learning (pp. 147–158). New York: Cambridge University Press.CrossRefGoogle Scholar

Magwenzi, K. (2024)**.** *The Effectiveness of Online Learning Technologies in Zimbabwean Primary and Secondary Schools During the COVID-19 Pandemic (2020-2022).* Available at: CSUSB ScholarWorks.

Makombe, P., & Kudzai, T. (2020). Socioeconomic disparities in digital education access: The case of Zimbabwean primary schools. *Education and Information Technologies, 25*(6), 4921-4938.

Mapolisa, T., & Tshabalala, T. (2013). An investigation into the challenges faced by primary school teachers in implementing the new curriculum in Zimbabwe. *International Journal of Advanced Research, 1*(8), 1–6.

Maringe, F., & Prew, M. (2020). ICT in Zimbabwean education: Challenges and opportunities. *African Education Review, 18*(2), 134-148.

Maringe, F., & Sing, N. (2014). Technology and pedagogy: ICT and teaching in Zimbabwean schools. *Journal of Education and Practice, 5*(2), 123–131.

Marungudzi, C. (2022). The integration of indigenous knowledge in Zimbabwe's school curriculum. *Journal of African Educational Studies, 14*(2), 44-60.

Mautone, P. D., & Mayer, R. E. (2001). Signaling as a technique to enhance learning. *Journal of Educational Psychology, 93(2),* 377-389.

Mavhunga, P. (2020). Culturally responsive pedagogies for Zimbabwean primary schools. *Zimbabwe Journal of Educational Research, 32*(1), 45–58.

Mayer, R. E. (2005). Cognitive theory of multimedia learning. *The Cambridge Handbook of Multimedia Learning*, 31-48.

Mayer, R. E. (2005). *The Cambridge handbook of multimedia learning*. Cambridge University Press.

Mayer, R. E. (2009). *Multimedia Learning: Second Edition*. Cambridge University Press.

Mayer, R. E. (2014). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 43–278). Cambridge University Press.

Mayer, R. E. (2017). Using multimedia for e-learning. *Journal of Computer-Assisted Learning, 33*(5), 403–423. https://doi.org/10.1111/jcal.12189

Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge University Press.

Mayer, R. E., & Chandler, P. (2001). When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages? *Journal of Educational Psychology, 93*(2), 390–397. https://doi.org/10.1037/0022-0663.93.2.390

Mayer, R. E., & Fiorella, L. (2022). *The science of learning and development: Multimodal learning principles*. Routledge.

Mayer, R. E., & Jackson, J. (2005). The case for coherence in scientific explanations: Quantifying the effects of multimedia design. *Journal of Educational Psychology, 97*(4), 563–570. https://doi.org/10.1037/0022-0663.97.4.563

Mayer, R. E., & Johnson, C. I. (2008). Revising the redundancy principle in multimedia learning. *Journal of Educational Psychology, 100*(2), 380–390. https://doi.org/10.1037/0022-0663.100.2.380

Mayer, R. E., & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. *Journal of Educational Psychology, 90*(2), 312–320. https://doi.org/10.1037/0022-0663.90.2.312

Mayer, R. E., & Moreno, R. (2002). Aids to computer-based multimedia learning. *Learning and Instruction, 12(1)*, 107-119.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist, 38*(1), 43–52. https://doi.org/10.1207/S15326985EP3801_6

Mayer, R. E., & Pilegard, C. (2014). Principles for managing essential processing in multimedia learning: Segmenting, pre-training, and modality principles. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 316–344). Cambridge University Press.

Mayer, R. E., Bove, W., Bryman, A., Mars, R., & Tapangco, L. (2001). When less is more: Meaningful learning from visual and verbal summaries of science textbook lessons. *Journal of Educational Psychology, 93*(1), 182–198. https://doi.org/10.1037/0022-0663.93.1.182

Mayer, R. E., Fennell, S., Farmer, L., & Campbell, J. (2004). A personalization effect in multimedia learning. *Journal of Educational Psychology, 96(2),* 389-395.

Mayer, R. E., Moreno, R., Boire, M. E., & Vagge, S. (2005). Maximizing constructivist learning from multimedia communications by minimizing cognitive load. *Journal of Educational Psychology, 97*(1), 40–50. https://doi.org/10.1037/0022-0663.97.1.40

Mayer, R. E. (1989). Systematic thinking fostered by illustrations in scientific text. Journal of Educational Psychology, 81, 240–246.CrossRefGoogle Scholar

Mayer, R. E. (2001). Multimedia learning. New York: Cambridge University Press.CrossRefGoogle Scholar

Mayer, R. E. (2005a). Principles for managing essential cognitive processing in multimedia learning: Segmenting, pretraining, and modality principles. In Mayer, R. E. (Ed.), Cambridge handbook of multimedia learning (pp. 169–182). New York: Cambridge University Press.CrossRefGoogle Scholar

Mayer, R. E. (2005b). Principles for reducing extraneous processing in multimedia learning: Coherence, signaling, redundancy, spatial contiguity, and temporal contiguity principles. In Mayer, R. E. (Ed.), Cambridge handbook of multimedia learning (pp. 183–200). New York: Cambridge University Press.CrossRefGoogle Scholar

Mayer, R. E., & Anderson, R. B. (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. Journal of Educational Psychology, 83, 484–490.CrossRefGoogle Scholar

Mayer, R. E., & Anderson, R. B. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. Journal of Educational Psychology, 84, 444–452.CrossRefGoogle Scholar

Mayer, R. E., & Chandler, P. (2001). When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages? Journal of Educational Psychology, 93, 390–397.CrossRefGoogle Scholar

Mayer, R. E., & Jackson, J. (2005). The case for coherence in scientific explanations: Quantitative details can hurt qualitative understanding. Journal of Experimental Psychology: Applied, 11, 13–18.Google ScholarPubMed

Mayer, R. E., & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. Journal of Educational Psychology, 90, 312–320.CrossRefGoogle Scholar

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. Educational Psychologist, 38, 43–52.CrossRefGoogle Scholar

Mayer, R. E., & Sims, V. K. (1994). For whom is a picture worth a thousand words? Extensions of a dual-coding theory of multimedia learning? Journal of Educational Psychology, 86, 389–401.CrossRefGoogle Scholar

Mayer, R. E., Bove, W., Bryman, A., Mars, R., & Tapangco, L. (1996). When less is more: Meaningful learning from visual and verbal summaries of science textbook lessons. Journal of Educational Psychology, 88, 64–73.CrossRefGoogle Scholar

Mayer, R. E., Dow, G., & Mayer, S. (2003). Multimedia learning in an interactive self-explaining environment: What works in the design of agent-based microworlds? Journal of Educational Psychology, 95, 806–813.CrossRefGoogle Scholar

Mayer, R. E., Heiser, H., & Lonn, S. (2001). Cognitive constraints on multimedia learning: When presenting more material results in less understanding. Journal of Educational Psychology, 93, 187–198.CrossRefGoogle Scholar

Mayer, R. E., Mathias, A., & Wetzell, K. (2002). Fostering understanding of multimedia messages through pre-training: Evidence for a two-stage theory of mental model construction. Journal of Experimental Psychology: Applied, 8, 147–154.Google ScholarPubMed

Mayer, R. E., Mautone, P., & Prothero, W. (2002). Pictorial aids for learning by doing in a multimedia geology simulation game. Journal of Educational Psychology, 94, 171–185.CrossRefGoogle Scholar

Mayer, R. E., Moreno, R., Boire, M., & Vagge, S. (1999). Maximizing constructivist learning from multimedia communications by minimizing cognitive load. Journal of Educational Psychology, 91, 638–643.CrossRefGoogle Scholar

Mayer, R. E., Steinhoff, K., Bower, G., & Mars, R. (1995). A generative theory of textbook design: Using annotated illustrations to foster meaningful learning of science text. Educational Technology Research and Development, 43, 31–43.CrossRefGoogle Scholar

Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teachers College Record, 115*(3), 1-47.

Mhlanga, D. (2021). The role of STEM and vocational training in Zimbabwe's heritage-based curriculum. *Education and Development Journal, 25*(1), 34-51.

Mhlanga, D. (2021). The role of vocational training in Zimbabwe's competency-based curriculum. *Education and Development Journal, 25*(1), 34-51.

Mhlanga, D., & Moloi, T. (2020). COVID-19 and digital learning in Zimbabwe: Lessons and challenges. *Education and Information Technologies, 25*(6), 4893-4910.
Ministry of ICT. (2021). *Zimbabwe's National E-Learning Strategy 2021-2025*.

Ministry of Primary and Secondary Education (MoPSE). (2015). *Zimbabwe e-Learning Strategy*. Government of Zimbabwe.

Ministry of Primary and Secondary Education. (2017). *Curriculum Framework for Primary and Secondary Education 2015-2022.* Government of Zimbabwe.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Molnar, A. (2021). *The 2021 Virtual Learning Report: The Digital Shift in North American Schools*. Education Week Research Center.

Moreno, R. (2005). *Instructional technology: Promoting the learning of scientific concepts*. In L. H. Mayer & R. E. Mayer (Eds.), *The Cambridge handbook of multimedia learning* (pp. 183-202). Cambridge University Press.

Moreno, R., & Mayer, R. E. (2007). Interactive multimodal learning environments. *Educational Psychologist, 42*(4), 227-235. https://doi.org/10.1080/00461520701621058

Moreno, R. (2007). Optimizing learning from animations by minimizing cognitive load: Cognitive and affective consequences of signaling and segmentation methods. Applied Cognitive Psychology, 21, 1–17.CrossRefGoogle Scholar

Moreno, R., & Abercrombie, S. (in press). Promoting awareness of learner diversity in prospective teachers: Signaling individual and group differences within virtual classroom cases. Journal of Technology and Teacher Education.

Moreno, R., & Mayer, R. E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity. Journal of Educational Psychology, 91, 358–368.CrossRefGoogle Scholar
Moreno, R., & Mayer, R. E. (2000). A coherence effect in multimedia learning: The case for minimizing irrelevant sounds in the design of multimedia messages. Journal of Educational Psychology, 92, 117–125.CrossRefGoogle Scholar

Moreno, R., & Mayer, R. E. (2002a). Verbal redundancy in multimedia learning: When reading helps listening. Journal of Educational Psychology, 94, 156–163.CrossRefGoogle Scholar

Moreno, R., & Mayer, R. E. (2002b). Learning science in virtual reality multimedia environments: Role of methods and media. Journal of Educational Psychology, 94, 598–610.CrossRefGoogle Scholar

Moreno, R., Mayer, R. E., Spires, H. A., & Lester, J. C. (2001). The case for social agency in computer-based teaching: Do students learn more deeply when they interact with animated pedagogical agents? Cognition and Instruction, 19, 177–213.CrossRefGoogle Scholar

Morgan, D. L. (1997). *Focus groups as qualitative research* (2nd ed.). Sage.

Mousavi, S. Y., Low, R., & Sweller, J. (1995). Reducing cognitive load by mixing auditory and visual presentation modes. Journal of Educational Psychology, 87, 319–334.CrossRefGoogle Scholar

Moyo, S., & Hadebe, T. (2020). The role of teacher digital literacy in ICT integration in Zimbabwean schools. *Journal of Educational Technology & Society, 23*(3), 78-92.

Mtebe, J. S., & Raisamo, R. (2014). Investigating students' behavioural intention to adopt and use mobile learning in higher education in East Africa. *International Journal of Education and Development Using ICT, 10*(3), 4-20.

Munatsi, S., & Mupa, P. (2016). The effectiveness of multimedia learning tools in teaching mathematics in primary schools: A case study in Zimbabwe. *Journal of Educational Research and Practice, 6*(2), 101-114. https://doi.org/10.5590/JERAP.2016.06.02.01

Mupa, P., & Chikunda, C. (2018). *Teacher preparedness and the use of digital learning tools in Zimbabwean primary schools*. International Journal of Educational Technology, 12(3), 152-165.

Mushure, B. (2021). Digital learning platforms and primary education in Zimbabwe. *Journal of African Educational Studies, 9*(3), 67-84.

Musingafi, M. C. C., & Zebron, S. (2019). Challenges of integrating ICT in Zimbabwean primary education. *International Journal of Educational Development, 39*(1), 112-124.

Musonda, P. (2018). *Challenges to integrating technology in education in Zimbabwe*. International Journal of Education and Development, 9(4), 221-230.

Mutisya, P., & Makokha, E. (2022). Enhancing e-learning effectiveness in Sub-Saharan Africa: A case for localized content. *African Education Journal, 15*(1), 22-40.
Muzvidziwa, V. & Seotsanyana, M. (2021). National identity and citizenship education in Zimbabwe's heritage-based curriculum. *Journal of Social Studies Education in Africa, 9*(3), 22-38.
Mwangi, M., Mutai, P., & Waithaka, E. (2022). Digital learning in African primary schools: A policy perspective. *African Education Review, 19*(1), 78-99.

Ndlovu, E., & Sithole, N. (2021). Digital content localization for Zimbabwean schools: A necessity for effective learning. *African Journal of Educational Studies in Mathematics and Sciences, 17*(1), 55-69.

Nyagura, B. (2021). *The digital divide in Zimbabwean schools: Bridging the gap*. UNESCO Education Report.

Nyarufuka, T. D. (2018)**.** *Challenges in Implementing ICTs in Zimbabwean Schools*. Available at: StudyLib.

Nziramasanga, C. T. (1999). *Report of the Presidential Commission of Inquiry into Education and Training.* Government of Zimbabwe.

Odera, P. (2020). Language diversity and e-learning: The role of multilingual education in digital pedagogy. *International Journal of Educational Technology*, *8*(2), 45-59.

O'Neil, H. F., Mayer, R. E., Herl, H. E., Niemi, C., Olin, K., & Thurman, R. A. (2000). Instructional strategies for virtual aviation training environments. In O'Neil, H. F. & Andrews, D. H. (Eds.), Aircrew training and assessment (pp. 105–130). Mahwah, NJ: Erlbaum.Google Scholar

Otto, F., Wanjala, A., & Njoroge, P. (2021). *Digital learning for all: Overcoming challenges in sub-Saharan Africa*. World Bank Education Series.

Paas, F., & Sweller, J. (2014). Implications of cognitive load theory for multimedia learning. *In R. E. Mayer (Ed.), The Cambridge handbook of multimedia learning* (2nd ed., pp. 27–42). Cambridge University Press.

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. Educational Psychologist, 38, 1–4.CrossRefGoogle Scholar
Paivio, A. (1986). Mental representations: A dual coding approach. New York: Oxford University Press.Google Scholar

Pappas, C. (2015). The adult learner: Characteristics and best practices. *eLearning Industry*. Retrieved from https://elearningindustry.com

Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). Sage.

Penney, C. G. (1989). Modality effects and the structure of short-term memory. Memory & Cognition, 17, 398–442.CrossRefGoogle Scholar

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist, 50*(4), 258-283. https://doi.org/10.1080/00461520.2015.1122533

Pollock, E., Chandler, P., & Sweller, J. (2002). Assimilating complex information. Learning and Instruction, 12, 61–86.CrossRefGoogle Scholar

Puentedura, R. R. (2013). SAMR: A model for integrating technology into teaching. Retrieved from http://www.hippasus.com

Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu*. European Commission.

Rwezuva, S., Makanyanga, C., & Sunguro, S. (2022). Expanding access to quality education: The power of digital learning in Zimbabwe. UNICEF Zimbabwe. Retrieved from https://www.unicef.org/zimbabwe/stories/expanding-access-quality-education-power-digital-learning-zimbabwe

Salomao A. Understanding what is theoretical framework. Mind the Graph website. Accessed August 5, 2023. https://mindthegraph.com/blog/what-is-theoretical-framework/

Selwyn, N. (2011). *Education and Technology: Key Issues and Debates.* Bloomsbury Academic.

Selwyn, N. (2020). *Should Robots Replace Teachers? AI and the Future of Education*. Polity Press.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3-10.

Silverman, D. (2016). *Qualitative research* (4th ed.). Sage.

Sivapalan, K., & Lee, S. (2020). Ethical considerations in presenting grouped data: A review of privacy concerns. *International Journal of Social Research Methodology, 23*(3), 345-358. https://doi.org/10.1080/13645579.2020.1719872

Spradley, J. P. (2016). *Participant observation*. Waveland Press.

Stull, A. T., & Mayer, R. E. (2007). Learning by doing versus learning by viewing: Three experimental comparisons of learner-generated versus author-provided graphic organizers. *Journal of Educational Psychology, 99*(4), 808–820. https://doi.org/10.1037/0022-0663.99.4.808

Sun, J. C., & Rueda, R. (2012). Situational interest, computer self-efficacy, and self-regulation: Their impact on student engagement in distance education. *Distance Education, 33*(2), 159-173.

Sweeney, L. (2019). *Data privacy in the digital age: Ensuring confidentiality and preventing breaches. Journal of Information Security, 8*(2), 104-115. https://doi.org/10.1016/j.jinfosec.2019.03.003

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction, 4*(4), 295–312. https://doi.org/10.1016/0959-4752(94)90003-5

Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. *Educational Psychology Review, 22*(2), 123–138. https://doi.org/10.1007/s10648-010-9128-5

Sweller, J. (1999). Instructional design in technical areas. Camberwell, Australia: ACER Press.Google Scholar

Sweller, J. (2005). Implications of cognitive load theory for multimedia learning. In Mayer, R. E. (Ed.), Cambridge handbook of multimedia learning (pp. 19–30). New York: Cambridge University Press.CrossRefGoogle Scholar

Sweller, J., Chandler, P., Tierney, P., & Cooper, M. (1990). Cognitive load and selective attention as factors in the structuring of technical material. Journal of Experimental Psychology: General, 119, 176–192.CrossRefGoogle Scholar

Tashakkori, A., & Teddlie, C. (2003). *Handbook of mixed methods in social & behavioral research*. Sage.

Tindall-Ford, S., Chandler, P., & Sweller, J. (1997). When two sensory modalities are better than one. Journal of Experimental Psychology: Applied, 3, 257–287.Google Scholar

Tromp, D., & Meijers, M. (2021). Anonymity and privacy in qualitative research: An ethical challenge. *Ethics and Social Welfare, 15*(2), 198-213. https://doi.org/10.1080/17496535.2021.1880357

Trucano, M. (2015). *Technology and Education: What Works and What Doesn't?* World Bank Group.
U.S. Department of Education. (2020). *Reimagining the Role of Technology in Education: 2020 National Education Technology Plan*.

UNESCO. (2018). *ICT competency framework for teachers (Version 3).* United Nations Educational, Scientific and Cultural Organization.
https://unesdoc.unesco.org/ark:/48223/pf0000265721

UNESCO. (2019). *Embracing linguistic diversity in education: A global perspective*. Paris, France: UNESCO Publishing.

UNESCO. (2021). *Global Education Monitoring Report: Digital Learning in Africa*.
UNESCO. (2022). *Smart Classrooms and Digital Learning in Zimbabwe: A Policy Review*.
UNICEF Zimbabwe (2024)**.** *Expanding Access to Quality Education: The Power of Digital Learning in Zimbabwe*. Available at: UNICEF.

UNICEF. (2020). *Digital education in Zimbabwe: Bridging the gap*. Retrieved from https://www.unicef.org/zimbabwe/digital-education

UNICEF. (2020). *Reimagining education in Zimbabwe: A digital future*. United Nations Children's Fund. https://www.unicef.org/zimbabwe/reports

Unwin, T. (2005). Towards a framework for the use of ICT in teacher training in Africa. *Open Learning, 20*(2), 113–129.

Unwin, T. (2008). *ICT4D: Information and Communication Technology for Development.* Cambridge University Press.

Unwin, T., Weber, M., & de Freitas, S. (2018). The role of mobile learning in promoting sustainable development. *UNESCO Working Paper Series*.

Vinter, J., Runnel, P., & Reiska, P. (2021). Digital education strategies in Estonia: Lessons for the future. *Journal of Educational Technology & Society, 24*(3), 88-104.

Voogt, J., Knezek, G., Cox, M., Knezek, D., & ten Brummelhuis, A. (2018). Under which conditions does ICT have a positive impact on teaching and learning? *Educational Technology Research and Development, 66*(1), 51-56.

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes.* Harvard University Press.

Wanjala, P. (2020). *Bridging the digital divide in African education: Strategies for the future*.
Warschauer, M. (2004). Technology and social inclusion: Rethinking the digital divide.

Cambridge, MA: MIT Press.

Wiles, R., Crow, G., Heath, S., & Charles, V. (2017). *The management of informed consent in social research: A review of the literature*. *International Journal of Social Research Methodology*, *20*(3), 249-268. https://doi.org/10.1080/13645579.2016.1210999

Wittrock, M. C. (1989). Generative processes of comprehension. Educational Psychologist, 24, 345–376.CrossRefGoogle Scholar
Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker, J. F. (2006). Instructional video in e-learning:

Assessing the impact of interactive video on learning effectiveness. *Information & Management, 43*(1), 15–27.

Zhou, G., & Zvoushe, H. (2012). Utilisation of information and communication technology for education in Zimbabwe: Opportunities and challenges. *International Journal of Educational Technology, 3*(1), 20–32.

Zhu, E. (2019). Virtual reality and its role in education: A review. *Journal of Educational Technology Development and Exchange, 12*(1), 5-14.

Appendices

Appendix A - Permission letter

ANNEX 19 Form GRSD 17 SAD/ 02/2025
CHINHOYI UNIVERSITY OF TECHNOLOGY

RESEARCH ETHICS CLEARANCE LETTER

NAME OF RESERCHER: - Moleen Varaidzo Shumba

STUDENT ID NUMBER: C23155084P **ID Number**: 59-101662-L-44

SCHOOL OF ART AND DESIGN

APPROVED RESEARCH TITLE: Designing Transformational multimedia content for Zimbabwean Primary Digital Learners.

I hereby confirm that the above mentioned Researcher is a Postgraduate Researcher at Chinhoyi University of Technology. The proposed study met all the requirements as stipulated in the University Policies and Guidelines and has been approved by the relevant committees.
The proposal adheres to ethical principles as outlined by the University. Permission is hereby granted to carry out the research as described in the attached approved proposal.

The main objective of the research is: To evaluate accessibility and effectiveness of e-learning content resources in Zimbabwean primary school learners

Expected Outcome:-To design transformative multimedia content integrating technology and pedagogy for digital learning specifically for Zimbabwean primary school learners.

In addition, the Researcher is urged to adhere to international and national ethical guidelines and all requirements by Chinhoyi University of Technology.

CHINHOYI UNIVERSITY OF TECHNOLOGY
DIRECTORATE OF RESEARCH AND GRADUATE STUDIES
24 FEB 2025
PRIVATE BAG 7724
CHINHOYI, ZIMBABWE

Best Regards

Yours Faithfully

Dr. M. C. Mwando
Chairperson, University Research Committee - Research Ethics
Tel: +263 6721 22203-5
E-mail: - researchandgraduatestudies@cut.ac.zw

Date: 24/02/2025

Appendix B – Teachers' consent form

Title of study: Designing transformational multimedia Digital learning content for Zimbabwean primary school learners.

Researcher: Moleen Varaidzo Shumba

Institution: Chinhoyi University of Technology, School of creative Art and Design

Contact Information: +263773380352, moleenvarry@gmail.com

Dear Participant

You are invited to participate in a research study that aims to evaluate the effectiveness of E-learning content in Zimbabwean primary schools with the aim of designing transformational multimedia learning content.

The researcher will take part in your digital classroom experience in any mode you prefer. You will then be interviewed in a one on one interview as a key informant for approximately 20 minutes. The discussion will focus on your views, experiences and opinions related to digital learning in primary schools. With your permission, the interview will be audio recorded for accuracy

Your participation is voluntary and with no benefits promised. You may choose not to answer certain questions and you may withdraw from the study at any time without penalty. Your contribution will provide valuable insights that may improve e-learning strategies in Zimbabwe. All information you provide will be kept confidential. Your name will not appear in any report and data will be stored securely and used only for academic purposes.

I have read and understood the above information. I voluntarily agree to participate in this interview.

Participant's Name: ……

Participant's Sinature: ……

Date: ……...

Researcher's Signature: …….

Appendix C – Parental/Guardian Consent form for learners.

Title of study: Designing transformational multimedia Digital learning content for Zimbabwean primary school learners.

Researcher: Moleen Varaidzo Shumba

Institution: Chinhoyi University of Technology, School of creative Art and Design

Contact Information: +263773380352, moleenvarry@gmail.com

Dear Parent/Guardian

Your child is invited to participate in a focus group discussion and ethnographic research study that seeks to understand digital learning practices and how e-learning content affects learners' academic performance and engagement.

The researcher will take part in digital classroom experience during school time and the focus group discussions will be conducted in two groups of fifteen grade four learners. The focus group discussion will last for approximately 40 minutes where children will be asked about their experiences and opinions on E-learning. The discussion will focus on your views, experiences and opinions related to digital learning in primary schools. The session may be audio recorded with your permission for accuracy.

The participation of your child is voluntary. The student may stop participating at any time without any negative consequences. Your child's response will remain confidential and no names will be used on the reports or publications. Their contribution will provide valuable insights that may improve e-learning strategies in Zimbabwe.

I have read and understood the above information. I give permission for my child to participate in this focus group discussion.

Parent/Guardian's Name: ……

Signature: ……

Date: ……...

Child's name: ……..

Researcher's Signature: ……..

Appendix D - Key Informant Interview guide for teachers.

1. How long have you been teaching primary level students?
2. Have you received any formal training in digital learning or educational technology?
3. What digital devices are available for teaching in your school? (Access to ICT gadgets)
4. How frequently do you use the digital tools mentioned above in teaching? (Daily, Weekly, Occasionally, Never)
5. Are there any digital learning platforms with digital learning resources or tools that you use for your students? (Name them and describe the type of resources accessed)
6. How effective do you find digital learning in improving student engagement and understanding?
7. What challenges are you facing when implementing digital learning in your teaching?
8. How do your students respond to digital learning? Do they find it enjoyable and beneficial?
9. What digital content formats (videos, interactive exercises, e-books, games) do your students engage with the most?
10. Does your school provide adequate digital resources and internet access for teaching?
11. What level of support or training have you received from the school administration regarding digital learning?
12. What improvements do you think should be made to better support teachers in using digital learning tools?
13. How do you currently design or adapt your teaching materials for digital platforms?
14. What features do you think are essential for an effective digital multimedia learning content?
15. What type of content delivery do you think would best suit grade four digital learners?
16. Are there any cultural or contextual aspects that should be considered when designing digital content for Zimbabwean primary learners?
17. What improvements would you like to see in digital learning content for primary school students?(The nature of content they find effective for digital learning)
18. How can digital learning be made more inclusive for students with limited access to technology?
19. What role should teachers play in the development of digital learning materials?

Thank you for participating in this study!

Appendix E - Focus group discussion interview guide

General Information

- Gender of the participants: Girls ☐ Boys ☐
- Ages of the participant: 9 year olds ☐ 10 year olds ☐ 11 year olds ☐
- Give an Ice breaker while asking their favourite subject.

General experience with digital learning

1. Have you ever used a computer, tablet, or phone for learning? If yes, how did you use it?
2. Do you enjoy learning using digital devices? Why/why not?
3. What is the difference between learning on a device and learning in a classroom with a teacher?

Accessibility and frequency of digital learning

4. How often do you use digital devices for schoolwork? (Every day, once a week, rarely?)
5. Where do you mostly use digital learning?
6. Do you always have access to a computer, tablet, or phone when you need it for learning? If not, what challenges do you face?

Digital learning tools and content

7. What kind of digital learning applications, websites, or programs do you use?
8. Which digital learning activities do you enjoy the most? (Watching videos, playing educational games, doing quizzes, etc.)
9. Are there any digital learning tools that you find difficult or confusing to use? Why?

Challenges and barriers

10. Have you ever faced problems when using digital devices for learning? (e.g., slow internet, device not working, no electricity, difficult content, etc.)
11. Do you feel that your teachers and parents help you when you struggle with digital learning? How?
12. What do you wish could be improved to make digital learning easier or more fun for you?

Engagement and effectiveness

13. Do you feel that digital learning helps you understand school subjects better? Why or why not?
14. Do you find digital learning interesting and fun, or do you prefer traditional classroom learning?
15. If you could change anything about digital learning, what would it be?
16. Is there anything else you want to share about your experience with digital learning?

Appendix F - Observation Checklist for ethnography.

Users Demographics and context

a) Age group of participants
b) Level of digital literacy
c) Device used

Engagement and participation
d) Level of interaction with educational content
e) Participation in discussions

g) Response to interactive elements

Communication and Collaboration

h) Peer to peer interaction

I) Interaction with teachers

j) Use of collaborative tools

4. Learning behavior and navigation

k) Navigation on the platform

l) Customization or personalization of learning materials

m) Patterns in revisiting previous content for review

5. Accessibility & Technical Challenges

n) Availability of subtitles and transcripts
o) Software glitches, crashes, loading times
p) Ease of accessing content across different devices and browsers

q) Barriers to participation

6. Motivation and emotional response

r) Level of emotional engagement while using the platform

s) Indicators of distraction

t) Expressions of satisfaction with the learning experience

u) Completion rate of assignments and course modules

7. Learning Outcomes & Effectiveness

v) Application of learned knowledge in discussions or assignments

w) Evidence of skill improvement over time

x) Ability to recall and apply information from past lessons

y) Engagement in self-directed learning beyond the platform

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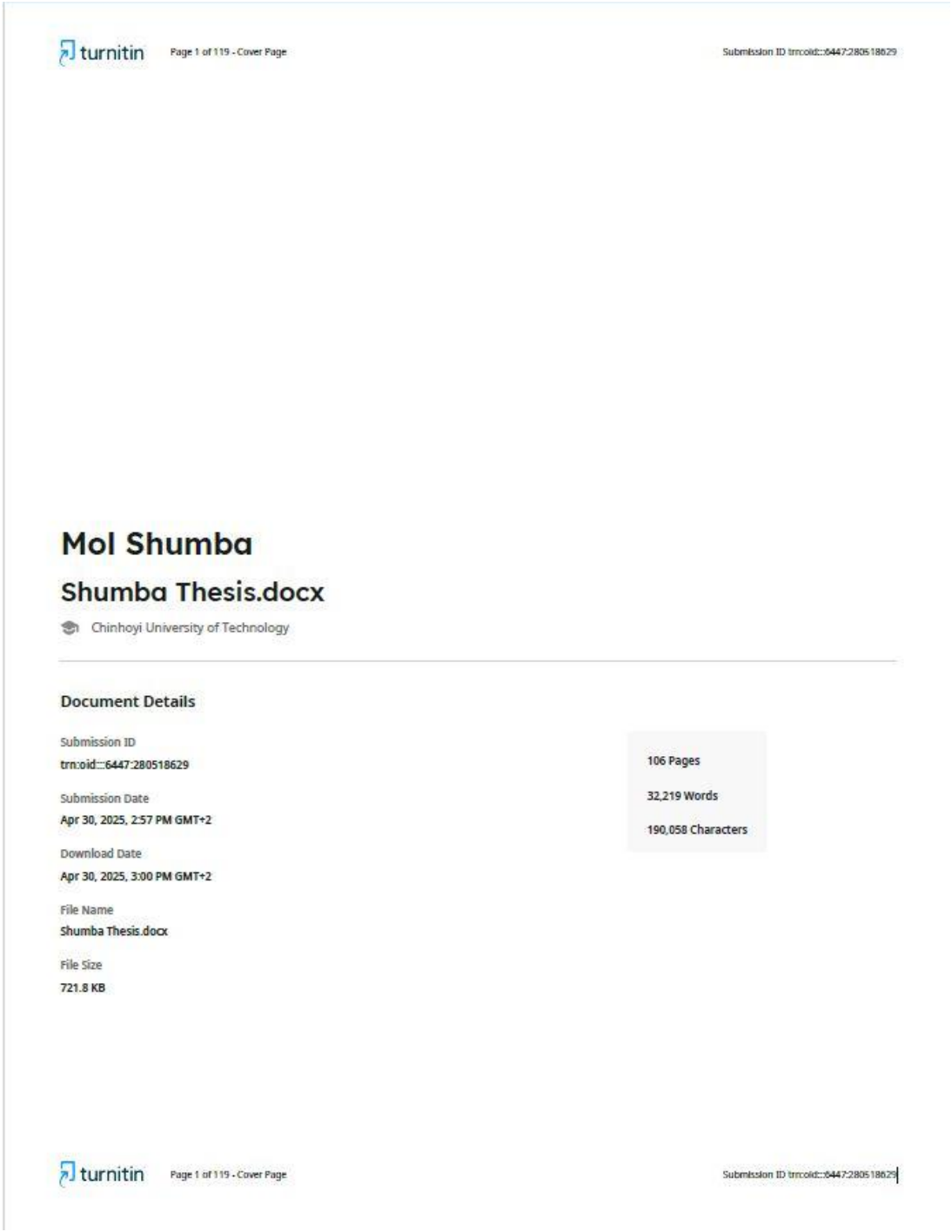

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