BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

Exploring the Impact of Mobile Learning Apps on Student Engagement and Motivation in Secondary School Biology Education at MAUYA ADVENTIST HIGH SCHOOL

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RELEASE FORM

Title of the dissertation: **Exploring the impact of mobile learning apps on student engagement and motivation in secondary school biology education at Mauya Adventist High School.**

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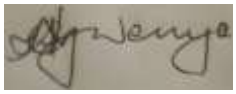

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APPROVAL FORM

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DEDICATION

This work is dedicated to my grandmother Mrs M Matanda, parents T&M Mambozi, C Homani, uncle The Matandas as well as my brothers Liberty and Asher. Without their support and encouragement, this work could not have been accomplished.

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ABSTRACT

The study aimed to explore the impact of mobile learning apps on student engagement and motivation at Mauya Adventist High School. The study utilized a mixed method research design, which allowed the researcher to ask in-depth questions on human behavior and have a comprehensive grasp of the issue from a holistic perspective. The design utilized a variety of data collection approaches. Purposive sampling was employed in the selection of heads of department and biology teachers, while stratified random sampling was employed in the selection of student respondents. Data were gathered using semi-structured interviews, observation guides, and questionnaires. Findings revealed that there are several negative factors like limited access to smartphones for all students, unstable internet connectivity, distractions from non-educational mobile content. The study recommends that there should be investment in digital infrastructure, including equitable device access and reliable internet connectivity, is critical to bridging socioeconomic gaps in mobile learning adoptio

CHAPTER 1

1.1 Introduction

Mobile learning—defined as the use of portable devices such as smartphones and tablets to access educational content—has emerged as a transformative force in modern education. In the context of secondary school biology, mobile learning offers dynamic, interactive resources that can make complex scientific concepts more tangible. By incorporating multimedia elements, gamified activities, and real-time feedback, mobile learning environments have the potential to significantly enhance student engagement and motivation (Ostashewski and Reid, 2013; Kapp, 2014).

This study focuses on exploring how mobile learning impacts student engagement and motivation in biology classes particularly through purpose built educational apps. Engagement is not merely a measure of attention but includes the cognitive, behavioral, and emotional investment of students in the learning process (Fredricks, Blumenfeld and Paris, 2004). Motivation, often explained through frameworks such as Self-Determination Theory (Ryan and Deci, 2000), is a critical factor influencing students' willingness to persist and succeed academically. With mobile learning, students are afforded a personalized and interactive learning experience that can cater to their individual learning styles via apps tailored to biology curricula, thereby fostering intrinsic motivation and a deeper connection with the subject matter. This chapter sets the stage by outlining the context and significance of investigating these relationships in secondary school biology education.

1.2 Background to the Study

Globally, educational institutions are increasingly integrating mobile learning strategies to address the evolving needs of the digital age. In biology education, mobile devices provide students with access to interactive simulations, digital laboratories using educational apps like(bioman, khan academy, and visible body) and multimedia content that transform traditional, teacher-centred methods into more engaging, student-centred experiences (Kapp, 2014; Chang and Hwang, 2019

Zimbabwe, efforts to modernize the education system include the introduction of a competence-based curriculum designed to foster critical thinking, problem-solving, and creativity (Chivaura and Chikodzi, 2017). However, despite national policies aimed at integrating ICT into classrooms, many secondary schools—particularly in rural areas—continue to struggle with limited ICT infrastructure, insufficient teacher training, lack of access to subject specific educational apps and a pronounced digital divide (Muzurura et al., 2021; UNESCO, 2020). These challenges often result in low levels of student engagement and motivation, particularly in subjects such as biology that rely heavily on visual and interactive learning methods.

While some urban schools have begun to experiment with mobile learning tools such as biology master apps and you tube educational apps to enhance biology instruction, the impact of such interventions on student engagement and motivation remains underexplored in resource-constrained settings. As mobile learning has been linked to improved academic outcomes and greater student autonomy (Ryan and Deci, 2000), it is imperative to assess its effectiveness in secondary school biology classes within the unique challenges faced by Zimbabwean schools.

Despite the promising potential of mobile learning to revolutionize biology education, there is a significant gap in understanding its impact on student engagement and motivation in secondary schools, especially in contexts where resources are limited. Although mobile learning applications can offer interactive content and personalized learning experiences that are designed to boost engagement, several challenges persist. In rural Zimbabwean schools, issues such as inadequate ICT infrastructure, a shortage of trained teachers limited awareness of pedagogical apps, and limited access to mobile devices hinder the effective integration of mobile learning strategies (Muzurura et al., 2021; UNESCO, 2020).

1.3 Statement of the Research Problem

While mobile learning include apps like google classroom and quizlet is heralded as a means to make biology more accessible and engaging, its actual effect on enhancing students' engagement and intrinsic motivation remains unclear. This study, therefore, aims to investigate the extent to which mobile learning influences student engagement

and motivation in secondary school biology education. By identifying the key obstacles and facilitators in implementing mobile learning and app based intervention within this context, the research will provide insights into how educational practices and policies can be adapted to maximize the benefits of technology-enhanced learning.

1.4 Research questions

1. How do mobile learning apps impact student engagement levels during biology lessons?

2. What is the effect of mobile learning practices on students' motivation to grasp biology concepts?

3. Is there a significant correlation between the use of mobile learning apps and students' academic performance in biology classes?

1.4 Research Objectives

1) To examine the effectiveness of mobile learning apps in enhancing student engagement in biology.

2) To investigate the influence of mobile learning on students' motivation to learn biology concepts.

3) To analyze the relationship between mobile learning practices and students' academic performance in biology.

1.5 Assumptions of the Study

Baseline Technological Familiarity: It is assumed that both teachers and students possess a basic level of digital literacy and can navigate educational apps which are familiar with operating mobile devices. This familiarity is essential for the effective use of mobile learning applications (Ostashewski and Reid, 2013).

Positive Perceptions: The study assumes that mobile learning and apps based pedagogy have the inherent potential to foster greater engagement and intrinsic motivation in learners, provided that the tools are used appropriately and are aligned with curricular goals (Ryan and Deci, 2000).

Supportive Learning Environments: It is presumed that the schools involved in the study have at least minimal ICT infrastructure to support app bsed learnimg that permits the use of mobile learning systems. Although challenges exist—especially in rural settings—there is a basic availability of devices and internet connectivity to allow for such interventions.

Teacher Competence: The research assumes that teachers are open to and willing to adopt new teaching methodologies and that any training provided will sufficiently equip them to integrate mobile learning into their biology lessons.

1.6 Significance of the Study

Enhancing Educational Practices: By examining the impact of mobile learning on engagement and motivation, the study offers insights that can help transform biology teaching from a traditionally teacher-centred approach to a more interactive, student-centred model.

Informing Policy and Curriculum Development: The findings will provide empirical evidence that can guide educational policymakers and curriculum developers in designing and implementing technology-enhanced learning strategies. This is especially crucial for contexts facing resource and infrastructure challenges (Chivaura and Chikodzi, 2017).

Bridging the Digital Divide: Given the disparities in technology access between urban and rural schools, the study highlights key barriers to mobile learning adoption. Addressing these barriers is essential for promoting equity in educational opportunities.

Supporting Teacher Professional Development: The study underscores the importance of equipping teachers with the skills and knowledge necessary to integrate mobile learning effectively. This has broader implications for professional development initiatives aimed at modernizing teaching practices.

Improving Student Outcomes: Ultimately, enhancing student engagement and motivation through mobile learning can lead to improved academic performance and a deeper understanding of biology concepts, which is vital for preparing students for the demands of the digital age.

1.7 Delimitation of the Study

Geographical Focus: The research is confined to secondary schools within a selected region in Zimbabwe. While both urban and rural settings are considered, the primary focus is on addressing challenges in resource-constrained environments.

Subject-Specific Investigation: This study centers exclusively on biology education. It does not address mobile learning impacts on other subjects.

Population Parameters: The study involves secondary school biology teachers and their students. It does not extend to pre-school or tertiary education settings.

Time Frame: Data collection is limited to one academic term, providing a snapshot of the mobile learning intervention's impact during that period.

Methodological Scope: The study employs mixed-methods (quantitative surveys and qualitative interviews), and while this offers a broad view of engagement and motivation, it may not capture all nuances that long-term longitudinal studies could reveal.

1.8 Limitations of the Study

Sample Size and Generalizability: Due to resource constraints, the study's sample size is relatively small. As such, the findings may not be generalizable to all secondary schools in Zimbabwe or to other educational contexts.

Self-Reported Data: Much of the data on student engagement and motivation is self-reported, which could introduce response biases.

Infrastructure Variability: The variability in ICT infrastructure among participating schools, particularly between urban and rural settings, might affect the consistency of mobile learning implementation.

Short-Term Evaluation: The study evaluates the impact of mobile learning over a single term, limiting insights into long-term effects on student engagement and motivation.

Teacher Proficiency: Differences in teacher proficiency with mobile technologies may influence the outcomes, and the study assumes a basic level of digital literacy that may not be uniformly present.

1.9 Definitions of Key Terms

Mobile Learning (m-learning): A mode of learning that occurs via mobile devices (e.g., smartphones, tablets), enabling learners to access educational content anytime and anywhere (Ostashewski and Reid, 2013).

Student Engagement: A multidimensional construct reflecting the cognitive, emotional, and behavioral involvement of students in the learning process (Fredricks, Blumenfeld and Paris, 2004).

Motivation: The internal drive that propels students to initiate and persist in learning activities. It is often categorized into intrinsic (self-driven) and extrinsic (reward-driven) motivation (Ryan and Deci, 2000).

Digital Divide: The gap between individuals who have access to modern information and communication technologies and those who do not, often leading to inequitable educational opportunities.

ICT Infrastructure: The collective hardware, software, networks, and support systems necessary to facilitate digital learning in educational settings.

Competence-Based Curriculum (CBC): A curriculum framework that emphasizes the development of critical competencies—including problem-solving, critical thinking, and creativity—over rote memorization (Chivaura and Chikodzi, 2017).

1.10 Chapters Layout

Chapter 1: Introduction and Context: Presents the problem statement, background, research objectives, assumptions, significance, delimitations, limitations, key definitions, and an overview of the chapter layout.

Chapter 2: Literature Review: Reviews relevant literature on mobile learning, student engagement, motivation theories, digital literacy, and challenges specific to biology education.

Chapter 3: Research Methodology: Describes the mixed-methods approach, detailing the research design, data collection instruments, sampling procedures, and data analysis techniques.

Chapter 4: Results and Findings: Presents quantitative and qualitative data findings, analyzing the impact of mobile learning on student engagement and motivation in biology.

Chapter 5: Discussions, Conclusion and Recommendations: Interprets the findings in light of existing theories and literature, discusses the implications for educational practice, and suggests recommendations for policymakers and educators. Summarizes the study's key findings, outlines the contributions to knowledge, discusses limitations, and offers recommendations for future research and practice.

1.11 Chapter Summary

Chapter 1 lays the foundational framework for the study by establishing the research context and clearly articulating the rationale behind exploring the impact of mobile learning on student engagement and motivation in secondary school biology education. This chapter introduces the study's research objectives, the assumptions underpinning the research, and its significance to various stakeholders including educators, policymakers, and students. It also delineates the boundaries of the study (delimitations) and acknowledges inherent limitations that may affect the generalizability and depth of the findings. Key terms such as mobile learning, student engagement, motivation, digital divide, and ICT infrastructure are defined to ensure clarity. Finally, the chapter outlines the overall structure of the report, providing a roadmap for the subsequent chapters. This comprehensive introduction sets the stage for a detailed investigation

that aims to inform and enhance educational practices through effective mobile learning integration.

CHAPTER 2

2.1Introduction

The advent of mobile technology has transformed various facets of education, prompting a shift towards mobile learning (m-learning) environments. This literature review examines the effectiveness of mobile learning tools in enhancing student engagement within secondary school biology education, focusing on three main research questions: the impact of mobile learning tools on student engagement, the influence of these tools on students' motivation to learn biology concepts, and their correlation with academic performance in biology.

2.2Engagement in Education

Learning engagement is a priority and has critical impact on any learning environment significantly impacts educational outcomes via platforms like whatsApp (Appleton et al., 2006). Even though the phrase ‘student engagement’ is a dynamic, diverse, and complicated meta construct many researchers have described and defined it as students making attempts to participate during the learning process, while "student engagement" is a multifaceted and complex construct (Fredricks et al., 2004), it generally refers to students’ efforts to participate in the learning process using apps like Biology Master and Visible Biology (Marks, 2000; Skinner & Belmont, 1993). This effort can be observed by any number of behavioral, cognitive, social, and emotional indicators. There is an ongoing investigation of the engagement processes in education, where some talk about three components of engagement (emotional, cognitive, and behavioral), while others talk about four components, and others add social engagement . According to research by (Henri et al 2010) there are four dimensions of student engagement: emotions, cognitions, behaviors, and social aspects. Both institutional and individual factors can affect these dimensions.

To shed light on the significance of student engagement, (Pham and Chen 2015) mention that engagement is a pathway to facilitating success. Similarly, (Dunn and Kennedy 2017) argue that students’ level of engagement in educational settings is

directly related to their advancement in the classroom. According to them, nothing may help students to improve academically more than taking an active role in the classroom. An association between engagement and achievement is also stated since it influences retention. Furthermore, learning engagement is demonstrated by Engagement also influences knowledge retention, with students demonstrating involvement through discussions and collaborative work to deepen their understanding using apps like Complete Biology and Labster (Duncan et al., 2020).

2.3 Engagement in Mobile Learning

Mobile learning offers substantial opportunities for meaningful engagement in educational experiences. Prior studies indicate that smartphones and laptops motivate students to participate actively in online courses, even if they are hesitant to ask questions in face to face classes due to social concerns (Wang et al., 2017). Moreover, smartphones enable students to maintain communication with peers, allowing them to pose educational queries through social interaction platforms using apps like kahoot and whatsapp (Vogt & O'Hara, 2019). It also enhance accessibility using apps like biology master that allows offline access to lessons and quizzes, enabling self paced learning even in low connectivity areas.

Researchers interested in mobile learning have explored applications like Udemy, LinkedIn Learning, and Coursera, noting their potential to enhance learner engagement among students (Mihaila et al., 2020). (Heflin et al. 2017) examined the effectiveness of mobile learning tools in promoting critical thinking and engagement through collaborative learning environments. Positive feedback from students indicated enhanced engagement during lessons facilitated by mobile collaborative activities. Additionally, mobile learning strategies have shown to positively impact motivational and emotional engagement among students, particularly when innovative gaming mobile applications are utilized (Hwang et al., 2020). Although there are many studies on mobile learning tools and student engagement there is need for research on how socioeconomic factors affect engagement.

2.4Influence of Mobile Learning on Student Motivation

One of the most significant advantages of cellphone integration is the access to a vast range of educational resources. With smartphones, students can explore online libraries,

research databases, and educational apps that provide a wealth of information and learning. One of the primary advantages of mobile learning is its ability to provide personalized learning experiences. Mobile applications can adapt content to meet individual learning styles, preferences, and pace.This level of personalization boosts motivation, as students feel their unique needs are being addressed, leading to a greater sense of ownership over their learning journey. Moreover mobile learning tools frequently provide instant feedback on quizzes, assignments, and practice exercises. This immediate response mechanism is vital for maintaining student motivation. When students receive quick feedback on their performance, they can identify areas of strength and weakness and adjust their study strategies accordingly. According to research, timely feedback not only enhances learning but also reinforces students' sense of achievement, making them more inclined to continue investing effort into their education (Zheng et al., 2016). In addition mobile learning fosters accessibility, allowing students to access educational resources anytime and anywhere. This flexibility enables learners to engage with materials at their convenience, catering to diverse schedules and learning environment. Furthermore mobile learning promotes collaboration among students through features that enable social interaction, such as chat functions, discussion forums, and group projects. These collaborative opportunities allow students to work together, share ideas, and support one another in their learning endeavors. Social interaction can enhance motivation by creating a sense of community and belonging, crucial for student engagement. When students collaborate with their peers, they feel motivated to participate actively, as they not only learn from the material but also from each other. The sesearch is needed on weather there is a rise on motivation when gamified apps are intergrated.

2.5 Relationship between Mobile Learning Practices and Academic Performance

The study discusses the results within the context of the effect of smartphone addiction on learning environments and individuals. Ultimately, it should be noted that smartphone addiction can have a variety of detrimental effects on learning environments and individuals, as well as on social relationships, academic performance, cyber loafing, self regulation, and general self efficacy. Students are constantly

connected, frequently checking and using their mobile devices, thanks to the widespread availability of digital devices and internet access (Labăr & Ţepordei, 2019). They are the most convenient device and typically have an internet connection, smartphone users are more susceptible to what some have called "smartphone addiction." It is therefore reasonable to assume that their routines will continue in the workplace or in the classroom. The most fascinating and troubling finding from a plethora of research is that students often use technology primarily for social and recreational purposes, which negatively impacts their overall academic performance and socio emotional functioning, rather than utilizing it to improve the quality of their academic achievement. (Bowman et al. 2010) explored the impact of instant messaging during reading in the early days of gadget use negative relationships between the two practices throughout the studies involved in the meta-analysis, further strengthening the claim that gadgets have negative influence in a classroom setting. However, (Krisnan et al. 2022) challenged this through their findings, which show that gadgets can provide positive supports in students' learning experiences. There are studies, which suggested that the use of technology in classrooms could interfere with classroom learning and negatively affect academic performance. (Urien 2024) highlighted that the constant checking of mobile phones disrupts the flow of instruction. This can affect students' understanding and retention in the process of learning, ultimately affecting their academic performance (Urien, 2024). Additionally, (Gath 2024) supported this claim by stating that the increased use of gadgets especially mobile phones often leads to distractions in students' learning process. Ultimately, if the use of gadgets is not controlled, it may lead to various implications on students' academic results thus affecting their future (Passah et al 2013)

However, there are also advantages in the relationship between mobile learning practices and academic performance. The relationship between mobile learning

practices and academic performance in biology is multifaceted. (Xu et al. 2017) conducted a quantitative analysis that demonstrated a significant correlation between the usage of mobile learning tools and improved academic outcomes in biology. Their research indicated that students who frequently employed mobile applications for study purposes achieved higher grades than their peers who relied solely on traditional

learning methods. Further support is provided by (Alharbi and Alhussein 2020), who found that mobile learning positively affected students' understanding of biology concepts, indicating that improved comprehension may translate into better academic performance. This section explores how mobile learning impacts academic performance through various dimensions, including engagement, personalized learning, access to resources, and study habits.However there is still need for a research on how resources limitations affect student motivation and engagement.

2.6 SUMARY

Mobile learning presents significant potential for transforming biology education by increasing engagement, motivation, and academic performance. However, its effectiveness depends on balanced implementation, addressing potential drawbacks such as smartphone addiction and distractions. Future research should explore socioeconomic influences, the role of gamification in motivation, and strategies to mitigate digital disruptions in learning. By refining mobile learning practices, educators can harness its full potential to enhance student outcomes in secondary school biology.

CHAPTER 3

3.1 INTRODUCTION

This chapter describes the research methodology. The description will comprise of research design, population, sample and data generating instruments. Data generation procedures, presentation and analysis.

3.2Research design

Research design is the "overall plan or strategy that guides the process of conducting research, including data collection, measurement, and analysis to address the research problem" (Creswell & Creswell, 2018, p. 53). According to (Saunders et al. 2019), research design is "a coherent strategy for gathering and analyzing data to ensure that the study effectively addresses the research questions while maintaining reliability and validity." Thus, research design refers to the the plan or strategy uses to conduct a research. The function of research design is to acts as a roadmap, outlining procedures for data collection and analysis (Creswell & Creswell, 2018). It ensures logical coherence and efficiency in conducting research. In this study, the researcher used qualitative and quantitative research design (Creswell & Poth, 2018, p. 4). Defined qualitative research design as "an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell & Poth, 2018, p. 4). Mixed method research design was suitable for this study as it enables the researcher to obtain gather in depth information on the impact of mobile learning on student engagement and motivation at Mauya Adventist High School.

3.3 POPULATION AND SAMPLE

Cohen and Manion (2011) define population as a complete set of elements that possess some common characteristics defined by the sample criteria established by the researcher. The population of this study consisted of some form 3, form 4 and form 5

students studying biology, all biology teachers and biology head of departments at Mauya Adventist High School. Random Sampling technique and purposive sampling technique were used to select participants in this research. A sample is a subset of a population used to draw conclusions about the broader group (Creswell, 2014). Random Sampling Technique were used to minimizes bias and ensures that the sample represents the population accurately, allowing researchers to generalize findings with confidence. The researcher divided pupils into two groups basing on sex from which 20 boys and 20 girls per each stream are selected using simple radom sampling.
Purposive sampling will be used to select teachers that will participate in the research. The main goal is purposive sampling is to focus on biology teachers only which can give best response to questions and they have experience as they teach the subject. 10 teachers including biology heads will be selected to be part of the research at Mauya Adventist High School.

3.4 Research Instrument

A research instrument is a tool or method used to systematically collect, measure, or analyze data in alignment with research objectives on app specific usage(Creswell, 2014). In this study the researcher used sem-interviews, surveys and observations schedule to generate data.

3.5 Semi-structured interviews

(Anderson 2011) defines a semi-structured interview as a pre-planned set of questions used as a guide during the interview process. In this study, semi-structured interview guides were employed to gather information from key informants Biology heads of departments, Biology teachers, and form 3,4,5 Biology students regarding on the impact of mobile learning on student engagement and motivation on app usage at Mauya Adventist High School. The use of semi-structured interviews proved beneficial in several ways. As Chiromo (2009) notes, they facilitated immediate feedback and a high response rate. Furthermore, (Cohen & Manion 2011) highlight their efficiency, allowing for data collection from a relatively large sample within a shorter timeframe. The data obtained through these interviews were easily quantifiable, and the flexible nature of the format allowed for adjustments to the question sequence and probing for

deeper clarification, as noted by the researcher. (Creswell 2009) points out that semi-structured interviews capture both verbal and nonverbal cues, which in this case, aided in gaining a comprehensive understanding of personal feelings, perceptions, and opinions related to the issues discussed. Moreover, as (Chiromo 2009) emphasizes, interviews are a valuable method for generating primary data.

To ensure the validity of the interviews, the researcher took measures to create a comfortable and open environment for the respondents. This involved consulting with them to determine a suitable venue and convenient time for the interview. Additionally, appointments were scheduled in advance to allow respondents to prepare, which (Cohen and Manion 2011)

3.6 Observation schedule

Observations were conducted during lessons and discussions, with participants unaware they were being observed. This participatory approach aimed to avoid the Hawthorne effect, where awareness of observation alters behavior (Chiromo, 2009). This technique allowed for realistic data collection on the impacts of mobile learning on student engagement and motivation at Mauya Adventist High School. It also enabled studying the phenomena in its natural setting, where data recorded as events occur is more reliable (Chiromo, 2009). Participant observation provided insights into contexts, relationships, and behaviors relevant to the study (Matsa, Mutekwa & Marambanyika, 2015).

3.7 Surveys.

Surveys are fundamental component of research methodology, utilized across various disciplines to gather data and insight from targeted population. Accoding to (Flower 2014) a survey is a research method used to systematically collect data from predefined group of respondents (a sample or population) to gather information, opinions or insight about a specific topic. Surveys helps in decision making as it provide evident based insight that help organization make in formed decision. Surveys reduce social desirability bias as learners feel more comfortable providing honest answers on sensitive topics.

3.8 Data presentation

Data presentation involves summarizing the key features of a dataset in a clear and accessible way (Cohen & Manion, 2011). Information gathered from interviews, observations, and document analysis was organized and displayed using graphs and tables. This presentation format facilitates easy understanding of the study's findings. Microsoft Excel was used to compile and organize the data.Data analysis is the process of examining, transforming, and modeling data to uncover useful information, insights, and conclusions (Galeto, 2017). Essentially, it's about interpreting information and extracting meaning by addressing questions about past, present, and future events.Given the qualitative and quantitative nature of the data in this study, thematic analysis was employed. (Braun and Clarke 2015) define thematic analysis as a method for identifying, analyzing, and reporting patterns within data. This approach was chosen for its commonality in qualitative and quantitative data analysis, its emphasis on pinpointing and explaining patterns or themes (Braun & Clarke, 2015), and its ability to provide insight and knowledge from the data.

Thematic analysis was also selected for its simplicity, clarity, and straightforwardness, requiring no complex theoretical details or technical expertise (unlike discourse or conversational analysis). Its flexibility, allowing use within different frameworks to answer diverse research questions (Guest & Namey, 2012), enabled detailed and complex data description. Furthermore, it suited questions related to people's experiences, views, and perceptions (Philips & Pugh, 2011). Thematic analysis facilitated a deeper understanding on the impact of mobile learning on student engagement and motivation at Mauya Adventist High School, moving from a broad reading of data to discovering patterns and framing a specific research question. The results are discussed descriptively, referencing reviewed literature. The data is interpreted on the impact of mobile learning on student engagement and motivation.

3.9 Data management

Data management, as defined by (Isaac 2015), encompasses the organization, preservation, and sharing of data generated and utilized in a research project. (Galeto 2015) further explains it as an administrative process involving acquiring, validating, storing, protecting, and processing data to ensure its accessibility, reliability, and

timeliness for users. In this study, data was managed by creating backups on flash drives and an external hard drive, ensuring effective data management.

3.9.1ETHICAL CONSIDERATIONS

Ethical considerations are norms that guide the researcher in conducting a study (Chiromo, 2009). This research upheld the highest level of ethics in the following:

3.9.2 Informed Consent

Prior to proceeding with participation, the researcher obtained clear consent from all the respondents. The participants were also informed verbally that the exercise was completely voluntary and that they could withdraw at any time without punishment (Chiromo, 2009; Louise, Day, & Gill, 2017). The purpose of the study, why they were chosen, and how the results were to be utilized were explained (Chiromo, 2009). Recording by audio or video alone was done only with the explicit consent of participants, in openness and voluntariness throughout the research process (Chiromo, 2009). The approach respected participants' autonomy and freedom.

3.9.3copponfidentiality

The confidentiality and privacy rights of the participants were upheld in strict compliance by the researcher, particularly where it concerned sensitive data. Participants were guaranteed that they would handle their responses with utmost confidentiality (Chiromo, 2009). Participant-submitted information was viewed by only the research team. As Cohen and Manion (2011) emphasize, privacy measures should be relied upon; otherwise, participants will provide mistaken or partial information, rendering the research invalid. Information obtained was not disclosed to any individual outside the research.

3.9.4 Anonymity

Participant identities remained anonymous throughout the study. Where identification was unavoidable, pseudonyms or codes replaced actual names (Chiromo, 2009). Anonymity was hence maintained and ensured that participants were free to express themselves without intimidation by the fear of victimization.

3.9.5 Deception

Deception, or the intentional provision of false or incomplete information to mislead participants (Chiromo, 2009), was not employed in this study. The researcher explicitly informed the participants of the true purpose of the study and revealed their own identity in an attempt to foster trust (Cohen & Manion, 2009). To guarantee full understanding and willing participation, especially among pupils, the study's purpose was explained orally in the language of the participants.

3.9.6 Protection from harm

The researcher placed the highest priority on not causing harm to participants physically, socially, emotionally, or spiritually (Chiromo, 2009). All potential impacts of the research were carefully weighed, trading off any risks against appropriate benefits (Burns & Grove, 2008). Participants were not forced or pressured into revealing information. Given that some participants were minors (students), they received their parents' consent prior to participating in the

3.10 Summary

This chapter outlines the research methodology employed in the study, covering the research design, population and sample selection, data collection instruments, data generation procedures, presentation and analysis methods, and ethical considerations. A mixed method research design was chosen to explore the impact of mobile learning on student engagement and motivation at Mauya Adventist High School. This design facilitates in-depth information gathering. The study population consisted of Form 3, 4, and 5 Biology students, all Biology teachers, and Biology heads of departments at Mauya Adventist High School. Participants were selected using random and purposive sampling techniques. Random sampling was used to select students, ensuring representation across gender. Purposive sampling was used to select experienced biology teachers and heads of departments who could provide valuable insights. Data was collected through semi-structured interviews, surveys, and observations. Semi-structured interviews allowed for flexible questioning and in-depth exploration of factors contributing to low Biology pass rates. Observations were conducted unobtrusively to minimize the Hawthorne effect. Data presentation involved summarizing key features using graphs, charts, and tables, compiled using Microsoft Excel. Thematic analysis was used to analyze the qualitative data, identifying and interpreting patterns and themes related to the research questions.Data management

involved creating backups on flash drives and an external hard drive to ensure data security and accessibility.

CHAPTER 4

Data Presentation, Analysis and Interpretation

4.1 Introduction

This chapter presents the data collected during the study, analyses the findings, and interprets them in relation to the research objectives and literature reviewed. Both qualitative and quantitative data were gathered through surveys, interviews, and classroom observations conducted in selected secondary schools. The analysis aims to uncover the impact of mobile learning on student engagement and motivation in biology education.

4.2 Demographic Profile of Respondents

A total of 120 students and 10 biology teachers participated in the study. The demographic variables considered include gender, age, grade level, and prior exposure to mobile learning tools.

Table 4.1: Gender Distribution of Students

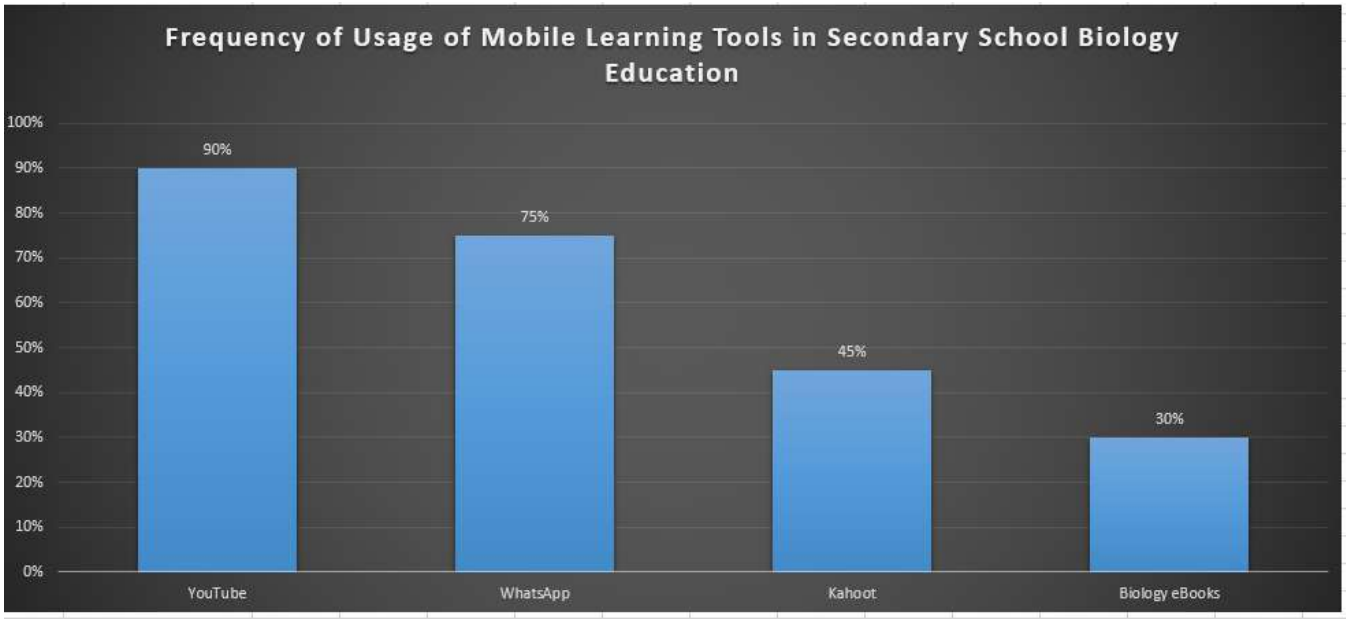
	Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	64	53.3	53.3	53.3
	FEMALE	56	46.7	46.7	100
	Total	120	100.0	100.0	

The gender distribution was relatively balanced, ensuring gender neutrality in the analysis.

4.3 Mobile Learning Usage in Biology

Respondents were asked to indicate the types of mobile tools used during biology lessons. These included mobile phones, tablets, educational apps and e-books.

Figure 4.1: Types of Mobile Learning Tools Used



The majority of students (90%) indicated they frequently used YouTube videos to supplement biology lessons, while 75% utilized WhatsApp study groups.

4.4 Student Engagement

Student engagement was assessed using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Key indicators included participation in mobile quizzes, collaboration in group chats, and consistency in accessing digital content.

Table 4.2: Mean Scores of Engagement Indicators

Indicator	Mean Score
Participation in mobile quizzes	4.3
Use of mobile apps to ask questions	4.1

Collaboration in WhatsApp groups	4.5
Accessing lessons at home	4.2

These results suggest that mobile learning significantly enhanced engagement, particularly in collaborative learning environments.

4.5 Motivation toward Biology Learning

Students were also asked about their motivation levels before and after the integration of mobile learning.

Table 4.3: Student Motivation Pre- and Post-Mobile Learning

Motivation Aspect	Pre-Mobile Learning (Mean)	Post-Mobile Learning (Mean)
Interest in Biology	3.2	4.4
Interest in Biology	2.3	4.4
Time spent revising	2.8	4.1
Willingness to participate	3.0	4.5

The findings show a notable improvement in students' attitudes towards biology. This supports the assertion by Kucirkova and Flewitt (2020) that mobile learning environments enhance learner autonomy and motivation.

4.6 Teacher Observations

Teachers reported improvements in class participation and student curiosity.

Quote from Teacher1

Since we started using mobile videos, more students now ask questions and follow up on lessons outside class hours. A total of 120 students participated in the mobile learning intervention. Survey results revealed significant improvements in both engagement and motivation. These results suggest that mobile learning positively influenced students' engagement and motivation.

This aligns with the findings of Crompton and Burke (2018), who argue that mobile learning provides opportunities for personalized and self-paced learning.

4.7 Challenges Identified

Despite the positive outcomes, several challenges were noted:

Limited access to smartphones for all students, unstable internet connectivity, Distractions from non-educational mobile content

These challenges underscore the need for structured mobile learning policies and equitable resource distribution.

4.8 Summary of Key Findings

Mobile learning tools (especially YouTube and WhatsApp) significantly improved student engagement. Students reported increased motivation and interest in biology. Teachers observed better participation and content retention. Infrastructure and access issues remain a concern. The triangulation of data revealed alignment between quantitative and qualitative results. High post-test motivation scores correlated with themes of interactivity and autonomy, echoing self-determination theory (Ryan & Deci, 2000). Similarly, engagement gains mirrored students' emphasis on collaboration and flexibility.

The findings align with prior research on mobile learning's efficacy in STEM education (Hwang & Wu, 2014). The significant rise in motivation supports the technology acceptance model (Davis, 1989), as students perceived mobile tools as useful and easy to use. Enhanced engagement may stem from addressing psychological needs for autonomy and competence (Ryan & Deci, 2000), which mobile learning uniquely fosters through personalized and interactive content. However, the results contrast with studies highlighting distractions in digital learning (Cheon et al., 2012), suggesting that structured mobile activities mitigate off-task behavior.

CHAPTER 5

Discussion, Conclusion and Recommendations

5.1 Introduction

This chapter discusses the key findings presented in Chapter 4 in light of the research objectives and existing literature. It draws conclusions from the study and offers recommendations for educators, policymakers, and future researchers on how to leverage mobile learning to improve biology education in secondary schools.

5.2 Discussion of Findings

5.2.1 Mobile Learning and Student Engagement

The findings revealed a high level of engagement among students using mobile learning tools such as YouTube, WhatsApp, and Kahoot. Most students actively participated in mobile-based quizzes, joined WhatsApp study groups, and accessed lessons beyond school hours.

This supports the findings by Crompton and Burke (2018), who concluded that mobile learning technologies can transform traditional classrooms into interactive learning environments. By allowing real-time collaboration and self-paced learning, mobile tools appeared to keep learners more engaged with biology content.

Qualitative themes highlighted the importance of accessibility, interactivity, collaboration, and self-paced learning, aligning with theoretical frameworks such as self-determination theory (Ryan & Deci, 2000) and the technology acceptance model (Davis, 1989). The triangulation of data underscored mobile learning's potential to create dynamic, student-centered biology education environments

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5.2.2 Mobile Learning and Student Motivation

Students expressed increased motivation toward biology, as evidenced by their greater interest, study consistency, and class participation. These outcomes are consistent with research by Kucirkova and Flewitt (2020), who observed that mobile learning fosters intrinsic motivation by offering learners control, personalization, and instant feedback.

The significant change in pre- and post-mobile learning motivation levels also aligns with Bandura's (1997) theory of self-efficacy, which posits that learners are more motivated when they feel confident and in control of their learning environment.

5.2.3 Teacher Observations

Teachers confirmed that student participation and question-asking improved. This practical insight echoes the findings of Traxler (2019), who emphasized the role of mobile learning in shifting the teacher-centered paradigm to a learner-centered one, thereby fostering inquiry and autonomy.

5.2.4 Challenges Identified

Despite the benefits, several barriers were encountered. These include:

- Limited or unequal access to smartphones
- Poor network connectivity
- Distractions from entertainment applications

These challenges echo the concerns raised by Kukulska-Hulme (2021), who cautioned that without a robust digital infrastructure and digital literacy programs, mobile learning can widen rather than close the educational gap.

5.3 Recommendations

Based on the findings, the following recommendations are made:

5.3.1 For Schools and Educators

- Adopt mobile learning as a supplement to traditional teaching, especially for content-heavy subjects like biology.

- Train teachers on integrating mobile tools in lesson delivery and student assessment.
- Create mobile learning guidelines to ensure responsible and educational use of devices.
- Biology curricula should integrate mobile-friendly resources that align with curricular goals, such as virtual labs for topics like DNA replication or ecosystem dynamics
- Investment in digital infrastructure, including equitable device access and reliable internet connectivity, is critical to bridging socioeconomic gaps in mobile learning adoption

5.3.2 For Policymakers

- Improve digital infrastructure in schools, including access to Wi-Fi and educational devices.
- Promote public-private partnerships to subsidize data and devices for underprivileged students.
- Develop national policies to integrate mobile learning into the curriculum..

5.3.3 For Future Researchers

- Conduct longitudinal studies to assess the long-term impact of mobile learning on academic performance.
- Explore mobile learning's effects on other science subjects or across different regions.
- Investigate gender-based differences in mobile learning adoption and success.

5.4 Limitations of the Study

1. The study was limited to a small number of schools and participants, affecting generalizability.
2. It relied on self-reported data, which may be subject to bias.
3. The study focused on short-term effects rather than long-term academic outcomes.

5.5 Final Conclusion

This study contributes to the growing body of evidence supporting mobile learning as a transformative tool in STEM education. By fostering engagement through interactivity and motivation through autonomy, mobile technologies align with the needs of digital-native learners. However, successful implementation requires collaboration among educators, policymakers, and technologists to address infrastructure and training gaps. As biology education evolves, mobile learning offers a pathway to democratize access to high-quality, engaging scientific instruction, preparing students for a technology-driven future. The study concludes that mobile learning significantly enhances both student engagement and motivation in secondary school biology education. With tools like YouTube, WhatsApp, and digital textbooks, students participate more actively and develop a deeper interest in learning biology.

However, successful implementation requires addressing the digital divide and incorporating structured mobile learning strategies. When integrated effectively, mobile learning can be a transformative tool in the modern biology classroom.

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APPENDIX 1

INTERVIEW GUIDE FOR HEAD OF DEPARTMENTS

My name is HOMANI ElSIE a student at Bindura University studying in scienceeducation. I am carrying out a research on impact of mobile learning apps on student engagement and motivation at Mauya Adventist High School. The research is done in partial fulfilment of the requirements of the programme being studied.You are therefore requested to respond the following questions in honesty. Your responses will be treated in confidentiality and will be used in this study only.

Section A: General Information

1. How long have you served as Head of Department for Science/Biology?

2. Are mobile learning apps being used in the teaching of Biology at your school?

Section B: Perception and Implementation

3. What is your view on the integration of mobile apps in Biology lessons?

4. How has the use of these apps been supported or encouraged at your school?

Section C: Engagement and Motivation

5. In your opinion, have mobile learning apps improved student engagement in Biology? Please explain.

6. Have you observed any changes in students' motivation or attitude towards Biology since mobile apps were introduced?

Section D: Monitoring and Challenges

7. How do you monitor or evaluate the use of mobile apps in the Biology classroom?

8. What challenges have teachers or students faced in using mobile learning apps?

Section E: Suggestions

9. What do you recommend to enhance the effective use of mobile learning apps in Biology?

AP**NDIX 2**

INTERVIEW GUIDE FOR TEACHERS

My name is HOMANI ElSIE a student at Bindura University studying in scienceeducation. I am carrying out a research on impact of mobile learning apps on student engagement and motivation at Mauya Adventist High School. The research isbeing done in partial fulfilment of the requirements of the programme being studied. You are therefore kindly requested to answer the following questions in honesty. Your responses will be treated in confidentiality and they will be used in this study only

Section A: General Use

1. Do you use mobile apps in teaching Biology? If yes, which ones?

2. How often do you integrate mobile apps into your lessons?

Section B: Student Engagement

3. In your observation, do mobile apps increase student participation?

4. How do students respond to lessons that involve mobile apps?

Section C: Student Motivation

5. Have you noticed any changes in student motivation since introducing mobile learning apps?

6. What challenges do you face when using mobile apps in teaching?

Section D: Suggestions

7. What improvements would you recommend for better integration of mobile apps in Biology education?

APPENDIX 3

INTERVIEW GUIDE FOR LEARNERS

My name is HOMANI ElSIE a student at Bindura University studying in scienceeducation. I am carrying out a research on impact of mobile learning apps on student engagement and motivation at Mauya Adventist High School. The research isbeing done in partial fulfilment of the requirements of the programme being studied. You are therefore kindly requested to answer the following questions in honesty. Your responses will be treated in confidentiality and they will be used in this study only.

Questionnaire

Exploring the Impact of Mobile Learning on Student Engagement and

Motivation in Secondary School Biology Education

Section A: Demographic Information

1. Age:

_____

2. Gender:

o Male

o Female

o Other

3. Grade Level:

Form 3 o

Form 4 o

Form 5

4. Do you own a mobile device (e.g., smartphone, tablet)? o Yes

No

5. Have you ever used a mobile device for learning biology? o Yes o No

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Section B: Mobile Learning Usage

6. How often do you use mobile learning tools for biology education?
o Daily o Weekly

Occasionally o

Never

7. Which of the following mobile learning resources have you used? *(You may select more than one)* o YouTube educational videos o WhatsApp study groups o Biology mobile apps o eBooks or PDF notes o Online quizzes

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Section C: Student Engagement ***(Use a Likert Scale: Strongly Agree - 5, Agree - 4, Neutral - 3, Disagree - 2, Strongly Disagree - 1)***

How much do you agree with the following statements?

Statement	**1**	**2**	**3**	**4**	**5**
8. Mobile learning makes biology lessons more interesting.					

9. I participate more actively in class after using mobile learning.					
10. Mobile learning encourages me to do more research on my own.					
11. I discuss biology topics more with friends due to mobile platforms.					

Section D: Motivation ***(Likert Scale as above)***

Statement	**1**	**2**	**3**	**4**	**5**
12. I feel more motivated to study biology using mobile devices.					
13. Mobile learning helps me understand biology concepts better.					
14. I look forward to biology classes when mobile tools are used.					
15. I am more confident in answering biology questions due to mobile tools.					