BINDURA UNIVERSITY OF SCIENCE EDUCATION

RESEARCH PROJECT

By

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Reg No: B1130506

HBScEd PHYSICS

TOPIC

AN ASSESSMENT ON THE INTEGRATION OF BLENDED LEARNING METHODS IN THE TEACHING AND LEARNING OF PHYSICS AT ORDINARY LEVEL

"A research project submitted to the Department of science and mathematics education in partial fulfillment of the requirements for the Bachelor of Science education in Physics degree.

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RELEASE FORM

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Research project title

"An assessment on the integration of blended learning methods in the teaching and learning of physics at ordinary level."

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TITLE OF RESEARCH STUDY

An assessment on the integration of blended learning methods in the teaching and learning of physics at ordinary level

1. To be completed by the student:

I certify that this research study meets the preparation guidelines as presented in the 'instructions' for typing research projects.

Signature of student: .....Date *01/06/2024*

2. To be completed by the Supervisor.

This research project is suitable for submission to the university.

Signature of Supervisor Date..2../06/2024

3. To be completed by the Chairperson of the Science and Mathematics.

I certify to best of my knowledge that the required procedures have followed and the preparation criteria have been met for this research study.

Signature of Chairperson.....Date...../…../2024

DEDICATION

This research project is dedicated to my late father, Joseph Lazarous Mpofu whose life continues to inspire long after he has departed.

'In loving memory of my father,
Whose wisdom and guidance illuminated my path.
Whose strength and resilience inspired my pursuit.
This work is not just a testament to my academic journey,
But a tribute to the enduring legacy you left behind.

Your unwavering belief in my potential,
And the values you instilled in me,
Have been the guiding stars in this endeavor
Though you are no longer with us,
Your spirit lives on through the pages of this project.

With every challenge faced and milestone achieved,
I felt your guiding hand and heard your encouraging words.
This research is a reflection of your enduring influence,
A symbol of gratitude for the sacrifices you made,
And a celebration of the dreams you had for me.

May this work honor your memory.
And may its contributions echo your profound impact on my life.
You are dearly missed, but your legacy endures,
Forever cherished, deeply respected, and always remembered.

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I express profound gratitude to my family, who has shown immense understanding and patience throughout the duration of this project. Their sacrifices have not gone unnoticed, and their ability to endure my frequent absences from home has allowed me to dedicate myself fully to my research.

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ABSTRACT

This study, titled “An assessment on the integration of blended learning methods in the teaching and learning of physics at ordinary level,” examines the impact of blended learning in three Mangwe district secondary schools. It aims to assess how these methods affect student engagement and learning outcomes in physics, a subject where traditional teaching methods have struggled to maintain student interest. Through a qualitative multi-case study, incorporating interviews, observations, and focus group discussions, the research offers insights into the experiences of students and educators with blended learning. The thematic analysis of data reveals that blended learning boosts student engagement by providing interactive, flexible, and accessible educational content, which supports diverse learning styles and promotes critical thinking.

Despite its benefits, the study identifies challenges such as technical limitations, insufficient teacher training, and resistance to new teaching methods. To overcome these, it recommends infrastructure investment, development of interactive content, personalized learning pathways, and community engagement. These strategies aim to create an inclusive and effective learning environment.

Overall, the research highlights the transformative potential of blended learning in physics education, suggesting that with the right support and resources, it can significantly improve student outcomes. The study’s recommendations for the Ministry of Primary and Secondary Education emphasize the need for technological advancement and pedagogical innovation to realize the full benefits of blended learning.

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ABBREVIATIONS

B.Y.O.D…….Bring your own device

MOPSE……. Ministry of primary and secondary education

STEM……Science, technology and mathematics

V.R…….Virtual reality

CHAPTER 1: INTRODUCTION

1.1 Introduction to the study.

This section introduces the study by laying out mainly the background of the study, the statement of the problem, research questions that need to be answered and why this research should be done. The introduction part also states the limitations as well as the delimitations of this study, adding on to give the key definitions that need to be understood in relation to the context of the research.

1.2 Background to the study.

The integration of blended learning methods into teaching and learning has increasingly become popular in recent years. However, implementation of these methods in the teaching and learning of physics classes seem to be unsatisfactory. The major problem is that there has been inadequate research on the challenges and barriers that hinder the successful implementation of these blended learning methods at ordinary level physics classes in Plumtree. Blended learning can be defined as an instructional teaching approach that combines online and face-to-face learning sessions (Boelens, et al., 2015). This definition is generally shared by other researchers (Horn and Staker, 2015), although various other definitions exist. According to Hodges et al (2020) there has been a growing interest in the use of technology in physics education, as it can offer a range of benefits, such as increased student engagement, improved conceptual understanding, and enhanced problem-solving skills. The technology can also provide access to resources and information that might not be available in traditional classroom settings.

Additionally, technology can offer opportunities for collaboration and communication between students and teachers. Alvarez (2020) indicates that various literatures report that utilization of information and communication technologies (ICT) can bring effect in improving teaching and learning process. Blended learning combines face to face instruction with online learning elements, such as videos, simulations and virtual labs. This approach has the potential to increase student engagement and improve student performance in physics. Hodges et al (2020), further emphasize that studies have shown that the use of technology in the classroom, which can be defined as a student's level of interest, motivation, and active participation in the learning

process, if used effectively, can increase student engagement and motivation by making the learning process more interactive and interesting. For example, simulations and online resources can make physics concepts more tangible and easier to understand, while collaborative tools can encourage students to work together and share ideas.

Furthermore, in support of use of blended methods, DaSilva et al (2019) reported that students taught with Android-based interactive physics mobile learning media applications and learning devices performed better and proved higher-order thinking skills (84.80%) compared to the students who were only taught using traditional teaching methods (55.50%). Based on these findings it makes good reason to use blended learning methods in the teaching and learning of physics. In physics, conceptual understanding refers to a student's ability to understand and apply the underlying principles and concepts of physics, rather than simply memorising facts and equations (Staker and Horn, 2012). Technology can support conceptual understanding by providing students with interactive resources that allow them to visualize and experiment with physics concepts. For example, simulations can allow students to see how different variables affect the outcome of a given experiment, which can help them to develop a deeper understanding of the underlying principles.

Furthermore, technology can play a role in helping students to develop and improve their problem-solving skills. For example, interactive resources can provide students with immediate feedback on their work, allowing them to identify and correct any mistakes they have made. This can help students to learn from their mistakes and improve their problem-solving strategies. Additionally, online resources can provide a range of problems for students to solve, which can help them to practice and refine their skills. There is also the idea of equity and accessibility. One of the benefits of technology in physics education, Wei et-al (2017) argue, is that it can help to level the playing field for all students, regardless of their background or ability. Stapa (2015) concurs with Wei et-al by emphasising that technology can provide students with alternative ways to learn and demonstrate their understanding, which can be particularly beneficial for students with disabilities or those who speak English as a second language.

Additionally, online resources can provide students with access to a wide range of information and resources that may not be readily available in their local area. One example is the use of virtual reality (VR) technology in physics education. VR can provide students with an immersive and interactive learning experience, which can help them to better visualize and understand physics concepts. For example, VR simulations of concepts like Newton's laws of motion or the laws of thermodynamics can allow students to explore these concepts in a more concrete and engaging way. Another example is the use of online repositories of physics problems, which can provide students with access to a wide range of problems and solutions, regardless of their location or financial situation. Advantages of using blended methods seem to outweigh its drawbacks. There is however limited research on the challenges and barriers that may hinder the successful implementation of blended learning methods at ordinary level physics classes. It is therefore against this background that this research sought to investigate the challenges and barriers, and assess their impact on student achievement. The researcher also intended to determine the benefits of using blended learning methods in the teaching and learning of physics at ordinary level. The research is grounded in constructivist and social constructivist theories of learning.

1.3 Statement of the problem.

The traditional methods of teaching and learning physics at the ordinary level have not been effective in engaging students and promoting student learning. A more effective approach is needed, such as blended learning, which combines traditional face-to-face learning with technology-enhanced learning. Blended learning has the potential to address the challenges and barriers that traditional methods have faced, and to provide students with more engaging and meaningful learning experiences. This issue of low levels of engagement and motivation among students, as well as low levels of conceptual understanding and problem-solving skills, has been widely recognised in recent years. Studies have shown that traditional teaching methods may not be enough to address these issues, and that more innovative and personalised methods are needed. Blended learning methods have shown promise in addressing these issues. According to Wei et-al (2017), the integration of blended learning methods in the teaching and learning of has been shown to be effective in enhancing students' conceptual understanding and problem-solving

skills in physics. More research is therefore needed to be done in order to reveal findings on how to effectively integrate blended learning methods into the teaching and learning of physics.

This study is aimed to contribute to the existing body of knowledge on:

- The impact of blended learning on student engagement and motivation has not been studied in depth, particularly in the context of physics.
- The benefits of using blended methods in the teaching and learning of physics at ordinary level.

Little is known about the barriers and challenges associated with implementing blended learning methods in the teaching and learning of physics so the research will bring awareness on these.

1.4 Main research question.

The research was guided by the following question.

"What is the impact of using blended learning methods in physics on student learning outcomes, including increased engagement and motivation in physics?"

1.4.1 Sub-research questions.

This main research question was then further broken down into two specific sub-questions that explored its different aspects.

1. What are the benefits of using blended learning methods in the teaching and learning of physics?
2. What are the challenges and barriers associated with using blended learning methods in the teaching and learning of physics?
3. What can be done to overcome challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics at ordinary level?

1.5 Research objectives.

1.5.1 Main research objective.

-To assess the impact of using blended learning methods on students' conceptual understanding and problem-solving skills in physics in three selected urban and peri-urban schools in Mangwe district, Plumtree.

1.5.1.1 Sub research objectives.

1. To evaluate the benefits of the use of blended learning on the teaching and learning of physics at ordinary level.
2. To investigate the challenges and barriers associated with use of blended learning methods in the teaching and learning of physics at ordinary level.
3. To find out the possible ways to overcome challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics at ordinary level?

1. 6 Purpose of the study.

The findings of this research will have implications for both educators and policy makers. For educators this research could provide valuable insights into the challenges and barriers to implementing blended learning in physics classes, and it could also offer suggestions to overcoming these challenges. For policy makers, this research could inform decisions about resource allocation and curriculum design to support the effective integration of blended learning in ordinary level physics classes. In addition, this research could contribute to the broader literature on blended learning and its impact on student achievement in STEM subjects.

1.7 Assumptions.

This research was based on the assumptions outlined below.

1.7.1. The Assumptions.

- Students have access to technology that can be used for blended learning.
- Teachers have the necessary skills and training to effectively use blended learning methods.
- The use of blended learning will result in improved student learning outcomes, including increased engagement and motivation.
- Qualitative methods, such as interviews and observations, will provide valuable insights into the impact of blended learning on students and teachers.
- The participants will provide honest Information to the researcher during the study.

1.8 Significance of the study.

Physics is a subject that is linked to a variety of branches that are concerned with scientific development needed by, not only our country but by the global world at large. Wei et al (2017), posit that the findings of several institutions in numerous countries across the world have demonstrated the effectiveness of blended learning, adding that academic institutions like Harvard university in the United States of America and Cambridge University in the United Kingdom have implemented various models of blended learning that have encouraged learners to register and join these courses It was therefore prudent to carry out this research so that its findings will contribute meaningful information.

-The findings of this research will:

1. Contribute to the understanding of how blended learning methods can be used to enhance student learning in physics and improve educational outcomes.
2. Provide insights into the challenges and barriers to implementing blended learning methods in the classroom. The challenges identified could help to inform future research and development in this area.
3. Inform the development of future policies and practices related to blended learning methods in the teaching and learning of physics.

It could also inform policy decisions on how to best support students and teachers in using these blended learning methods in the teaching of physics classes.

1.9 Limitations.

1.9.1 Insufficient generalizability.

Small sample sizes and context specific findings limit broader applicability. This multi case study focused on individual cases in the district. The small sample makes it challenging to generalize findings to broader populations. The researcher cannot automatically extend conclusions from these single cases to an entire population.

1.9.2. Network infrastructure variability:

The study focused on learners and teachers from urban schools with good network connectivity and a rural school with an intermittent network. However, this variation in network infrastructure

could impact the effectiveness of blended learning. Urban schools may have reliable internet access, facilitating seamless integration of online resources, while the rural school's intermittent network could hinder access to digital content and collaborative tools: The quality and consistency of network connectivity directly influence the implementation of blended learning. Uneven access to online materials and communication tools may create disparities in learning experiences among students and teachers.

1.9.3. Digital literacy

Digital literacy and training is yet another limitation. Blended learning requires both learners and teachers to navigate digital platforms effectively. However, assuming that all participants possess the necessary digital literacy skills might be unrealistic. Urban students and teachers may be more familiar with technology due to their exposure to digital devices and online resources. In contrast, rural participants might face challenges in adapting to digital tools. Lack of adequate training or support could hinder their ability to fully engage with blended learning components

1.9. 4. Contextual limitations

Contextual differences are also a limitation in that urban and rural schools operate within distinct contexts, affecting teaching and learning dynamics. Factors such as class size, teaching methods, and student demographics vary significantly. While blended learning aims to enhance educational experiences, its effectiveness depends on alignment with the specific context. Urban schools may have larger classes, diverse student backgrounds, and different pedagogical approaches. In contrast, the rural school's smaller class size and unique challenges (e.g., limited resources) require tailored strategies for successful integration.

To mitigate against these challenges the researcher used different strategies. For insufficient generalizability the researcher used triangulation. Multiple data sources were, used (interviews, observations and focus groups) to strengthen findings. To mitigate network variability the researcher considered schools that could accommodate different technological environments and provide offline resources (e.g., downloadable materials) for students with limited internet access. Content was tailored to the specific context or local examples, to mitigate against the contextual differences.

Subjectivity: Findings can be influenced by the researcher's biases and interpretations.

Limited generalizability: Time-Consuming: Data collection, transcription, and analysis can be resource-intensive.

Lack of replicability: Difficulty in replicating qualitative studies exactly.

1.10. Delimitation of the study.

The research was conducted in three selected schools in Mangwe district, Matabeleland south province in Zimbabwe. Only urban and peri-urban schools were considered. These spatial limitations helped contextualize findings and ensure that they are relevant to the specific educational setting. Two urban schools A and B, and one peri-urban school C, were chosen from Mangwe district. Amongst the three selected schools, internet connectivity there in the urban schools and is there in the peri urban school, though intermittent. Only the students doing ordinary level were considered. The researcher used convenience methods to sample the participant schools, was used to select schools due to time constraints. Purposive methods were employed to select participant classes and teachers because the study focussed on those who teach or learn physics. Simple random method to select the physics learners was meant to prevent researcher's bias. The data was collected through interviews, focus groups and observations of lessons. The qualitative data was analysed using thematic methods. Instrumental delimitations involved decisions related to the tools, instruments, or resources used in the study in order establish instrumental boundaries to manage constraints such as time, budget, or access to specific resources. The use of only one researcher's interview schedule, observation schedule and focus group guide instead of multiple printed questionnaires cut down the high cost which would have been incurred on printing hard copies for the learners, who made up the bulk of the participants in this study. This research used interviews on teachers by both face to face and online means and focus group tool' method in order to manage both time and financial constraints. Conducting interviews via calls and through face-to-face interactions might yield different results.

1. 11 Definition of key terms.

-**Blended learning methods**" are the use of both in-person and face to face and online learning activities to provide a more flexible and comprehensive learning experience (Booleans, 2015).

-**Physics** is the study of the physical world and the laws that govern it.

-**Technologies** are defined as the use of digital tools and resources to enhance the learning process (Almasaeid, 2014).

-**Ordinary level** is the form 3 or forms 4 grades at secondary school of education.

-**Integration** is the process of combining different learning methods into one cohesive learning experience (Alvarez, 2020).

1.12 Organisation of the study.

This research is organised into five chapters. Chapter 1 provides an overview of the research. It introduces the study and the lays down the background of the study, purpose of the study, statement of the problem, main research question, sub-questions, research objectives, assumptions, significance of the study, delimitations, limitations, and gives a definition of key terms used in the research. Chapter 2 presents a literature review related to this research study. It provides a theoretical framework of the study giving discussions under sub topics in line with research questions. The chapter then highlights the research gaps identified by the study. Chapter 3 outlines the methodology used for this research, including the design, sampling, data collection, and data analysis methods. Chapter 4 presents the findings of the research, and lastly Chapter 5 provides a discussion of the findings and implications for future research.

1.13 Chapter summary.

This chapter was focused on giving an overview of the research study. The main research question was to assess “the impact of using blended learning methods on students' conceptual understanding and problem-solving skills in physics", in three selected schools urban and peri urban schools in Mangwe district. The problem that prompted this research was that it was observed that there are low levels of engagement and motivation among students, as well as low levels of conceptual understanding and problem-solving skills, as being widely recognised in recent years, yet studies have shown that traditional teaching methods may not be enough to address these issues, and that more innovative and personalised methods are needed. Blended learning is one such method that has shown promise in addressing these issues. However, there have been no in depth research that has been done to adequately address the impact of using blended teaching and learning methods in the teaching and learning of physics at ordinary level.

Furthermore, the benefits of using these methods, the challenges and barriers in implementing the methods in the teaching and learning of physics at ordinary level have not been satisfactorily addressed. A main research question and two sub-questions were formulated for this study. The corresponding objectives for the main research question and sub questions were also formulated. Hypotheses and assumptions based on this research study were stated down. The researcher proceeded to outline the significance of this study and to describe its delimitations and limitations. The key definitions associated with the study were given. The terms that were defined are blended learning methods, physics, technologies, ordinary level and integration. The researcher outlined how the study was organised, with particular mention of the chapter lay out and brief description of what each chapter entails. The contents of chapter 1 are an essential link to chapter 2 which is about review of literature related to this study.

CHAPTER 2: LITERATURE REVIEW.

2.1 Introduction.

This literature review aims to explore the benefits and challenges of using blended learning methods in the teaching and learning of physics at ordinary level. The review will focus on research published on or after 2012. The literature review will draw on studies from a variety of countries and contexts. It will also explore the impact of blended learning on student engagement, motivation, and achievement, as well as the challenges and barriers to effective implementation. Possible solutions on how to overcome the challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics at ordinary level will be suggested. This review will contribute to the body of knowledge on blended learning and its impact on physics education. This research study focused on the assessment of the integration of blended learning methods in the teaching and learning of physics at ordinary level and the main research question is; “What is the impact of using blended learning methods in physics on student learning outcomes, including increased engagement and motivation in physics?" Main question was further broken down into three sub questions.

Therefore the literature review will be based on the three sub-questions which are outlined below.

1. What are the benefits of using blended learning methods in the teaching and learning of physics at ordinary level and,
2. What are the challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics at ordinary level?
3. To find out the possible ways to overcome challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics at ordinary level?

The researcher laid down a theoretical framework and unveiled themes. The aims of the literature review are to identify the main ideas from the research questions and research objectives of this study so that gaps in knowledge in the current literature are identified.

2.2 Theoretical Framework.

This research study will be guided by Constructivist Theory. According to Almulla (2023) constructivism is a learning theory that emphasizes the active role of learners in building their

own understanding. Rather than passively receiving information, Almulla (2024) highlights, learners engage in reflective processes, create mental representations, and incorporate new knowledge into their existing cognitive structures. Here are some key points about constructivism. According to constructivism, knowledge is constructed rather than being innate or passively absorbed. Learners actively build new knowledge upon their prior learning experiences. Zhao et al (2023) indicate that active learning social context is some of constructivist key points. They allude to that learning is an active process adding that instead of viewing learners as empty vessels to be filled with information, constructivism asserts that meaningful understanding arises from active engagement with the world. This can involve experiments, problem-solving, and real-world applications. For social context, Zhao et al (2024) argue that all knowledge is socially constructed and earning occurs through interactions with others. They cite an example that, Vygotsky emphasized the role of community in shaping thinking and understanding. Therefore blended learning, which combines face-to-face and online learning, aligns well with constructivist principles. It allows learners to engage both in-person and through digital platforms, fostering deeper understanding and personalized learning experiences.

2.3 Review of related literature.

2.3.1Perceptions on the benefits of integrating blended learning methods in the teaching and learning of physics.

Blended learning offers several advantages for teaching physics at the ordinary level:

Bates, (2015), outlines that the benefits include flexibility and accessibility, enhanced engagement, Interactive online resources (videos, simulations, quizzes) and engaging students beyond traditional lectures. Richardson et al (2012) and Hodges et al support that in-class activities can focus on problem-solving, collaborative projects, and deeper understanding. Blended learning combines traditional face-to-face instruction with online components and offers several benefits. In other words, it is a type of learning that combines remote and face-to-face teaching. Amiruddin, (2022) posits that recent studies that look at the academic and social benefits of this teaching method have emphasised the usage of blended learning. Since it combines traditional and online teaching modes, the strengths of blended learning rest on both teaching approaches. Studies trace how online learning gained popularity. They indicate that use

of online methods gained popularity during the COVID-19 lockdown. According to Krasnova and Shurygin (2019), the impact of digitalisation on education was already a reality before the COVID-19 pandemic with the rise of online education but it was made mainstream because of the lockdown, except in those cases where the digital divide made it impossible, forcing students to access education from home. After the first wave, Krasnova and Shurygin (2019) analyse that the teaching world faced the challenge of the new school year and this is where blended learning emerged as a firm commitment in the present and looking to the future.

Furthermore, blended learning, most studies show, is a type of learning that combines remote and face-to-face teaching with one objective, to bring together the best of both worlds to achieve more efficient learning. Vaughan et al (2013), emphasise the importance of building communities of inquiry in blended learning and the need to explore the benefits and challenges related to its presence and interaction. In the same vein this is particularly important in schools, hence this research study. The benefits of blended learning methods as perceived by different scholars are outlined below.

2.3.1.1 Flexibility and accessibility of blended learning methods.

Flexibility and accessibility are important features of blended learning methods because they can help to ensure that all students have equal access to the learning materials and opportunities. In traditional classroom settings, students with different needs, such as those with disabilities or those who live in remote areas, may not have the same access to educational resources. Blended learning methods can help to overcome these barriers by making the learning materials and opportunities available online, where they can be accessed from anywhere. Additionally, the flexibility of blended learning can allow students to self-pace and adapt the learning materials to their individual needs.

Since blended methods combine traditional face to face learning methods and online components, these online components make the methods become more flexible and accessible than using only the traditional face to face methods. Traditional methods require that the teacher and students interact face to face. When teachers and their students are separate then interaction becomes a challenge, when face to face methods are the only approach. With online methods

integrated to the traditional methods then learning and teaching becomes better, due to the numerous benefits of blending. Blended learning also offers flexible time frames that can be personalised to each person, offering them the ability to learn at their own pace. Students can choose their pace and explore topics based on their needs. On the other hand, teachers can adapt content to address specific student challenges and interests. Clark and Mayer (2016), argue that self-pacing for slow or quick learners reduces stress, increases satisfaction, and information. Hence blended methods are regarded as beneficial.

Furthermore, with blended methods students can review online resources, watch pre-recorded lectures, and engage in discussions at their convenience. (Krasnova and Shurygin, 2019). Students can review also engage in discussions, and complete assignments outside traditional class hours. This is supported by Giarla (2016), who posits that blended learning allows students to access online materials anytime and from anywhere, allowing for greater flexibility in their learning journey. Powell et al, (2015) also supports the view and concurs with Giarla (2016) on that blended methods are accessible and flexible in that they accommodate diverse learning styles and preferences, thereby catering for individual needs of the students. In addition, the face-to-face sessions provide opportunities for personalised support and interaction with teachers. Therefore, research should explore how to design blended courses that accommodate diverse learning styles and cater to students with varying schedules or accessibility needs.

2.3.1.2 Engagement, motivation and interaction.

Student engagement and motivation are important factors in blended learning methods because they can influence the overall success of the learning process. Students who are engaged and motivated to learn are more likely to actively participate in the learning activities, ask questions, and seek out additional resources. This can lead to a deeper understanding of the material and better learning outcomes. Additionally, engaged and motivated students are more likely to feel positive about their learning experience, which can lead to a lifelong love of learning and interest in the subject. On the other hand, students who are not engaged or motivated may not make the most of the learning opportunities, leading to lower performance and less positive feelings. There is some evidence to suggest that blended learning can have a positive impact on student engagement and motivation. For example, studies have found that blended learning can increase

students' sense of ownership over their learning, which can lead to increased engagement. Interactive online resources, simulations, and multimedia can enhance student engagement and understanding of physics concepts.

Additionally, some studies have found that blended learning can increase students' motivation to learn, as it can allow them to work at their own pace and choose their own learning activities. Some students may also find blended learning more motivating due to the novelty of the learning environment or the increased interactivity of the learning activities. Research has found that blended learning encourages student engagement and interaction. (Krasnova and Shurygin, 2019) argue that blended learning encourages active participation, pointing out that the students can collaborate during in-person sessions, work on group activities, and ask questions.

Furthermore, online components, such as discussion forums and quizzes, promote engagement beyond the classroom. According to Garrison and Kanuka (2014), blended learning happens when a classroom is combining classroom instruction with online learning, utilising a variety of media to enhance engagement, physical contact between students and educators, and creating a relevant yet inspiring learning environment through different teaching strategies concurrently. These are likely to keep students focused for longer. The use of computers to look up information and data is a tremendous lifesaver, combined with access to resources such as the internet to conduct research. Blended learning can make physics more engaging by incorporating multimedia, simulations, and interactive elements. Research can focus on strategies to maintain student motivation, such as gamification, peer collaboration, and real-world applications. This engagement and interaction with the resources keeps students focused for longer periods than they would be with books or paper resources. This engagement also helps develop learning through exploration and research. Powell et al, (2015), stress that blended learning methods are a vital tool for fostering understanding on a worldwide scale adding on to say that interaction between students and the teacher, as well as students with one another, can create online communities and learning practices where knowledge, concepts, insights, and other learning outcomes become easily shared and appreciated.

2.3.1.3 Enables teachers and students to collaborate in teaching and learning.

Teacher and student collaboration is important in blended learning because it can help to create a positive and productive learning environment. In a traditional classroom, the teacher may be the main source of information and direction, but in a blended learning setting, students can have a more active role in their own learning. When teachers and students collaborate, they can share ideas, ask questions and work together to find solutions to problems. This can lead to a deeper understanding of the material, increased motivation, and better learning outcomes.

Additionally, collaborative learning can help to build relationships between students and teachers, which can create a more positive and supportive learning environment. Many experts believe that blended learning has the potential to develop 21st century skills, such as digital literacy and collaboration. Digital literacy refers to the ability to effectively use technology to communicate, solve problems, and access information. Blended learning can help develop digital literacy by giving students opportunities to use technology in meaningful ways, such as through online discussions and collaborative projects. Collaboration is another important 21st century skill, and blended learning can help develop this skill by requiring students to work together on projects, even when they are not physically in the same space. This can help students develop skills such as communication, teamwork, and leadership.

Blended learning is a concept that enables teachers and students to collaborate in teaching and learning through different settings. Blended learning can be defined as a transformative concept that can be used for both online learning and offline learning and aims to maintain the cooperative learning whether in constructive learning or learning with the help of computer (Lalima & Dangwal, 2017). Similarly, blended learning combines particularly in face-to-face and online learning with instructional modalities (Tayebinik & Puteh, 2012). Blended learning can boost digital intelligence and the acquisition of digital skills. Blended learning can provide students with more opportunities to use digital tools and resources, such as online simulations, videos, and interactive exercises. This can help students develop their digital literacy skills, such as using technology effectively and efficiently. Blended learning provides students with the opportunity to learn independently and equipped them with more options of learning. Ahmed and Eljack (2020) mentioned that the environment of blended learning is very healthy. For instance,

students can search for other platforms available through an internet connection to learn, this motivates students to look for learning resources to achieve their academic goals and encourages them to take advantage of other websites' potential to enhance their understanding.

Moreover, blended learning can also encourage students to collaborate and communicate with each other online. Basically, the concept of blended learning is to improve the learning content and the way it is being learnt, not to discard the role of the teacher in the classroom (Bakeer, 2018). In addition, Bakeer (2018) also stated that every student has distinct styles of learning, thus, a blended learning approach meets the students' needs rather than traditional classroom settings. Thus, blended learning refers to a combination of a variety of pedagogical approaches in order to achieve the best learning and teaching outcomes (Caner, 2012).

2.3.1.4 Cost-Effectiveness.

Cost effectiveness and improving learning outcomes are important aspects of blended learning because they can help to make the most of limited resources and maximize the benefits of the learning process. Traditional classroom learning can be expensive, especially when it comes to providing resources like textbooks and classroom materials. By incorporating digital resources and online activities, blended learning can help to reduce costs while still providing high-quality learning experiences. Additionally, by effectively using blended learning methods, schools and teachers can see improved learning outcomes, which can help to increase student success and achievement. Picciano (2017) asserts that 'cost-effectiveness is a benefit of blended learning which reduces the need for physical resources such as textbooks and other printed materials whilst Krasnova and Shurygin, 2019) indicate that institutions can optimize classroom space and faculty time. Blended learning is often more affordable than traditional face-to-face instruction. It reduces the need for physical resources like textbooks and printed materials. Textbooks and other printed media tend to be costly. Large amounts of money are needed to resource Science departments in schools with Physics textbooks. An analysis of some local textbook book publisher catalogues has shown that Physics textbooks are more expensive as compared to textbooks for other subject areas. Hence use of blended methods in the teaching and learning of physics at ordinary level is crucial to counter such cost challenges. Use of online resources

enables teachers to save time by avoiding tasks like photocopying and grading. It optimizes classroom time by focusing on interactive activities.

2.3.1.5 Improved learning outcomes:

As physics teachers and physics students engage in the teaching and learning process it is a good endeavour to aim at improving learning outcomes. Krasnova and Shurygin (2019), argue that research shows that blended learning positively impacts student achievement as it combines the best of both worlds; technology-enhanced learning and face-to-face interactions. These scholars further, add on to say that the blended methods enable students to benefit from a variety of instructional methods, leading to deeper understanding and retention. They also indicate that, blended learning offers a balanced approach that integrates technology, fosters engagement, and enhances learning outcomes. Use of blended learning methods is therefore a valuable strategy for teaching physics effectively at ordinary level.

2.3.1.6 Increased student interest, motivation and performance.

A majority of students seem to be so much connected to cell phones. This can be a hint to their liking of modern technology. Therefore, it is reasonable to think that when technology is integrated into school lessons, learners are more likely to be interested in, focused on, and excited about the subjects they are studying. Hewand Cheung (2014) support this view by stating that developing such an interest becomes an advantage, particularly in the teaching and learning of subjects that might be monotonous, like maths and science. When an individual is motivated, his or her performance tends to be higher than when motivation is low.

2.3.1.7 Provides student autonomy and instils a disposition of self-advocacy.

As students use online technologies they are likely to develop habits of setting targets and meeting deadlines. Blended learning provides students with opportunities to practice self-regulation and self-reflection. Powell et al (2015) argue that the use of eLearning materials increases a student's ability to set appropriate learning goals and take charge of his or her own learning, which develops an ability that will be translatable across all subjects. This view is supported by Lalima and Dangwal (2017) who point out that as students use the blended methods they then become self-driven and responsible, tracking their individual achievements,

which helps develop the ability to find the resources or get the help they need, self-advocating so they can reach their goals. Blended learning also instils a sense of ‘student ownership over learning (Caner, 2012). Another advantage is that through personalization blended learning caters to individual student needs enabling adaptive platforms to adjust content based on performance. Krasnova and Shurygin (2019), insist that the blended methods promote improved learning outcomes.

2.3.1.8 Teacher development and professional learning.

Teacher development and professional learning are important in blended learning because they can help teachers to effectively use the methods and technologies involved in the process. Blended learning can require teachers to learn new skills, such as using online platforms and creating digital resources. Professional development opportunities can provide teachers with the necessary training and support to effectively use these new skills. Additionally, professional learning can help teachers to adapt their teaching strategies to best meet the needs of their students and to ensure that the blended learning methods are having the desired impact. Without on-going professional learning, teachers may struggle to effectively use blended learning methods.

Blended learning can have a positive impact on teacher development and professional learning in some ways. First, blended learning can help teachers develop new skills and knowledge related to technology use and instructional design. Additionally, blended learning can help teachers develop skills related to self-directed learning, since they will often be required to seek out resources and support independently.

Finally, blended learning can help teachers learn more about their students' learning preferences and needs, since they will be able to collect data on student progress and performance through the use of technology. This can help teachers tailor their instruction to better meet the needs of their students.

2.4 Perceptions on the challenges and barriers associated with blended methods.

Despite its benefits, blended learning faces challenges. These include the need for specialized equipment or software, technological challenges, equity and inclusion, lack of expertise among teachers and difficulty of assessing student learning in blended environment. The specific challenges and barriers associated with blended learning in physics, as perceived by some scholars include the following:

2.4.1. The need for specialized equipment or software.

A lack of specialized equipment or software can be a significant challenge in the teaching and learning of physics at ordinary level. This is because physics is a subject that often relies on the use of specialized equipment and software to conduct experiments, analyse data, and model phenomena. Without access to this equipment and software, students may not be able to fully engage with the subject and may not develop the skills necessary to succeed in higher-level courses. Additionally, teachers may not be able to effectively demonstrate certain concepts without the necessary tools, which can make it difficult for students to understand and apply these concepts. In physics, practical experiments and hands-on activities are crucial for understanding concepts. However, not all students have access to specialized laboratory equipment or facilities at home. Becirovic (2023) posit that a lack of access to physics laboratories or equipment can hinder students' ability to perform experiments, collect data, and analyse results. Without hands-on experience, their understanding of physical phenomena may remain theoretical. The challenge should be to ensure equitable access to blended learning resources for all students. However, limited availability of devices or internet infrastructure in certain regions may become a barrier.

2.4.1.1 Software challenges.

Blended learning often involves using digital tools, simulations, and software applications. Francom, (2020) argue that physics simulations, virtual laboratories, and modelling software enhance learning experiences. However, students may face challenges if they lack access to the required software. Some specialized physics software can be expensive or require specific hardware specifications. Additionally, students need technical proficiency to navigate and utilise these tools effectively

2.4.1.2 Technological challenges.

Ensuring reliable internet access for all students can be problematic, especially in resource-constrained settings. Technical glitches, software compatibility issues, and platform maintenance can disrupt the learning process. In the same vein, another challenge is that some students may struggle with self-directed learning or lack digital literacy skills.

2.4.1.3 Equity and inclusion.

The availability of specialized equipment and software can vary significantly across educational institutions. Schools with limited resources may struggle to provide equal opportunities for all students. Ensuring equitable access to technology is essential to avoid widening educational disparities.

2.4.1.4 The lack of expertise among teachers.

A lack of expertise among teachers is another challenge that can impact the teaching and learning of physics at ordinary level. Kuo et al (2014) note that, since physics is a complex subject that requires specialized knowledge and skills, teachers may not have the expertise necessary to effectively teach the material. In their view Kuo et al (2014) indicate that this can lead to confusion and frustration for students, who may not receive the support they need to understand the material. Additionally, a lack of expertise among teachers can make it difficult for them to adapt to the changing needs of their students or to adopt new instructional methods. This can make it harder for students to learn in an optimal way and can negatively affect their overall achievement. Benson et al (2014) correctly suggest that in blended learning environment, teachers should have at least the required knowledge and skills to mix the right blending in teaching and learning process. As such, the use of technology tools should best meet the needs of the learners while ensuring the appropriateness of right blended learning nature of the course. (Bralic and Divjak, 2018)

2.4.1.5 Instructional challenges.

Designing effective blended learning experiences requires expertise in both pedagogy and technology. According to Becirovic (2023) teachers may need training to create engaging online

content and activities and also need to take heed of the barriers and challenges that can affect effective use of blended methods.

2.4.1.6 Class size considerations.

Managing larger classes in a blended format can be challenging. Providing individualized attention becomes more complex as class sizes increase. Student Engagement and motivation can be difficult to maintaining in both online and face-to-face settings when class sizes are too large. (Becirovic, 2023). The challenge can be in designing interactive and stimulating online content to engage students effectively. Barriers such as student disengagement due to passive online experiences may occur. Research should find out how it can devise effective strategies to manage varied class sizes so that students are kept engaged and motivated.

2.4.1.7 Technical support.

Students and instructors may encounter difficulties with online tools or platforms. Adequate technical support is essential to address these issues promptly. Hamutoglu, (2021), indicate that a lack of professional development opportunities or inadequate support can hinder teachers from incorporating these tools seamlessly.

2.4.1.8 Collaboration and communication.

Balancing online and face-to-face interactions requires intentional planning, according to Bai and Lo (2018) who also argue that even encouraging student collaboration and peer-to-peer communication can be challenging. They also indicate that whilst specialised equipment and software enhance blended learning experiences in physics, addressing challenges related to access, training, and equity is crucial for effective implementation. Interactions between students, teachers, and Content, citing that lended learning should facilitate collaborative discussions, peer learning, and knowledge construction. Well-designed online activities and discussions can contribute to better learning outcomes. In the same vein well designed connections between online and offline activities can do so. Seamless integration between online and face-to-face components is essential. Blended learning should bridge the gap between virtual and physical learning spaces. This view is supported by Nortvig (2017) who argue that activities that link theory to practice, such as laboratory sessions or fieldwork, enhance student understanding.

2.4.1.9 Inadequate training and familiarity.

Many physics teachers may not be adequately trained in using technology for teaching. Blended learning requires proficiency in both face-to-face and online instructional methods. This view is supported by Amandu et al (2013) who states that lack of familiarity with learning management systems (LMS) or other digital tools can hinder effective implementation.

2.4.1.10 Resistance to change:

Resistance to change among educators can be a barrier associated with the use of blended learning methods in the teaching and learning of physics at ordinary level. Some teachers may resist adopting new teaching methods due to comfort with traditional approaches. Changing from traditional teaching methods to blended learning requires a shift in pedagogical approaches may be a problem for teachers yet the blended learning requires a shift in mind set and pedagogical practices, which can be challenging for educators. This means training teachers to design effective blended learning experiences is essential

2.4.1.11 The difficulty of assessing student-learning in a blended environment.

Assessing student learning in a blended environment can be a challenge for a number of reasons. First, it can be difficult to accurately measure a student's understanding when they are working both in-person and online. Hamutoglu, (2021), argue that the assessment tools and rubrics used in a traditional classroom setting may not be as effective in a blended environment. This can make it difficult for teachers to accurately assess student learning and provide appropriate feedback. Additionally, the asynchronous nature of blended learning can make it difficult to assess students' engagement and motivation, since they may not be interacting with the material in a traditional classroom setting. The assessment of student learning in a blended environment presents several challenges and barriers when implementing blended learning methods in the teaching and learning of physics.

The challenges and barriers are outlined below:

- **Diverse assessment approaches:**

Blended learning combines face-to-face and online components, leading to a variety of assessment methods. Vo et al (2020) posit that designing assessments that align with both modes

can be complex adding that traditional paper-based exams may not fully capture online learning outcomes.

- **Technical challenges:**

Online assessments require reliable internet access, compatible devices, and familiarity with digital tools. Becirovic (2023) emphasises that technical issues such as connectivity problems, platform glitches can affect assessment integrity. Another problem regarding technical challenges is that some students may lack the necessary digital literacy skills to navigate online platforms effectively. Therefore, providing training and support to enhance students' digital literacy is essential. However, attempts to provide training and support can face barriers like resistance to using technology due to unfamiliarity or discomfort. Hence more research is needed to find ways of overcoming resistance to using these technologies.

- **Balancing formative and summative assessment:**

Blended learning allows for on-going formative assessment such as quizzes, discussions and periodic summative assessments like examinations. To strike a balance between these types while maintaining consistency can be challenging. (Adams et al, 2017). Online assessments lack direct supervision which may, raise concerns about academic integrity. Ensuring that students' work on their own and preventing cheating requires innovative strategies. Research can investigate valid and reliable assessment methods, including formative and summative assessments, to measure student progress accurately.

- **Feedback and timeliness.**

Providing timely feedback is essential for student progress. In a blended environment, managing feedback across platforms can be challenging. Ensuring that students receive constructive feedback promptly is crucial. Bates, (2015), advises that addressing these assessment challenges requires thoughtful design, staff development, and a focus on student learning outcomes.

2.5 Possible solutions for overcoming the challenges and barriers associated with use of blended methods.

Alvarez, (2020) suggested that institutions can invest in robust infrastructure and provide training for both educators and students on using technology effectively to counter technological

challenges. Adoption of user-friendly platforms and tools should be encouraged and this can be done by design clear learning objectives and align them with assessment methods. (Becirovic, 2023). According to Benson et al (2014) there is need to provide detailed instructions for online activities and foster active engagement through discussion forums, quizzes, and collaborative projects. Teachers need to be equipped with the necessary expertise for the online technologies. This can be done through workshops, training seminars and staff development sessions. Similarly the learners need support systems to assist them not only get the knowledge of using online platforms but also to keep abreast to its dynamics. To overcome problems linked to large class sizes a possible solution is to consider smaller group sizes for effective interaction. Alternatively (Adams et al, 2017) argue that breakout sessions, peer teaching, and personalized feedback can be used to manage larger classes. There should be establishment of a reliable technical support system for both educators and student. This can be done by regularly updating resources and troubleshooting common issues. Collaboration challenges need fostering collaboration among educators, students, and administrators. Interdisciplinary cooperation should be encouraged and sharing of best practices done.

2.6 Research gaps.

From this literature review the following research gaps were identified, there is need for the following interventions:

2.6.1 Pedagogical strategies for enhancing student autonomy.

More research is required to find out about how students can be assisted to work independently with minimum supervision. According to Bates, (2015) ineffective pedagogical approaches to foster student autonomy in blended learning environments should be studied so that improvement measures are established. There is need to explore how students can take ownership of their learning process and make informed decisions about their learning pathways. This researcher further suggests that instructors need to adapt teaching strategies to leverage technology effectively, which requires professional development.

2.6.2 Equitable access to specialized equipment and software.

Means to examine strategies to ensure equitable access to necessary equipment and software for blended learning are required. Moreover, disparities related to technology access, especially in resource-constrained settings should be addressed. Research should identify best practices for supporting students who may struggle with online tools or lack reliable internet connectivity.

2.6.3 Staff development and teacher training.

There is need to explore effective methods for enhancing teachers' expertise in blended learning. Again professional development programs that empower educators to design and implement effective blended learning experiences need to be investigated and implemented. Research can explore effective professional development programs, mentorship, and resources to help instructors design and implement blended courses.

2.6.4 Assessment strategies in blended environments.

There is need to investigate innovative assessment methods that align with blended learning. Exploring the formative and summative assessment approaches that capture both online and face-to-face learning outcomes need to be done. However, designing fair assessments that align with blended learning objectives can be complex. A common barrier is that the traditional assessment methods may not fully capture blended learning outcomes. The challenge is for research to find out how creating meaningful assessments that measure both conceptual understanding and practical skills can be done.

2.6.5 Collaboration and interaction models.

The effective collaboration models between teachers and learners in blended settings need further studying and also how collaborative activities impact learning outcomes and engagement need to be investigated.

2.6.6 Cost-effectiveness and sustainability:

This is very important. An examination cost-effective strategy for implementing blended learning is essential. Successful implementation largely depends on cost management. If you incur more

costs implementing any program becomes difficult. More research is needed to investigate the long-term sustainability of blended approaches in diverse educational contexts.

2.7 Filling gap in student perceptions and motivation:

Exploring students' perceptions of blended learning, including their motivation, satisfaction, and engagement is yet another gap that needs filling. There should be more investigations on factors that influence student preferences for blended versus traditional learning.

2.8 Chapter summary.

This chapter reviewed the literature related to the use of blended learning methods in the teaching and learning of physics. A theoretical framework was laid down on the research questions for this research. The literature reviewed, addressed the research questions which are about the benefits or advantages of using blended learning methods in the teaching and learning of physics. It also looked into research question on the challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics. Along way problems were identified for the challenges and barriers associated with the blended learning methods. Specific barriers and challenges were noted down and suggestions on what research could do about them were given. The themes that surfaced and explored in this literature review, include the impact of blended learning on student engagement and motivation, the impact of blended learning on conceptual understanding and problem-solving skills, the impact of blended learning on 21st century skills, such as digital literacy and collaboration as well as the impact of blended learning on teacher development and professional learning. Also the literature review led to the identification of some research gaps thereby paving way for future research on these gaps.

Furthermore, it was noted that the main advantages of blended learning are that it improves student motivation and performance, promotes participation, self-learning and teamwork, opens new forms of interrelation between teachers and students, allows greater flexibility, and boosts digital intelligence and the acquisition of digital skills among others. It can be deduced from the literature studied that with the heavy integration of technologies, we can be able to improve teaching, information retention, engagement, responsibility, and enjoyment. However, blended learning is not without its disadvantages. According to specialists, the main one is that initially it

can be complicated given the demand for individual work and the essential acquisition of technological skills that it entails, and it can cause a lengthening of the learning curve. Studies suggest that students never outgrow their learning styles, meaning blended learning is more important than ever, no matter what the industry is, from schools to corporations, from all walks of life. In summary, research on blended methods should focus on enhancing learning experiences, addressing barriers, and promoting effective teaching practices in physics education.

CHAPTER 3: METHODOLOGY.

3.1 Introduction.

The chapter focused on the research methodology that was used for the whole study. It covered the research paradigm, approach, design, population and sampling as well as data collection instruments. It also delved on the data analysis and finally looked into the ethics and measures of trustworthiness. The researcher looked into the methodology employed to investigate the benefits and challenges of using blended learning methods in the teaching and learning of physics at the ordinary level. Blended learning, which combines face-to-face classroom instruction with online-mediated components, has gained prominence in educational settings. It offers a learner-centred approach that is personalizable and accessible, integrating various learning opportunities to empower students in both formal and informal learning actions. The study aimed to shed light on how this approach impacts both educators and learners within the physics domain.

3.2 Research design.

Mouton, et al (2012) defines a research design as the overall strategy that a researcher chooses to integrate the different components of the study in a coherent and logical way, thereby ensuring an effective address of the research problem. The design, Mouton, et al (2012) add on to say, constitutes the blueprint for the collection, measurement, and analysis of data. From these statements a researcher therefore needs to be following the blueprint to achieve the research objectives.

A multi-case study design and a qualitative approach were selected for this research. Paredes et al, (2021) defines a case study as an in-depth examination of a specific individual, group, organization, event, or phenomenon. Case studies involve detailed data collection, often using multiple sources (e.g., interviews, observations, documents), and an in-depth analysis of one or more "cases", such as students or teachers within a specific context , such as a school or a classroom with an aim to provide a holistic view of the subject. There are several reasons that compelled the researcher to choose a multi case study design for this research. Sejdiu, (2014) alludes to Paredes et al , (2021)' s view that case studies provide rich contextual understanding meaning that they allow a researcher to delve deeply into the specific context of blended learning implementation in physics education. It also allows the exploration of challenges, successes, and

nuances unique to physics education. Furthermore it allows exploration of complex interactions. Blended learning involves various components that include online platforms, classroom activities and student engagement hence a case study is considered justifiable design for such studies. Creswell and Poth, (2018) posit that case studies allow a researcher to explore complex phenomena in depth, and they're useful for understanding the context and meaning behind certain behaviours or experiences. Kuo et al concurs with Creswell and Poth, (2018) in their view that case studies involve in depth research when they state that researchers analyse real-life situations to gain insights, understand complex issues, and explore causal relationships.

Moreover a case study was appropriate choice since it also allows researcher to examine how these elements interact and impact physics teaching and learning. By studying individual classes or schools, you can understand students' experiences, preferences, and learning outcomes related to blended learning. A multi case study was appropriate for doing this. Another reason for choosing the case study is because of its practical implications. (Adams et al, 2017) support the view that case studies have practical implication when the state that, findings from case studies can inform practical recommendations for educators, policymakers, and curriculum designers aiming to enhance physics education. In other words case studies provide depth, context, and practical insights, making them a suitable approach for investigating blended learning methods in physics education.

The target population of this research included all physics teachers, physics students and school administrators from secondary schools in Mangwe district. However the accessible population consisted of learners, teachers and school administrators from the two urban schools, A and B as well as one peri urban school C. The researcher used convenience sampling methods to select the three schools under study. Purposive sampling was used to select the physics teachers and school administrators. Learners were chosen using stratified sampling and simple random sampling techniques. The researcher collected data using interview schedules on teachers and Administrators, observation guides on physics classes as well as focus group discussions on physics learners. The data was presented and analysed using thematic methods.

3.3 Research methodology.

To explore the research questions and assumptions, the researcher adopted a qualitative research methodology. The American Psychological Association (APA) defines qualitative research as a methodological approach that focuses on understanding people's beliefs, attitudes, behaviours, and experiences through the collection and analysis of non-numerical data. Such data can include text, videos, or audio materials used to gather in-depth insights into a problem or generate new ideas for research.

Qualitative methods allow researcher to delve into the nuances of educators' and students' experiences, perceptions, and challenges. Bhandari, (2020) emphasises that qualitative research method is a valuable approach for exploring and understanding complex phenomena, human experiences, and social context adding to say that it also focuses on exploring and understanding people's beliefs, attitudes, behaviours, and experiences through non-numerical data collection and analysis. American Psychological Association, (2018) indicates that these methods are commonly used in fields such as anthropology, sociology, education, and sciences. Stake (2016) posits that this approach is flexible and can adapt to the study's needs as it progresses, which is particularly useful in educational settings where variables are numerous and fluid. Additionally its exploratory nature is a valuable factor. Marsh (2012) concurs with this point by stating that qualitative research is ideal for exploring new areas where little is known, such as the integration of innovative teaching methods in specific fields like physics. The methods are also well-suited for studying human behaviour and the reasons that govern such behaviour, which is essential when assessing the adoption and effectiveness of blended learning methods in the teaching and learning of physics at ordinary level. Also qualitative methods were chosen because they can capture the subjective experiences of participants, providing insights into their attitudes, beliefs, and motivations regarding blended learning. The case study design allows adaptation during data collection based on emerging themes.

Data Collection was done with reference to the research questions of this study:

1. What are the benefits of using blended learning methods in the teaching and learning of physics?

2. What are the challenges and barriers associated with using blended learning methods in the teaching and learning of physics?

3. What can be done to overcome challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics at ordinary level?

The data was collected through In-depth Interviews whereby researcher engaged with participants to explore their perspectives, beliefs, and experiences regarding the benefits of using blended learning methods in the teaching and learning of physics at ordinary level as well as the challenges and barriers associated with the use of these blended learning methods. The researcher made direct observations of behaviour, interactions, and social contexts during physics lessons. Researcher engaged in focus group discussions with learners to uncover shared viewpoints between participants. Interviews on physics teachers and school administrators were also conducted. Through these interviews, observations and focus groups the researcher managed to gather useful data related to the study

Approaches to qualitative research:

According to Bhandari, P. (2020), the following are approaches to qualitative research:

Grounded Theory: Here the researchers are said to collect rich data and develop theories inductively.

Ethnography: The researchers immerse themselves in groups or organizations to understand their cultures.

Action Research: Collaborative research linking theory to practice for social change.

Phenomenological Research: Investigating phenomena by describing participants' lived experiences.

Narrative Research: This involves examining how stories are told to understand participants' perceptions.

The research approach includes:

Interviews: Semi-structured interviews with physics educators who have experience with blended learning. These interviews were meant to provide insights into their pedagogical practices, strategies, and reflections on the benefits and challenges.

Focus Groups: Engaging with students through focus group discussions was intended to allow the researcher to understand their perspectives on blended learning. Researcher explored their experiences, preferences, and asked about any challenges and barriers they encountered during blended learning.

Observation: The researcher observed specific items as indicated in the observation schedule during physics lesson (See Appendix 4).

3.3.1 Research paradigm/philosophy.

Poni, M. (2014) defines research paradigm as a philosophical framework that a research is based on. It offers a pattern of beliefs and understandings from which the theories and practices of your research project operate. Research is a systematic method of gaining new information, or a way to answer questions. It can be regarded as a systematic and controlled enquiry through which data are collected, analysed and interpreted to eliminate difficulties and improve conditions.The constructivist research paradigm was employed for qualitative this case study. The constructivist paradigm is rooted in the belief that knowledge is actively constructed by learners through their interactions with the environment, social context, and prior experiences. (Georgiou and Sharma, 2015). The key aspects of the constructivist paradigm relevant to this study are as follows:

Learner-centred approach.

In a constructivist framework, according to Meli, et al (2022) learners are active participants who construct meaning by engaging with content, peers, and instructors. Meli et al (2022) go on to intelligently state that learning is not a passive process. From a constructivist point of view we can point out that the learning of physics at ordinary level should involve sense-making, reflection, and negotiation of understanding based on the idea of active learning in contrast to passive learning.

Social interaction and collaboration

According to Georgiou and Sharma (2015), constructivism emphasizes the importance of social interactions adding that learners benefit from discussions, collaboration, and sharing diverse perspectives. Blended learning environments provide opportunities for both face-to-face and online interactions, fostering collaborative learning. Through collaboration learners are likely to

attain benefits linked to the use of blended learning methods in the teaching and learning of physics at ordinary level.

Authentic contexts and real-world relevance

Meli et al, (2022) argue that learning occurs best when situated in authentic contexts. Blended learning can incorporate real-world scenarios, simulations, and practical applications. This is supported by Beams, (2017) who adds on to say that physics concepts become meaningful when students connect them to everyday experiences or relevant problems. When the ordinary level students are connected to such everyday experience they are likely to participate in the development of technology for our country and the world at large.

Multiple perspectives and personal meaning

Constructivist teaching encourages students to explore multiple viewpoints, question assumptions, and develop their own understanding. Blended learning allows for personalized learning paths, catering to individual interests and needs. This is important in the teaching of physics at ordinary level based on the fact that the different viewpoints of students are likely promote a number of skills like ability to make meaningful analysis pertaining to the teaching and learning of physics at their level.

Reflection and metacognition

Constructivist pedagogy promotes metacognition-thinking about one's own thinking. Students reflect on their learning processes and adjust strategies accordingly.

Blended learning platforms can facilitate self-assessment, reflection, and goal-setting.

Such kind of attitude is good since it encourages learners to work at most without supervision. They even become self-starters, being able to put and meet targets on their own. Adoption of such a stance by students doing physics at ordinary level is recommended.

The components of a research paradigm

The three pillars of research paradigms are ontology, epistemology and axiology. These components are addressed in connection with this research study of an assessment on the integration of blended learning methods in the teaching and learning of physics at ordinary level.

Ontology

Application ontology to this Study:

Ontology views reality as socially constructed and context-dependent (Matta, 2021). Ontology addresses the question, "What is reality?" It explores the study of being and what you aim to research. In the context of this study, the constructivist ontology acknowledges that learners' understanding of physics is not fixed but rather shaped by their interactions with technology, peers, and the learning environment. It recognizes that reality is multifaceted and influenced by individual perspectives. The relevance to technology access when exploring technology access, it was considered how learners' ontological assumptions impact their engagement with digital tools. The research sought to find out whether they are open to diverse ways of knowing and constructing knowledge in the teaching and learning of physics at ordinary level through technology.

Application of epistemology to this study

Epistemology focuses on how individuals create knowledge through interaction emphasizes understanding and interpretation. It acknowledges that knowledge is shaped by cultural, historical, and social contexts. The application to this study is based on that constructivist epistemology aligns with the research focus. It emphasizes that knowledge in physics is actively constructed by learners through interactions with blended learning methods. Epistemological assumptions influence how learners perceive the validity of information obtained from technology. In this study this pillar also attempted to find out whether there is relevance to the teaching methods. It investigates how teaching methods (both traditional and technology-enhanced) shape students' epistemological beliefs. Are they encouraged to question, explore, and co-construct knowledge collaboratively?

Application of axiology to this study (Ethics and values):

Axiology in constructivism recognizes that researchers' values and ethical considerations play a crucial role. The researcher considered the ethical implications of using tools that include interviews questionnaires. The researcher put in mind how values related to equity, accessibility,

and inclusivity impact teaching decisions. Furthermore the relevance to access to technology was not overlooked. Reflection on the ethical dimensions of technology access was done. For example it was investigated whether there are any disparities in access that need to be addressed and also how could teaching methods promote ethical use of technology in the teaching and learning of physics at ordinary level.

3.4 Population and sampling.

3.4.1 Population.

In research studies, according to Plano et al (2016), the term "population" refers to the entire group of individuals or elements that a researcher wants to study or draw conclusions about. It represents the larger target group that researchers aim to study or generalize findings to. Morse (2018) argues that population can be defined based on various characteristics, such as geographical location, age, income, or other relevant factors. This means a researcher will define population based on the interest of the particular study in question. The population inclusion criteria used in this research was based on all students currently enrolled in ordinary level physics classes whilst the exclusion criteria was on students not doing physics at ordinary level or those in advanced levels. The target population or the specific group of interest of this study was all physics learners at ordinary level, all physics teachers and school administrators in the district. The total population size was the combined total of all eligible students, teachers and school administrators from the 18 schools in Mangwe district. The study population was 18 secondary schools, 36 school administrator, 24 Physics teachers and 900 physics learners drawn from Mangwe district giving a total of 960. The findings of this research are to be generalized to the broader group known as the theoretical population. An accessible population is a subset of the target population .Since it is often not possible or it is very difficult to study the whole population, researchers often draw samples from the target population to make inferences about the entire population . Similarly for this research, a sample was selected from a target population so that the findings are inferred to the whole population.

Table 3.4 Population of physics learners of physics learners

	Number of learners in Class		
School	**Form 3**	**Form 4**	**Total**
A	30	28	58
B	28	28	56
C	12	10	22
Total	70	66	136

3.4.2 Sampling.

A sample is a subset of the population that a researcher actually collects data from. (Creswell, 2014)It is essential to select a sample that is representative of the entire population. Researchers use sampling techniques to collect data efficiently and draw conclusions about the entire population. The researcher determined a sample of 30 physics learners across the three schools.

3.4.2.1 Convenience sampling.

Scribbr (2022) defines convenience sampling as a non-probability sampling method where units (participants or elements) are selected for inclusion in the sample based on their ease of accessibility to the researcher. This can be due to geographical proximity, availability at a specific time, or willingness to participate in the research. Convenience sampling was used to select three schools from 18 schools in the district. Schools, A and B which are in an urban set up and school C which is a peri-urban school were chosen for the research because they are in the same proximity or geographical location which made it convenient for the researcher to conduct the study. Schools, A and B had good internet connectivity for blended learning and school C has internet connectivity though intermittent. The other schools in the district are located where there is no internet connectivity or where it is poor or is intermittent, thereby making implementation of blended learning difficult. Convenience sampling was suitable because the researcher needed to quickly gather data from readily available sources. It was chosen to facilitate time efficiency. The schools were easily accessible due to their central locations and accessibility making data collection more efficient. Consideration of practical constraints was made, basing on the fact that conducting research in schools can be time-consuming and resource-intensive. Convenience sampling allowed the researcher to work within practical constraints.

3.4.2.2 Purposive sampling.

According to Paredes et al, (2021) purposive sampling is defined as the choosing of individuals who can provide deep, rich, significant data on the subject being investigated. Purposive sampling was used to select three (3) teachers and three (3) administrators across the three selected schools. This sampling technique was intended to get contributions from the physics teachers because they have significant data on the subject area. Purposive sampling allowed the researcher to deliberately select experienced physics teachers who could provide insights into blended learning methods. Their expertise and classroom experiences were assumed valuable for the assessment. The school administrators were required to provide in depth information pertaining to policy and other relevant issues on implementation of blended learning in schools. The researcher also considered efficiency and resource optimization. Given limited resources, purposive sampling allowed researcher to focus on relevant cases without interviewing all the teachers and administrators in the entire population.

3.4.2.3 Stratified sampling.

Stratified random sampling is a method of selecting a sample from a population by dividing it into homogeneous sub groups or strata, and then randomly selecting individuals from each group for study (Taherdoost, 2016). The process of classifying the population into groups before sampling is called stratification. Stratification was done by dividing the student population into strata based on class. The population was divided into form 4 and form 3 classes, for the three schools A, B and C. This sampling technique was selected because of its representativeness. The method ensured that each class at ordinary level was adequately represented in the sample. This approach allows researcher to capture any diversity within the student body at ordinary level. Stratified sampling increases the precision of estimates because it ensures that each sub group is proportionally represented in the sample. Meriam (2015) asserts that this precision is especially important when you want to make accurate inferences about specific sub groups. Stratified random sampling enabled meaningful comparisons between different student classes. Instead of randomly selecting students from the entire population, stratified sampling allows researcher to focus efforts on specific strata thereby increasing precision and efficiency. Matta (2021) claims that this targeted approach can be more efficient in terms of time, resources, and data collected.

After stratified sampling, simple random sampling was used to select learners as shown in table 3.5 below.

The table 3.5 below shows the figures of the sample.

	Number of learners in Class		
School	**Form 3**	**Form 4**	**Total**
A	7	6	13
B	6	6	12
C	3	2	5
Total	16	14	30

3.5 Data collection tools.

Creswell (2014) considers data collection methods as referring to the systematic procedures used to gather information or observations for research purposes whilst research instruments are tools used to collect, measure, and analyse data related to a specific research topic. These can include surveys, questionnaires, tests, interviews, or checklists. Creswell (2015), state that qualitative case studies often use a combination of interviews, observations, and document analysis in order to get deeper insights and minimise biases. The data for this research was collected by gathering information using interview schedules, observation guides and focus group discussions. The researcher conducted interviews on physics teachers and school administrators. Learners were engaged in focus group discussions to find out about their perceptions, experiences about the benefits, challenges and barriers related to use of blended learning in physics were explored. The researcher also enquired about what could be done to deal with the challenges and barriers associated with the integration and implementation of blended learning methods.

3.5.1 Interviews.

Interviews as defined by Hennink, (2014) involve direct conversations with individuals to gather information, insights, and perspectives. The researcher prepared a list of open- ended questions in advance. For this research interview schedules were used to collect data from physics teachers and school administrators. An "Interview schedule for physics teachers" was used to collect data from the physics teachers. (See Appendix 1). An "Interview schedule for school administrators"

was used to collect data from school heads.(See Appendix 2). Interviews allow a researcher to explore participants' experiences, challenges, and successes related to blended learning. When using interviews you can therefore gain insights into their perceptions, strategies, and recommendations for effective implementation.

3.5.1.1 Advantages of interviews

- In-depth information: Interviews provide a deep understanding of participants' experiences, thoughts, and feelings.
- Flexibility: They can be structured, semi-structured, or unstructured, allowing for flexibility in how questions are asked and answered.
- Rich data: Interviews often yield rich, qualitative data that includes non-verbal cues, off-the-cuff reactions, and emotional responses.
- Contextual understanding: They offer context to the responses, helping researchers understand the 'why' behind the answers.

3.5.1.2 Disadvantages of interviews.

- Time-consuming: Interviews can be lengthy to conduct and transcribe.
- Interviewer bias: The presence of the interviewer can influence responses.
- Costly: Financial costs can be high due to travel or transcription services.
- Participant reluctance: Individuals may be reluctant to share sensitive information face-to-face.

3.5.1.3 Interview schedule for teachers (see Appendix 1).

The Interview schedule for physics teachers was used to collect data that was contributed by the physics teachers from the three schools A, B and C. This interview schedule consisted of open ended questions that asked about the experience of the teachers, their perceptions on blended learning methods, the challenges and barriers faced in the integration of blended learning methods in the teaching and learning of physics at ordinary level (see Appendix 1). Before conducting the interview the researcher made arrangements and asked for consent from the teachers. Ethical considerations were taken note of, to enable the teachers to participate freely and openly. The researcher was guided by a printed interview schedule to ask the questions.

3.5.1.4 Interview schedule for school administrators. (See Appendix 2)

An interview schedule for school administrators was prepared. (See Appendix 2) The interview consisted of a list of questions on school policies, perceptions on blended learning methods, challenges and/ or barriers associated with the integration of blended learning methods. Questions on how to balance online activities and in person components were asked. The researcher also had interest to include questions on how to handle resistance of teachers and stakeholders towards the integration of blended learning methods in physics. There were also questions on what support systems were required by the schools to successfully integrate blended learning methods.

3.5.2 Observations.

In qualitative research, an observation schedule refers to a systematic method of collecting behavioural data within a controlled environment (Bates, 2015). It involves noting and recording the occurrence of target behaviour whenever it is seen during a stated time interval. This can be done using fixed time periods or random time intervals. For this research observation of physics classes were made during formally timetabled periods using an observation schedule prepared by the researcher.

3.5.2.1 Observation schedule for physics classes. (See Appendix 3)

Observations were to collect data during lessons in physics classes. An observation guides was prepared in advance. The Observation guide consisted of five sections A, B, C, D, and E. (See Appendix 3) The questions in section A are on school information, section B are on teacher information, section C on the physics classroom context, part D on the observations made during the physics lessons and part E is on reflections and recommendations made by the researcher after observing the physics lessons.

3.5.2.2 Advantages of Observations.

- Direct access: Observations give direct access to the phenomena being studied, allowing researchers to gather data in real-time.
- Behavioural patterns: They help in understanding behavioural patterns, psychological characteristics, attitudes, and beliefs of subjects.

- Natural environment: Observing subjects in their natural environment reduces artificiality and provides more genuine data.
- Non-verbal cues: Researchers can gather data on non-verbal communication, which can be as informative as verbal communication

3.5.2.3 Disadvantages of observations.

- Observer influence: The presence of an observer can alter the behaviour of participants.
- Subjective interpretation: Observations can be subject to the observer's interpretation and bias.
- Limited internal thoughts: Observations do not provide access to the internal thoughts or feelings of participants.
- Ethical concerns: There may be privacy concerns, especially if participants are unaware of being observed.

3.5.3 Focus group discussions.

According to Hennink, (2014) a focus group is a research technique that brings together a small group of people to answer questions in a moderated setting. Participants are chosen based on predefined demographic traits. The goal is to shed light on a specific topic of interest through group dynamics and discussion.

3.5.3.1 Focus group discussion guide.

Focus group discussion guide was prepared and used to collect data from physics learners who were selected to participate. A list of questions relevant to the research study was written in advance and used to guide the researcher during the discussions. (See Appendix 4) The focus group discussion guide was prepared to collect data from the physics learners.

3.5.3.2 Advantages of focus groups.

- Group dynamics: Can reveal group norms, dynamics, and varying perspectives.
- Synergy: Participants can build on each other's ideas, leading to richer data.
- Cost-effective: Can gather data from multiple participants simultaneously.

- Stimulating environment: The group setting can encourage participants to open up more than they would individually.
- Diverse perspectives: Captures a wide range of views and experiences.
- Facilitator control: A skilled facilitator can guide the discussion to cover specific topics.

3.5.3.3 Disadvantages of focus groups.

- Group think: Risk of dominant voices overshadowing others, leading to conformity.
- Moderator influence: The facilitator's behaviour and questions can influence the discussion.
- Less depth: Individual responses may be less detailed than in one-on-one interviews.
- Sensitive topics: Participants may be less willing to discuss sensitive issues in a group setting.

3.6 Data collection and analysis procedures.

Researchers must maintain rigor and transparency during data collection and analysis. There should be dependability, ensuring consistency and reliability in the research process. The researcher made careful choice of data collection methods.

3.6.1 Data collection procedure.

3.6.1.1 Conduction of interviews on physics teachers and school administrators.

The researcher used semi-structured interview guides with open-ended questions to allow for in-depth responses from the selected physics teachers and school administrators across the three schools. The researcher made prior arrangements for the interviews, with the selected participants. The researcher had to conduct one-on-one interviews in a quiet, comfortable setting to encourage open communication. Responses from the interviews were then recorded with consent so that they could be later transcribed for analysis.

3.6.1.2 Observation of physics classes.

The researcher used a standardized observation form to record details for the sections given(see Appendix 3). The teacher made advance arrangements to conduct the class observations across the selected schools. Multiple lessons were observed at different times to capture a range of

activities and interactions. The researcher maintained a non-intrusive presence to minimize the "observer effect." The researcher took down notes during the class visits by filling the observation form. The descriptive notes were later converted into descriptive narratives captured the context and details of the behaviours observed.

3.6.1.3 Conduction of focus group discussions with learners.

The researcher made arrangements to conduct focus group discussions with physics learners. Focus groups of 6-8 students from each school were formed. The researcher ensured that the focus group discussions are well-structured, and the participants are representative of the larger student body, and ethical considerations, such as consent and confidentiality, are addressed. The moderator, in this case the researcher facilitated the discussions, ensuring all participants had the opportunity to speak. The researcher took down notes and recorded audios for accuracy , with consent from the participants. The discussions from the focus groups were then transcribed for textual analysis.

3.6.2 Data analysis procedures.

3.6.2.1 Coding strategies.

The researcher made every effort to keep questions along particular themes in addition to keeping the sample small, to identify recurring ideas and experiences. Coding data in qualitative research can be difficult (Creswell, 2012). Coding was done using predetermined themes from the literature review, as well as emergent themes from the data. Creswell (2012) stated that thematic analysis would provide the researcher with the opportunity to code data, categorized into various themes and note patterns. This approach was appropriate for coding as it allowed for the natural grouping of issues that would have influenced the perceptions of the interviewees. According to Creswell, coding involves taking text data gathered during the data collection process, segmenting sentences into categories and labelling the categories with a term. In using this approach, in coding themes, the researcher located the central categories that relate to the topic discussed. Coding included taking the data gathered during the data collection process, breaking sentences into themes and labelling them with a term. The major themes of student engagement, flexibility, accessibility and control, enhanced of learning experience technological

issues, assessment issues and teachers' professional development were amongst the strong cases drawn from the data.

3.6.2.2 Thematic analysis.

This study used thematic analysis as a method of analysing data. A theme relates to the degree and / or intensity of occurrence of an expressed idea or a specific subject (Kampira, 2021). The more expressed an idea is, the more likely it is a theme for particular subject. The implication here is that a theme is the main idea of a specific topic of discussion or interest. According to Braun and Clark (2017), the purpose of thematic analysis is to identify patterns of meaning across a data set that provides an answer to the research being addressed. Similarly, Peterson (2017) asserts that "thematic analysis involves immersing oneself in the data in order to identify common ideas or themes that emerge based on the phenomenon under investigation and that resonate with the research questions posed in the study". This implies that this method is used to deduce meaning from a data set in order to provide answers to the research questions.

For this research themes and patterns in the interview transcripts responses were identified. Direct quotes from participants were used to illustrate key points. After these themes and patterns are identified the data is organised into meaningful categories. The researcher transcribed data from all interviews and focus group discussions by reading through the transcripts and observation notes multiple times to familiarize with the data. Data was organised by identifying items of interest or words related to the emerging themes. The data were carefully analysed. After data analysis reporting was done by presenting findings in a clear, structured format in line with the emerging themes on benefits, challenges and barriers and possible solutions to overcome the challenges.

3.7 Trustworthiness and dependability

3.7.1 Trustworthiness.

Poth and Munce (2020), state that trustworthiness refers to the establishment of validity and reliability of qualitative research. They further highlighting that qualitative research is trustworthy, when it accurately represents the experience of the study participant. Researchers must establish the trustworthiness of their findings. The researcher considered several criteria to

enhance trustworthiness of this research study. Some of the criteria considered by the researcher that ensure the quality and rigor of a qualitative research are outlined below.

3.7.1.1 Credibility.

It is demonstrating that the findings accurately represent the phenomenon.Credibility is demonstrated when participants recognize the reported research findings as their own experiences (Creswell, 2014). To ensure credibility, the researcher asked participants the same main questions.

3.7.1.2 Transferability.

This entails providing comprehensive and detailed explanations to enhance the applicability of findings to other contexts. Transferability refers to the extent to which the findings can be applied in other contexts, or with other participants (Timans, et al 2019).

3.7.1.3 Conformability.

Plano and Ivankova, (2016) interestingly point out that conformability refers to the objectivity or neutrality of the data, such that there will be agreement between two or more independent people about the data's relevance or meaning.

3.7.1.4 Objectivity

Objectivity refers to minimizing bias and maintaining a neutral stance during data collection and analysis. Researchers should be transparent about their own perspectives and biases. Reflexive journaling helps maintain objectivity by reflecting on personal biases and assumptions.

3.7.2 Dependability.

Dependability refers to the consistency and repeatability of the research findings. It ensures that the study's findings are consistent with the collected data and that similar results could be obtained if the study were repeated under similar circumstances. To address dependability under ethical considerations, the researcher conducted the study with a commitment to ethical standards with a mind to protect participants and ensure the integrity of the research process. This involved informed consent, confidentiality, non-maleficence the ensuring that the research

does not harm the participants. The researcher also had to ensure that the research design and methods do not disadvantage or unfairly burden any participants. For example, the use of blended learning tools should not compromise the students' right to privacy or equal access to education. Overall, maintaining dependability in qualitative research required a careful balance between rigorous methodological approaches and adherence to ethical principles throughout the research process

3.8 Ethical issues.

Researchers should obtain necessary research permits or approvals from relevant authorities or institutions. (Fried et al, 2020). Ethical issues and considerations have mainly to do with permission to carry out the research, the participation of respondents, the community and public as well as the process employed to analyse data. High standard of ethical considerations should be maintained. These considerations were addressed at each phase of the study. Merriam and Tisdel (2015, argue that ethical considerations are crucial in qualitative research to ensure the well-being of participants, maintenance of trust, and upholding the integrity of the study. The key aspects of ethical considerations are:

3.8.1 Informed consent.

Informed consent involves obtaining voluntary and informed agreement from participants before their involvement in the study. Researchers must obtain informed consent from participants before involving them in the study. Participants should be fully aware of the purpose, procedures, risks, and benefits of the research. This is for purposes of showing respect for autonomy. Participants have the right to make informed decisions about their participation. The researcher asked for consent before the targeted participants could be interviewed. This was done for ensuring transparency.

3.8.2 Confidentiality and privacy:

Researchers must protect participants' identities and sensitive information. The researcher assured participants that their identities will not be linked to any sensitive information raised in relation to this study. Such ethical responsibility safeguarding privacy prevents harm or

unintended consequences. Ethical considerations also encourage trust. Participants are more likely to share openly when assured of confidentiality.

3.8.3 Ethical imperative.

Upholding participants' dignity and rights is fundamental. The researcher ensured that under no circumstances should the dignity and rights become violated intentionally. The findings of the study are more likely to be meaningful where participants were dealt with in a respectable manner.

3.9 Summary

The research focused on assessing the integration of blended learning methods in teaching and learning physics at the ordinary level at three selected secondary schools. The study adopted a qualitative case study approach, examining two urban schools A and B and then one peri-urban school C. The internet network is fairly strong in urban areas but intermittent in peri-urban regions. The Participants for this research were 30 learners, 3 physics teachers and 3 administrators representing diverse backgrounds and abilities. The 3 physics teachers provided insights into instructional practices whilst the 3 administrators offered perspectives on policy implementation and resource allocation. The study was based on the assumptions that the teachers and learners have access to technology and also the teaching approaches used are effective. The study investigated how technology availability influences blended learning adoption. It also considered variations between urban and peri-urban settings.

Furthermore the study investigated the challenges and barriers associated with the use of the teaching and learning of physics at ordinary level. Obstacles faced by teachers and learners when implementing blended learning was explored. Efforts to identify factors hindering successful integration were made. Data Collection Methods used included interviews and questionnaires. The researcher conducted interviews by engaging with participants to understand their experiences, beliefs, and challenges related to blended learning. For interviews Open-ended questions were asked to allow for rich, context-specific responses. The Questionnaires were administered to learners, teachers, and administrators. Qualitative items explored attitudes, preferences, and perceived effectiveness of blended learning. Observations were also done to

observe classroom interactions during blended learning sessions. These have the advantage of capturing real-time practices, teacher-student dynamics, and technology use.

The researcher organised focus groups by gathering learners and teachers to discuss shared experiences. These focus groups facilitate deeper exploration of themes related to blended learning.

Data collected from the participants was subjected to Thematic Analysis so that recurring patterns, themes, and meanings are identified. Themes emerged from interviews, questionnaires, observations, and focus group discussions. Coding and interpretation ensured reliability. The findings of this study will inform, pedagogical strategies advising how to optimize blended learning for physics education. Furthermore the findings will contribute to Policy recommendations and address technology gaps and barriers associated with the use of blended methods in the teaching and learning of physics at ordinary level. The research study will also promote professional development and enhance teachers ' capacity for blended instruction. In the next chapter the data collected from the research is presented, analysed and the discussed.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION.

4.1 Introduction

This chapter examined the impact of blended learning on teaching physics at the ordinary level through a qualitative case study. It drew on data from interviews with teachers, classroom observations, and focus group discussions with physics learners, to offer a detailed view of how blended learning is applied. The study analyzed this data to identify key themes and insights, discussing them in the context of academic literature and teaching frameworks. Findings on perceptions on the benefits of integration of blended learning methods, its challenges and barriers as well as possible solutions to overcome problems were discussed. Data was analyzed to answer key questions and provide actionable strategies for educators to improve physics instruction in line with the research questions.

4.2 Bio Data.

This section presents Bio Data of the participants of this study. Bio Data typically refers to biographical and demographic information about individuals participating in the study. Tables presenting Bio Data for participants are given under each sub heading of each group of participants. The Bio Data for the participants of this study are the names, age and gender. Bio Data for physics teachers and school administrators were presented on the same table since the researcher collected data from them through interviews. Bio Data tables for learners across the three schools were also presented.

4.2.1 Bio Data for physics teachers and school administrators.

Three Physics teachers and three school administrators (heads) across the three schools participated in this study. Two physics teachers were males and one was a female. All the school administrators were males. All the three physics teachers are holders of Bachelor of Science degrees from Zimbabwe State Universities. All the physics teachers were found to be exposed to blended learning methods. The two male teachers worked in urban secondary schools whilst the other female teacher worked in a peri urban school with intermittent internet connection. In terms of the administrators two of them were heads of the two urban schools whilst the other one was a head in the peri urban school. All the school heads had degrees in administration and all had more than 10 years' experience as school heads and more than 30 years' experience in

teaching. Table 4.2a below summaries some Bio Data for the three physics teachers and three heads.

Table 4.2 (a) Bio Data for physics teachers and School administrators

School	Participant	Code	Age	Gender	Professional qualifications	Teaching experience (years)
A	Teacher 1	T1	35	M	BSc. Physics	12
B	Teacher 2	T2	36	M	BSc. Physics	10
C	Teacher 3	T3	30	F	BSc. Physics	6
A	Administrator 1	H1	60	M	B.Ed. Admin	30
B	Administrator 2	H2	55	M	B.Ed. Admin	25
C	Administrator 3	H3	56	M	Bed. Admin	28

4.2.2 Bio Data for physics learners.

The learners who participated in this study were doing physics at ordinary level. 16 form 3 and 14 form 4 learners, giving a total of 30 were involved in the study. The learners were selected across the three schools. Of the three schools, school A and B were in an urban set up. School A is a boarding school with some learners who are day scholars whilst school B is a day school. School C is a peri urban day school. Both male and female learners participated in the study. The learners who participated in this study were between the ages of 15 and 18 years of age. The tables 4.2(b), 4.2(c) and 4.2(c) below summaries the Bio Data for learners from schools A, B and C respectively. Codes were assigned to participants so that their original names are not used for ethical considerations. The three teachers for school A, B and C were coded as participant T1, T2 and T2 respectively whilst the school administrators for school A, B and C were coded as participant H1, H2 and H3 respectively. The 13 learners from school A were coded as participants A1 up to A13. For school B, the 12 learners were coded as participants B1 to B12. Then for school C, the 5 learners were coded participants C1, C2, C3, C4 and C5.

Table 4.2 (b) Physics Learners Bio Data: School A

School	Participant	Code	Age	Gender	Class
A	1	A1	15	M	F3
	2	A2	15	F	F3
	3	A3	16	M	F3
	4	A4	15	F	F3
	5	A5	16	M	F3
	6	A6	17	F	F3
	7	A7	15	M	F3
	8	A8	17	M	F4
	9	A9	17	F	F4
	10	A10	18	M	F4
	11	A11	17	F	F4
	12	A12	18	M	F4
	13	A13	17	F	F4

Table 4.2 (c) Physics Learners Bio Data: School B.

School	Participant	Code	Age	Gender	Class
B	1	B1	15	M	F3
	2	B2	15	F	F3
	3	B3	15	M	F3
	4	B4	16	F	F3
	5	B5	15	M	F3
	6	B6	15	F	F3
	7	B7	17	M	F4
	8	B8	18	F	F4
	9	B9	17	M	F4
	10	B10	17	F	F4
	11	B11	17	M	F4
	12	B12	17	F	F4

Table 4.2 (d) Physics Learners Bio Data: School B.

School	Participant	Code	Age	Gender	Class
C	1	C1	16	M	F3
	2	C2	15	F	F3
	3	C3	15	M	F3
	4	C4	18	F	F4
	5	C5	15	M	F4

4.3 Perceptions from research questions.

This section presented and analysed the data that was collected from the participants of this study through interviews on physics teachers and school administrators, focus group discussions with ordinary level Physics learners as well as lesson observation of physics classes. The perceptions of participants of the study were analysed under emerging themes in line with the research questions.

4.3.1. Perceptions from interviews on teachers and school administrators.

The perceptions of teachers that were found from data collected from interviews on physics teachers were analyzed thematically. The data were analyzed according to the themes emerging from the research findings in line with the research questions.

4.3.1.1 Perceptions on Benefits.

4.3.1.1.1 Increased student engagement.

The interview responses from physics teachers and heads indicated a link between blended learning methods and student engagement. The use of interactive and diverse content has been highlighted as a key factor in this increased engagement. Blended learning, which combines traditional face-to-face instruction with online learning activities, allows students to interact with the material in various ways, catering to different learning styles. The responses also indicated that there is increase in student engagement as attributed to the interactive and diverse content provided by these methods, which seems to cater to different learning styles and preferences. They have observed that blended learning, with its interactive and diverse content, has led to more engaged students.

Teacher, T2: said:

"*Blended learning has increased student engagement by providing interactive and diverse content." whilst*

School administrator, H2 also concurred with the sentiments aired by teacher, T2 relating to improved student engagement when he said;

"Blended learning has significantly increased students engagement and motivation, as they find the interactive online components very stimulating."

Teacher, T1 also alluded to the same views that blended learning leads to increased engagement of students in physics classes and he had this to say:

"Blended learning can lead to higher levels of student engagement through interactive online modules and hands-on classroom experiments".

The school administrator, H3 said there was need to work on challenges that affect integration of blended learning methods. He said efforts to employ blended methods in Zimbabwean schools should be advanced. He said the advantages were quite numerous and worthy. One statement addressing his support for blended methods is when he said:

"Blended learning can increase student engagement through interactive simulations and digital tools that make abstract physics concepts more tangible."(H3)

Teacher, T2 indicated that blended learning has led to Increasing engagement and facilitates personalised learning.

Teacher, T2 said:

"Blended learning has enhanced my teaching experience by facilitating personalized learning. It allows me to tailor content to individual student needs motivating them to be engaged in my lessons".

Additionally, the mention of motivation by the teachers suggests that students are more inclined to participate actively in their learning process when they find the material stimulating. This

could be due to the dynamic nature of online components that often include multimedia elements, interactive tasks, and immediate feedback.

4.3.1.1.2 Enhancement of learning experience.

The respondents explained that the use of blended learning promoted opportunities of involvement of learners in learning activities for their deeper understanding of the concepts or phenomena. Both the physics teachers and school administrators asserted that the use of blended learning contextualizes their learning activities, allowing learners to apply their learning skills and knowledge, facilitating them in handling and using learning materials and analyzing their learning outcomes. The teachers echoed that blended learning allowed students to explore content in various formats, reinforcing their understanding. Their views suggested that It also accommodated diverse learning styles and schedules.

Teacher T2 explained by saying:

"We use blended learning approach to extend individual support to the learners. The learners feel comfortable and pleasure while using technology-based learning materials for meeting their individualized learning needs; and according to their own pace".

Teacher, T1 raised the same views as teacher T2, pertaining to blended learning when he said:

"It allows for a more personalized learning experience and helps students to learn at their own pace."

Administrator, H1 also asserted,

"*Blended learning creates interest and motivation among students by involving their more senses. Thus they are engaged to optimum level of their potential in learning activities. They learn according to their mental capacities. They can blend their knowledge and information with learning activities and situations".*

The school administrator of school B showed an appreciation of blended methods when he compared online methods to traditional methods. The administrator, H2 said:

"Blended learning in physics allows students to visualize complex concepts through simulations that are not possible in a traditional classroom. It also provides flexibility for students to self-pace.

This response suggested that blended methods complement traditional teaching by providing practical insights into abstract physics concepts.

4.3.1.1.3 Flexibility, accessibility and control.

The responses from physics teachers and school administrators led researcher to observe flexibility as yet another emerging theme. They said students have the flexibility to learn at their own pace, revisiting complex topics and accelerating through familiar ones. They also acknowledged that they use blended learning because of its innovative nature that allows access to modern learning materials and latest developments in pedagogy.

Furthermore Accessibility also emerged as a theme during analysis of the research findings. The teachers said online components are accessible from anywhere, making it easier for students to engage with the course material outside the classroom. Teachers were found to appreciate the ability to adapt teaching methods to suit individual student needs, which is crucial in a subject as challenging as physics. The physics teachers generally pointed out that if given easy access, students can benefit from the wide range of resources, allowing for varied learning experiences. Both teachers and students said they found out that, having more control over the learning process leads to better engagement and understanding. Teacher, T1 was quoted as saying:

"*Blended learning has revolutionized our approach to teaching physics. The flexibility to switch between online and face-to-face interactions means we can tailor the learning experience to each student's needs."*

Teacher, T2 said:

"The accessibility of online resources has allowed students to learn at their own pace, which is particularly beneficial for complex topics in physics where they may need more time to grasp the concepts." and he added on to say:

"Having control over the learning materials and pace has empowered students to take charge of their learning, leading to a more self-directed and motivated approach."

The school administrator, H1 of school B concurred with the views of teacher T2 on the "self-pace" advantage of blended learning methods. They considered that blended methods generate student interest.
H1"s words were quoted as:
"*Students have more control over the pace of their learning, which can increase interest and motivation."*

School administrator, H3 contributed some views which supported the strength of blended learning methods in the teaching of physics classes.
The administrator, H3 said these words about blended methods in relation to the flexibility and accessibility:

"It offers a richer learning experience by combining the strengths of both traditional and digital methods, making learning more dynamic and accessible."(H3)

The responses indicated that the teachers appreciated the ability to adapt teaching methods to suit individual student needs, which is crucial in a subject as challenging as physics. The perceptions suggested that they believe that students benefit from the easy access of a wide range of resources, allowing for varied learning experiences. Control also emerged as a theme in that both teachers and students found that having more control over the learning process leads to better engagement and understanding.

4.3.2 Perceptions from observations of physics classes.

4.3.2.1 Perceptions on benefits.

4.3.2.1.1 Increased student engagement and motivation.

Blended learning was observed to encourage students to engage with course materials beyond traditional lectures. Students can interact with content at their own pace, revisit materials, and seek clarification. The gamified elements in the online platform were observed to make learning physics more engaging. Increased student engagement is likely to lead to better retention and application of physics concepts. Enhanced engagement was observed in the classes that participated in the study. The integration of gamified elements in online platforms showed

significant levels of student engagement, and made the learning process become more interactive and enjoyable to learners. It was observed that blended are flexible and allowed students to access materials at their convenience, leading to better work-life balance and the ability to self-pace.

The learners were provided with a variety of resources. All the three Teachers T1, T2 provided their physics classes multiple numbers of videos, quizzes. Teachers T1 and managed to offer interactive simulations. They said these simulations proved useful though they said implementing them was subject to some technical challenges. The simulations according to the teachers, catered to different learning styles.

4.3.2.1.2 Effective use of interactive simulations

The researcher observed that effective use of interactive simulations can enhance conceptual understanding and engagement. Interactive simulations are accessible online, allowing students to engage with them. In school A, online resources and simulations enabled some students to access resources such as websites, videos, and simulations to reinforce their understanding of physics concepts. These simulations allow students to visualize abstract concepts and explore phenomena that might be challenging to demonstrate in a traditional classroom setting. Interactive simulations promote active learning by encouraging students to manipulate variables, observe outcomes, and draw conclusions. Students become active participants rather than passive recipients of information, leading to better engagement and retention. Simulations provide a bridge between theoretical concepts and real-world applications, making physics more tangible and exciting.

4.3.2.1.3 Accessibility.

Blended learning can be a great equalizer, providing high-quality education resources to students regardless of location. The researcher observed that some students with physical disabilities or those living in remote areas can benefit from the accessibility of digital content. The learners from the peri urban school C said they stayed at their rural home and had to walk long distances to and from school daily. Their physical contact time with teachers seemed to be lower as compared to the learners from school A and C. It was observed that learners from school A had

more contact time because learners were staying in as borders. School B learners were day scholars who stayed in residential suburbs in that town. These learners had a chance to be at school after normal school hours to study or interact with their teachers. Even during weekends they could sometimes easily go to school for lessons. Some learners were observed to be actively involved in online platforms for their physics classes. Teachers, T1 and T2 said they used online platforms that included Google classroom to interact with their learners. The learners expressed pleasure that even if they faced data challenges they could download online components using the school" Wi-Fi and then go on to study at their homes. These advantages enjoyed by school A and B learners were not there for the school C learners. It was observed that the learners capitalized on WhatsApp platform to supplement face to face lessons. It was observed that the learners school C relied more on downloaded online components accessed by their teacher from internet. The WhatsApp platform was mainly used as it seemed to have better connection as compared to online platforms like Google classroom.

4.3.2.1.4 Active participation in group activities: fosters deeper learning and critical thinking.

Group activities during online lessons especially using the Google classroom by the teachers and learners in school A and B was observed to be fostering deeper learning and critical thinking. The learners' active participation seemed well-aligned with the principles of blended learning in physics education. It was observed that blended learning, which combines online digital media with traditional classroom methods, offers a rich environment for active learning where students can engage with the material, the instructor, and each other in various ways. In a blended learning environment, these group activities can take place both in-person and online, offering flexibility and continuity in the learning process. Online forums and collaborative platforms between learners, especially in schools A and B which had better online services, extended the classroom's collaborative space, allowing students to engage in discussions and problem-solving activities beyond school hours. This continuous engagement, according to the teachers' observations in those schools was said to have led to more profound learning outcomes and a better grasp of physics concepts. The teachers said active participation in group activities within a blended learning framework could significantly enhance the teaching and learning of physics by promoting deeper learning and critical thinking. Positive teacher-learner and peer interactions

during use of online platforms can facilitate more frequent and diverse interactions, contributing to a supportive learning environment. Peer interactions during group work and discussions promote knowledge exchange and social learning. Teacher-student interactions can be facilitated through online platforms, addressing individual queries and providing personalised feedback. This means the blended method leverages the strengths of both traditional and digital learning methods to provide a comprehensive educational experience.

4.3.2.1.5 Promoting self-directed learning.

The researcher observed that blended learning methods increased students' engagement during physics lessons. Students took ownership of their learning process. Students in all the three schools showed higher engagement levels when digital tools were used alongside traditional teaching methods. Furthermore diverse learning paces were accommodated by the various learning speeds, offered by blended learning methods allowing students to learn at their own pace. There was practical application especially in schools A and B where a noticeable shift towards applying theoretical knowledge to practical situations, was seen to be facilitated by interactive simulations and experiments online. These observations indicated that blended learning offers flexibility in terms of time and location, allowing students to access materials outside of the classroom. Learners indicated that the methods also enhanced understanding through combination of traditional and digital methods leading to a deeper understanding of physics concepts. An active learning environment was seen to be fostered and it is likely to enhance both the quality of instruction and student learning outcomes.

4.3.3 Perceptions from focus group discussions.

4.3.3.1 Perceptions on benefits

4.3.3.3.1 Enhanced comprehension and feedback

The responses from learners suggested that the implementation of immediate feedback and flexible learning schedules has a positive impact on the students' understanding of physics concepts. Some of the responses taken from the focus groups are stated below.

"The immediate feedback on quizzes and assignments helps me understand concepts better." (B10)

"The flexibility in learning schedules allows me to learn at my own pace." (A11)

These responses highlighted two themes significantly in the context of educational experiences. These are the theme of enhanced comprehension and feedback. This theme captures the impact of immediate feedback mechanisms, such as online quizzes, on learners' understanding. The feedback helps students quickly identify their strengths and weaknesses, allowing for targeted improvement. It's a form of formative assessment that supports adaptive learning, where the course content or approach can be adjusted in real-time to meet the learners' needs. The general views of the learners in school A were echoed by Learner, A2 who praised blended methods saying*:*

"The immediate feedback from online quizzes has helped us to identify areas we need to work on."

The statement "The immediate feedback on quizzes and assignments helps me understand concepts better" indicated that students valued the prompt responses they receive after completing quizzes and assignments. This immediate feedback loop allowed them to quickly identify areas of misunderstanding and correct misconceptions, leading to enhanced comprehension of the subject matter whilst the quotation,

"The flexibility in learning schedules allows me to learn at my own pace," highlighted the importance of self-paced learning. It suggested that when students are not pressured by rigid schedules, they can absorb information more effectively; catering to their individual learning speeds and styles. Quite a number of responses emphasized the role of visual simulations in making complex physics concepts more accessible. The learners acknowledged that simulations provided dynamic and interactive representations of abstract ideas, making them easier to grasp. These approaches align with the multimedia principle of learning, which suggests that people learn better from words and pictures than from words alone.

A learner, B2 boldly said:

"I find the online simulations helpful in understanding complex physics concepts." whilst another learner commended blended methods as being useful because of their flexibility.

Learner, A9 expressed interest in the flexibility of blended methods and said these words:

"The flexibility to review lectures online has improved my grasp of the topics."

The insights from the focus group discussions aligned with educational theories that emphasize active learning and the importance of formative assessment. Immediate feedback serves as a

critical component of the learning process, enabling students to engage in self-regulation and take ownership of their learning journey.

Additionally, flexible learning schedules resonate with the concept of differentiated instruction, where education is tailored to the diverse needs of learners, accommodating different learning preferences and abilities. In the context this qualitative research case study, such emerging themes were indicative of a shift towards more student-centred learning approaches in physics education. They reflect a growing recognition of the need for educational practices that support individual learning processes and promote a deeper understanding of complex scientific concepts. The implication is that the positive feedback from students suggests that such educational strategies may lead to improved academic outcomes and greater student satisfaction. It may also encourage educators to consider integrating more adaptive learning technologies and pedagogical methods that prioritize student feedback and individual learning paths.

4.3.3.1.2 Active learning and real-world relevance.

A number of learners in the focus groups echoed that blended learning has made physics more relatable by linking theory with real-world applications. Their responses touched on the effectiveness of blended learning in making education more engaging and applicable to real-life scenarios. The learners appreciated the fact that blended learning combines traditional classroom teaching with digital media and online resources, thereby creating a richer learning environment. By linking theoretical physics concepts with practical applications students can see the relevance of what they're learning to the world around them.

The responses of some individual learners which reflected the general views of other focus group participants are stated below.

"Interactive online activities are more engaging than just listening to lectures."(A2)

I find opportunities for collaborative learning with peers through online discussions."(A8)

"I have access to a variety of resources online, including videos, simulations, and interactive modules."(A5)

"There's enhanced engagement through interactive and multimedia content."(C1)

The contribution from participant A2 and C1 pointed out that engagement is enhanced when content is interactive and multimedia-rich. This indicated that learning materials which include interactive elements can lead to higher levels of student engagement, possibly because they make learning more immersive and less passive whilst the views of learner, A8 reflected on the social aspect of learning, highlighting the value of collaboration. Online platforms facilitate discussions and group work, which can lead to deeper understanding through peer-to-peer interaction and collective problem-solving. The views of participant A5 emphasised the availability and diversity of online educational resources suggesting that the digital age has expanded the tools available for learning, allowing students to explore subjects through various formats that cater to different learning styles.

Other responses gathered from the discussions that showed appreciation of blended methods by the participants are as follows.

"I enjoy the convenience of accessing materials from anywhere."(C1)

"I feel empowered by being able to control my learning journey." (A9)

"I appreciate the real-world applications demonstrated in online simulations." (A3)

"I enjoy the group discussions and collaborative projects in our blended learning setup. (B8)

Generally the views from focus group discussions indicated that the connection between theory and practice not only enhances motivation but also deepens understanding as students could contextualize theoretical knowledge. It is was analyzed that both themes, active learning and real world relevance underscore the importance of integrating technology into education to foster a more interactive and personalized learning experience. Moreover the themes reflect a shift from passive reception of information to active engagement with content, which is a cornerstone of modern pedagogical approaches.This personalisation can enhance problem-solving skills as it allows learners to tackle challenges that are suited to their current level, ensuring that they are neither bored with tasks that are too easy nor overwhelmed by those that are too difficult.

4.3.3.1.3 Enhancement of problem-solving and critical thinking.

The learners generally suggested that educational experiences that are tailored to the individual and encourage self-direction can significantly enhance one's ability to solve problems and think critically. Such skills are invaluable in both academic and real-world settings, where complex

problems require innovative solutions. Some of the direct quotations that reflected the general views of the physics learners are:

"I enjoy personalized learning experiences with adaptive learning paths." (A5)
"It has helped in the development of my self-directed learning skills." (C4)

The first quote from A4, suggested that learners valued adaptive learning paths which cater to their personal learning pace, style, and interests whilst the second quote from C4, highlighted the development of self-directed learning skills. This is a key component of critical thinking and problem-solving because it involves the ability to set goals, monitor progress, and reflect on one's own understanding and performance. Both quotes together reflect a shift towards educational strategies that prioritize critical thinking. This involves analysing facts to form a judgment, which is essential in problem-solving scenarios. The enhancement of problem-solving skills is likely a result of the combination of personalized learning paths and self-directed learning. When learners can navigate their own educational journey, they are more likely to encounter and solve a variety of problems, which strengthens their ability to think critically and solve problems in the future.

4.4 Findings on the challenges and barriers associated with integration of blended methods.

This section will present and analyse data findings on the challenges and barriers that participants raised. Whilst the perceptions of participants indicated quite a number of benefits during the research study, they also indicated the challenges and barriers that they considered to affect the successful integration of blended learning methods in the teaching and learning of physics at ordinary level. These challenges and barriers will be discussed under emerging themes in relation to the findings from the responses gathered from all the three research instruments that were employed in this study. The data on the challenges and barriers associated with the use of blended methods gathered from interviews, observation of physics classes as well as focus group discussions was carefully categorised under relevant themes and carefully analysed.

4.4.1 Impact on engagement and motivation

Findings from some of the participants of this study suggested that, while blended learning has the potential to enhance engagement and motivation, it requires careful planning and support to ensure that all students can benefit from its methods. By addressing the challenges faced in self-directed learning, educators can help improve student performance and foster a more inclusive and effective learning environment.

Participants raised the following comments on the impact of engagement and motivation.

"It is not always the case that blended learning methods increase engagement" (T1)

"Maintaining student focus in an online environment can be challenging (T3)

The comment from participant T3 could be considered to suggest that the challenge of maintaining student focus in an online environment is a significant concern that impacts student engagement and motivation. Unlike a controlled classroom environment, students may face numerous distractions at home or wherever they are accessing the online content. The lack of face-to-face interaction with peers and instructors can lead to feelings of isolation and decreased motivation. The comment pointed to the difficulty of keeping students engaged during online sessions. It suggested that while blended learning methods are often implemented with the intention of enhancing student engagement and motivation, the outcome is not guaranteed. Students have unique learning styles, preferences, and motivations. Blended learning might not cater to all these individual needs equally, leading to varied levels of engagement.

The response from participant, T1 highlights a critical aspect of blended learning, the balance between guided instruction and self-directed learning. The participant's observation that "Some students feel overwhelmed by the self-directed component of blended learning" suggests that while blended learning aims to foster independence and self-motivation, it can also lead to feelings of being overwhelmed. This could be due to a variety of factors, such as a lack of clear instructions, insufficient scaffolding, or the student's personal learning style.

A learner coded as participant C1, was quoted saying:

"I feel there's less interaction with my classmates compared to traditional classes." whilst B7 complained saying:

"I miss the hands-on experiments we used to do in traditional classes."

The perceived lack of interaction by the participant C1's statement highlights a perceived reduction in peer-to-peer engagement. This suggested that the blended learning environment may need to incorporate more collaborative tools and strategies to foster interaction. These insights imply that educators need to employ specific teaching strategies that promote active learning and interaction in a blended environment. The second response from participant B7 reflects a limitation of online learning components in blended environments. Traditional physics classes often rely on experiments to illustrate concepts, and the absence of these practical experiences can affect the depth of understanding and engagement in the subject.

While blended learning has the potential to increase engagement and motivation, its success is not a one-size-fits-all solution and depends on multiple interrelated factors. It also presents challenges like student overwhelm. Addressing these challenges requires thoughtful integration of support mechanisms and continuous adaptation based on student feedback. This balanced approach can help in maximizing the potential of blended learning methods at the ordinary level of physics education. It' is therefore important for educators to recognize these challenges and work towards creating a blended learning environment that is accessible, well-designed, and supportive of all students' needs.

4.4.2 Flexibility, accessibility and connectivity challenges

Technical Issues like limited access to reliable internet and digital devices can hinder the effectiveness of blended learning. Participant H3, stressed that blended methods are adversely affected by intermittent internet connectivity in his school.

"*One major challenge is the lack of reliable internet infrastructure and access, which can hinder the seamless integration of online components in our blended learning approach." (H3)*

This response suggested that intermittent internet connectivity is a barrier to blended learning, especially in regions with poor internet infrastructure. This challenge can disrupt the continuity of learning and affect the efficacy of online resources.

All the school administrators, physics teachers who were interviewed raised concerns about internet connectivity as well ensuring all students have equal access to the resources needed for

blended learning. Students generally complained that whenever internet connectivity was poor it became impossible for them to work online. The responses below show the general views that were raised by the participants.

"Sometimes, the internet connectivity issues hinder my learning process." (T2)

"Internet connectivity issues can make it hard to access online materials." (B12)

"Not all students have the same access to devices, which can be a barrier." (T1)

The response on internet connectivity points to a critical challenge in blended learning environments. The reliance on internet connectivity means that any disruption can significantly impact the learning process. This issue can be particularly acute in areas with unstable internet infrastructure, leading to inconsistent learning experiences. This was particularly the case with school C.

Similar to the point stated above, the response from B12 on internet connectivity underscores the dependency on reliable internet access for blended learning. Without consistent connectivity, students may face difficulties in accessing necessary online educational resources, which can impede their learning progress.

The final response given by participant, T1 addresses the issue of unequal access to technology. Blended learning assumes that students have personal access to devices such as computers or tablets. However, this is not always the case, creating a divide where some students may not fully participate in the digital aspects of the course. Overall these responses suggest that while blended learning methods offer flexibility and can enhance the learning experience, they also introduce challenges that need to be addressed. Ensuring stable internet connectivity, providing opportunities for hands-on learning, and equalizing access to technology are crucial for the effective implementation of blended learning in physics education. These insights can inform educators and policymakers to improve the infrastructure and support systems necessary for a successful blended learning environment.

4.4.3 Technological challenges.

The physics teachers, school administrators as well as the physics learners mentioned that students may face challenges such as lack of access to reliable technology or internet connectivity, which can hinder their ability to participate fully in blended learning activities. Two direct quotations that reflected the general ideas of the majority of participants are:

"Our computer laboratory is poorly equipped and this limited access to technology and unreliable internet connectivity is a major barrier. "The Wi-Fi is always down. (T3)

"I encounter technical issues with learning platforms or software."(C5)

These responses provided highlighted two significant technological challenges in the context of blended learning methods for teaching physics at the ordinary level.

First the limited access to technology or unreliable internet connectivity. This challenge points to the digital divide, where some students may not have the necessary devices or stable internet connections to participate effectively in blended learning.

The lack of access can lead to unequal learning opportunities, with some students unable to engage with online resources or participate in virtual labs and simulations crucial for understanding physics concepts. Technical difficulties with platforms or software can disrupt the learning process, causing frustration and disengagement among students.

4.4.4 Infrastructure and adaptability

The physics teachers and school administrators were for the general idea that infrastructure improvement underscores the importance of equitable access to technology for successful implementation of blended learning methods. Some of the participants cited lack of necessary policies for implementation whilst others condemned lack of funding.

Participant T3 was quoted saying:

"Lack of clear guidelines on technology use in education has been a hindrance to adopting blended learning."

The above response meant that while blended learning presents a promising approach to physics education, it requires concerted efforts to overcome technological and instructional challenges. By investing in infrastructure, training teachers, and developing a supportive curriculum, the potential of blended learning can be fully realized.

Participant, H3 proposed:

"*There should be policies that provide funding for technology infrastructure and training for teachers which are crucial for successful implementation.*"

Some participant suggested that both educators and students may require additional training to use blended learning tools effectively, which can be time-consuming and costly. Participant, T3 asserted that

"Teachers may not be adequately trained to implement blended learning effectively."(T3)

This response from (T3) points to a gap in professional development for educators, which is crucial for the successful adoption of blended learning methodologies. The teachers advised that, professional development programs focused on blended learning pedagogies, technological proficiency, and online student engagement strategies could be part of the solution. Continuous training and support for teachers to develop the necessary skills to implement blended learning effectively can be offered. This includes not only technical skills but also pedagogical strategies for engaging students in a blended environment.

Participant B2, said:

"Sometimes, I feel isolated without face-to-face interaction." (C5)

This response reflected a common psychological challenge associated with blended learning, where the lack of physical presence can lead to feelings of isolation and disconnection among students.

Strategies to mitigate this issue might include creating online discussion forums, and encouraging collaborative online projects to foster a sense of community.

It was also observed that some students struggled with the self-directed aspect of blended learning, particularly those who seemed accustomed to more structured, traditional learning environments. Some students may struggle with the self-regulation required for managing their learning outside the traditional classroom setting.

Adaptability to various online platforms was observed to be a challenge not only to teachers but to learners as well

"Adapting to various online platforms for teaching physics can be overwhelming" (T2)

Offering continuous training and support for teachers to develop the necessary skills to implement blended learning effectively. This includes not only technical skills but also pedagogical strategies for engaging students in a blended environment.

Blended learning requires a shift in mindset that not all educators and students are ready for. There is need to conduct workshops and seminars to familiarize all stakeholders with the benefits and methods of blended learning.

Addressing the challenges of infrastructure and adaptability is essential for the success of blended learning. It requires a holistic approach that considers the emotional well-being of students and the professional readiness of teachers.

4.4.5 Alignment and workload management

The teachers pointed out that maintaining a balance between online and in person instruction is challenging, but they ensured that online components complement rather than replace in-person instruction."

Participant T2 said:

"Sometimes the online content is not perfectly aligned with what we do in class." whilst participant T1 raised a concern that:

"It can be overwhelming to manage both online and offline workload."

Some learners said they encounter time management difficulties. One participant from school B gave the statement below:

"I find difficulty in managing time effectively for self-paced learning." (B11)

Students may struggle with self-discipline and procrastination, leading to ineffective time management. The lack of a structured schedule in self-paced learning can result in students falling behind. Another participant from school A revealed that there were potential risks of getting diverted to something else during self-paced learning. The learner said:

"There's a potential for distraction from non-academic online activities."(B9)

It was observed from the learner's response that easy access to entertainment and social media can divert attention from academic tasks.

Another participant, A10 was raised issues about the burden that they sometimes face in their classes. Her words were as follows:

"The overload of information can be overwhelming for some of us." (A10)

This means that the vast amount of available online resources can overwhelm students, causing cognitive overload. This suggested that learners could be facing difficulty in discerning relevant information from irrelevant or low-quality content. Teachers suggested that possible solutions

would be teaching information literacy skills to help students process and filter information effectively. The issue of multitasking with digital devices is also a potential challenge and was found to likely reduce the quality of learning.

4.4.6 Assessment challenges.

The responses from the participants highlighted a significant concern in the realm of blended learning, particularly regarding the assessment of students.

The teachers participating in the study said they observed that ensuring academic integrity in online platforms was difficult. Participant, T2 said:

"There are assessment challenges in ensuring academic integrity online.”(T2)

It was observed that the nature of online assessments is such that online assessments often lack the controlled environment of in-person exams, making it easier for students to access unauthorized materials or collaborate inappropriately. The impersonal nature of online assessments can reduce the perceived seriousness of cheating, leading to more academic dishonesty.

Participant T3 also concurred strongly with participant T2, about academic integrity. He indicated that it is challenging to verify that the student who is enrolled in the course is the same individual completing the assessments. He said:

"Even if someone does the online activities on behalf of our learners or even if he copies information goggled from the internet, how would you know? You see the problem; you will just assume it is the learner's work."(T2)

This response also suggested that there is a risk of students outsourcing their assignments or using online services to complete exams.

4.5 Possible solutions or Strategies to overcome challenges and barriers associated with integration of blended learning methods.

4.5.1 Possible solutions to the impact on engagement and motivation of learners.

The emerging theme of increased student engagement is a significant finding that underscores the potential of blended learning in enhancing the educational experience. It was observed that while there are challenges, the benefits such as improved motivation and interaction with the content are clear. The participants of this study, the physics teachers and school administrators in

particular, generally highlighted that addressing the barriers requires a concerted effort from educational institutions, teachers, and policymakers to ensure that blended learning can be effectively integrated into the physics curriculum at the ordinary level.

To mitigate challenges associated with the engagement and motivation, the school administrators and physics teachers said educators could provide clearer guidelines and expectations for the self-directed components. A range of resources to cater to different learning preferences can be offered, regular check-ins to monitor student progress implemented and support provided. Participants suggested quite a number of possible solutions. They said there is need to enhance interactive content by continually developing and incorporating interactive simulations, digital tools, and diverse multimedia content to cater to various learning styles. There is also a need to facilitate learning by using blended learning platforms to create personalized learning pathways for students, which can be adjusted based on their progress and understanding. The provision of training for teachers to effectively design and implement blended learning strategies that maximize student engagement is crucial.

Another measure is infrastructure improvement. The educational institutions should ensure that the necessary technological infrastructure is in place to support blended learning methods, including reliable internet access and adequate devices for students.

Parents and the community must be involved. Therefore educators should engage parents and the community in understanding the benefits of blended learning to garner support and address any resistance to new methods. Furthermore there is need for Regular feedback mechanisms for the blended learning activities. This can be done by implementing systems for regular feedback from students to continuously improve the blended learning experience. Another solution relates to Research and Development. The education system should encourage on-going research into the effectiveness of different blended learning approaches and adapt teaching methods accordingly.

By addressing these solutions, educators can further enhance student engagement and motivation, making the learning of physics more interactive, enjoyable, and effective.

4.5.2 Possible solutions to flexibility, accessibility and connectivity challenges.

The physics teachers and school administrators suggested that the challenges of flexibility, accessibility, and connectivity in blended learning are significant but surmountable. By enhancing internet infrastructure, optimizing online resources, and equalizing access to technology, we can bridge the digital divide. These efforts will ensure that blended learning not only offers flexibility but also becomes a truly inclusive educational model. By addressing these challenges head-on, educators and policymakers can create a more equitable and effective environment for blended learning, ensuring that every student has the opportunity to succeed in the digital age.

The intermittent internet connectivity experienced by schools, as highlighted by Participant H3, is a significant impediment to blended learning. The dependency on stable internet access is a recurring theme in the concerns raised by school administrators and physics teachers. Students like T2 and B12 express frustration when connectivity issues disrupt their learning process, emphasizing the need for consistent online access. The digital divide in device access participant T1's observation about unequal access to technology underscores a critical digital divide. Blended learning presupposes that all students have personal devices, yet this is not the reality for many, leading to disparities in participation and learning outcomes.

These challenges can be solved by enhancing internet infrastructure. The teachers suggested that there should be collaboration with network service providers.

Participant, T3 had this to say:

"Schools should partner with internet service providers to improve infrastructure, especially in remote areas. These companies can install network boosters."

Participant, T2 said there was need for their school administrator to request for government subsidies. T2 added on to suggest that, through appropriate structures their heads should discuss about strategies to overcome challenges. He had this to say about the administrators:

"Lobby for government subsidies to support the installation of reliable internet connections in educational institutions."(T2)

He also suggested that community internet hubs can with robust connectivity for students to access outside school hours can then be established.

Participant H1 explained that if internet is poor or intermittent then educators should improvise. He commented.

“Poor connection is a frustration, but to overcome the internet connectivity issues, we could create offline-accessible resources and ensure that key online materials are available for download during school hours.”

The suggested solution addresses the challenge of internet access by providing alternative means to access learning materials. This ensures that all students have the necessary resources to benefit from the blended learning model.

Participant, H3 also raised the point that offline accessible learning materials can be developed and distributed so that they can be accessed offline, ensuring continuity during connectivity outages. This school administrator also appealed for the need for empowering students through equalizing access to digital devices. He said:

"*Government through our ministry should provide the relevant devices and technologies or implement device lending programs to provide tablets or laptops to schools without access. (H3)*

Participant, H2 had similar thoughts about promoting device equality in learners. He said:

"*As schools we may need to seek grants and donations to fund the purchase of devices for educational use; phones and laptops to supplement school-provided devices. We want to ensure no student is left behind."(H1)*

The school administrator for school A hinted that another solution is to have what he described as "Bring Your Own Device (BYOD) policies. He said in his school they implemented the policy. He said the following words.

"In our school we encourage learners to bring their own devices so that they are not left behind”. (H1)

4.5.3 Possible solutions to technological challenges.

The research revealed that technological challenges can be overcome in a number of ways. One participant had the following to say:

“Providing subsidized or free access to necessary technology and internet can help.” (H3)

This statement suggested a solution to one of the key challenges in implementing blended learning methods, which is technology. The majority of the participants of this study agreed that equity in technology access is essential. This suggested that subsidized or free access to

technology and the internet can level the playing field, ensuring all students have the opportunity to participate in blended learning regardless of their socio-economic background. By removing financial barriers, more students may be able to engage with the blended learning curriculum, potentially leading to higher course completion rates. There should be support for remote learning in areas where students may not have reliable access to physical classrooms, such support can be crucial for continuity of education. Forming partnerships with technology companies and internet service providers could be a way to provide cost-effective solutions.

School administrator, H2 proposed what he termed "Targeted support'.

The participant, H3 had this to say:

"Identifying students who most need support can ensure that resources are allocated efficiently".

However it must be noted that while providing subsidized or free access to technology and the internet as a strong potential solution to the technological challenges of blended learning, it requires careful planning and management to ensure it is effective and sustainable. It's a solution that addresses the immediate need for access but should be part of a broader strategy that includes training, support, and quality assurance to truly enhance the teaching and learning of physics through blended methods.

Infrastructure improvement involves investing in reliable and accessible technology. Almost all the research participants seemed to support technology improvement. Almost all the participants emphasized the need for training to go hand in hand with technological advances especially in this era of technology.

Participant T2 and A13 aired views on training and support as a possible solution to technological challenges.

"Continuous training for educators should be offered to improve their instructional design skills and technological literacy in order to enhance the quality of blended learning."(T2)

"We need intensive training as students so that we become familiar with the learning platforms and software." (A1)

These views suggested that the participants needed more training to keep abreast to the technology level.

The views of participant, T2 and A1 were complemented by participant H1, who said:

"Infrastructure improvement includes providing adequate devices and ensuring stable internet connectivity for both teachers and students, who should be well trained to use the technology."

Addressing these technological challenges is crucial for the successful integration of blended learning methods. It requires a concerted effort from educational institutions, teachers, and policymakers to ensure that all students have equal access to the technology needed for modern physics education.

4.5.4 Possible solutions to alignment and workload management challenges.

Ensuring that online materials and activities align with the curriculum and learning objectives can be challenging. One physics teacher said, although not easy, the potential solutions are implementing semi-structured timetable for self-paced modules, providing time management resources and training for students.

"Establishing a structured schedule with clear deadlines would help manage time."(T1)

He explained educators should encourage the use of website blockers during study times and incorporate engaging educational technology that competes with non-academic distractions. Participant H2 contributed on the how workload challenges can be handled. He suggested:

"Maintaining a balance is crucial to prevent over-reliance on technology and to preserve the benefits of face-to-face interaction."

The school administrators suggested views on the need to careful consider blended learning in the new curriculum. The administrator of school B had this to say: (H2)

"Curating content to provide a balanced amount of information would be helpful."

The administrators' views suggested that collaborating with curriculum developers to create online resources that align with learning objectives could enhance the blended learning experience.

4.5.5 Possible solutions to infrastructure and adaptability challenges.

The challenges that were presented regarding infrastructure and adaptability implementation highlighted several key areas that need to be addressed. Adaptability is the need for the education system to be adaptable to incorporate new methods of teaching and learning.

1. Policy development and funding.

The research findings suggested that clear guidelines should be developed and funding can be secured. There should be comprehensive policies that provide clear guidelines on technology use in education to facilitate the adoption of blended learning. Institutions can advocate for policies that allocate funding specifically for technology infrastructure and professional development of teachers.

2. Professional development:

The participants also suggested continuous training programs. The ministry of education or institutions can implement ongoing training programs for teachers that focus on blended learning pedagogies, technological proficiency, and online student engagement strategies. Support systems that include resources, mentorship, and a community of practice to share experiences and best practices can also be created.

3. Psychological Support:

Fostering community is encouraged. This can be done by developing online discussion forums and collaborative projects to reduce feelings of isolation and promote a sense of community among students. Those learners who feel isolated should be provided with personalized support. This can be in the form of counseling services and workshops to help students cope with the psychological challenges of blended learning.

4. Curriculum and instructional design:

Blended learning curriculum: Design a curriculum that supports blended learning, with a balance of online and face-to-face interaction. Teachers should be trained in instructional strategies that are effective in a blended learning environment, such as flipped classrooms and project-based learning.

Participant T1 encouraged that teachers be trained. He commented that:

"Conducting professional development workshops for teachers on blended learning is crucial."(T1)

5. Technological adaptability:

Technology use should be simplified. Educators should streamline the number of platforms used and ensure they are user-friendly to reduce the "overwhelm" of adapting to various online platforms. Educators should encourage a culture of technological adaptability among teachers and students through regular workshops and seminars.

6. Mindset Shift:

Awareness campaigns are an essential tool. Conducting workshops and seminars to raise awareness about the benefits and methods of blended learning is encouraged. Change management entails the support of educators and students in the transition to blended learning with change management strategies that address resistance and promote acceptance. When the school administrator of school A was asked how he handled resistance from teachers or other stakeholders who may be hesitant to adopt blended learning approaches he replied that:

"We conduct regular training sessions, provide support, and actively involve teachers in the planning process to address their concerns." (H1)

By tackling these challenges with a holistic approach that includes infrastructure improvement, policy development, professional training, psychological support, and a supportive curriculum, the potential of blended learning in physics education can be fully realized. It's important to consider the emotional well-being of students and the professional readiness of teachers to ensure a successful transition to this innovative educational model.

4.5.6 Possible solutions to assessment challenges.

The interview responses you've provided highlight a significant challenge in online education: ensuring academic integrity. The primary concern is the difficulty in verifying the authenticity of learners' work submitted online. From research it was found that there are two main issues:

1. Proxy test-taking: whereby someone other than the learner completing online activities.
2. Plagiarism: whereby learners copy information from the internet without proper citation.

The Potential solutions to these challenges are use of Proctoring Software. The educators can implement software that monitors students during assessments through video, audio, and activity

tracking to deter cheating. Turnitin Integration is software that can be utilized for plagiarism detection. Educators can use Turnitin to check for copied content in learners' submissions. While some technological solutions like plagiarism checkers and proctoring software can be used, they are not foolproof and can sometimes be circumvented. These solutions may also raise privacy concerns among students and can be seen as intrusive.

Design of assessment should be such that it requires critical thinking and application of knowledge, which are harder to cheat on compared to multiple-choice or direct-answer questions. Educators suggested that it is important to conduct workshops for learners about the importance of original work and how to properly cite sources. The school administrator, H3 had the following views about cheating in online assessments:

"it is important to educate students about the importance of academic integrity and the consequences of dishonesty."(H3)

This response suggested that educators need to be vigilant and proactive in creating a culture of integrity. The administrator highlighted that there provide clear guidelines on what constitutes cheating and ensure that students understand the boundaries. Institutions must have clear, enforceable policies regarding academic integrity and the consequences of violating them. There should be support systems in place for educators to report and address instances of academic dishonesty.

Regular updates to course material by changing assessment questions and course content regularly to prevent the circulation of answers is advisable. Peer reviews are yet another potential solution. Educators should encourage learners to have learners to evaluate each other's work, which can encourage accountability and reduce the likelihood of cheating. By implementing a combination of these strategies, educational institutions can enhance the integrity of online assessments and ensure that the work submitted truly reflects the learners' own efforts and understanding. It was observed that while blended learning offers flexibility and accessibility, it also presents challenges in maintaining academic integrity. A multifaceted approach involving technology, pedagogy, and policy is essential to address these challenges effectively.

4.6 Discussion.

In this section of this study, the researcher combined real-world findings and academic insights on blended learning in high school physics. The project, "An Assessment on the integration of blended learning methods in the teaching and learning of physics at ordinary level," examines how new teaching methods can blend with traditional physics education. Data from a thorough literature review was used to shape this discussion. The literature review has been the guide, showing the researcher the promise of blended learning for changing education, as well as its possible downsides. We look at how blended learning can make classes livelier and fit different students' learning needs. The problems that the teachers and students could face were looked into. The literature gives us mixed opinions. Some participants see these issues as big roadblocks, while others are more hopeful about blending new and old ways of teaching. Research will also suggest ways to solve these problems, based on what the literature says and what has been found in this study. Research questions were kept in mind to guide this discussion. These help researcher to explore the good points, face the challenges, and find solutions. The researcher will compare data with academic theories to see if they match up. As we discuss blended learning in physics, we understand its power to change education. Findings should help teachers, decision-makers, and scholars create a better learning environment for physics through smart use of blended learning.

4.6.1 Research question 1.

4.6.1.1 Comparison of research findings on benefits with related literature.

4.6.1.1.1 Student engagement

The convergence between the literature and the current research findings on blended learning is evident. Both underscore the enhanced engagement and motivation that blended learning brings to educational settings. The literature posits that blended learning "encourages active participation" (Krasnova and Shurygin, 2019) and "creates online communities and learning practices" (Powell et al., 2015), which is in harmony with the observed boost in student engagement in physics through the use of interactive content and digital tools. Furthermore, the research findings echo Garrison and Kanuka's (2014) emphasis on the inspiring learning environment created by the mix of classroom and online instruction. The personalized aspect of blended learning, highlighted by the research, aligns with the literature's advocacy for active

participation and collaboration. Thus, the research findings not only agree with but also reinforce the literature's assertions, demonstrating the practical benefits of blended learning in fostering an engaging and motivating educational experience.

4.6.1.1.2 Flexibility, accessibility and control.

Blended learning methods, as discussed in the literature and observed in research findings, offer significant benefits in educational settings. The literature emphasizes the flexibility and accessibility of blended learning, which allows students to access materials at their convenience, catering to various learning styles and needs (Giarla, 2016; Powell et al., 2015). This is echoed in the research findings, where the flexibility of blended learning in physics is highlighted, enabling students to control their learning pace and access modern materials and pedagogical innovations from any location.

Moreover, both sources agree on the importance of self-pacing. Clark and Mayer (2016) suggest that self-pacing can reduce stress and increase satisfaction, which aligns with the research findings where control over learning resources and pace is seen to foster a self-directed approach. This approach is linked to increased motivation and a more dynamic learning experience, as noted by teachers and administrators in the research findings.

4.6.1.1.3 Collaboration and active participation in group activities: fosters deeper learning and critical thinking and self-directed learning.

Blended learning, as my research findings corroborate, transcends traditional pedagogical boundaries, fostering an environment where active learning and real-world application of physics theories thrive. This educational paradigm shift is echoed in the literature, with Lalima and Dangwal (2017) highlighting its capacity to maintain "cooperative learning across settings," and Tayebinik and Puteh (2012) acknowledging its integral role in instructional modalities. Moreover, Bakeer (2018) underscores its "adaptability to individual learning styles," which is pivotal for personalized education. The findings of this research further reveal that learners not only relish the interactive content and collaborative online discussions but also the diverse resources that blended learning offers, culminating in a personalized, immersive experience. This method's promotion of critical thinking and problem-solving skills is instrumental, as it empowers students to take control of their learning journey and apply knowledge in a contextual

manner. Hence, blended learning signifies a transformative leap from passive reception to an active, technology-integrated education—a true reflection of 21st-century learning dynamics.

4.6.2 Research Question 2.

4.6.2.1 Comparison of research findings on challenges and barriers with related literature.

The research findings on the challenges of blended learning in physics education resonate with the issues highlighted in the related literature. The lack of specialized equipment or software mentioned by Becirovic (2023) aligns with the researcher's observation of the technical issues and unreliable internet that disrupt the continuity of learning. Francom (2020) underscores the importance of physics simulations, virtual laboratories, and modelling software, which are critical for an engaging learning experience but are often hindered by high costs and the need for technical proficiency, a challenge that the researcher also noted, in ensuring inclusivity and engagement.

The lack of expertise among teachers in both subject matter and blended learning tools, as pointed out by Kuo et al. (2014) and Benson et al. (2014), is consistent with the research findings on the professional development gaps and the need for training in blended learning pedagogies. This lack of expertise can lead to student confusion and hinder learning, which this research identified as a significant barrier to student motivation and engagement.

Hamutoglu (2021) emphasizes the need for adequate technical support, which corresponds with the challenges that the researcher found in maintaining student focus and providing clear instructions and scaffolding. Bai and Lo (2018) discuss the necessity of intentional planning for effective collaboration and communication, echoing the researcher's suggestion for more collaborative tools and strategies to overcome the lack of hands-on experiments and peer interaction in online settings.

Moreover, Amandu et al. (2013) mention the inadequate training and familiarity with digital tools among teachers, which is a concern shared by the findings of this research, particularly in the context of equitable technology access and clear guidelines. The resistance to change among educators, preferring traditional methods over new blended learning approaches, is a cultural

challenge that both the research findings and the literature have identified as a hurdle to the successful implementation of blended learning methods.

The literature therefore provided a strong foundation that supports research findings. The challenges of implementing blended learning in physics education are multifaceted, involving technical, instructional, and cultural barriers. Addressing these challenges requires a concerted effort to provide equitable access to technology, professional development for educators, and intentional planning to ensure a supportive and effective blended learning environment. By recognizing and addressing these issues, educators can create a more inclusive and engaging learning experience for students in physics education.

4.6.3 Research question 3.

4.6.3.1 Comparison of research findings on possible solutions to related literature.

The integration of blended learning methods in physics education at the ordinary level presents a unique set of challenges and opportunities. The findings of this research offered a comprehensive suite of solutions that align well with the related literature, suggesting a consensus on the strategies needed to overcome these barriers.

Enhancing interactive content: Both the research findings of this study and Alvarez (2020) emphasize the importance of interactive content. Alvarez suggests investing in robust infrastructure and training for educators and students, which supports the researcher's recommendation to develop interactive simulations and multimedia content. This alignment indicates a shared understanding of the need for engaging and diverse educational materials in blended learning environments.

Personalized learning pathways: The findings on personalized learning pathways are echoed by Becirovic (2023), who advocates for clear learning objectives aligned with assessment methods. This suggests a literature-backed approach to creating tailored educational experiences that cater to individual student needs and progress.

Infrastructure improvement: The necessity of reliable internet access and adequate devices, as highlighted in this research, is reinforced by the literature. Alvarez (2020) calls for robust infrastructure, which directly supports the researcher's strategy for infrastructure improvement. This agreement underscores the critical role of technology in facilitating effective blended learning.

Community engagement: The findings on community engagement find resonance in the literature's emphasis on collaboration and interdisciplinary cooperation, as mentioned by Adams et al. (2017). The literature suggests that involving all stakeholders, including parents and the community, is essential for the successful adoption of blended learning methods.

Regular feedback mechanisms: The implementation of regular feedback systems in the findings is not directly addressed in the literature. However, the call for detailed instructions and active engagement through discussion forums by Benson et al. (2014) implies a need for on-going communication and assessment, which can be facilitated by feedback mechanisms.

Flexibility, accessibility, and connectivity: The literature supports the research strategies for enhancing internet infrastructure and ensuring equal access to digital devices. The collaboration with network service providers and lobbying for government subsidies, as suggested by the participants of this study, is a practical approach that aligns with the literature's call for investment in technology and support systems.

BYOD Policies: While the literature does not specifically mention BYOD policies, the emphasis on user-friendly platforms and tools suggests a literature-supported move towards flexible and accessible technology use, which BYOD policies can facilitate.

Assessment challenges: The possible solutions to assessment challenges, such as implementing proctoring software and designing critical thinking assessments, are in line with the literature's focus on academic integrity and proper citation practices. This alignment indicates a shared concern for maintaining the authenticity of learners' work.

The consensus points to a multifaceted approach involving technological investment, pedagogical innovation, community involvement, and continuous improvement through feedback. By implementing these strategies, educators can create a more inclusive, engaging, and effective learning environment that prepares students for success in the digital age.

CHAPTER 5: SUMMARY, RECOMMENDATIONS AND CONCLUSIONS

5.1 Introduction

This chapter served as the capstone of this study, weaving together the pivotal themes and dialogues that have shaped this investigation. It revisited the core inquiries that propelled this study, delineating the paths taken to illuminate them. Here, the researcher distilled the essence of the research discoveries, highlighting the study's valuable contributions. The chapter extended beyond theoretical insights, offering pragmatic guidance to policymakers, educators, and communities, advocating for the seamless melding of blended learning strategies within ordinary level physics pedagogy. Lastly, it cast a vision for the horizons of future inquiry, laying the groundwork for the next wave of academic exploration.

5.2. Summary of the study.

This research focused on the assessment of the integration of blended learning methods in the teaching and learning of physics at ordinary level at the ordinary level, in three selected secondary schools in the Mangwe district. The impetus for this inquiry stemmed from the researcher's observation of the prevalent emphasis on blended learning in academic discourse, juxtaposed with the challenges and barriers encountered during its implementation. Consequently, the researcher embarked on an exploration of the perspectives held by school administrators, physics educators, and ordinary level physics learners. The constructivist approach was judiciously chosen for this study to facilitate an understanding of the subjective experiences of the participants, allowing for the construction of knowledge through their unique perspectives. This approach aligns seamlessly with the study's aim to unravel the intricacies of blended learning implementation, as it underscores the importance of context and the active role of learners and educators in shaping their educational journey.

The study was structured into five comprehensive chapters:

Chapter 1: Introduction and framework.

This chapter set the stage for the investigation, outlining the study's background, objectives, and the pivotal research question driving the inquiry. It also delineated the study's scope, significance, and the foundational assumptions, alongside clarifying key terminologies.

Chapter 2: Review of related literature.

The study wove a rich tapestry of theoretical insights, aligning the literature review with the research questions to construct a robust theoretical scaffold for the study.

Chapter 3: Methodology.

The chapter detailed the qualitative multi-case study design, elaborating on the selection process, data collection through interviews, lesson observations, and focus group discussions, and the subsequent thematic analysis. This methodological narrative underscored the qualitative nature of the research and spotlighted the gaps the study aimed to bridge.

Chapter 4: Data presentation, analysis and discussion.

This chapter focused on the articulation of data, presented the findings and engaged in a critical analysis, culminating in a thematic synthesis where themes emerged organically from the research questions. Data narratives were recorded down and insights deduced from those narratives highlighted.

5.3 Conclusions.

5.3.1 Conclusions on research question 1.

The benefits of using blended learning methods in the teaching and learning of physics at ordinary level are:

- **Enhanced student engagement-**Blended learning methods encourage active participation and create a motivating educational environment. They foster student engagement through interactive content and digital tools.
- **Flexibility and accessibility-**These methods provide flexibility, allowing students to access materials at their convenience and control their learning pace, which caters to diverse learning styles and needs.
- **Collaboration and critical thinking-**Blended learning promotes collaboration, active participation in group activities, and self-directed learning, leading to deeper understanding, critical thinking, and real-world application of physics theories.

5.3.2 Conclusions on research question 2.

The challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics at ordinary level are:

- **Technical issues:** The lack of specialized equipment or software, high costs, and the need for technical proficiency can disrupt learning continuity and engagement.
- **Professional development gaps:** There is a lack of expertise among teachers in both subject matter and blended learning tools, leading to student confusion and hindering motivation and engagement.
- **Cultural Resistance:** Resistance to change among educators who prefer traditional methods over blended learning approaches presents a cultural challenge to implementation.

5.3.3 Conclusions on research question 3.

The possible solutions to the challenges and barriers associated with the use of blended learning methods in the teaching and learning of physics at ordinary level are:

- **Enhancing interactive content:** Investing in robust infrastructure and training for educators and students is crucial. Developing interactive simulations and multimedia content can make learning more engaging and cater to different learning styles.
- **Personalized learning pathways:** Creating clear learning objectives aligned with assessment methods can provide tailored educational experiences. This approach supports individual student needs and tracks their progress effectively.
- Infrastructure Improvement: Ensuring reliable internet access and providing adequate devices are essential. A strong technological foundation is necessary for the effective implementation of blended learning.
- **Community engagement:** Involving all stakeholders, including parents and the community, can enhance the adoption and success of blended learning methods. Collaboration and interdisciplinary cooperation are key.
- **Regular feedback mechanisms:** Implementing systems for regular feedback can facilitate on-going communication and assessment. This helps in maintaining active engagement and addressing students' needs promptly.

- **Flexibility, accessibility, and connectivity:** Enhancing internet infrastructure and ensuring equal access to digital devices are important strategies. Collaboration with network service providers and seeking government subsidies can support this goal.
- **BYOD policies:** Adopting "Bring Your Own Device (BYOD) policies can promote flexible and accessible technology use. This aligns with the literature's emphasis on user-friendly platforms and tools.
- **Assessment challenges: I**mplementing proctoring software and designing assessments that promote critical thinking can address assessment challenges. This ensures academic integrity and the authenticity of learners' work.

Overall by focusing on technological investment, pedagogical innovation, community involvement, and continuous feedback, educators can foster a more inclusive, engaging, and effective learning environment. This environment will not only prepare students for success in the digital age but also transform physics education at the ordinary level.

5.4 Contributions of the study.

- **Enhanced student engagement**: This study contributes evidence to the body of knowledge asserting that blended learning methods can significantly increase student engagement. By demonstrating that interactive content and digital tools lead to active participation and a motivating educational environment, the research supports the integration of technology in educational settings.
- **Flexibility and accessibility:** The study's findings on the flexibility and accessibility of blended learning methods contribute to the understanding of how these approaches can be tailored to meet diverse learning styles and needs. This is particularly valuable in promoting inclusive education where students have varying schedules and learning preferences.
- **Collaboration and critical thinking**: The research underscores the potential of blended learning to enhance collaboration, active participation in group activities, and self-directed learning. These findings contribute to the pedagogical strategies aimed at developing deeper understanding, critical thinking, and the practical application of physics theories.

- **Identification of challenges and barriers:** The study identifies key challenges and barriers to the implementation of blended learning methods, such as technical issues, professional development gaps, and cultural resistance. These insights are crucial for educators, policymakers, and stakeholders aiming to overcome these obstacles and improve the teaching and learning experience.
- **Practical Implications for policy and practice:** The study provides actionable recommendations for addressing the identified challenges. This includes the need for better infrastructure, professional development for teachers, and strategies to encourage cultural shifts in educational practice.
- **Foundation for future research:** Theconclusions lay the groundwork for future research to explore solutions to the challenges of blended learning. This could lead to the development of more effective blended learning models and teaching practices in physics education.

Overall, the researcher considers this study to be a valuable contribution to the field by providing a comprehensive analysis of the benefits and challenges of blended learning in physics education, offering insights that can inform practice, policy, and future research.

5.5 Recommendations.

5.5.1 Recommendations to the Ministry of Primary and Secondary education.

- **Invest in Infrastructure:** Allocate funds for technological infrastructure to support blended learning, including reliable internet access and digital devices.
- **Develop policies:** Create policies that encourage the use of blended learning methods, such as BYOD (Bring Your Own Device) initiatives.
- **Provide training:** Offer professional development programs for teachers to enhance their expertise in blended learning tools and physics subject matter.
- **Encourage innovation:** Support the development of interactive simulations and multimedia content to make physics more engaging.

5.5.2 Recommendations to the teachers.

- **Embrace blended learning:** Integrate blended learning methods into your teaching practices to enhance student engagement and cater to diverse learning needs.

- **Seek professional development:** Actively participate in training programs to improve your technical proficiency and pedagogical skills.
- **Foster collaboration:** Encourage group activities and collaborative projects that promote critical thinking and real-world application of physics theories.
- **Utilize feedback:** Implement regular feedback mechanisms to adjust teaching methods and address student needs effectively.
- **Provide feedback:** Participate in feedback systems to help educators refine their teaching strategies and better support learners.

5.5.3 Recommendations to the physics learners.

- **Engage actively:** Take advantage of the interactive content and digital tools available to you for a more motivating educational experience.
- **Self-directed learning:** Utilize the flexibility of blended learning to control your learning pace and follow personalized learning pathways.
- **Collaborate**: Participate in group activities to enhance your understanding and develop critical thinking skills.
- **Seek support:** Reach out to teachers and peers for help when facing technical issues or gaps in understanding.

5.5.4 Recommendations to the community.

- **Support education:** Get involved in the educational process by providing resources and support for blended learning initiatives.
- **Promote accessibility:** Work with network service providers to enhance internet infrastructure and ensure equal access to technology.
- **Encourage lifelong learning:** Advocate for the importance of continuous learning and the adoption of new educational methods.

By implementing these recommendations, each group can contribute to overcoming the challenges associated with blended learning and enhance the teaching and learning of physics at the ordinary level. The collaborative effort will lead to a more inclusive, engaging, and effective learning environment that prepares students for success in the digital age and transforms physics education.

5.6 Suggestions for future research.

Building on the convergence between literature and current findings, future research should explore the longitudinal impact of blended learning on student engagement, particularly in physics education. Studies could investigate how sustained use of interactive content and digital tools affects motivation and learning outcomes over time. Additionally, research could investigate the personalization of blended learning environments, examining how they cater to diverse learning styles and needs in various educational settings.

Given the benefits of flexibility, accessibility, and control, further studies are warranted to understand the optimal balance between online and in-person components that maximize learning efficiency. Research could also focus on the psychological aspects of self-pacing, such as its effects on stress levels and overall student well-being.

Collaboration and active participation are crucial for deeper learning and critical thinking. Future research should therefore investigate the design and implementation of group activities in blended learning frameworks, assessing their effectiveness in fostering a self-directed learning approach. Studies could also evaluate the role of technology in supporting cooperative learning across different settings and its adaptability to individual learning styles.

Addressing the challenges and barriers identified, future research should assess the technical and infrastructural needs of blended learning, including the availability of specialized equipment and software. It would be beneficial to explore strategies for overcoming technical issues, such as unreliable internet access, and the high costs associated with advanced simulations and virtual laboratories.

The professional development of educators is another critical area for future research. Studies should examine the effectiveness of training programs in blended learning pedagogies and their impact on teaching practices. Additionally, research could explore the integration of technical support within educational institutions to maintain student focus and provide clear instructions.

Finally, future research should consider the cultural aspects of adopting blended learning methods, identifying ways to overcome resistance among educators and promote a shift towards more innovative teaching approaches. By addressing these multifaceted challenges, researchers can contribute to the development of a more inclusive and engaging blended learning environment in physics education.

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APPENDIX 1: INTERVIEW SCHEDULE FOR PHYSICS TEACHERS

1. Which form (s) do you teach physics?
2. How many years of teaching experience do you have?
3. How has blended learning positively impacted your experience in physics teaching?
4. What specific challenges, barriers or difficulties have you encountered while implementing blended learning in your physics classes?
5. Have you faced any challenges related to accessing online resources for teaching physics?
6. How have you tried to overcome challenges of implementing blended learning?
7. How has internet connectivity affected your ability to implement blended learning effectively?
8. What do you think can be done to effectively implement blended learning in areas with intermittent internet connection?
9. What additional support would you need to blended learning more effective?

Appendix 2: INTERVIEW SCHEDULE FOR ADMINISTRATORS.

1. Are there any policies that hinder or facilitate the adoption of blended learning methods?
2. What policies or guidelines do you think are necessary to support the successful implementation of blended learning in physics education?
3. How do you perceive the impact of blended learning on student engagement and motivation in Physics classes?
4. Have you observed any improvements in student performance or understanding due to the integration of blended learning?
5. What benefits do you believe blended learning brings to students who may have different learning styles or preferences?
6. In your opinion, how does blended learning enhance the overall learning experience for Physics learners?
7. What challenges or obstacles have you encountered while implementing blended learning methods in Physics education?
8. How do you address issues related to technology access, especially for students who may not have reliable internet connectivity or devices?
9. Are there any concerns about maintaining a balance between online and in-person components of blended learning?
10. How do you handle resistance from teachers or other stakeholders who may be hesitant to adopt blended learning approaches?
11. What strategies or support systems have you put in place to overcome these challenges?

APPENDIX: 3 **OBSERVATION SCHEDULE**

Observation Research Instrument Schedule: Blended Learning in Physics Classrooms.

PART A .School Information

	School Name	
	District	
	Type of school	
	Observation Date and Time	

PART B. Teacher Information:

	Teacher' name	
	Teaching experience(years)	
	Subjects taught	

PART C. Classroom Context:

(*Describe the physical classroom environment, seating arrangement, and available technology (e.g., projectors, interactive whiteboards, and computers***).**

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PART D. OBSERVATION

ITEM	OBSERVATION	COMMENTS
Blended Learning Components: Online resources (websites, videos, simulations		
In-class activities (group work, discussions, hands-on experiments		
Student Engagement and Interaction (note how students engage with blended learning materials)		
Student interactions (with peers, teacher, and technology).		
Positive outcomes **(**related to blended learning)		

Benefits:

(Identify any improved student engagement, enhanced understanding of physics concepts, and increased motivationflexibility in learning pace etc.)

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Challenges and Barriers:

(Document challenges faced during blended learning, technical issues (internet connectivity, device availability), student resistance or lack of familiarity with online tools, balancing online and face-to-face components etc.)

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Teacher Strategies:

[Observe how the teacher addresses challenges, adaptations made due to internet connectivity (peri-urban school), strategies to maintain student engagement, use of blended learning tools effectively]

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Assessment Methods:

[Note how assessments are conducted, formative assessments (quizzes, discussions),summative assessments (tests, projects)]

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PART D: Reflections and Recommendations:

After each observation, reflect on the overall experience.

Provide recommendations for improving blended learning implementation.

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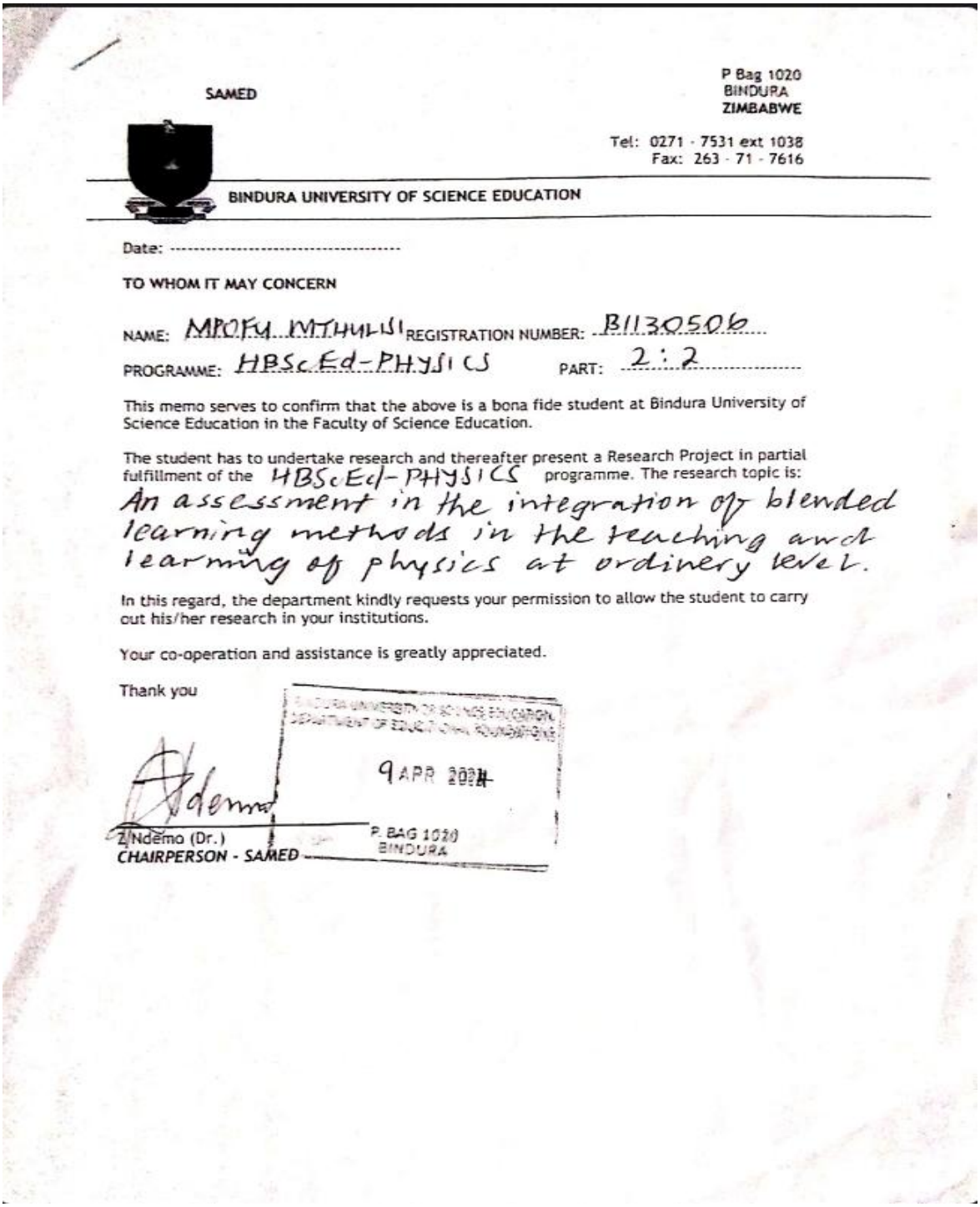
Adopted from : Analyzing and Accelerating Web Access in a School in Peri-Urban India 2: Where Is the Peri-Urban?

APPENDIX 4: FOCUS GROUP DISCUSSION GUIDE.

1. What positive experiences have you had with blended learning methods in your Physics classes?
2. How has blended learning improved your understanding of Physics concepts?
3. Have you found blended learning to be more engaging or motivating compared to traditional teaching methods?
4. In what ways has blended learning enhanced your problem-solving skills or critical thinking abilities?
5. What difficulties have you encountered while using blended learning methods?
6. Are there any technical challenges related to accessing online resources or platforms?
7. How do you manage time when balancing both online and in-person learning components?
8. Have you faced any resistance from peers or teachers regarding the adoption of blended learning?
9. What strategies do you think would help overcome these challenges?

[Researcher will encourage open discussion and allow participants to share their experiences and perspectives]

APPENDIX 5: LETTER FROM BINDURA UNIVERSITY SCIENCE AND MATHEMATICS DEPARTMENT FOR PERMISSION TO COLLECT DATA.



SAMED

P Bag 1020
BINDURA
ZIMBABWE

Tel: 0271 - 7531 ext 1038
Fax: 263 - 71 - 7616

BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: ----------

TO WHOM IT MAY CONCERN

NAME: MPOFU MTHULISI REGISTRATION NUMBER: B1130506

PROGRAMME: HBSc Ed-PHYSICS PART: 2:2

This memo serves to confirm that the above is a bona fide student at Bindura University of Science Education in the Faculty of Science Education.

The student has to undertake research and thereafter present a Research Project in partial fulfillment of the HBSc Ed-PHYSICS programme. The research topic is:
An assessment in the integration of blended learning methods in the teaching and learning of physics at ordinary level.

In this regard, the department kindly requests your permission to allow the student to carry out his/her research in your institutions.

Your co-operation and assistance is greatly appreciated.

Thank you

9 APR 2021

Z Ndemo (Dr.)
CHAIRPERSON - SAMED

P. BAG 1020
BINDURA