BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION

AN ASSESSMENT ON THE INTEGRATION OF INQUIRY BASED APPROACHES IN THE TEACHING AND LEARNING OF PHYSICS AT ORDINARY LEVEL

NDLOVU AUTMAN INNOCENT

(B1130326)

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

JUNE 2024

SUPERVISOR: DR N. ZEZEKWA

Approval form

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Supervisors' signature. 4/06/24

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Project title	An assessment on the integration of inquiry-based approaches in the teaching and learning of physics at Ordinary level.
Project owner	NdlovuAutman Innocent
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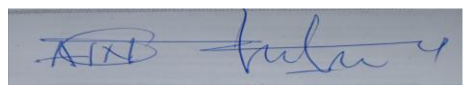
Name: NdlovuAutman Innocent Signature: 

Degree: Bachelor of Science education physics degree (Honors)

University: Bindura University of Science Education

Home address: 2892 Nketa 7

P.O. Nkulumane, Bulawayo.

Email: ndlovuautman@gmail.com Phone: +263779759567

Dedications

I would like to dedicate this project to my wife Privilege, daughter Ashlyn and son Nigel, who provided constant love, support and inspiration throughout my academic journey. Your unwavering encouragement and belief in my abilities have been invaluable, and I am grateful for the sacrifices you have made to help me pursue my dreams.

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Abbreviations

1. IBL: Inquiry based learning
2. STEM: Science Technology Engineering Mathematics
3. AR: Argumented Reality

Abstract

The study assessed the integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level. It emphasized on the identification of inquiry-based methods of instruction, their benefits, challenges and solutions to challenges and how they can be fused and put into effective use. A qualitative approach was employed, purposive random sampling sixteen students, eight from form three and eight from form four classes at high school A. Closed structured interviews and a questionnaire was used to collect data from physics teachers and learners respectively. The collected data was then analyzed by both qualitative and quantitative means and presented in tables and in form of phrases and statements.

The perceived benefits have the potential to enhance student engagement which was best explained as an Inquiry-based learning that allows students to take ownership of their learning, better understanding of scientific concepts and critical thinking skills. The perceived challenges on the integration of inquiry based approachesare not limited to inadequate resources, teacher preparedness; measuring quality of inquiry; testing performance and this hindered the effective implementation of inquiry-based approaches in physics education.

To put inquiry-based approaches into action, it was recommended that educators should receive comprehensive professional development to effectively implement inquiry-based approaches in the teaching of physics, professional development offer specialized training and ongoing support for educators, curriculum developers and educators should collaborate to align the physics curriculum with inquiry-based learning principles. Curriculum Integration advocated for an integrated STEM approach to address global challenges, aligning physics education with real-world issues such as energy and health. This provided a context for inquiry-based learning and foster interdisciplinary connections.

Contents

CHAPTER ONE: INTRODUCTION

1.1Introduction

This chapter will focus on the background of study, statement of the problem, research questions, and significance of study, limitations, delimitations, definition of key terms and lastly the organization of study. At the end of the chapter is the summary of the chapter.

1.2Background of study

In recent years, there has been a growing interest in the implementation of inquiry-based learning approaches in the field of education. This approach encourages students to actively participate in their own learning processes (Kasembe, 2011). These processes may include posing questions, investigating phenomena and exploring possible solutions. Inquiry based learning is a student-centered approach that encourages active engagement, critical thinking and problem-solving skills. Although inquiry-based learning has demonstrated positive outcomes in various learning areas, its effectiveness in the teaching and learning of physics at Ordinary level remains largely unexplored. The current situation in science education suggests that the gap between how science subjects are taught and how are perceived in society is rapidly increasing (Etkina, 2012). Recent curricula reforms in developing countries have called for classroom practitioners to embrace more active forms of teaching and learning and shun teacher dominated forms of lesson delivery (Kasembe, 2011). This underpinned by the need to for the learners to effectively master science concepts and applies them to everyday life. Hence curriculum innovations are calling upon teachers to facilitate inquiry-based learning which creates the opportunity for the learners to actively engage in the learning process. To this end, ministry of primary and secondary education (2015:3 p.126) projects that the "study of physics enables learners to be creative and innovative in industry and society that can promote the application of physics in industrial process for value addition". In view of this thrust in the ministry of primary and secondary education (2015) has embraced the inquiry based learning to orchestrate development of inquiry skills in learners in ordinary level physics. Numerous studies conducted on the assessment of integration of inquiry based learning approaches in the teaching and learning of physics at Ordinary level have underscored the teachers' appreciation of the innovation. However, the actual classroom practices have been different across the educational settings. This has been largely attributed to various classroom environments and diversity in availability of resources, school climate and classroom size (Howitt, 2007). Facilitators tend to perpetuate archaic practices they are familiar with despite the calls for modernized teaching strategies. This points to the idea that a lot still need to be done to improve teaching and learning of physics at Ordinary level. Etkina (2013) advances the notion that facilitators tend to teach in the manner they were taught at secondary school. Considering that the majority of Zimbabwe physics teachers are likely to have been subjected to old fashioned teaching and learning style, it would be interesting to determine the extent to which they have embraced inquiry-based learning approaches in their classroom. Hence it is pertinent to bring to the fore how individual teachers value inquiry-based learning approaches in the teaching and learning of physics at Ordinary level. One such approach facilitators could be struggling with could be inquiry-based instruction. This is also an argument for the need to implement into science subjects the contemporary methods of instruction that can reduce the gap between understanding of nature based on the knowledge taught in school and extracurricular knowledge obtained from different information sources (Mtetwa, 2017) This research aims to assess the integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level. The study will assess the impact of this approach on the student understanding, motivation and overall performance in physics.

1.3Statement of the problem

The calamity of learners under performance in ordinary level physics has been a much-discussed educational issue. In solving any problem, it is pertinent to understand the causes of the problem. Many causes and factors have been studied as the etiological starting point for investigating the phenomena of school success or failure. These causes are looked into from different several perspectives including the effect of use of traditional ways and methods instruction in physics. It is also in this regard that the researcher desires to assess the integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level. If the traditional methods are kept in use or if the inquiry-based learning approaches are not addressed, then the performance in physics at Ordinary level will keep on maintaining the old trends of poor performance. Literature pertaining to physics education at Ordinary level is awash with evidence pointing to every limited use of inquiry-based learning approaches in the physics instructional teaching and learning (Rumnarian, 2016). Some researches into integration of inquiry based science teacher perceptions and classroom practices in Zimbabwe schools has been undertaken to date (Mtetwa, 2017). This study sought to assess the integration of inquiry based learning approaches in the teaching and learning of physics at Ordinary level.

1.4Research questions

1. What are the perceived benefits of successful integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level?

2. What are the challenges of teachers and learners towards the use of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level?

3. What are the solutions to challenges associated with integration of inquiry-based learning approaches in physics instruction?

1.5 Assumptions

- ✓ The researcher is objective not biased.
- ✓ The researcher observation and interpretations are reliable.
- ✓ Data collected is representative of the population under study.
- ✓ The findings are generalizable to other population.

1.6 Significance of study

The significance of this study cannot be underestimated. It tends to add to the body of knowledge and existing research of the subject inquiry. The study emphasizes on the identification of inquiry-based methods of instruction, how they can be fused and put into effective use. This will not only help to curb the problems of old-fashioned methods of instruction and fruitless learning but it will enhance and improve learners' knowledge, scientific and problem-solving skills. Both learners and facilitators stand to achieve better results in terms of academic performance. Improved academic performance is likely to make nation status improve in terms of scientific development contribution to the global world as well as enhancing the adoption of scientific applications in the social, economic and political areas of modern world is possible if learners are scientifically literate. Findings from this study may enhance teachers' performance through sharing good practices and promote inquiry-based learning approaches in the teaching and learning of physics at Ordinary level. The findings may also inform reality definers to revisit the Ordinary level physics syllabus section of methods and activities to align with twenty first century global trends of inquiry-based learning approaches in the teaching and learning of ordinary level physics paradigms. The results will guide physics teachers in designing instructional strategies that can promote active learning and critical thinking through integration of inquiry-based learning approaches.

1.7Limitations

According to Kazima (2014), limitations are challenges that are expected or encountered by the researcher during the research period. In the same view, Caswell (2017) view limitations of the study as those characteristics of the design or methodology that impact or influence the interpretation of the findings from research. The researcher foresees the following challenges:

The participants in the study will be a sample of physics teachers and learners at schoolA in Imbizo district, and thus, any generalizations may not be representative of all the situations in the district or the nation as a whole. However, the sample selection will be carefully done so that it gives a closer representation of the situation of the schools. Time will be another limiting factor. The research will only be carried out during school working hours.

1.8 Delimitations

According to Cohen, Manion and Morrison (2005), delimitations refer to the boundaries within which a research endeavor operates. Issues such as the context, geographical cover and the time frame are encompassed in the delimitation.

The research will be limited to only one secondary school. The researcher would not be able to carry research from all the schools in the cluster so that costs will be minimized, budget time and ensure manageable research. The study will target only two teachers, two student teachers and eight learners from form three and eight learners from form four at school A. The main thrust of the study will be an assessment on the integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level.

The researcher expects to work on the research project as from February to June 2024.

1.9Definition of terms

The variables of this study is the inquiry based learning method of instruction for physics and the classes where the subject is taught. The researcher will assess learners in the different levels in the same school with reference to the use of inquiry-based learning approaches.

According to Howie (2003) inquiry-based learning aim to engage learners in active participation and critical thinking through investigating, questioning and problem solving.

Inquiry based learning is defined as a teaching and learning approach that emphasizes active, hands on learning as well as the development of critical thinking, problem solving and research skills, (Howitt, 2007). Rumnarian (2016) argues that in an inquiry based approach, students are encouraged to ask questions and explore topics by collecting and analysing information, developing hypothesis and drawing conclusions. They are guided by the teacher but they have more autonomy in the learning process and are encouraged to take an active role in their own learning.

Integration in the context of education, refer to the process of incorporating new approaches, methods, or content into the existing curriculum or learning environment, Howitt (2007). In the context of this this thesis, integration would involve incorporating inquiry based learning into the teaching and learning of physics at ordinary level, this could include making changes to the curriculum, lesson plans, teaching methods as well as providing professional development for facilitators.

1.10Organization of study

This thesis consists of five chapters with several sub topics. This chapter which is chapter one introduced the study and outlined its focus. This chapter also discusses the context of the study in which the integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level are reviewed. Chapter two reviews the literature mainly focusing on the benefits, challenges, solution to challenges of integration of inquiry base approaches in the teaching and learning of physics at ordinary level and the research gaps. Chapter three focuses on the research methodology and research design. It discusses the conceptual framework and research design, composition of the sample and methods used in capturing, recording, transcribing and analyzing collected data. Chapter four focuses on the findings of the study led by data presentation, analysis and discussion as well as the summary and conclusion are placed in chapter five. Finally, the bibliography and appendices are placed at the end of the thesis.

1.11 Summary

Ordinary level physics teacher value inquiry-based learning approaches in the instruction but are utilizing it in their classrooms to a limited extent. Mere application without value addition to learning and teaching practices does not benefit a leaner. The physics teachers are still stuck with teacher centered teaching and learning paradigm. This is tantamount to promoting low learners' outcomes. Therefore, the integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level can enhance key competences that are essential for effective implementation of inquiry-based learning approaches for credible and appropriate scientific processes and competence development.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter will focus on the review of literature on the assessment on the integration of inquiry based approaches in the teaching and learning of physics at ordinary level. Reviewed literature is on the factors that influence the successful integration of inquiry based approaches, secondly the benefits and challenges associated with integration of inquiry based approaches as well as perceptions and attitudes of both teachers and learners in the integration of inquiry based approaches in the teaching and learning of physics at ordinary level.

2.2 Theoretical framework

According to Howit, (2007) there are a number of theories that can be applied to inquiry-based learning approaches. One is constructivist theory, which emphasizes the importance of active learning and student-centered learning environments, another is constructivist grounded theory, which focuses on the process of learning as a way to understand and explain the world.

Constructivism is a learning theory that emphasizes the active role of learners in building their understanding and knowledge. It is based on the idea that individuals actively construct or make their own knowledge, rather than passively receiving information. This theory posits that learners construct knowledge through experiences, reflection, and active mental engagement, building on their existing cognitive structures (Labrie, 2017). According to constructivist theory, learning is an active process in which students construct their own understanding of the world through exploration, inquiry, and experimentation. The teacher's role is to provide a supportive environment for learning and to facilitate the students' construction of knowledge. This theory can be applied to inquiry-based learning by emphasizing the importance of student-driven inquiry and allowing students to explore and construct their own understanding of the subject matter (Gholam, 2019).

The constructivist grounded theory is explained by Leon (2022) as a theory which is an extension of constructivist theory, and it suggests that learning is a process of developing theories to explain one's experience of the world. According to this theory, knowledge is constantly evolving and can be improved through inquiry, reflection, and discussion. In the context of inquiry-based learning, constructivist grounded theory emphasizes the importance of students' self-reflection and the need for open-ended, reflective questions.

Cognitive constructivism specifically states that knowledge is actively constructed by learners based on their existing cognitive structures. This means that individuals use their previous knowledge and experiences to construct new understanding and knowledge.

In essence, constructivism describes how learning happens, emphasizing that learners construct knowledge for themselves through individual and social processes as they engage with new information and experiences. Overall, constructivism stands in contrast to more passive forms of learning and suggests that learners are active participants in the construction of their own knowledge, emphasizing the importance of experiential learning and active mental engagement.

Constructivism in the context of physics education emphasizes the active role of learners in constructing their understanding of physics concepts through inquiry, exploration, and reflection. This approach requires educators to integrate inquiry, exploration, and assessment into their instructional methods, fostering an environment where students actively engage with the subject matter and build their knowledge based on their experiences and interactions with the material (Ahmed, 2019).

To add on, the theory discussed is not mutually exclusive, it can all be applied in different ways to inquiry-based learning. It's also important to note that this theory is not static but constantly evolving and adapting to new technologies and educational practices. One of the key takeaways from this discussion is that there is no one-size-fits-all approach to inquiry-based learning. Different theories can be applied in different ways to suit the needs of different learners and different learning contexts. It is all about finding the right combination of theories and practices to support inquiry-based learning in the most effective way.

Inquiry based approaches

According to Adrini, (2016) there are a variety of approaches related to inquiry-based learning, including:

- ✓ Project-based learning, which involves students working on an authentic project or problem.

- ✓ Problem-based learning, which is similar to project-based learning but focuses specifically on solving real-world problems.
- ✓ Place-based learning, which is based on the idea that learning happens best when it is grounded in a specific place or context.
- ✓ Service-learning, which connects classroom learning to community service projects.

The project-based learning approach involves having students work on a project or task that is meaningful and relevant to them. The project might be related to a specific academic subject, or it could be interdisciplinary. The goal is for students to gain a deeper understanding of the topic by engaging in hands-on, collaborative work (Patall, 2013). Project-based learning is often used in conjunction with inquiry-based learning, as it encourages students to explore and discover information for themselves. One of the benefits of project-based learning is that it allows students to develop a variety of skills, such as communication, collaboration, critical thinking, and problem-solving (Maxwell, 2015). It can also be used to address a variety of subjects and content areas, and it can be tailored to different grade levels and abilities.

One important thing to keep in mind with project-based learning is that it's important to give students a clear structure and set of guidelines to follow. Without these, students can easily become overwhelmed or get off track. It's also important to provide regular feedback and support throughout the project, so that students can stay on track and make progress (Patall, 2013).

The problem-based learning approach is similar to project-based learning, but it's specifically focused on helping students solve real-world problems. The problem might be related to an academic subject, or it could be more open-ended and interdisciplinary. In either case, the goal is for students to develop creative and innovative solutions (Peters, 2015).

Maxwell (2015) states one of the benefits of problem-based learning is that it helps students develop a deep understanding of the subject matter and learn to apply their knowledge to new situations. It can also foster a sense of curiosity and motivation, as students become invested in finding a solution to the problem. Just like with project-based learning, it's important to give students a clear structure and process to follow when engaging in problem-based learning. Additionally, it's important to ensure that the problem is challenging but not overwhelming. Otherwise, students may become frustrated and disengaged (Caswell, 2017).

The place-based learning approach emphasizes the importance of learning about the world around us and our connection to the environment and community. It's similar to project-based learning, but it's specifically focused on place and context. This can be especially useful in subjects like geography, history, and environmental science (Saunders, 2012). Wegner (2009) gave an example, say a class is learning about the history of a particular city. In a place-based learning approach, students would not only learn about the historical events that took place in the city, but they would also explore the physical environment of the city and the social and cultural context. They might visit historical sites, interview local residents, and learn about the city's economic and political history. This approach can help students gain a deeper understanding of the subject matter and its context (Marshall, 2013).

2.2.1 Benefits of successful integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level.

Wenning (2010) ponders that there are a number of perceived benefits associated with inquiry-based learning at the Ordinary level, some perceived benefits include:

- ✓ Increased student engagement and motivation.
- ✓ Better understanding of scientific concepts.
- ✓ Improved critical thinking and problem-solving skills.
- ✓ Greater ability to apply scientific knowledge to real-world situations.

According to Duran (2016) the perceived benefit of increased student engagement and motivation is best explained as an Inquiry-based learning that allows students to take ownership of their learning, which can lead to increased interest and engagement. Additionally, inquiry-based learning can be more relevant and meaningful to students, making them more motivated to learn. In terms of the difficulty in planning and assessing student progress, this is a common concern among teachers who are new to inquiry-based learning. However, there are a number of tools and strategies that can help with planning and assessment, such as backward design and rubrics. Inquiry-based learning encourages active participation and engagement among students, fostering a deeper understanding of physics concepts through hands-on exploration and experimentation. Additionally, teachers can use formative assessment to track student progress throughout the inquiry process (Mupira, 2018).

The next perceived benefit is improved critical thinking and problem-solving skills. Inquiry-based learning encourages students to ask questions, generate hypotheses, design and conduct experiments, and analyze data. This process helps students develop important critical thinking and problem-solving skills, which can be applied to a variety of situations. This approach promotes the development of critical thinking skills as students are encouraged to ask questions, analyze data, and draw conclusions based on evidence, thereby enhancing their ability to think critically and solve complex problems. (Mupira, 2018).

Caswel (2017) says another perceived benefit is better understanding of scientific concepts. Inquiry-based learning helps students build a deeper understanding of scientific concepts by allowing them to make connections between concepts and apply them in real-world situations. Additionally, inquiry-based learning encourages students to consider alternative explanations and evaluate evidence, which can lead to a more robust understanding of scientific concepts.

Furthermore, another perceived benefit is the ability to apply scientific knowledge to real-world situations. Inquiry-based learning helps students develop the ability to apply their scientific knowledge to new situations, which can be especially useful in careers that require scientific knowledge, such as engineering, medicine, and research. By connecting physics concepts to real-world phenomena and applications, inquiry-based learning helps students see the practical relevance of what they are learning, making the subject more meaningful and applicable to their lives. (Mupira, 2018).

In overall, the integration of inquiry-based learning approaches in physics education not only enhances students' understanding of the subject but also cultivates essential skills such as critical thinking, problem-solving, and real-world application, preparing them for success in both academic and practical contexts.

2.2.2 Challenges of teachers and learners towards the use of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level.

Chiapetta(2008) argues that the one perceived challenge of inquiry-based learning is the possibility of negative learning experiences. When students are asked to generate their own ideas and make their own decisions, they may experience frustration or anxiety if their ideas are not successful. Additionally, students may experience feelings of failure or inadequacy if they struggle to answer complex questions or design effective experiments (Mupira, 2018).

It is important for teachers to be aware of the potential for negative learning experiences and to take steps to mitigate these risks. For example, teachers can provide clear expectations and guidelines for student work, provide scaffolding and support when needed, and encourage students to view failures as opportunities for growth. Inquiry-based learning requires a greater time commitment from both teachers and students. Teachers need to invest time in developing effective inquiry-based lessons and providing scaffolding and support to students. Students may need more time to complete inquiry-based tasks and activities, especially if they are unfamiliar with the process (Ahmed, 2019). According toCaswell (2017) the Integrating inquiry-based learning approaches in the teaching and learning of physics presents the following challenges that educators may encounter:

Resource limitations: Implementing inquiry-based learning often requires access to various resources, such as laboratory equipment, technology, and materials for hands-on experiments. Limited resources can hinder the effective implementation of inquiry-based approaches in physics education.

Time constraints: The time required for inquiry-based learning activities, including exploration, experimentation, and reflection, may conflict with the constraints of a traditional classroom schedule. Finding sufficient time for in-depth inquiry can be a challenge within the existing curriculum framework.

Teacher training and support: Educators may require specialized training and ongoing support to effectively implement inquiry-based learning in physics education. This includes developing the skills to facilitate student-led inquiry, manage group dynamics, and provide guidance without overshadowing students' exploration.

Assessment and evaluation: Traditional assessment methods may not align well with the open-ended nature of inquiry-based learning. Designing appropriate assessments to evaluate students' understanding and skills developed through inquiry-based activities can be a challenge for educators.

Student engagement and motivation: Some students may initially struggle with the open-ended nature of inquiry-based learning, requiring additional support to develop the skills and confidence needed to engage in self-directed exploration and experimentation.

Addressing these challenges requires a comprehensive approach that includes providing adequate resources, ongoing professional development for educators, and creating a supportive learning environment that encourages student engagement and inquiry-based exploration in physics education (Ahmed, 2019).

2.2.3 Solutions to challenges associated with integration of inquiry-based learning approaches in physics instruction.

According to Chiapetta (2008) the following are the solutions to challenges in Integrating Inquiry-Based Learning in Physics Education

Resource management and access: Collaborate with other educators and institutions to share resources and equipment for inquiry-based activities. Seek external funding or grants to acquire necessary materials and technology for hands-on experiments and exploration.

Curriculum integration: Advocate for an integrated STEM (Science, Technology, Engineering, and Mathematics) approach to address global challenges, aligning physics education with real-world issues such as energy and health. This can provide a context for inquiry-based learning and foster interdisciplinary connections.

Professional development: Offer specialized training and ongoing support for educators to develop the skills needed to facilitate inquiry-based learning effectively. This includes guidance on instructional planning, student engagement, and assessment methods tailored to inquiry-based activities.

Assessment strategies: Design and implement assessment methods that align with the open-ended nature of inquiry-based learning. Utilize a variety of assessment tools, including performance-based assessments, portfolios, and self-assessments, to evaluate students' understanding and skills developed through inquiry-based activities.

Technology integration: Explore the use of technology, such as augmented reality (AR) and computer software, to enhance inquiry-based learning experiences in physics education.

Integrating technology can support simulation-based learning and provide additional resources for student exploration and understanding.

By implementing these solutions, educators can address the challenges associated with integrating inquiry-based learning approaches in the teaching and learning of physics, creating a supportive environment that fosters student engagement, critical thinking, and real-world application of physics concepts (Mupira, 2018).

Literature review

Benefits of Inquiry-Based Learning approaches in the teaching and learning of physics at ordinary level.

In a video titled, Skills Students Need for Their Future (2012), Dr. Tony Wagner delivers a speech where he identifies a variety of skills needed for student success in a global economy. The skills are: critical thinking, problem solving, collaboration and leading with influence, agility and adaptability, initiative and entrepreneurialism, effective oral and written communication, accessing and analyzing information and curiosity and imagination. Marks (2013) explains that: "In an inquiry-based learning classroom, students learn, practice, and reflect on these skills in an authentic process that imitates those processes used in the real world" (p. 23). Inquiry-Based Learning is an instructional strategy that brings teaching and learning into alignment with the student and the skills needed for future success. Many studies have been conducted on the benefits of applying inquiry-based learning in the classroom. Guido (2017) identifies benefits of inquiry-based learning, arguing that it:

- ✓ reinforces curriculum content,
- ✓ warms up the brain for learning,
- ✓ promotes a deeper understanding of the content,
- ✓ helps make learning rewarding,
- ✓ builds initiative and self- direction,

- ✓ works in almost any classroom, and
- ✓ Offers differentiated instruction.

According to Sockalingam and Schmidt (2011), when students are provided the opportunity to work on a problem, they gain new knowledge and further extend and deepen their current understanding. When students explore and investigate, they take responsibility for their learning, as they are expected to make decisions and reach conclusions and judgments. Similarly, Hwang and Chang (2011) argue that when students learn by means of discovery and investigation in authentic settings, they improve their critical thinking skills. Goldston et al. (2010) argue that inquiry-based learning considers the knowledge aspect of learning, yet places great emphasis on critical thinking, problem solving, and communication abilities. A research study by Gu et al. (2015) has found that students involved in inquiry-based practices have reported higher levels of academic self-efficacy, resolved conflicts at a higher rate, been less afraid to take risks, and more likely to continue trying different ways to be successful when they failed. Marks (2013) concludes that students who are actively engaged in inquiry do not only master content but master habits of mind. Harlen (2013) mentions that developing understanding through students' own thinking and reasoning has many benefits for students including: enjoyment and satisfaction in finding out for themselves something that they want to know, seeing for themselves what works rather than just being told, satisfying and at the same time stimulating curiosity about the world around them, and developing progressively more powerful ideas about the world around them.

Challenges of Inquiry-Based Learning approaches in the teaching and learning of physics at ordinary level.

Inquiry is a term used both in education and in daily life to refer to seeking explanations or information by posing questions (Harlem, 2013). Inquiry based learning approach is an instructional practice where learners are at the center of the learning experience and take ownership of their own learning by posing, investigating, and answering questions (Caswell &LaBrie, 2017). It is also considered a form of self-directed learning where learners take responsibility for their learning (Spronken-Smith & Walker, 2010). Bell, Smetana, and Binns

(2005) use the phrase, ‘active learning process’, to refer to the nature of inquiry where learners are expected to answer a research question using data analysis and information exchange. Inquiry based learning approach is seen as a system of learning that supports the development of learners’ problem solving and critical skills. Saunders-Stewart, (2012) consider the many forms of inquiry based learning approaches and mention that it includes analysis, problem solving, discovery, and creative thinking. Although inquiry is learner oriented, Zangori, Forbes, and Biggers (2012) argue that teachers may direct learners at times during the learning process, as some beginner students may need more instruction to hone their inquiry skills. Guido (2017) examines inquiry from both a learner and a teacher’s point of view. He explains that from a learner’s perspective, inquiry based learning approaches focuses on investigating an open question or problem, while from a teacher’s perspective, inquiry-based teaching focuses on moving learners beyond basic curiosity into the realms of critical thinking and understanding. Inquiry based learning approaches is rooted in constructivism, which is a learning theory, and states that humans construct their own knowledge and meaning from their personal experiences (Tamim& Grant, 2013). Therefore, in such a case, knowledge is being built rather than delivered by the teacher. John Dewey, a constructivist and an advocate of inquiry based learning approaches, states that learners should actively be in engaged in the learning process. He explains: “if you have doubts about how learning happens, engage in sustained inquiry: study, ponder, consider alternative possibilities, and arrive at your belief grounded in evidence” (Dewey, 1998, as cited in Mapes, 2009, p.11). John Dewey strongly believed that learners need to be reflective problem solvers (Santrock, 2017). Jerome Bruner contributes to constructivism and is primarily concerned with making education more relevant to student needs at each stage, and he believes that teachers could accomplish this by allowing learners to actively participate in the learning process (Roblyer&Doering, 2013). His theory, discovery learning, is a form of inquiry based learning approaches and states that learners are more likely to understand and remember concepts that they discover during their interaction with the environment (Roblyer&Doering, 2013). Lev Vygotsky known for his social constructivism theory explains that social interaction and critical thinking are two main ingredients of a learning process (Liu & Chen, 2010). He describes inquiry based learning approaches as an “integral part of creating a social constructivist classroom” (Powell &Kalina, 2009, p. 244).

2.3 Research gaps

There are a few potential research gaps that could be explored in this area. One is the lack of research on the effectiveness of inquiry-based learning in physics education at the ordinary level, specifically in terms of student achievement and understanding of physics concepts. Another is the lack of research on the implementation of inquiry-based learning in a school with limited resources, which may have different needs and challenges compared to schools with more resources. Additionally, there is a need for more research on the professional development needs of teachers implementing inquiry-based learning in their classrooms. Now, the next step in developing the research design would be to consider what data could be collected to address these research gaps.

2.4 Summary

The chapter focused on the literature from previous researches about the assessment of the integration of inquiry based learning approaches in the teaching and learning of physics at ordinary level. It reviewed literature on the factors, benefits, challenges of integration of inquiry based learning approaches as well as attitudes of both students and teachers towards integration of inquiry based learning approaches in the teaching and learning of physics at ordinary level.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The chapter will focus on the research methodology, design, population, sample and sampling techniques as well as the methods of gathering information and presenting data. Mouton (2003), posits that research methodology dwells on the process, types of tools and procedures to be used by the researcher in the whole data collection process.

3.2 Research design

Research design refers to the overall plan for conducting a research study. It includes the research questions, the research methods, and the procedures for collecting and analyzing data (Maxwell & Creswell, 2015). There are different types of research designs, such as experimental, correlational, and case study designs. A research design is a detailed plan of how a research is going to be carried out (Tashakkori, 2014). In the same view, Kothari (2004) consolidates that a research design is a systematic and orderly approach taken towards data collection so that information about a subject of interest can be gathered. This study is based upon a qualitative case study research design.

According to Caswell and Plano Clark (2011) the case study design is orchestrated through the researcher soliciting qualitative data only to gain a deep understanding of the case, rather than to generalize the findings to a larger population. This study intends to use a case study method of approach.

A case study is a research method that involves studying a single case in depth. The case can be an individual, a group, an event, or an organization. The goal of a case study is to gain a deep understanding of the case, rather than to generalize the findings to a larger population. This is different from other research methods, such as surveys or experiments, which are designed to produce generalizable findings (Wisdom & Creswell, 2015).

According to Hungler (2015) case studies are a type of qualitative research design that involves an in-depth study of a single case, such as a person, group, or event. Case studies are often used to explore complex phenomena that cannot be easily studied through other means. Case studies have the advantage of providing rich, detailed data about the case, but they have the disadvantage of being difficult to generalize to a larger population (Maxwell & Creswell, 2015).

Case studies typically involve a number of steps. First, the researcher identifies and selects a case for study. Next, the researcher develops a research question and a plan for collecting and analyzing data. Data is then collected through methods such as interviews, observations, or document analysis. Finally, the researcher analyzes the data and writes up the findings in a case report (Maxwell & Creswell, 2015).

Schumacher, (2011:186) further add that there are strengths and weaknesses of case studies where the key strength of case studies is that they can provide in-depth, detailed insights into a particular case. This can be very valuable for understanding complex phenomena that are difficult to study in other ways. However, a key weakness of case studies is that it can be difficult to generalize the findings to a larger population.

Kumar (2011) further mention that another important consideration in case studies is the issue of researcher bias. Because case studies often involve a close relationship between the researcher and the case, it can be difficult for the researcher to remain objective. The researcher must be aware of this potential bias and take steps to minimize it.

One way to minimize bias in case studies is to use multiple sources of data, such as interviews, observations, and documents as well as questionnaires. This helps to ensure that the data is as accurate and unbiased as possible. It's also important for the researcher to be transparent about their own biases and assumptions (Kumar, 2015).

The study was guided by the constructivist philosophy perspective which insist that value is determined by realistic consequences hence the case study design was considered the most appropriate approach for the attainment of this task.

3.3 Research methodology

In this research, a qualitative research approach was mainly adopted in the collection of data. According to Saldana (2016), qualitative research refers to a kind of research that deals with human feelings, views, opinions, assumptions, perspectives and experiences in order to find meaning and to understand why certain phenomena are happening in a particular set up. Schumacher (2017) further adds that qualitative research is concerned with understanding social phenomena from participants' perspective, by analyzing the many contexts of respondents and by narrating their understanding of their situations and events. The qualitative research approach was employed as it uses and derive meaning from the research participants' perspective (De Vos, 2018). It also led the researcher to interact with study participants in their real-life settings, where they can freely express themselves, their views and perceptions.

3.4 Research paradigm

Constructivism is a learning theory that emphasizes the active role of learners in building their understanding and knowledge. It is based on the idea that individuals actively construct or make their own knowledge, rather than passively receiving information. This theory posits that learners construct knowledge through experiences, reflection, and active mental engagement, building on their existing cognitive structures (Labrie, 2017). According to constructivist theory, learning is an active process in which students construct their own understanding of the world through exploration, inquiry, and experimentation. The teacher's role is to provide a supportive environment for learning and to facilitate the students' construction of knowledge. This theory can be applied to inquiry-based learning by emphasizing the importance of student-driven inquiry and allowing students to explore and construct their own understanding of the subject matter (Gholam, 2019).

3.5 Population and sampling

3.5.1 Population

A population, in the context of research, is the entire group of individuals that the researcher is interested in studying. Hungler (2016) defines population in terms of specific characteristics, such as age, gender, or location. It's important to clearly define the population in order to ensure that the sample is representative of the population. A population refers to the respondents that will partake in a particular study (Fink, 2019), and usually these have one to more characteristics of interest to the researcher. Hungler (2016) concur that a population is the totality of all the objects, subjects or members that conform to a set of specifications. In this thesis the population comprised of physics teachers, student teachers and selected learners from school A inImbizo district, Bulawayo.

3.5.2 Sampling

Maxwell (2015) defines sampling as the process of selecting a subset of individuals from a population for study. There are two main types of sampling which are probability sampling and non-probability sampling. Probability sampling, such as random sampling, uses a chance mechanism to select participants. Non-probability sampling, such as purposive sampling, uses a non-random process to select participants based on certain criteria. Sampling, as Kumar (2011) defines it as the act, process, or technique of selecting a suitable portion, or a representative part of a larger population to become the basis for predicting the state of an unknown piece of data. Caswell (2014) views sampling as a process of selecting samples from a group or population to become the foundation for estimating and predicting the outcome of the population as well as to detect the unknown piece of information. There are a few different options of sampling techniques that can be used in a thesis, one option is purposive sampling, where you select participants based on specific criteria that are relevant to your research question. Another option is convenience sampling, where you select participants based on who is readily available. And finally, snowball sampling, where you recruit participants through referrals from other participants (Kumar, 2011). Purposive sampling was adopted in this research.

According to Maxwell (2015) a sample is the subset of individuals from the population that is actually studied in the research. The sample is selected using a sampling method, such as random sampling or purposive sampling. The sample should be carefully chosen in order to ensure that it is representative of the population. A representative sample allows the researcher to make inferences about the population based on the results of the study (Maxwell & Creswell, 2015).

The study participants were drawn from two physics teachers, two student teachers and sixteen ordinary level learners. Physics teachers will have selected using purposive sampling and invited to the interview and sixteen ordinary level physics learners will purposively selected to complete a questionnaire. The whole population sample was fully accessible with respect to school administration and science department.

3.5.2.1 Convenience sampling

Convenience sampling involves selecting participants based on their easy accessibility to the researcher. This method is characterized by the selection of individuals or units that are readily available and convenient to include in the study. Convenience sampling is often used when researchers require quick and easy access to participants, making it a pragmatic choice for studies with resource or time constraints. However, convenience sampling may introduce biases, as the sample may not be representative of the broader population, potentially impacting the generalizability of the findings (Caswell, 2014). In summary, convenience sampling prioritizes accessibility and ease of inclusion.

3.5.2.2 Purposive sampling

Purposive sampling is a non-probability sampling which uses a non-random process to select participants based on certain criteria.Purposive sampling, also known as purposeful or judgmental sampling, involves intentionally selecting participants based on specific characteristics, knowledge, experiences, or other criteria relevant to the research objectives. This method allows researchers to target individuals or units that possess the desired attributes or insights, aligning with the specific focus of the study. Purposive sampling is often employed in qualitative research, where the emphasis is on capturing diverse perspectives and in-depth understanding. While purposive sampling enables researchers to target specific characteristics of interest, it may limit the representation of certain groups within the population, requiring careful consideration of the potential biases introduced (Kumar, 2011).In summary purposive sampling focuses on intentional selection based on specific criteria relevant to the research objectives.

3.6 Research Instruments

Research instruments, according to Merriam (1998), are the physical tools that will be utilized by a researcher to gather or solicit for information about a subject of study from selected respondents. This view is supported by Tuckman (2014), who defines a research instrument as a tool used by the researcher in the systematic collection of data. The study will employ a closed survey questionnaire for sixteen learners with eight items, an interview schedule for four facilitators with seven items, an observation schedulefor four facilitators and four learners' books and document analysis guide.

3.6.1 Questionnaire

A questionnaire is a research tool in which the researcher provides a list of questions and asks learners only to respond to the questions in writing. Questionnaires can be paper-based or online, they are often used in surveys, where the researcher collects responses from a large number of people and they are typically more structured than interviews, and they allow for a higher level of standardization (Cohen and Manion, 2016). In this thesis, the paper based questionnaire was used. A questionnaire is a research tool in which the researcher provides a list of questions and asks participants to respond to the questions in writing. They are often used in surveys, where the researcher collects responses from a large number of people. Questionnaires are typically more structured than interviews, and they allow for a higher level of standardization. The survey questionnaire is deemed most appropriate for soliciting for technical data addressing the research questions (Maxwell & Creswell, 2015). In this research, sixteen learners were targeted to give responses to the questionnaire.

3.6.2 Interview

An interview is a research tool in which the researcher asks questions of a participant in order to gather information. There are different types of interviews, including structured interviews, semi-structured interviews, and unstructured interviews. In a structured interview, the researcher asks a fixed set of questions in a specific order. In a semi-structured interview, the researcher has a list of questions, but there is more flexibility in the order and wording of the questions. In an unstructured interview, the researcher has no specific questions, and the conversation is more free-flowingstudy (Maxwell & Creswell, 2015). The structured interview will be carried out on teachers. It will address issues that are related to the inclusion and the integration of inquiry based approaches in the teaching and learning of physics at ordinary level. An interview schedule was designed consisting of items of the desired behavior to be observed. The interview guide was used to solicit for deeper information pertaining to the preferred teaching practices to corroborate survey responses.In this research, two teachers and two student teachers were targeted to give responses to the interview.

3.6.3 Observation schedule

According toCohen and Manion (2016) anobservation schedule is a tool that helps researchers analyze and interpret documents such as books, articles, letters, or other written materials. It usually consists of a set of questions or prompts that guide the researcher in identifying and interpreting the key themes, ideas, and concepts in the document. An observation schedule can be used for both qualitative and quantitative research.

The observation schedule targeted two scheme books, four learners' practical books of work per form and lesson observation of four lessons assessing whether the inquiry based instruction is adopted.

3.7 Data collection, presentation procedure and analysis method

3.7.1 Data collection procedures

The research will utilize interviews, questionnaire and observation schedule as tools for collecting data. Since the research will focus on the facilitators and learners, who are the main sources of information, interviews will be administered to facilitators and questionnaire to learners so as to get their views and responses about the integration of inquiry based learning approaches in the teaching and learning of physics at ordinary level.

There are a few options for recording the interview data. One option is to take handwritten notes during the interviews. This allows capturing of detailed information, but it can be time-consuming and may not be as reliable as other methods. Another option is to use a recording device, such as a digital recorder or a smartphone, to record the interviews (de Vaus, 2016). This can be a more efficient way to collect data, but it's important to get permission from the participants before recording the interviews. Handwritten notes are a good option in this research because they have the advantage of allowing the researcher to take more detailed notes and to make notes on non-verbal communication, such as body language and tone of voice (Fink, 2003). Analyzing the handwritten notes is easier and they can help the researcher to retain the nuances of the interviews and get a deeper understanding of the participants' perspectives.

3.7.2 Data presentation

Descriptive statistics will be employed to elaborate qualitative data collated into emerging themes for purposes of analysis and discussion. This will enhance data presentation clarity and facilitate easy analysis and interpretation. The learners’ responses to the closed statements in the questionnaire will be categorized and ranked.

Three primary sources of data will be used for this study, the interview schedule, a questionnaire and an observation schedule, these are typically referred to as the primary data sources. Salkind (2010) defines a primary data source an original data source, one in which the data are collected personally by the researcher, for a specified purpose. For qualitative data analysis, Leech &Onwuegbuzie (2007), suggest that either of Content analysis, Narrative analysis, Discourse analysis, grounded theory or conversation analysis, can be made use of. For this study, the researcher will use narrative analysis, which entails analyzing text from sources such as interview and questionnaire transcripts. According to Leech &Onwuegbuzie (2007), narrative analysis usually involves re-formulating narratives dispensed by people in different contexts and based on their different occurrences. According to Dudovskiy's (2016) there are three steps of qualitative data analysis and will be used in the analysis on this research, and these are as follows:

- ✓ Coding- categorizing data and assigning titles to the data.
- ✓ Identifying themes- scanning primary data for words and phrases most commonly used by respondents, comparing primary data with findings in literature review, searching for missing information.
- ✓ Summarizing Data- linking research findings to hypotheses, research objectives and questions and making conclusions.

In order to carry out this thesis the researcher will make the following assumptions:

- ✓ The respondents will fully understand the purpose of the research.
- ✓ The respondents will be willing to assist the researcher during the course of the research.
- ✓ The test represents the demography under study.
- ✓ The data collection instruments have validity and measure the desired constructs.

According to Dudovskiy's (2016) data presentation procedures involve the visual representation of data sets to effectively convey information to an audience and listed some key steps and considerations for effective data presentation as follows:

- ✓ Organize Your Data.

Before presenting data, it's essential to organize it in a structured and coherent manner to ensure clarity and coherence in the presentation.

- ✓ Identify Your Audience.

Understanding the audience's background, knowledge, and expectations is crucial for tailoring the presentation to effectively communicate the data to the intended viewers.

- ✓ Choose a Presentation Type.

Selecting the appropriate presentation type, such as charts, graphs, tables, or visualizations, based on the nature of the data and the message to be conveyed is essential for effective data presentation.

- ✓ Label Your Data.

Clear and informative labeling of data elements, axes, and units is important to ensure that the audience can easily interpret the presented information.

- ✓ Introduce Your Research.
- ✓ Providing context and background information about the research or data being presented helps the audience understand the significance and relevance of the information.
- ✓ Create Presentation Slides.

Developing well-structured and visually appealing presentation slides that effectively convey the data and key findings is crucial for engaging the audience.

- ✓ Edit Your Slides.

Reviewing and refining the presentation slides to ensure clarity, coherence, and visual appeal is an important step in the data presentation process.

- ✓ Practice.

Rehearsing the presentation to become familiar with the content, flow, and timing helps in delivering a confident and impactful presentation.

In addition to these steps, data presentation often involves the use of data visualization techniques, such as charts, graphs, and maps, to make the data more accessible and comprehensible to the audience Dudovskiy's (2016). According to Cohen and Manion (2016) effective data presentation aims to convey complex information in a visually engaging and understandable manner, facilitating the audience's comprehension and interpretation of the presented data.

3.7.3 Data analysis procedures

According to Saldana (2016) data analysis procedures involve a systematic approach to processing and interpreting data to derive meaningful insights and conclusions. The process typically consists of several stages, each crucial to ensuring the accuracy and usefulness of the results.

- ✓ Identifying the Problem.

The data analysis process often begins with identifying a problem or question that can be addressed through data. This step is essential for framing the analysis and guiding the subsequent data collection and processing efforts.

- ✓ Data Collection.

Once the problem is identified, the next step involves collecting relevant data. This may include gathering raw data from various sources, such as surveys, experiments, or existing databases.

- ✓ Data Cleaning and Preprocessing.

Data cleaning and preprocessing are critical stages in data analysis. This involves identifying and addressing errors, inconsistencies, missing values, and outliers in the data to ensure its quality and reliability.

- ✓ Data Modeling and Analysis.

The actual analysis phase involves applying statistical and/or logical techniques to describe, condense, and evaluate the data. This may include the use of various statistical methods and techniques to model and analyze the data, such as regression analysis, hypothesis testing, clustering, or machine learning algorithms.

- ✓ Interpreting and Reporting Results.

Once the data is analyzed, the results are interpreted to derive meaningful insights and conclusions. This often involves summarizing the findings, identifying patterns or trends, and drawing inferences based on the analysis.

- ✓ Validation and Verification.

Validation and verification procedures are employed to ensure the accuracy and reliability of the analysis results. This may involve cross-validation techniques, sensitivity analyses, or other validation procedures to assess the robustness of the findings.

Overall, the data analysis process is a structured sequence of steps that lead from raw data to actionable insights. It involves careful attention to each stage, from problem identification to result interpretation, to ensure the accuracy, reliability, and usefulness of the analysis outcomes (De Vos, 2018).

3.8 Trustworthiness and dependability

3.8.1 Trustworthiness

Data trustworthiness in the context of qualitative research is a critical aspect that ensures the reliability, accuracy, and integrity of the data and the subsequent findings (Collins, 2000). There are principles and criteria contribute to establishing data trustworthiness:

- ✓ Articulating Evidence.

  Qualitative researchers are required to articulate evidence of primary criteria to ensure the trustworthiness of the data, which may include aspects such as credibility, transferability, dependability, and conformability.
- ✓ Process-Based Data.

  Qualitative research is uniquely positioned to provide process-based, narrated, storied data that is closely related to the human experience, contributing to the trustworthiness of the findings.

- ✓ Precise Analysis.

To be accepted as trustworthy, qualitative researchers must demonstrate that data analysis has been conducted in a precise, consistent, and exhaustive manner.

In summary, data trustworthiness encompasses various criteria and principles, including credibility, accuracy, completeness, and public trust, which are essential for establishing the reliability and integrity of both qualitative and quantitative data in research and organizational contexts (Collins, 2000).

3.8.2 Dependability

In the context of qualitative research, dependability is associated with the consistency and stability of the data, ensuring that the findings are not influenced by external factors and that the results can be replicated or confirmed under similar conditions. This is achieved through rigorous data collection methods and thorough documentation, which contribute to the dependability of the research outcomes (Collins, 2000).

According to Braun (2006) data dependability refers to the reliability and consistency of data, ensuring that it can be trusted as a basis for analysis and decision-making. It encompasses the assurance that data will yield the same or very similar results each time a particular measurement or observation is repeated, thus providing a dependable and trustworthy foundation for various applications and analyses.

Furthermore, in the realm of data reliability, dependability is closely linked to the concept of data observability, which pertains to the degree to which data and the insights derived from it can be trusted and relied upon. This emphasizes the importance of ensuring that the data remains consistent, trustworthy, and transparent throughout its lifecycle, from collection to analysis and interpretation (Coleman, 2014).

To sum up, data dependability is fundamental to establishing the trustworthiness and integrity of data, whether in the context of research, audits, or organizational decision-making. It underpins the reliability and stability of data, ensuring that it can be consistently relied upon for accurate and meaningful insights.

3.9 Ethical considerations

According to Sanders(2016) ethical considerations play a crucial role in various domains, guiding the responsible and respectful conduct of research, decision-making, and the use of emerging technologies.Ethical considerations in research encompass a set of principles that guide research designs and practices, emphasizing the importance of respecting the rights and dignity of individuals participating in studies. This includes upholding confidentiality, obtaining informed consent, and addressing legal and ethical issues that may arise during the research process.

3.9.1 Confidentiality

Data confidentiality refers to the protection of sensitive information from unauthorized access, disclosure, or theft(Colins,2000). It is a critical aspect of data security and privacy, ensuring that valuable assets, such as customer information, personal data, and proprietary knowledge, are safeguarded against unauthorized use or exposure.Mosteller (1995) identified the following ideas to be safeguarded and confidential:

- ✓ Data Security Management: Data security is integral to protecting digital information from corruption, damage, and theft, and it involves robust management and strategy processes.
- ✓ Guidelines for Data Confidentiality: Guidelines for maintaining data confidentiality include encrypting sensitive files, managing data access, physically securing devices and paper documents, and securely disposing of data.
- ✓ Practice of Protecting Digital Information: Data security is the practice of protecting digital information from unauthorized access, corruption, or theft throughout its entire lifecycle.
- ✓ Maintaining Confidentiality in Relationships of Trust: Maintaining confidentiality requires safeguarding the information that an individual has disclosed in a relationship of trust and with the expectation of privacy.

To conclude, data confidentiality encompasses a range of measures and practices aimed at protecting sensitive information from unauthorized access, ensuring the privacy and security of valuable assets, and upholding ethical standards in data management and security (Colins,2000).

3.9.2 Anonymity

According to Braun(2006) data anonymity, also known as data anonymization, is the process of protecting private or sensitive information by removing or encrypting identifiers that connect an individual to stored data. This ensures that the people whom the data describe remain anonymous, thereby safeguarding their privacy and confidentiality. Anonymization is a data processing technique that removes or modifies personally identifiable information, resulting in anonymized data that cannot be directly linked to specific individuals. In practice, data anonymization involves methods such as removing or encrypting personally identifiable data in a dataset, ensuring that individual names or numbers are not associated with the data provided, and rendering personal data anonymous in a manner that prevents the identification of specific individuals. This process is essential for protecting the privacy of individuals, particularly in sensitive areas such as healthcare, research, and personal data privacy.

Finally, data anonymization is a critical technique for safeguarding privacy and confidentiality, ensuring that individuals' personal information remains protected and anonymous in various data sets and contexts.

3.9.3 Informed consent

Informed consent is a fundamental ethical principle in research and data collection, ensuring that individuals are fully informed about the key elements of a study and what their participation will involve. Coleman (2014) identified some key aspects of informed consent as it relates to data collection:

- ✓ Voluntary Participation: Informed consent ensures that individuals can enter research or data collection freely, without coercion or undue influence.
- ✓ Documentation of Consent: In most research, informed consent is documented using a written document that provides key information regarding the research, ensuring that participants are fully informed about the nature of the study.
- ✓ Ethical Cornerstone: In surveys, interviews, and other forms of data collection, informed consent is considered the cornerstone of ethical research, emphasizing the importance of respecting participants' autonomy and decision-making.
- ✓ Data Protection Regulation: In the context of data protection regulations, informed consent is essential for the collection and processing of personal data, ensuring that individuals are adequately informed and provide specific consent for the use of their data.
- ✓ Disclosure of Information: Informed consent involves the disclosure of appropriate information about the research or data collection, enabling participants to make voluntary and informed decisions about their involvement.

To sum up, informed consent is a critical ethical safeguard in research and data collection, ensuring that individuals are fully informed about the nature of the study and voluntarily agree to participate, particularly in the context of data protection regulations and clinical research.

3.10 Summary

The chapter focused on the research methodology and chosen the qualitative case study research method and design in the case of school A. Survey questionnaire, interview and an observation schedule will be adopted as research tools and primary data sources gathered from a carefully and purposively selected sample of population of physics teachers and learners. Collected data will be presented on tables and narrative analysis will be employed comparing gathered data and findings with findings from the reviewed literature. However, a key weakness of the chosen research method and design is that it can be difficult to generalize the findings to a larger population.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

Data presentation refers to the process of transforming raw data into visual format that is easy to understand and interpret. It is crucial for making data easier to comprehend by the intended audience, often by using visual elements like charts, graphs and tables to convey complex information in a clear and concise manner (Bell, 2005).

Data analysis is a process of inspecting, cleansing, transforming and modelling data with the main aim of discovering useful information. It is essential for discovering meaningful insights from data collected, and it often includes the techniques such as coding qualitative data, data modelling and discovering useful information from data (Morrison et. al 2011).

This chapter focuses on the processes of presenting, analysing and discussing numerical and non-numerical data from questionnaires, interviews schedules and observation schedules by employing qualitative data analysis methods, understanding the nature of qualitative research, and effectively interpreting and presenting the insights derived from the data.

4.1Bio data

Table 4a Bio data

	Male	*Female*	*Total*
Teachers	03	01	04
Form 3 learners	06	02	08
Form 4 learners	05	03	08

Table 4a above shows the sample population contacted during data gathering and it gives a total of 16 learners and 4 facilitators.

4.2 Data presentation and analysis

4.2.0 Perceptions on the benefits of inquiry based approaches

4.2.1 Findingsfromquestionnaires

Non numerical data from learners was collected using questionnaire.

The perceived benefits of inquiry based approaches in the learning of physics, learners come up with different and recurred responses such as:

- ✓ Independence and love for learning.
- ✓ Critical thinking.
- ✓ Making connections.
- ✓ Nurturing passions and talents.
- ✓ Engagement and critical thinking.
- ✓ Active role in learning.

- ✓ Problem solving and lifelong learning skills.
- ✓ Safe and supportive environment.
- ✓ Helps learner to showcase their talents.
- ✓ Increases research skills.

The above responses provide evidence that inquiry-based learning helps students develop a love of learning through independence, rather than simply following along with a lesson. It encourages students to think critically about the information they are presented with and to question the information, fostering a deeper understanding. Inquiry-based learning helps learners make their own connections about what they learn, fostering curiosity and deeper engagement. Students can improve certain transferable skills through inquiry-based learning, many of which relate to initiative, self-direction, and organization. It nurtures passions and talents, increases motivation and engagement, and allows students to explore their interests. It keeps students engaged, encourages them to improve their critical thinking, and gives them the opportunity to ask deep, thoughtful questions. Requiring the student to take an active role in the process may be the most significant benefit of inquiry-based learning. Inquiry provides both the impetus and experience that helps students acquire problem-solving and lifelong learning skills. Lastly, it creates a safe and supportive environment for students to engage in discussion and debate, promoting engagement in scientific discussion.

4.2.2 Findings from interview schedules

Non-numerical data from 4 facilitators was collected by using interview schedules and recorded in form of handwriting. The perceived benefits of inquiry based approaches in the teaching of physics at ordinary level were identified.Facilitator A has this to say about the benefits of inquiry based approaches "It increases student engagement and motivation" Increased student engagement and motivation is best explained as an Inquiry-based learning that allows students to take ownership of their learning, which can lead to increased interest and engagement. Facilitator C pondered that inquiry based approaches lead to "Increased student engagement and motivation". This is seen when learners are involved in active participation and engagement among students, fostering a deeper understanding of physics concepts through hands-on exploration and experimentation. The idea of "Better understanding of scientific concepts" was pointed out all facilitators. This unveils that inquiry-based learning helps students' build a deeper understanding of scientific concepts by allowing them to make connections between concepts and apply them in real-world situations. "Improves critical thinking and problem-solving skills" was a recurred point, this gives an emphasis that inquiry-based learning encourages students to ask questions, generate hypotheses, design and conduct experiments, and analyze data. This process helps students develop important critical thinking and problem-solving skills, which can be applied to a variety of situations." Greater ability to apply scientific knowledge to real-world situations" was pointed out by facilitator B,this gives a view that Inquiry-based learning helps students develop the ability to apply their scientific knowledge to new situations, which can be especially useful in careers that require scientific knowledge, such as engineering, medicine, and research.

All facilitators alsopointed out the points listed below as benefits of inquiry based approaches;

- ✓ Improved mastery of concept.
- ✓ Learners can quickly recall the concepts learnt long back.
- ✓ Improves confidence on both facilitators and learners.

4.2.3 Findings from observation schedule

- ✓ Only one research project was given to learners per term.
- ✓ Improves facilitators' familiarity with integration of inquiry based approaches.

Few research projects given to learners encourages them innovation and critical thinking skills and also help facilitators to get used and always engaged with inquiry based teaching approaches.

4.3.0 Challenges on the integration of inquiry based approaches

4.3.1 Findingsfromquestionnaires

The perceived challenges or difficulties on the integration of inquiry based approaches in the learning of physics, learners come up with different and recurred responses such as:

- ✓ Resource limitation.
- ✓ Time constraints.
- ✓ Low students' engagement.

- ✓ Low students' motivation.
- ✓ Difficulty in recognizing success.
- ✓ Reluctance to participate
- ✓ Lack of exposure

The given ideas give the discussion of implementing inquiry-based learning that it often requires access to various resources, such as laboratory equipment, technology, and materials for hands-on experiments. Limited resources can hinder the effective implementation of inquiry-based approaches in physics education. The time required for inquiry-based learning activities, including exploration, experimentation, and reflection, may conflict with the constraints of a traditional classroom schedule. Finding sufficient time for in-depth inquiry can be a challenge within the existing curriculum framework. Some students may initially struggle with the open-ended nature of inquiry-based learning, requiring additional support to develop the skills and confidence needed to engage in self-directed exploration and experimentation. Students may struggle to recognize when they have successfully completed their work, as highlighted in a source discussing students' inability to recognize their success. Students may exhibit reluctance to participate in inquiry-based learning, which can hinder the effectiveness of this approach. Educators may require specialized training and ongoing support to effectively implement inquiry-based learning in physics education.

4.3.2 Findings from interview schedules

Perceived challenges of integration of inquiry based approaches in the teaching of physics at ordinary level were pointed out by facilitators and facilitator B has this to say" Assessment and evaluation". Here the challenges with inquiry-based learning is knowing how and what to assess. With students investigating different questions, determining how to assess their work can be complex. All facilitators pondered the issue of "Teacher preparedness". Some facilitators may feel unprepared for integration of inquiry-based learning approaches, finding it haphazard and preventing them from being able to prepare properly. Also the issue of "Measuring quality of inquiry".Teachers face challenges in measuring the quality of inquiry and using appropriate assessment methods, as mentioned in an article discussing challenges facing teachers implementing inquiry-based teaching. Facilitator A has this to say about challenges of inquiry based approaches “Testing performance”. When facilitators focus learning time on learner-led inquiries, testing performance can become a challenge. The point that appeared most frequently is;

- ✓ No facilitator has ever had received any training or professional development on integrating inquiry-based learning in physics teaching.

4.3.3 Findings from observation schedule

- ✓ Timeframe for learners to do research projects and practical, and for facilitators to do the marking was very limited.
- ✓ Resources are limited for practical to be carried out successfully.
- ✓ School and class timetables are closely packed.

Time is always a challenge when coming to contact with learners, school master timetable and teacher timetable are closely packed giving the facilitators’ limited time to teach or assess learners.Practical need adequate resources which is not practical the most of the schools.

4.4.0 Solutions to challenges of integration of inquiry based approaches

4.4.1 Findings fromquestionnaires

Based on the solutions to challenges of inquiry based approaches in the learning of physics, learners came up with different and recurred responses listed and analysed:

- ✓ Educators can provide clear criteria for success and guide students in self-assessment.
- ✓ Educators can incorporate interactive and hands-on activities, provide real-world examples, and encourage collaborative learning experiences.
- ✓ Offering choice and autonomy in learning topics can help increase student engagement.
- ✓ Providing professional development opportunities for educators to deepen their knowledge of inquiry-based learning methods and strategies, this can include workshops, mentorship programs, and access to resources that support effective implementation.
- ✓ Provision of ICT tools and Wi-Fi for research

One common challenge with inquiry-based learning is the difficulty in measuring success. Students may struggle to recognize when they have been successful in their work. To address this, educators can provide clear criteria for success and guide students in self-assessment. This can help students understand what success looks like in the context of inquiry-based learning. Another challenge is low student engagement. Some students may struggle to stay motivated and engaged in self-directed inquiry, to overcome this, educators can incorporate interactive and hands-on activities, provide real-world examples, and encourage collaborative learning experiences. Additionally, offering choice and autonomy in learning topics can help increase student engagement. When teachers focus learning time on learner-led inquiries, testing performance can become a challenge. One solution is to incorporate formative assessment methods that align with the inquiry-based approach. This can include ongoing feedback, self-assessment, and peer evaluation to gauge student progress and understanding. Educators may face obstacles related to their own understanding and implementation of inquiry-based learning. Addressing this challenge involves providing professional development opportunities for educators to deepen their knowledge of inquiry-based learning methods and strategies. This can include workshops, mentorship programs, and access to resources that support effective implementation. Measuring the quality of inquiry can be a significant challenge for teachers. To address this, educators can develop rubrics and assessment tools specifically tailored to evaluate the quality of inquiry-based projects. These tools can help provide clear expectations and criteria for assessing the depth and effectiveness of student inquiries. Provision of ICT tools and Wi-Fi for research for both facilitators and learners can boost confidence, participation and involvement.

4.4.2 Findings from interview schedules

Solutions to the challenges or difficulties faced when implementing inquiry-based learning in physics lessons, the responses from facilitators recurred as follows:

- ✓ Educators can develop rubrics and assessment tools specifically tailored to evaluate the quality of inquiry-based projects.

To address this, these tools can help provide clear expectations and criteria for assessing the depth and effectiveness of student inquiries. Providing professional development opportunities for educators to deepen their knowledge of inquiry-based learning methods and strategies.

- ✓ Resource Management and Access.

This was clearly said by facilitator D, and addressing this challenge involves providing professional development opportunities for educators to deepen their knowledge of inquiry-based learning methods and strategies. This can include workshops, mentorship programs, and access to resources that support effective implementation

- ✓ Curriculum Integration.

Curriculum Integration advocate for an integrated STEM (Science, Technology, Engineering, and Mathematics) approach to address global challenges, aligning physics education with real-world issues such as energy and health. This can provide a context for inquiry-based learning and foster interdisciplinary connections.

- ✓ Professional Development.

Professional Development offer specialized training and ongoing support for educators to develop the skills needed to facilitate inquiry-based learning effectively. This includes guidance on instructional planning, student engagement, and assessment methods tailored to inquiry-based activities.

- ✓ Technology Integration

Technology Integration as hereby said by facilitator B explores the use of technology, such as augmented reality and computer software, to enhance inquiry-based learning experiences in physics education. Integrating technology can support simulation-based learning and provide additional resources for student exploration and understanding.

4.4.3 Findings from observation schedule

- ✓ Meager of classes.
- ✓ Capitalizing on afternoon periods.
- ✓ Laboratory assistant sometimes facilitate the practical lesson when the subject teacher is committed to other duties.

In order for the facilitator to increase time of contact with learners, temporary meager of classes is crucial and grabbing chances of afternoon time when learners have to attend co-curricular activities. Lab assistance must also take part in case the subject teacher is tied up.

4.5 Discussion

The findings from research toolsaiming on answering the research question of perceived benefits of integration of inquiry based approaches in the teaching and learning of physics at ordinary level provides evidence that inquiry-based learning helps students develop a love of learning through independence, rather than simply following along with a lesson. Authors reported a range of benefits such as encouraging students to think critically about the information they are presented with and to question the information, fostering a deeper understanding.Mohnkern(2017) extended on the above notion and argued that inquiry-based learning helps learners make their own connections about what they learn, fostering curiosity and deeper engagement. Literature also reveals that learners can improve certain transferable skills through inquiry-based learning, many of which relate to initiative, self-direction, and organization (Stern, 2017). Practical nurtures passions and talents, increases motivation and engagement, and allows students to explore their interests and keeps learners engaged, encourages them to improve their critical thinking, and also gives them the opportunity to ask deep, thoughtful questions. Friesen and Scott (2013) emphasized the authenticity thatrequiring the learners to take an active role in the process may be the most significant benefit of inquiry-based learning. Inquiry provides both the impetus and experience that helps learners acquire problem-solving and lifelong learning skills. Lastly, it creates a safe and supportive environment for learners to engage in discussion and debate, promoting engagement in scientific discussion(Mupira, 2018).Increased student engagement and motivation is best explained as an Inquiry-based learning that allows learners to take ownership of their learning, which can lead to increased interest and engagement. Inquiry-based learning encourages active participation and engagement among earners, fostering a deeper understanding of physics concepts through hands-on exploration and experimentation. Inquiry-based learning encourages students to ask questions, generate hypotheses, design and conduct experiments, and analyze data. Friesen and Scott (2013) stresses that this process helps learners develop important critical thinking and problem-solving skills, which can be applied to a variety of situations. Literature also point out that inquiry-based learning helps learners build a deeper understanding of scientific concepts by allowing them to make connections between concepts and apply them in real-world situations and helps learners develop the ability to apply their scientific knowledge to new situations, which can be especially useful in careers that require scientific knowledge, such as engineering, medicine, and research(Creswell, 2017).

The perceived challenges or difficulties on the integration of inquiry based approaches in the teaching and learning of physics at ordinary level gives the discussion of implementing inquiry-based learning that it often requires access to various resources, such as laboratory equipment, technology, and materials for hands-on experiments. Saunders-Stewart et.al (2012) stresses that limited resources can hinder the effective implementation of inquiry-based approaches in physics education as well as the time required for inquiry-based learning activities, including exploration, experimentation, and reflection, may conflict with the constraints of a traditional classroom schedule.Beshears (2017) argues that finding sufficient time for in-depth inquiry can be a challenge within the existing curriculum framework, some learners may initially struggle with the open-ended nature of inquiry-based learning, requiring additional support to develop the skills and confidence needed to engage in self-directed exploration and experimentation.Learners may also struggle to recognize when they have successfully completed their work, as highlighted in a source discussing learners' inability to recognize their success. Walker(2017) presented a list of challenges with implementation of inquiry based learning and it includeslearnersexhibitingreluctance to participate in inquiry-based learning which can hinder the effectiveness of this approach; educators may require specialized training and ongoing support to effectively implement inquiry-based learning in physics education. The trickiest challenges with inquiry-based learning is knowing how and what to assess. With students investigating different questions, determining how to assess their work can be complex. Some facilitators may feel unprepared for inquiry-based learning, finding it haphazard and preventing them from being able to prepare properly. Facilitators also face challenges in measuring the quality of inquiry and using appropriate assessment methods, as mentioned in an article discussing challenges facing teachers implementing inquiry-based teaching. When facilitators focus learning time on learner-led inquiries, testing performance can become a challenge (Patall, 2018).

Based on the solutions to challenges of inquiry based approaches in the learning of physics,one common challenge with inquiry-based learning is the difficulty in measuring success. Learners may struggle to recognize when they have been successful in their work. To address this, educators can provide clear criteria for success and guide students in self-assessment. This can help learners understand what success looks like in the context of inquiry-based learning(Stern,2017). Another challenge is low student engagement whereby some learners may struggle to stay motivated and engaged in self-directed inquiry, to overcome this, educators can incorporate interactive and hands-on activities, provide real-world examples, and encourage collaborative learning experiences.Saunders-Stewart et.al(2012) derived from literature review an inventory based on challenges and authors reported a range of these challenges which included offering choice and autonomy in learning topics can help increase learners' engagement. When teachers focus learning time on learner-led inquiries, testing performance can become a challenge. One solution is to incorporate formative assessment methods that align with the inquiry-based approach. This can include ongoing feedback, self-assessment, and peer evaluation to gauge student progress and understanding. Educators may face obstacles related to their own understanding and implementation of inquiry-based learning. Addressing this challenge involves providing professional development opportunities for educators to deepen their knowledge of inquiry-based learning methods and strategies. This can include workshops, mentorship programs, and access to resources that support effective implementation (Bayramet,al.2017). Measuring the quality of inquiry can be a significant challenge for teachers. To address this, educators can develop rubrics and assessment tools specifically tailored to evaluate the quality of inquiry-based projects. These tools can help provide clear expectations and criteria for assessing the depth and effectiveness of learners' inquiries (Walker, 2017).Addressing this challenge involves providing professional development opportunities for educators to deepen their knowledge of inquiry-based learning methods and strategies. This can include workshops, mentorship programs, and access to resources that support effective implementation. Resource management and access collaborate with other educators and institutions to share resources and equipment for inquiry-based activities. Seek external funding or grants to acquire necessary materials and technology for hands-on experiments and exploration.Curriculum Integration advocate for an integrated STEM (Science, Technology, Engineering, and Mathematics) approach to address global challenges, aligning physics education with real-world issues such as energy and health (Patall,2018). This can provide a context for inquiry-based learning and foster interdisciplinary connections. Professional Development offer specialized training and ongoing support for educators to develop the skills needed to facilitate inquiry-based learning effectively. This includes guidance on instructional planning, learner engagement, and assessment methods tailored to inquiry-based activities.Armstrong (2016) points out that technology integration explores the use of technology, such as augmented reality (AR) and computer software, to enhance inquiry-based learning experiences in physics education. Integrating technology can support simulation-based learning and provide additional resources for learner exploration and understanding and it is the responsibility of school administration and district schools' inspectors to make sure science teachers receive enough training on inquiry based approaches in the teaching and learning.

4.6 Summary

This chapter focused mainly on presenting, analyzing and discussion of data collected from sampled population using various data collection tools which included questionnaire, interview and observation schedule. Data collected represented the ideas of whole population under study and was presented in form of narrative statements which were shortly analyzed. Discussion of results was done relating the findings from the relevant literature and ideas of other authors.

CHAPTER FIVE. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter will mainly focus on the summary and conclusion of the research basing on an assessment on the integration of inquiry based approaches in the teaching and learning of physics at ordinary level which lead to more meaningful learning experience for learners. The researcher will later on highlight the recommendations for future improvements by other researchers so as to improve and find more solutions to the challenges faced by facilitators and learners in the implementation on inquiry based teaching and learning.

5.2 Summary

This research project consists of five chapters with several sub chapters. Chapter one introduced the study and outlined its focus and key objectives in form of research questions, background of study and statement of the problem. It also highlighted limitations, delimitations, sampling and sampling techniques and finally definition of key terms used in this research project. This chapter also discusses the context of the study in which the integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level are reviewed. Chapter two reviewed the literature mainly focusing on the perceived benefits, challenges, solution to challenges of integration of inquiry base approaches in the teaching and learning of physics at ordinary level analyzing what other scholars had said and identified the research gaps. Chapter three focused on the research methodology and research design. It discusses the conceptual framework and research design, composition of the sample and methods used in capturing, recording, transcribing and analyzing collected data, research instruments in general. Data collection procedures, trustworthiness and dependability, ethical considerations and lastly, the informed consent were considered. Chapter four focused on the findings of the study from data collection instruments and the targeted population, followed by data presentation, analysis and discussion. The summary, conclusion and recommendations are placed in this chapter. Finally, the references and appendices are placed at the end of the research project.

5.3 Conclusion

In conclusion, the integration of inquiry based approaches in the teaching and learning of physics at ordinary level has the potential benefits, challenges and the solution to those challenges. The benefits have the potential to the significantly enhance the student engagement which is best explained as an Inquiry-based learning that allows students to take ownership of their learning which can lead to increased interest and engagement in the process on inquiry based instruction. Increased student engagement and motivation which is seen when learners are involved in active participation and engagement among students, fostering a deeper understanding of physics concepts through hands-on exploration and experimentation. The idea of “Better understanding of scientific concepts” unveiled that inquiry-based learning helps students’ build a deeper understanding of scientific concepts by allowing them to make connections between concepts and apply them in real-world situations. Critical thinking and problem-solving skills are also improved and this gives an emphasis that inquiry-based learning encourages students to ask questions, generate hypotheses, design and conduct experiments, and analyze data. This process helps students develop important critical thinking and problem-solving skills, which can be applied to a variety of situations. Learner will gain greater ability to apply scientific knowledge to real-world situations, this gives a view that Inquiry-based learning helps students develop the ability to apply their scientific knowledge to new situations, which can be especially useful in careers that require scientific knowledge, such as engineering, medicine, and research.

The perceived challenges or difficulties on the integration of inquiry based approaches in the learning of physics are summarized in this discussion of conclusion of implementing inquiry-based learning that it often requires access to various resources, such as laboratory equipment, technology, and materials for hands-on experiments. Limited resources can hinder the effective implementation of inquiry-based approaches in physics education. The time required for inquiry-based learning activities, including exploration, experimentation, and reflection, may conflict with the constraints of a traditional classroom schedule. Finding sufficient time for in-depth inquiry can be a challenge within the existing curriculum framework. Some students may initially struggle with the open-ended nature of inquiry-based learning, requiring additional support to develop the skills and confidence needed to engage in self-directed exploration and experimentation. Students may struggle to recognize when they have successfully completed their work, as highlighted in a source discussing students' inability to recognize their success. Students may exhibit reluctance to participate in inquiry-based learning, which can hinder the effectiveness of this approach. Educators may require specialized training and ongoing support to effectively implement inquiry-based learning in physics education. Assessment and evaluation; Teacher preparedness; Measuring quality of inquiry; Testing performance; Timeframe for learners to do research projects and practical, and for facilitators to do the marking was very limited and lastlyschool and class timetables are closely packed.

Solutions to challenges of inquiry based approaches in the learning of physics prevails when educators can provide clear criteria for success and guide students in self-assessment; incorporate interactive and hands-on activities;offering choice and autonomy in learning topics can help increase student engagement; providing professional development opportunities for educators to deepen their knowledge of inquiry-based learning methods and strategies. To address the solutions educators can also provide clear criteria for success and guide students in self-assessment, this can help students understand what success looks like in the context of inquiry-based learning, educators can incorporate interactive and hands-on activities, provide real-world examples, and encourage collaborative learning experiences. Additionally, offering choice and autonomy in learning topics can help increase student engagement andincorporation of formative assessment methods that align with the inquiry-based approach can include ongoing feedback, self-assessment, and peer evaluation to gauge student progress and understanding.Adding more flesh on the solutions to the challenges faced during integration of inquiry based approaches, educators can develop rubrics and assessment tools specifically tailored to evaluate the quality of inquiry-based projects by providing professional development opportunities for them to deepen their knowledge of inquiry-based learning methods and strategies.Curriculum Integration advocate for an integrated STEM (Science, Technology, Engineering, and Mathematics) approach to address global challenges, aligning physics education with real-world issues such as energy and health. This can provide a context for inquiry-based learning and foster interdisciplinary connections.Professional Development offer specialized training and ongoing support for educators to develop the skills needed to facilitate inquiry-based learning effectively. This includes guidance on instructional planning, student engagement, and assessment methods tailored to inquiry-based activities.Technology Integrationexplores the use of technology, such as augmented reality and computer software, to enhance inquiry-based learning experiences in physics education. Integrating technology can support simulation-based learning and provide additional resources for student exploration and understanding.

Benefits, challenges and solution to challenges that hind3rs the implementation of inquiry based instruction have been highlighted.

5.4 Recommendations

Professional Development.

Educators should receive comprehensive professional development to effectively implement inquiry-based approaches in the teaching of physics. This training should focus on creating a supportive classroom environment that encourages student exploration and inquiry. Professional Development offer specialized training and ongoing support for educators to develop the skills needed to facilitate inquiry-based learning effectively. This includes guidance on instructional planning, student engagement, and assessment methods tailored to inquiry-based activities.

Curriculum Design.

Curriculum developers and educators should collaborate to align the physics curriculum with inquiry-based learning principles. This involves designing learning experiences that allow students to engage in authentic scientific inquiry, problem-solving, and experimentation.

Curriculum Integration.

Curriculum Integration advocate for an integrated Science, Technology, Engineering, and Mathematics approach to address global challenges, aligning physics education with real-world issues such as energy and health. This can provide a context for inquiry-based learning and foster interdisciplinary connections.

Assessment Practices.

Assessment methods need to evolve to align with inquiry-based learning. Educators should consider incorporating formative assessment strategies that provide ongoing feedback to students and inform instructional decisions. This can help in gauging students' understanding of scientific concepts and their ability to apply inquiry skills.

Resource Allocation, management and access.

Schools should allocate resources for the acquisition of laboratory equipment, technology, and materials that support hands-on inquiry-based learning experiences in physics. Access to these resources is essential for creating an environment conducive to inquiry and experimentation. Providing professional development opportunities for educators to deepen their knowledge of inquiry-based learning methods and strategies which can include workshops, mentorship programs, and access to resources that support effective implementation

Technology Integration.

Technology Integration explores the use of technology, such as augmented reality and computer software, to enhance inquiry-based learning experiences in physics education. Integrating technology can support simulation-based learning and provide additional resources for student exploration and understanding.

Collaborative Learning.

Encouraging collaborative learning experiences can enhance the effectiveness of inquiry-based approaches. Students should be given opportunities to work in groups, engage in discussions, and solve problems together, fostering a sense of shared inquiry and discovery.

It is concluded therefore that by understanding the benefits and perceived challenges of inquiry based approaches in the teaching and learning and considering the solutions to these challenges and finally implementing these recommendations, educators can create a more dynamic and engaging learning environment that promotes a deeper understanding of physics concepts and nurtures students' scientific inquiry skills and hence promoting the integration of inquiry based approaches in the teaching and learning of physics at ordinary level.

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APPENDICES

Appendix 1. Questionnaire

Brief notes

Inquiry based learning is defined as a teaching and learning approach that emphasizes active, hands on learning as well as the development of critical thinking, problem solving and research skills,(Howitt, 2007). Rumnarian (2016) argues that in an inquiry based approach, students are encouraged to ask questions and explore topics by collecting and analysing information, developing hypothesis and drawing conclusions. They are guided by the teacher but they have more autonomy in the learning process and are encouraged to take an active role in their own learning.

Your responses are confidential

Answer the following questions using your own understanding in the spaces provided.

1. What do you think are the benefits of inquiry-based learning in physics?

____
____
____
____
____

2. What challenges do you think you might face when using inquiry-based learning in physics?

____
____
____
____
____

3. What do you think are the solutions to challenges you think you might face when using inquiry-based approaches in the learning of physics?

____
____
____

4. Do you think inquiry-based learning can help you to develop your problem-solving skills? **Yes / No**

On a scale from 1 to 5, with 1 being strongly disagree and 5 being strongly agree, please rate the following statement by encircling the number rating:

5. "I feel that inquiry-based learning is an effective way to learn physics." **1 2 3 4 5**

6. "I prefer inquiry-based learning to traditional, teacher-led instruction." **1 2 3 4 5**

True or false

Tick either true or false

7. Inquiry-based learning requires expensive equipment and materials." ***True or false***
8. Inquiry-based learning can be used in all physics topics and units." ***True or false***

THE END

Appendix 2. Interview schedule

Brief notes

Inquiry based learning is defined as a teaching and learning approach that emphasizes active, hands on learning as well as the development of critical thinking, problem solving and research skills,(Howitt, 2007). Rumnarian (2016) argues that in an inquiry based approach, students are encouraged to ask questions and explore topics by collecting and analysing information, developing hypothesis and drawing conclusions. They are guided by the teacher but they have more autonomy in the learning process and are encouraged to take an active role in their own learning.

Respond freely and your name and answers remain confidential between the interviewer and the interviewee.

Answers given will be summarized and recorded on a paper by writing

1. What is your familiarity with inquiry-based learning in the teaching of physics?

____

____

2. How often do you engage in inquiry-based activities in your physics lessons?

____

____

3. What benefits do you perceive from using inquiry-based learning approaches in physics education?

____

____

____

4. Are there any specific challenges or difficulties you face when implementing inquiry-based learning in your physics lessons?

____

____

____

5. To what extent do you believe inquiry-based learning enhances student engagement and understanding of physics concepts?

____

____

6. What do you think are the solutions to the challenges or difficulties you face when implementing inquiry-based learning in your physics lessons?

____

____

____

7. Have you received any training or professional development on integrating inquiry-based learning in physics teaching?

THE END

Appendix 3.Observationschedule

Objectives (are they inquiry based oriented)

Number of planned practical lessons per term

Number of done practical lessons per term

Relevance of media to inquiry based instruction

Exercise books

Average practical work written per term

____

Average research oriented tasks done per term

____

Lesson observation

Introduction____

____

Objectives____

____

____

Methodology____

____

____

Media____

____

____

Appendix 4. Document analysis sheet

Title of Document: Scheme books, learners' books and lesson observation.

Date of Document: April 2024

Author of Document: NdlovuAutman Innocent

Purpose of Document: For assessment on the integration of inquiry-based learning approaches in the teaching and learning of physics at Ordinary level.

Target Audience of Document: Facilitators and learners' documents.

Key Findings/Points Covered in Document: Scheme book objectives, lessons and practical work given to learners.

Main Arguments/Claims Made in Document: Facilitators to use inquiry-based learning approaches in the teaching and learning of physics.

Methodology Used in Document: Assessing documents of facilitators who are interviewees.

Data Sources Used in Document: Scheme books, learners' books and lesson observation.

Strengths of Document: Focused on selected physics teachers and leaners documents.

Limitations of Document: Assessed documents might not reflect what transpires on the ground.

Relevance of Document to Research/Study: Enables the assessment on the integration of inquiry based approaches in the teaching and learning of physics at ordinary level.

Personal Reflections on Document: It reflects what transpires during teaching and learning of physics at ordinary level.

Additional Comments/Notes: The activities were done successfully.

Appendix 5. Consent form

An assessment on the integration of inquiry-based approaches in the teaching and learning of physics at Ordinary level.

NdlovuAutmanInnocent (B1130326)

Introduction: This research will focus on the assessment of the integration of inquiry-based approaches in the teaching and learning of physics at Ordinary level aiming to find out the benefits, challenges and solutions to challenges faced during inquiry-based instruction.

Purpose of research: The purpose of this research is to assess the benefits and challenges associated with inquiry-based teaching and learning, and finding out the remedies to challenges so that inquiry-based teaching and learning in implemented throughout the lesson.

Duration: This research might be completed within a month provide all participants will be available on the scheduled dates and times.

Benefits: In this research, the benefits will be explained in detail fir both learners and facilitators.

Confidentiality: The data provided by the participants will be considered strictly confidential and will not be given to others without written permission from the participants.

Right to refuse or discontinue: The participants have the right to discontinue or decline the participation in the research anytime if he or she feels to do so.

Read and provide the information by tick in circles ☑

- ○ I confirm that the participation in this research project is voluntary.

- ○ I acknowledge that I won't be receiving any payment in regard with my participation.

- ○ I acknowledge that I have the right to decline participation in this research when I have a reason to do so.

- ○ I understand that the researcher will not identify me by name in any report using information captured from the questionnaire and or interview I completed.

- ○ I understand that the researchers will publish their materials in the books, internet and other research related projects.

- ○ I have read and understood what the research is all about and how will affect the target audience.

Participant information

Name: ____

Surname: ____

Gender: ____

Age: ____

Phone number: ____

Signature of participant and date: ____

Research representative

Name of individual taking consent: ____

Date: ____

Signature: ____

Appendix 6. Confirmation letter

SAMED

P Bag 1020
BINDURA
ZIMBABWE

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

BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: 16 APRIL 2024

TO WHOM IT MAY CONCERN

NAME: NDLOVU AUTMAN.L. REGISTRATION NUMBER: B1130326

PROGRAMME: HBScEdPh. 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 HBScEdPh programme. The research topic is:

AN ASSESSMENT ON THE INTEGRATION OF INQUIRY BASED APPROACHES 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

BINDURA UNIVERSITY OF SCIENCE EDUCATION
DEPARTMENT OF EDUCATIONAL FOUNDATIONS
9 APR 2024
P. BAG 1020
BINDURA

THE HEAD
INDUNA HIGH SCHOOL
16 APR 2024
P. BAG LW 1
LLEWELLIN, BULAWAYO
TEL: (025) 2266522/74341

Z Ndemo (Dr.)
CHAIRPERSON - SAMED

CamScanner