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ASSESSING THE IMPACT OF TECHNOLOGY IN THE TEACHING AND LEARNING OF O' LEVEL PHYSICS: A CASE STUDY OF A SELECTED HIGH SCHOOL IN PLUMTREE

BY

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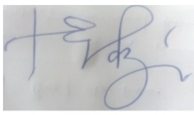

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DEDICATION

This research project is dedicated to my loving family who has been there throughout this research journey. My husband Blessings Guhwa, your unwavering support guidance and encouragement has been instrumental in shaping my research endeavors. Your selfless and love have inspired me to pursue my passions and I am forever grateful

ABBREVIATIONS AND ACRONYMS

ICT – Information communication technology

T&L –teaching and learning

ABSTRACT

The Study was conducted to assess the impact of technology in the teaching and learning of "O" level Physics at a selected school in Plumtree. The objectives of the study were to assess the impact of specific technological tools or resources on student learning outcomes, to compare different approaches of integrating technology into teaching practices and their effectiveness and to assess teacher attitudes and perceptions towards using technology in the classroom at selected school in Plumtree. Literature review was gathered from local and global scholars and authors to compare what other researchers have done. A mixture of quantitative and qualitative analysis survey methods were used. A total of 25 students and 5 teachers were respondents used for the study to capture effectiveness of technology in teaching and learning of Physics. The study revealed that the usage of projectors was ranked top and received a positive rating of (1.5), followed by web-based learning and wireless and mobile technology, which were placed second and received a good rating of (1.4). On the other hand, the usage of audio or video cassettes, computers, and virtual classrooms received negative ratings of 0.7, 0.3, and 0. Most study respondents (20%) indicated that technology enhances critical thinking and problem-solving abilities, while 19% others highlighted that it fosters student collaboration and only felt that technology enhances and transforms the learning process. Mobile learning, project-based learning, and online collaborations were used to compare different methods of incorporating technology into Physics teaching techniques. The results of the study showed that while aiding students' conceptual understanding, mobile learning in Physics T&L promotes creativity and higher order thinking. The researcher recommended teachers to have confidence in the productivity of technology. All of the teaching methods needed for discipline,

class management and lesson delivery must be used by a teachers in class. Facilitators ought to be in charge of technology therefore, strict guidelines like internet passwords and page blocking must be implemented before classes start. In the event that resources are limited facilitators can utilize the limited technology accessible to benefit every learner such as projectors, power point and handouts.

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CHAPTER ONE

1.1 Introduction

This chapter includes details regarding the study's background, problem statement, aim, objectives, research questions, and importance. It also draws attention to the study's limitations, assumptions, and delimitations.

1.2 Background to the problem

Given the speed at which technology is developing, educators are always looking for new and innovative ways to utilise various technological tools and resources to improve the educational experience for their students (Karniawati, Simamora & Zain, 2021). Numerous studies conducted throughout the world have demonstrated that when technology is used in the classroom properly, it may dramatically increase student enthusiasm, engagement, and academic success. Nevertheless, Riyanto & Muhammad (2021) revealed that there is still controversy over whether technology improves student outcomes in the teaching and learning of Physics worldwide, even if it is widely used in classrooms. As will be discussed below, diverse pedagogical configurations, technology resources, and administration goals have resulted in a variety of ICT effectiveness on student performance.

Numerous Asian studies have shown that there has been a steady increase in the use and effectiveness of technology in the teaching and learning of Physics. To improve the learning experience for students, a lot of educational institutions and schools have started implementing technology, such as interactive whiteboards, online simulations, and educational apps (Hashim & Muda, 2020). Additionally, educators are utilising online tools and resources to enhance their instruction and give students more help. Asia views technology as having a generally beneficial impact in the teaching and learning of Physics, with many teachers noting the increased comprehension and participation of their students (Karniawati, Simamora & Zain, 2021). In a similar spirit, it is widely acknowledged that technology is used in Physics education across United Kingdom.

According to Riyanto & Muhammad (2021) modern technology is available in many schools, including interactive multimedia tools, online laboratories, and virtual reality simulations. Online platforms are being used by educators to collaborate and communicate with students. In France, there is a general consensus regarding the usefulness of ICT in teaching and learning of Physics, with many teachers applauding its capacity to make difficult ideas more approachable and interesting for pupils.

When compared to other regions, the use of technology in Physics teaching and learning is still somewhat restricted in Uganda and Nigeria (Riyanto & Muhammad, 2021). Nonetheless, there are programmes in place to boost teacher and student digital literacy and expand access to technology in the classroom. Projectors and laptops are examples of basic technology that some schools are beginning to use in their classrooms. Although it is still early, the use of technology in Physics education in Africa is thought to be promising. As to a UNESCO research, a mere 25% of African schools has internet connectivity, underscoring the existence of a digital divide across the continent (Hashim & Muda, 2020). Despite these obstacles, the potential advantages that technology may have for education are becoming more widely acknowledged in Africa. More specifically, ICT-based Physics teaching and learning is progressively gaining popularity in Zimbabwe.

Tablets, interactive whiteboards, and educational software are just a few of the technologies that many schools are beginning to incorporate into their classrooms. Online tools are increasingly being used by teachers to enhance their instruction and give pupils more assistance (Ghavifekr & Rosdy, 2015). There has been a growing focus on using technology into teaching and learning methods in Zimbabwean schools. To increase access to educational resources, the government has worked to equip schools with computers and internet connectivity. The efficient use of technology in schools is still hampered by a number of serious issues, including inadequate finance, a lack of teacher preparation, and inadequate infrastructure (Saripudin, Rohendi & Abdullah, 2020).

1.3 Importance of the study

The objective of this research is to assess how information and communication technology (ICT) use affects O' level Physics teaching and student learning. Researchers can ascertain whether integrating technology into the classroom improves students' comprehension, engagement, and general academic achievement by evaluating the usefulness of technology in this setting. With the purpose of improving student results in Physics education, educators can use this information to make well-informed decisions on the integration of technology into their teaching practices and curriculum design.

1.4 Statement of the problem

In recent years, there has been a growing trend of integrating technology into O' level Physics instruction. Teachers are using a variety of technological tools and resources to improve the learning process for students. Traditionally, textbooks, lessons, and practical experiments have been the primary components of O’ level Physics teaching and learning pedagogy. The techniques have proven successful in teaching students the fundamentals of concepts; they might not always accommodate the wide range of learning preferences and styles that students possess. On the other hand, the integration of technology in education has created new avenues for dynamic and captivating educational experiences by utilising virtual laboratories, collaborative platforms, multimedia materials, simulations, and online tests.

Numerous studies have demonstrated the positive effects of incorporating technology into Physics instruction on student motivation, knowledge, performance, and engagement. For instance, a research by Jones et al. (2018) discovered that students' conceptual understanding was stronger in physics experiments conducted in virtual labs than in traditional hands-on labs. In a similar vein, Smith et al.'s meta-analysis from 2019 showed that adding multimedia tools to physics lessons significantly raised student achievement. Even with these encouraging results, more investigation is still required to assess the long-term effects and applicability of technology on O' level Physics student performance. Research has demonstrated that the use of traditional pedagogical methods yields low grade results to the use of technology strategies with respect to knowledge retention, the development of critical thinking skills, the ability to solve problems, and overall academic accomplishment.

At a selected High School in Plumtree, there is a constant debate on whether or not technology improves O' level Physics achievement, despite the fact that technology is widely used in classrooms. Since the 2017 Zimbabwean curriculum was implemented in the educational system, the school has embraced the use of technology in both teaching and learning. In order to prepare students for the workforce and entrepreneurship, the curriculum placed more emphasis on the development of critical thinking and practical skills, creativity, and problem-solving capabilities than on memorised material.

Therefore, additional study is required to fully comprehend how the use of various technological tools and resources has affected the performance of Physics teaching and learning at a selected High School in Plumtree.

1.5 Main research objective

Assess the effectiveness of technology in the teaching and learning of O’ level Physics at selected school in Plumtree.

1.6 Research objectives

1. To evaluate the impact of specific technological tools or resources on student learning outcomes at selected school in Plumtree.

2. To compare different approaches to integrating technology into teaching practices and their effectiveness at selected school in Plumtree.

3. To assess teacher attitudes and perceptions towards using technology in the classroom at selected school in Plumtree.

1.7 Hypothesis

(H0): There is no significant difference in the academic performance of students in O' level Physics when technology is used in teaching

(H1): There is a significant difference in the academic performance of students in O' level Physics when technology is used in teaching

1.8 Significance of the study

Students

The goal of the study was to determine how well computer technology can be used to teach and learn O' level Physics. The purpose of the findings is to support a suitable balance between teaching and learning that encourages students to actively participate in the subject matter. This implies that regular technology use could help support students who struggle with a variety of issues that have been identified, such as concentration, topic mastering, and attitude. Moreover, this may result in the application of computer technology as a tool to enhance Physics learning objectives and close the knowledge gap between learners and teachers. The study uses computer technology as a helpful tool. In the current study, tool will serve to create an initiative that stimulates learners' interest while enhancing their performance in Physics and approach to teaching and learning.

Teachers

The goal of the study was to shed light on the benefits and drawbacks of utilising computers in the classroom. The study will also offer suggestions for the most effective ways to incorporate computer technology into Physics lessons in order to enhance student learning.

School

After the research's objectives are met, the school would successfully employ technology to build a solid reputation if the students' performance, attitude, and approach to Physics would all improve. The study would also make the administrators of the school more aware of the impact of completely integrating computer technology to guarantee efficient mathematics instruction.

1.9 Delimitation of the study

Only one school in Plumtree will be the subject of the study. O' level Physics teachers and students, and administrative personnel will be the study's intended demographic. The context that will be presented will be limited to the effectiveness in O' level Physics teaching and learning.

1.10 Limitations

1. The cost incurred to carry out the research findings resulted in restricted sample size, which could have an impact on how broadly the findings can be applied

3. The findings resulted in biasness from teacher perceptions. Teachers differed in their comfort and experience levels when it came to using ICT technologies, which affected how they perceive the study and how they responded to it.

4. The investigation were constrained by time, which had an effect on the scope and depth of information gathered.

1.11 Definition of terms

ICT- The use of technology to improve teaching and learning is referred to as ICT (Information and Communication Technology) in educational settings.

Effectiveness – defined as the degree to which ICT tools and resources can enhance student learning outcomes

ICT effectiveness- The degree to which ICT tools and resources can fulfil their stated purposes of improving teaching and learning

ICT resources- refers to the different hardware, software, and digital resources as well as technologies that can be used in the teaching and learning process.

Student achievement – is the term used to describe how well students perform academically as a result of using ICT tools and resources

T&L –teaching and learning

Well-informed decisions - When teachers employ ICT tools and resources to enhance teaching methods and student results, they are making well-informed decisions based on data and evidence obtained.

Curriculum design – Planning, creating, implementing, and assessing educational initiatives are all part of curriculum design, which focuses on skillfully on using ICT tools and resources into the curriculum.

1.12 Organisation of the study

Five chapters make up this research document: the first covers the study's background, research problem, significance, and scope. It also highlights the research questions that need to be answered to meet the set objectives. The second chapter reviews the literature on the study area using theoretical, conceptual, and empirical evidence. The third chapter describes the research methodology used to carry out the research. The fourth chapter examines the presentation, analysis, and interpretation of the data collected in the research. The final chapter five highlights the conclusions drawn from the research findings. It also offers recommendations to all participants as well as areas for further research.

1.13 Summary

In this chapter, the researcher gave a brief background of the study, statement of the problem, research questions, hypothesis, significance of the study, delimitations and limitations. Chapter two is going to focus on review of related literature of the research proposal.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter reviewed relevant literature and concentrated on providing a thorough effect of technology in teaching and learning of O' level Physics. The subtopics are drawn from the research questions used to guide the review of the literature. In this chapter addressing the primary research topic was the main aim. Views from different authorities were also explored.

2.2 Impact of technological tools or resources on student learning outcomes

In accordance with Yasin (2018) the effective use of digital technology requires not only that instructors have adequate access to tools, resources, and equipment, but also that they have access to adequate knowledge, training, and support systems. Giving educators this assistance will enable them to comprehend the advantages and uses of digital technology and empower them to use digital technology efficiently.

However, the way Physics is taught and mastered in classrooms has been completely transformed by ICT technologies and resources. With the help of these resources, instructors may now more easily impart difficult ideas in a dynamic and captivating way while giving students the chance to independently investigate and experiment with physics subjects (Li, 2016). The current section will discuss about the effects of technology tools and resources on physics teaching and learning in this research study.

Internet on learning outcomes in Physics education

Science and technology advancement are inextricably linked to the advancement of education. Because it is the best media for swiftly and readily obtaining the most recent information in a variety of forms, the internet a creation of science and technology is growing in popularity (Li, 2016). Text, animation, music, and video display can all be combined to create dynamic and interactive websites thanks to the usage of the internet and the Web in education through multimedia. In addition, information may be readily obtained from a variety of sources across the nation via internet media Karniawati, Simamora & Zain, (2021), which can aid in quickening the pace of learning, adjusting to the worldwide flow of knowledge, and inspiring students to participate in educational activities (Yasin, 2018).

Previous research findings indicate that the use of technology and the internet affects student learning outcomes and motivation (Li, 2016), shapes instructors' perceptions and ideas about technology and increases flexibility in how time and place are used. In addition, the internet has been used for assessment and evaluation of educational activities. To be sure, there are educators in communities that do not view the internet as a successful learning tool because they fear that western culture will infiltrate the native way of life (Lage, Platt, & Treglia, 2019).

It is evident from the summary of the research findings above that not all nations or societies view the internet as a necessary tool for effective educational implementation (Yasin, 2018). Although it is undeniable that internet media has been successful in inspiring and enhancing student learning outcomes, some communities are worried that outside cultural intervention will occur and that learning will no longer be valuedly applied to the local environment (Lage, Platt, & Treglia, 2019). Given these two opposing points of view, further investigation is required to determine how internet use affects students' learning outcomes in physics in the Acehnese community, a nation rich in both local and religious culture.

Simulation software

A common tool in physics education is simulation software, which gives students interactive, practical experiences. Simulation software can improve students' comprehension of difficult physical ideas by letting them change variables and see the results in real-time simulations. For instance, the University of Colorado Boulder's PhET Interactive Simulations are utilised all around the world to get students involved in physics experiments that would be risky or challenging to carry out in a traditional lab setting.

Simulations, according to the University of New South Wales (Sydney, Australia), are educational programmes that let students engage with the world that their teacher has established (Lekhu MA (2016). Simulations are educational tools that can be utilised in conjunction with lessons, individual or small group inquiry activities, homework assignments, and testing facilities, according to Maweu & Yudah (2020). Since well-made simulations enable teachers to assess students' comprehension and increase their engagement in the learning process, the physics education community has dedicated itself to enhancing the instructional value and efficacy of science teaching as well as enhancing students' understanding of science (Mohamedhoesein, 2017).

By simulating real-world events in an artificial setting within a social context, simulations can be utilised for learning purposes in both basic and complicated studies (Yasin, 2018). It is believed that simulations will facilitate thought experiments, support inquiry-based teaching strategies, and elevate the significance of students' cooperative learning, visual representation, and conceptual understanding of fundamental physics ideas ((Yasin, 2018).

The application of simulation as an analytical tool facilitates the integration of theoretical knowledge and practical application. According to (Mohamedhoesein, 2017), simulations serve as an exploratory tool by connecting analytical theory and experiment to test hypotheses in situations where a real laboratory practical would be impractical, expensive, or dangerous. Learners can participate in interactive learning activities both inside and outside of the classroom thanks to simulations that are incorporated into the expanding and existing online platforms. This promotes inquiry, allows for in-depth interaction with the content of lessons, and gives access to laboratories dedicated to observing and investigating scientific principles.

As a result, students are better able to comprehend, attain, and grasp concepts, which helps them to develop a range of abilities necessary for the workplace of the Fourth Industrial Revolution (Riyanto & Muhammad, 2021). Teachers should be reminded by Yasin (2018) that simulations can be an effective assessment technique for assessing complex science learning.

Virtual labs

Similar hands-on learning opportunities are provided by virtual labs, which give students access to virtual experiments that replicate actual laboratory conditions (Hoye, 2017). With the help of these virtual labs, students may carry out experiments effectively and safely while also learning real-world data gathering and analysis techniques. For example, Labster is an online resource that provides virtual laboratories for physics and other science courses. Through interactive simulations, students may study ideas like motion, electricity, and magnetism.

Practical activities and Physics are mutually dependent. A practical experience is an instructional component that allows students to gain knowledge via inquiry. Thus far, the physics teaching laboratory has served as the primary location for the practicum in physics (Jarosievitz, 2017). But in light of the Covid-19 pandemic, educators are creating virtual learning environments and teaching virtual practicum design (virtual lab). Virtual practicum is one way to give learning opportunities despite these constraints, or as a substitute for practicum in cases where laboratory facilities are scarce and implementation is time-consuming and costly (Karniawati, Simamora & Zain, 2021). A lab exercise known as Virtual Practical is conducted in front of a computer. Undoubtedly, this Virtual Practical also needs a Virtual Laboratory, sometimes known as a Virtual Laboratory.

A set of laboratory tools known as Virtual Laboratory, or simply Virtual Laboratory, is a computer-operated interactive multimedia-based software that mimics laboratory activities and makes the user feel as though they are in a real laboratory. The use of Virtual Laboratory is crucial to the execution of practicum tasks. Virtual laboratories are utilised for demonstrations prior to the practicum actually taking place in the laboratory, as revealed by Ervina (2019). Additionally, this virtual laboratory can accommodate the demands of the students by allowing them to do practicums at any time and place without needing instructor supervision.

With the aid of virtual laboratories, students can do experiments in a subjective manner at any time or place by using computers, tools, and materials (DeWitt, Archer & Moote, 2019). Virtual laboratories are necessary to improve conceptual understanding during the learning process. A virtual laboratory is an extension of a physical laboratory, meant to strengthen its areas of weakness rather than to replace it. Virtual laboratories are an excellent option for teachers, especially those teaching science, to undertake practicals, particularly in light of the COVID-19 epidemic. In order to create effective virtual laboratory-based learning, educators must first analyse the fundamental learning abilities (Ghavifekr & Rosdy, 2015).

Interactive whiteboards

It has also been demonstrated that interactive whiteboards increase student participation and engagement in physics classes. Interactive whiteboards let professors present multimedia materials on a big screen, including movies, animations, and interactive simulations (Lage, Platt & Treglia, 2019). This helps assist pupils understand abstract ideas better. Interactive whiteboards have been introduced in Singaporean classrooms by educational institutions such as Raffles Institution to support group problem-solving and collaborative learning during physics classes.

Online tutorials

Students can access extra materials for independent study outside of the classroom through online tutorials. Comprehensive video lessons on a variety of physics topics are available on platforms such as Khan Academy, which can help supplement classroom education and give students more practice chances (Lage, Platt & Treglia, 2019). Similar to this, regional programmes like Singapore's Physics Cafe provide online tutorials and study guides designed especially for O level physics students getting ready for their exams.

Mobile Apps

According to Demir & Akpinar (2018), mobile apps have gained popularity as instruments for improving physics education for students. While apps like Pocket Physics offer interactive simulations and self-assessment quizzes, PhyWiz and other apps offer rapid access to formulas and explanations for common physics difficulties. Students can interact with physics subjects at their own pace and while on the go using these smartphone apps.

Mobile devices' ubiquity makes learning possible outside of traditional classroom settings. Studies on this extensively used learning trend have revealed that excessive information or poorly designed multimedia content causes needless cognitive load, which in turn lowers learning efficacy (Ghavifekr and Rosdy, 2015). Therefore, learners' working memory is likely to become overloaded in the absence of well-designed learning materials and teaching methodologies. Therefore, the supplied learning contents need to be readjusted and reconstructed based on relevant cognitive theories in order to improve learning efficiency in mobile learning.

Augmented reality (AR)

Augmented reality (AR) technology superimposes digital data on real-world situations. Ghavifekr and Rosdy (2015) posits that it has the potential to completely transform the way physics topics are taught. With AR apps like Elements 4D, for instance, users may interact with simulated molecules and elements on their tablets or smartphones. Teachers can build immersive learning experiences that bridge the gap between theoretical concepts (Karniawati, Simamora & Zain, 2021) and real-world applications by integrating augmented reality (AR) technology into physics classes.

Online collaboration

Students can collaborate online on group projects and assignments regardless of where they are physically located thanks to online collaboration technologies. Students can communicate and work together more easily when they use platforms like Microsoft Teams or Google Classroom, which offer shared areas for discussion, file sharing, and group editing. These resources can support

Technology and cooperative learning from the abacus to the computer, technology has always been utilised to support group learning (Ghavifekr and Rosdy (2015). Students learn through cooperation in a classroom that is assisted by information and communications technology (Means, Toyama, Bakia & Jones, 2013). Through peer cooperation, computer-assisted collaborative learning promotes active learning and knowledge creation. It is useful for engineering courses since software tools help to facilitate and support it (Gomez-Sanchez et al., 2009).

Recently, collaborative learning tools have received a lot of attention. Different kinds of tools have been employed by educational establishments. Learning management systems, like Moodle, are extensively utilised in many educational systems and offer the ability to access knowledge resources, share files, and participate in forums for discussions without time or space constraints (Valavicius & Babravicius, 2018). Another well-known tool for group learning is Wiki. The well-known Wikipedia project demonstrates the effectiveness of wikis as a collaborative learning tool. Wikipedia is a collaborative website that offers an integrated social communication function as well as the ability to easily create information resources (Valavicius & Babravicius, 2018). Academics have recently seen an impact from collaborative game-based learning technologies (Maweu & Yudah, 2020). By incorporating games into the learning process, students can arrange resources for information and share what they have learned from playing games with other students. Furthermore, it has been noted that game-based learning improves students' capacity for strategic thought and increases their level of focus in the classroom (Maweu & Yudah, 2020).

Lastly, a practical method for obtaining student replies is to use clicker devices. According to studies, using a clicker helps students pay attention and participate in class (Riyanto & Muhammad, 2021). The instructor displayed the question on the screen and let the students to click on one of the possible answers.

Student response systems accessible via the internet Web-based student response systems have been employed for a variety of objectives during the past 20 years, including collaborative learning (Riyanto & Muhammad, 2021).Teachers can use a variety of helpful, free online student response systems, such as those found at http://socrative.com, http://webclicker.org, http://www.quizsocket.com, https://getkahoot.com, http://versoapp.com, http://www.infuselearning.com, etc., to creatively engage students with smart technology. In order to improve students' performance in the physics course, we encourage teamwork among students in this study by using the Socrative interactive response system app.

2.3 Approaches to integrating technology into teaching practices and their effectiveness

1. Flipped Classroom Model: Using lectures or instructional videos from home, students participate in discussions and hands-on activities during class time. The flipped classroom paradigm has been shown in studies by Lage, Platt, & Treglia (2019). to enhance student engagement and performance in high school settings.

2. Project-Based Learning: Using this method, students work on technologically oriented real-world projects. According to a research by Thomas (2014), project-based learning helps improve students' critical thinking abilities and creativity in high school. Because they give students practical, real-world experiences that might improve their comprehension of difficult ideas, simulations and project-based learning are useful teaching and learning aids (Thomas, 2014). Students can see the significance and relevance of what they are studying by applying theoretical information to real-world scenarios through simulations. As students collaborate to finish a project or find a solution, Lage, Platt, and Treglia (2019) claim that project-based learning also fosters creativity, critical thinking, cooperation, and problem-solving abilities. Students who receive this kind of instruction may find it especially helpful in acquiring critical abilities that will help them in their future employment.

3. Blended Learning: This method mixes online learning exercises with conventional in-person education. According to a Means, Toyama, Murphy & Jones (2013) meta-analysis, blended learning has the potential to enhance student performance in high school environments.

4. Gamification: To boost student interest and engagement, gamification is the process of introducing game aspects into instructional activities. Gamification has been shown in a study by Hamari, Koivisto &Sarsa (2014) to improve learning results and student motivation in high school settings.

5. Personalised computer Learning: Using technological tools like adaptive software, personalised learning adapts lessons to each student's unique requirements and interests. According to a Pane, Steurle, Hamilton & Stecher (2015) study, high school students' academic performance can be enhanced through personalised learning.

6. Collaborative Online Tools: Students can collaborate virtually on assignments and projects by using collaborative online tools like Padlet and Google Docs. According to a Ariffin (2017) study, high school students' ability to collaborate can be improved by using collaborative web technologies.

7. Virtual Reality: Students can investigate immersive virtual worlds for instructional reasons thanks to virtual reality technology. According to a study by Agyei (2020) virtual reality in high school classrooms can improve student involvement and comprehension of difficult ideas.

8. Social Media Integration: Teachers and students may communicate and work together more easily by using social media sites like Instagram and Twitter. Social media integration has been shown in a study by Agyei (2020) to improve student participation and engagement in high school settings.

9. Mobile Learning: Educational content may be delivered anywhere, at any time, using mobile devices like tablets and smartphones. According to a 2015 study by Hamari, Koivisto & Sarsa mobile learning can give high school pupils more access to instructional resources.

10. Data-Driven Instruction: This method entails utilising student data to adjust lessons and tailor them to the individual needs of each student. In high school settings, data-driven instruction has been shown to boost academic attainment (Lage, Platt & Treglia, 2019).

In general, research have indicated that incorporating technology into teaching techniques can lead to favourable consequences for students' academic achievement, motivation, engagement, and critical thinking abilities. However, the effectiveness of these approaches has varied to some extent at the high school level.

2.4 Teacher-student attitudes and perceptions towards using technology in the classroom

Teacher perceptions

A number of studies have been carried out to evaluate the attitudes and perceptions of teachers on the use of technology in the classroom. According to a research by Awan & Gauntlett (2013), educators who felt positively about integrating technology into the classroom thought it may improve student engagement and learning. These educators were also assured of their capacity to integrate technology into their lessons.

Teachers with negative attitudes towards technology integration frequently mentioned a lack of time, resources, and training as obstacles to implementing technology in the classroom, according to a different study by Maweu & Yudah (2020). These educators also voiced worries about the possible interruptions and diversions that technology might introduce into the classroom.

According to a more recent study by Hashim & Muda (2020), perceived utility, usability, and social influence were among the variables that affected teachers' attitudes towards technology integration. Teachers were more likely to be in favour of using technology into their lesson plans if they thought it was helpful and simple to use.

These studies collectively indicate that a range of factors, such as perceptions of integration hurdles, personal experiences with technology use in the classroom, and opinions about the advantages of technology, impact teachers' attitudes towards using it in the classroom Hashim & Muda (2020). It is imperative that school districts and educators have sufficient assistance and training to enable them to overcome obstacles and cultivate a positive mindset regarding the integration of technology into the classroom.

Student Computer Attitudes

Students' perceptions of the value of technology and their intention to utilise computers for various tasks are influenced by their attitudes towards them. Hashim & Muda (2020) made the observation that people's attitudes about technology determine how much of it is used, regardless of how advanced and potent it is. Numerous studies have demonstrated that a number of characteristics, including age, gender, and socioeconomic level, influence people's attitudes towards computers. Younger people tend to have more positive attitudes towards using computers than their older colleagues, according to recent studies about the effect of age on attitude towards computers (Saripudin, Rohendi, & Abdullah, 2020).

This suggests that young learners will likely utilise computers for different things than do older students. Students generally had good attitudes towards technology, according to Maweu & Yudah (2020), who also noted that fifth-graders had stronger computer attitudes towards interaction than students in earlier stages. The study also revealed that pupils who had ICT instruction exhibited much more positive views than students who did not receive any computer instruction. Questions about computer phobia, degree of liking technology, attitudes towards using technology in school, enjoyment of using computers, productivity/utility of computers, and computer use for e-mails were included in related studies that looked into attitudinal and motivation/personality factors towards technology in education. These studies have shown strong links between students' opinions and how it affects their use of technology (Valavicius and Babravicius, 2018).

The most significant component of attitude towards computers, according to Pamuk and Peker (2009), is computer anxiety. This means that people who experience computer anxiety are more likely to voice aversion to using computers and to have unfavourable attitudes towards them..

Computer Competencies

Studies on computer competencies—also known as computer performance, computer ability, or computer achievement—are conducted in contrast to studies on computer attitudes, which have received a lot of attention (Ha, Joa, Gabay, & Kim, 2018). According to a number of studies (Valavicius & Babravicius, 2018; Ha, Joa, Gabay, & Kim, 2018; Mohamedhoesein, 2017), computer competencies are positively correlated with an individual's willingness to choose and participate in computer-related activities, expectations of success in such activities, and persistence or effective coping behaviours when faced with computer-related difficulties. Some research (Agyei 2012; Valavicius & Babravicius, 2018; Mohamedhoesein, 2017) have defined computer competencies as computer knowledge and skills. Low tendencies in ICT knowledge and proficiency in databases, spreadsheets, and key concepts in ICT for College were noted by Valavicius and Babravicius (2018). Additionally and university students' proficiency in analysing texts, file management, and presentation -making, among other computer-related tasks, was highly praised. Additionally, according to Valavicius and Babravicius (2018), only 17.9% of college students knew how to send emails, 16.4% knew how to do web searches for information, and 20.6% knew how to print documents or photos. According to the study, competency is the capacity to carry out a computer task. It was assessed by looking at the computer knowledge and skills that students acquired as a result of ICT initiatives.

Students Use of technology

It is now impossible to avoid using various ICTs for various tasks. Writings about students' use of technology in the classroom are crucial. With the use of contemporary ICTs, students can quickly recover their information. Students can access and disseminate electronic material, such as e-books and e-journals, and enhance their learning by using a variety of contemporary ICTs, including wireless networks, the Internet, search engines, database systems, webpages, and Web 2.0. Numerous investigations, including those by Anderson & Jiang (2018), have noted this. According to their survey by Maweu & Yudah (2020), rather of contacting friends or teachers for help, students would rather use search engines to find online tutorials for homework. Additionally, research indicates that pupils' ICT use is not restricted to to communicate and have fun in addition to studying.

According to Mohamedhoesein (2017), 83% of students in the US and 90% of students in the Netherlands use cellphones for social media. Students communicate via text messaging, emails, social media posts, and other online media on a variety of platforms in their daily lives (Ha, Joa, Gabay, & Kim, 2018).Students communicate mostly using social media platforms such Facebook, Instagram, WhatsApp, Telegram, Twitter, and Telebay (Ha, Joa, Gabay, & Kim, 2018; Maweu & Yudah, 2020). Students use these platforms to interact with friends and larger peer groups, as well as to establish their own identities (Maweu & Yudah, 2020). Numerous research (Awan & Gauntlett, 2013; Anderson & Jiang, 2018; Ha, Joa, Gabay, & Kim, 2018) have shown a substantial correlation between students' use of of social media and their wish to establish online connections. Students appear to be motivated to utilise social media for engagement because they are afraid of missing out or want to avoid social isolation (Mohamedhoesein, 2017).

2.5 Research gaps

With so many educators integrating different technological tools and resources into their teaching techniques, technology has become an essential component of education. Technology can improve student learning and participation in physics education by offering interactive simulations, virtual labs, and multimedia resources. Nevertheless, there are still a number of research gaps that need to be filled in spite of the increasing use of technology in physics teaching and learning (T&L).

The absence of thorough studies that look at the effects of particular technological tools on student learning outcomes is one of the major research gaps in the effectiveness of technology T&L of physics. The use of technology in physics education is the subject of an expanding corpus of research, but most of it focuses on attitudes and broad trends rather than on particular treatments or instruments. For instance, Hrepic et al.'s 2007 study discovered that students' conceptual knowledge was stronger in physics classes that employed interactive simulations than in those that did not. To ascertain which kinds of experiments work best for certain learning purposes and student populations, more study is necessary.

A further area of research lacking in physics technology T&L is the insufficient emphasis on teacher professional development and training. Even while many teachers are keen to use technology in the classroom, it's possible that they lack the abilities and expertise needed to do so successfully. According to research by Ertmer et al. (2012), student outcomes in physics education may be enhanced by teacher preparation programmes that emphasise incorporating technology into teaching. To find the best approaches for teacher professional development in this field, more research is necessary.

Further study is also required to determine how technology T&L affects underrepresented student populations in physics education. Research has indicated that some demographics, such women and minorities, could encounter obstacles in their academic pursuits related to physics, including stereotype threat and underrepresentation in the discipline. By facilitating more access to resources and offering individualised learning experiences, technology has the ability to remove some of these obstacles. To find out how various technology interventions can help diverse learners in physics education, more research is necessary.

This indicates that while technology can improve physics instruction, there are still a number of unmet research questions in this field. Future research should concentrate on finding the best practices for teacher professional development, analysing the effects of certain technological tools on student outcomes, and investigating the ways in which technology might benefit underrepresented student populations in physics education. Teachers can more effectively use technology to enhance student learning in physics classes by filling in these gaps.

2.6 Chapter summary

This chapter offers a thorough summary of the body of research on the effectiveness of technology in Physics instruction. The literature emphasized on the empirical and local research that were presented in accordance with each objective under study. The chapter also provided context for the current investigation by outlining areas in which more research is required and providing a framework for filling in the research gaps in the literature.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter's presentation was structured to provide a clear explanation of the methods used to accomplish the goals and objectives of the research. The development was made up of information gathered from participants, who are defined as teachers and students from a selected school in Plumtree. The following provides a detailed explanation of the research tools, including questionnaires and research designs. This chapter also addresses the research paradigm, various research designs, populations, validity, reliability, ethical issues, data collection techniques, and data presentation and analysis methods. The goal of optimum focus concentrates on the work that completely examines the effect of technology use in teaching and learning of Physics.

3.2Research design

3.2.1 Research paradigm

A paradigm is a set of beliefs that directs both research and decision-making (Creswell & Poth, 2017). Paradigms typically centred on theoretical viewpoints, methods of operation, and comprehending reality. In order to properly address the issue at hand, the study employs the pragmatism paradigm. Because the pragmatism paradigm is linked to a mixed research approach that effectively gathers the greatest amount of data for analysis, it was selected. The flexibility and adaptability of the mixed research approach to various study designs is one of its advantages (Creswell, 2014). A variety of data collection tools, including questionnaires and interviews were strategically employed to confirm and analyse the information gathered about the effectiveness of technology on the teaching and learning of Physics.

3.2.2 Research methodology

A mixed research method is used to examine the effectiveness of technology in teaching and learning of Physics. To ensure that numerical data and descriptive analysis were carried out from collected data, both quantitative and qualitative research methods will be employed. As per Yen's (2018) assertion, the mixed research approach enables the researcher to employ diverse data instruments such as interviews and questionnaires. The results and conclusions reached from the study were significantly impacted by the usage of a variety of instruments. Additionally, by linking, validating, and correcting data collected from various instruments, the researcher can validate the study's conclusions (Creswell, 2014). However, the preparation, distribution, and collection of data instruments for the design take a lot of time. The researcher had to conserve time to make follow ups for the data tools.

3.2.3 Research strategy

A research strategy, according to Creswell (2014), is a comprehensive strategy for reinforcing the researcher's internal and external validity. In a similar vein, Yin (2018) claims that the word research strategy refers to the fundamental plan or strategy of the study and the reasoning that allowed for the legitimate extraction of more broadly applicable results. In general, the procedure involved selecting the best research technique to deal with the issue being studied.

A survey method was employed as the research strategy. The research field under investigation was both qualitative and quantitative, which is why it was selected. In research, a survey is valued because it allows the investigator to look at the depth of data for a particular case and place.

Even though designing a survey takes time, it is also connected to a conceptual framework that may be used to address the research questions that are important to the topic of the study. The survey approach is chosen because it is frequently employed for investigative reasons to learn more about factors and relationships that are crucial in a certain circumstance (Yin, 2018).

As a result, semi-structured questionnaires and focus groups helped with the analysis and inference of a wide range of answers to both open-ended and closed-ended questions. Participants are better able to communicate their information in-depth when they use open-ended questions. As a result, the survey approach was important since it functioned as an empirical and descriptive procedure, giving the researcher no choice but to look at the attributes under study.

3.3 Research methods

3.3.1 Population

According to Yin (2018), a population is a collection of people who the researcher is interested in because they share one or more traits. Therefore, O' level Physics students and teachers from a chosen Plumtree secondary high school make up the study's population.

Sample

A series of statistical measurements are needed in research, which is a practical system, in order to draw conclusions about accurate and trustworthy data. This is the reason a sample was limited to one secondary high school in Plumtree that was chosen. A sample is a subset of a population that is chosen to reflect the complete group, according to Creswell (2014). A total of 35 research participants in all, comprising 30 students and 5 teachers, were chosen to carry out the study.

Sampling procedure

For students to properly address the effectiveness of technology in Physics teaching and learning, random selection was used. In addition to helping to accomplish the comparability effect among students based on the scope of integrating Physics with technology among various personalities, the sampling technique employed also eliminated bias.

Male and female students at the school were divided into groups or strata. A sample of five students from each stratum was chosen at random by the researcher and all totalled to 30 students. This was carried out to guarantee that male and female students participated equally. On the other hand, a purposive sample design was used to choose 5 teachers in Physics. Purposive sampling refers to the intentional selection of an informant based on the attributes they possess (Yin (2018). It is preferable to have a diverse set of teachers (participants) to guarantee that the primary data has the greatest amount of variability.

3.3.2 Data collection methods

3.3.3 Data analysis instruments/methods

Questionnaires

A questionnaire was utilised in this study to collect data from the study participants (students). According to Babbie & Mouton (2018) and Creswell (2014), a questionnaire is therefore a formalised set of questions incorporating one or more measuring scales intended to gather primary data. In this instance, Yin (2018) assert that questionnaires are designed based on the study's research objectives. According to Babbie & Mouton (2018) the researcher employed both structured and unstructured questionnaires to obtain relevant, accurate, and sufficient data. Interestingly, the researcher also ensured that the questionnaire is clear, dependable, and valid.

According to Merriam & Tisdell (2015) questionnaires were selected because they provide respondents enough time to read and comprehend the questions' contents before responding appropriately. Additionally, they provide the responders ample time to complete their responses. If respondents are forced to provide answers right away, some of them may provide misleading information. As a result, surveys was designed taking into account respondents' comprehension levels and allow participants to reply independently of the researcher (Creswell, 2014).

Focus group interviews

In this research, focus groups were also be employed. According to Creswell (2014), focus groups are described as those in which the subject matter is precisely and concisely discussed, with an emphasis on facilitating and documenting participant interaction. Group interviews, like focus groups, typically consist of four to eight individuals, or even twelve, depending on the interviewee's skills, the topic matter, and the nature of the participants, as highlighted by Creswell (2014). According to Marshall & Rossman (2016) it is inevitable that fewer interviews are used when the subject matter is more difficult. In this instance, all required data will be accessed through 4 participating Physics teachers.

Lesson observation

In order to assist the researcher in understanding the viewpoints held by the study populations, participant observation was employed as a data instrument (Creswell, 2014). The researcher had to set time to visit participants in their teaching and learning. The observation approach is typically seen as feasible if the observer remains anonymous. As a result, the researcher observed the lessons and participated in instruction. In order to prevent behaviour changes, it was also helpful for participants to remain unaware that they were being watched. Participant observation was employed because it provided unrestricted access to information and allowed for the observation of conduct as it naturally transpired.

Assessment tool

In order to gauge how successful a strategy is, assessment instruments are crucial in research. Assessment instruments can be used to assist researchers in analysing how technology affects student learning outcomes, engagement, and attitudes towards the topic of physics when it comes to teaching and learning (T&L) in this context (Creswell, 2014). The current study sought to use the assessment tool for students. This will help the researcher to make well-informed decisions about the integration of technology in Physics education by successfully utilising assessment tools.

According to a Hake (2018) study, teachers teaching physics can learn a lot about students' misunderstandings and comprehension by employing evaluation techniques like concept inventories. The assessment tool was chosen for the current study to assist academics in pinpointing areas where technology integration in physics teaching needs to be improved. The tool will demonstrate how students make progress in their comprehension of specific topics. The tool will also give researchers data-driven insights into the learning outcomes of students and assist in identifying areas where instructional practices need to be improved.

Thus, students will sit for a quiz and answer it individually and in groups after an ICT integrated Physics lessons. Results will be analysed to give a better insight of the impact of technology.

3.4 Reliability and validity

3.4.1Validity

Validity, in the words of Marshall & Rossman (2016) is the degree to which an inquiry gauges the non-empirical and empirical assessments that it is intended to gauge. In order to make sure that the questions are precise and not confusing, the researcher had to move quickly towards the measurement of validity and reliability of the questionnaire and observation guide.

According to Creswell & Poth (2017) one of the key elements in determining the validity and dependability of data is understanding the social environment in which it is gathered. To ensure data consistency and participant flexibility, the study included self-administered questionnaires and interviews. By doing this, prejudice between the participant and the researcher is often avoided.

Additionally, validating replies improved validity by confirming that participants grasped the goal of the study and by maintaining precise and thorough field notes to document changes in responses over time (Neuman & Robson, 2014).

3.4.2 Reliability

According to Creswell (2014) reliability is the stability or consistency of a measurement. In accordance with Leedy & Ormrod (2014) the investigator re-examined the methods of data collection, ensuring consistency by having the same participants complete the same instrument over an extended period of time and comparing the outcomes with those from earlier tests. Internal homogeneity, a measure of how closely related but disparate items all measure the same thing, was checked in order to determine reliability (Neuman & Robson, 2014). In order to properly evaluate the impact of computer technology on mathematics teaching and learning, the researcher employed a random sample of O' level Physics students and facilitators. Once more, a series of linked questions were posed in order to provide a deeper comprehension of the topic being studied.

3.5 Ethical issues

Ethics, in Silverman (2016) is the study of morality. He goes on to say that participants must be told about the research before they choose to participate in it, and ethical guidelines and consent processes must be followed. The participants' rights to withdraw from the study were upheld, and their interests were safeguarded. The participants were given a clear explanation of the research's objectives prior to requiring their agreement, and any information they chose to divulge would remain private. To maintain secrecy, the questionnaire was to have no space for names (Neuman & Robson, 2014).

Accurate measurements of the research sample and suitable procedures were employed to prevent misuse of research results as a result of the researcher's avoidance of the unethical generalisation of data (Creswell & Poth, 2017). At last, the researcher requested permission from the directors of the Department of Educational Foundations, the Provincial Education Director, the District Education Officer, the administrative staff of the schools, and the School Development Association to conduct the study.

Students can investigate immersive virtual worlds for instructional reasons thanks to virtual reality technology. According to a study by Agyei (2020) virtual reality in high school classrooms can improve student involvement and comprehension of difficult ideas.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The methods and steps that have to be taken to choose the study population and participants were covered in the previous chapter. This chapter paid attention to the analysis, interpretation, and data presentation of the study's findings. These are arranged in accordance with the three primary research questions given to direct the investigation. The study was limited to one selected Plumtree secondary high school, whose data went through the initial and intermediate statistical phases of data sorting and filtering. As a result, conclusions about this chapter were made using concepts and literature as a guide and the study findings.

4.2 Demographic data

Table 4. 1: Total response rate

Participants	**Questionnaire**		**Response rate**
Students	Administered	Returned	
	30	25	83%
	Interview attendance		
Teachers	Expected	Actual	

	5	5	100%

(Source: Raw data, 2024)

The research data on analysing the effectiveness of technology in the teaching and learning of O' level Physics was drawn from 35 participants, as Table 4.1 demonstrates. Regarding the 30 questionnaires distributed to the student participants, 25 were deemed usable and 5 were returned spoilt or incomplete. This resulted in an appropriate total response rate of 83%, which is deemed significant for analysis and highly satisfactory in representing the population of interest as stated by Babbie (2019), whose prescribed standard minimum response rate is 70%. The interview attendance was meaningful because all five expected participants attended, yielding a 100% attendance rate for the collection of data through interview

4.3 Gender participation

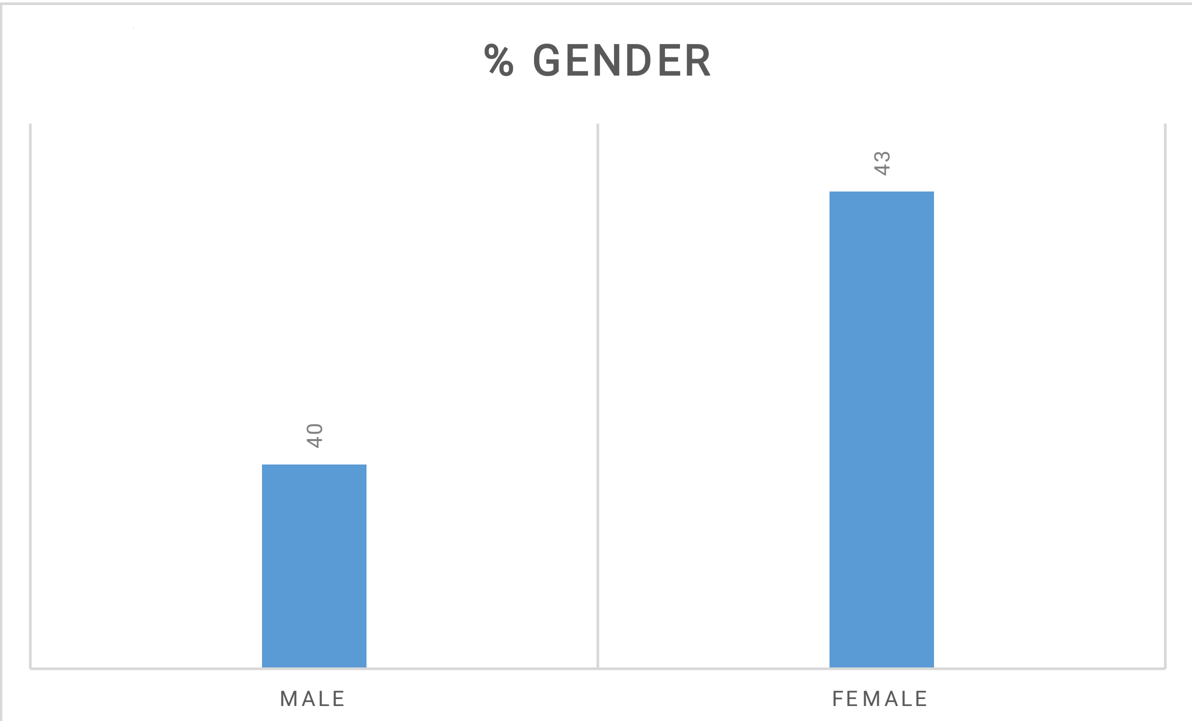

Figure 4. 2: Gender of participants

The demographic information about each student participant's age that was taken from the questionnaire is displayed in Figure 4.1 above. As illustrated in Figure 4.1, the research findings were primarily given by male participants (40%), with female participants accounting for 43% of the total study findings.

4.3.1 Age

Table 4. 2: Age of study participants

Age	Frequency	Percentage%
<= 14 years	2	8%
15 years	7	28%
16 years	11	44%
16+ years	5	20%
Total	25	100%

(Source: Raw data, 2024)

The age range of study participants used to analyse the effectiveness of technology in O' level teaching and learning of Physics is displayed in Table 4.2. Table 4.2 shows the age range of the respondents, which was less than 14 to more than 16 years old. Of the respondents, 44% were 16 years old, 28% were 15 years old, and 20% were between the ages of 16 and older. Participants in the study who were 14 years of age or less had a low participation rate of 8%.

4.4 ICT resource familiarity

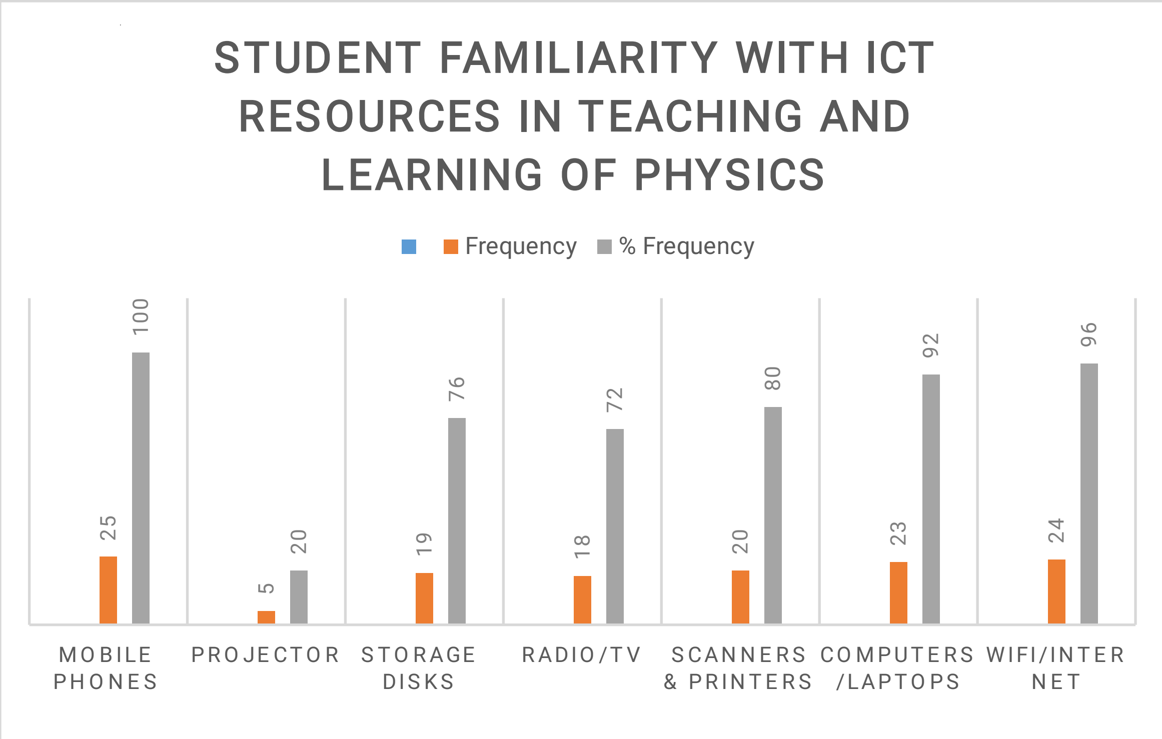

Figure 4. 3: ICT resources for teaching and learning

The various ICT tools that students are comfortable to using for Physics instruction and learning at school are depicted in Figure 4.2. Figure 4.2 explicitly shows that 100% of students are familiarized to using their phones for educational purposes. 96% of respondents then said WIFI or the Internet, 92% mentioned computers or laptops, and 80% mentioned scanners and printers. Only 20% of study participants expressed interest in projectors, compared to 76% who named storage discs and 72% who indicated radios/TVs. The study participants are aware of the technology resources employed in education, according to the current findings. They strongly like computers/laptops, mobile phones, and WIFI/the internet. The results of the study are consistent with those of Demir & Akpinar (2018), who showed that mobile apps have increased popularity as instruments for improving Physics education for students.

4.4.1 Lesson delivery

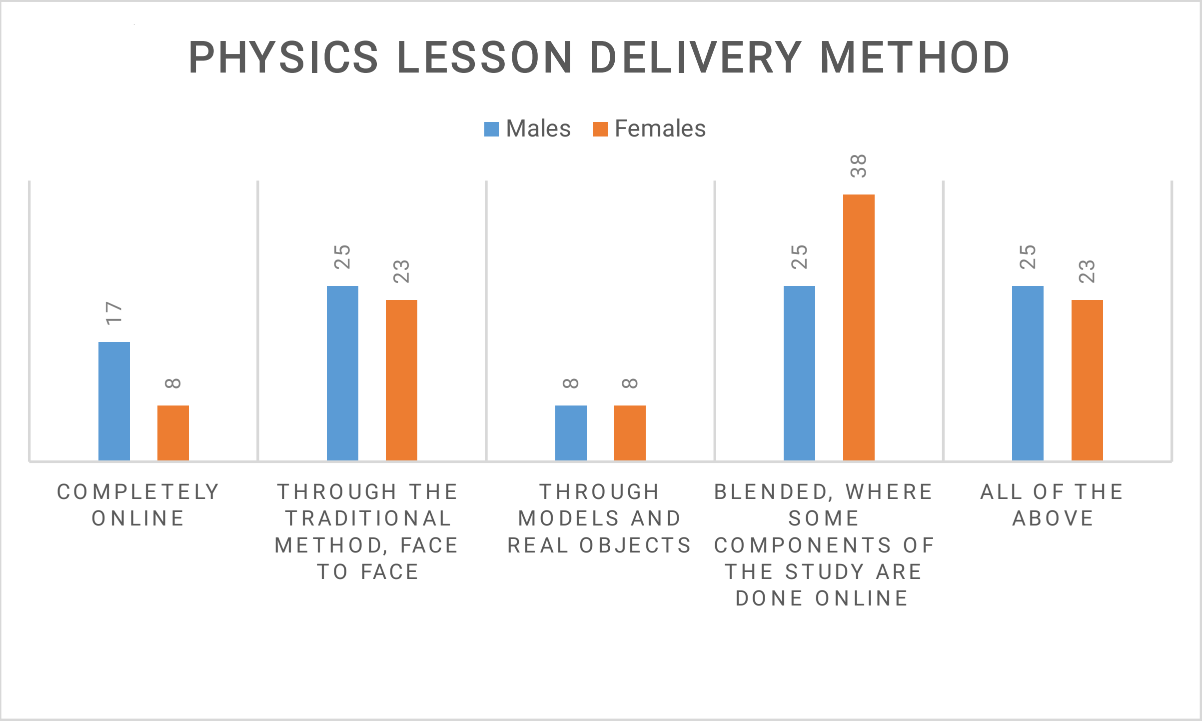

Figure 4. 4: Lesson delivery method

The way that lessons are delivered at a particular Plumtree school is depicted in Figure 4.3. Out of the participants, 17% of men and 8% of women said that all of the classes are done online, while 25% of men and 23% of women said that the traditional technique is done in-person. Eight percent of the respondents, male and female combined, said that real objects and models are used. While 25% of men and 38% of women identified a hybrid strategy, 25% of men and 23% of women said their school uses all of the mentioned lesson delivery strategies.

4.5 Impact of each technological tool or resource for student learning outcomes

Table 4. 3: Impact of technological resources on student outcomes

No	Theme	SD	D	NS	A	SA	Ratio	Rank
Web based learning	Promotes collaborative learning and knowledge creation	4 (16%)	5 (20%)	3 (12%)	8 (32%)	5 (20%)	1.4	2
Projector	I get to concentrate and understand better when a projector is used	3 (12%)	5 (20%)	5 (20%)	7 (28%)	5 (20%)	1.5	1
Computer based learning	They provide so many sources that assist me to work at my own space of time. I am able to relate on the written concepts	8 (32%)	5 (20%)	8 (32%)	3 (12%)	1 (4%)	0.3	7

Virtual classrooms	Improves student learning and participation	5 (20%)	5 (20%)	9 (36%)	4 (16%)	2 (8%)	0.7	6
Content delivery via e-networks	Powerful tool because I can access and disseminate electronic material with my friends.	4 (16%)	5 (20%)	4 (16%)	3 (12%)	9 (36%)	1.3	4
Wireless and mobile technology	Provides a convenient communication method and easy access to information. Improves problem solving skills	2 (8%)	7 (28%)	3 (12%)	2 (8%)	11 (44%)	1.4	2
Audio or video tapes	Allows me to hear the teacher’s voice, tone and emphasis in understanding feedback provided	1 (4%)	8 (32%)	8 (32%)	8 (32%)	0 (0%)	0	8
Emails, CD-ROM, I-pods	Platform for learning experience and it improves my reading and learning habits.	5 (20%)	3 (12%)	8 (32%)	4 (16%)	5 (20%)	1	5

(Source: Raw data, 2024)

The result table from the study participants, which is based on their opinions about the influence of technology resources employed on student outcomes, is shown in Table 4.3 above. The item column assessed, the descriptive effect column, the rank column specifying the order of importance, and finally the participants' mutual level of satisfaction columns, which evaluate the perceived findings from strongly disagree to strongly agree, are all included in the result table. Table 4.3 thus demonstrates that the usage of projectors was ranked top and received a positive rating of (1.5), followed by web-based learning and wireless and mobile technology, which were placed second and received a good rating of (1.4). Delivery of content through e-networks was evaluated favourably at (1.3), placing it fourth, followed by favourable ratings for emails, CD-ROMs, and iPods. On the other hand, the usage of audio or video cassettes, computers, and virtual classrooms received negative ratings of 0.7, 0.3, and 0.

Following the participants' interview, corresponding findings were collected:

Interviewee H7F professed that *“Our school has been using technology for teaching and learning for a few years now. I've noticed that when it comes to using additional technology tools, the majority of students prefer mobile learning. They interact, converse, and exchange positive ideas over the WhatsApp platform.”*

Interviewee KV8 purported that: *“Despite this, we lack essential equipment like projectors. It has shown to be beneficial for student outcomes during the few brief periods I have utilised it in the classroom. Students work together more when they use projectors and movies, which also lengthens their attention span. However, because other students will frequently become disoriented during class, it frequently makes classroom management challenging”.*

Interviewee 56N highlighted that: *"The majority of technology tools are efficient. Students may forget to use other learning materials as a result of using these tools. I can assure for the fact that students utilise computers for non-academic activities such as social networking (Facebook, Instagram, and WhatsApp) and gaming or viewing videos.”*

Interviewee NKB emphasized that: *"I've seen that a lot of students tend to overlook textbooks and other learning resources. On the other side, difficulties in the teaching and learning of Physics are caused by a lack of internet access in schools, a shortage of computers, and unfamiliar computer-based applications.”*

Interviewee XD4 purported that: *"The difficulties we experience as facilitators in maximising the use of technology resources are related to the lack of current software that can be used for both teaching and learning physics and that interacts with students in a productive manner."*

According to the study's findings, web-based learning, wireless technology, and virtual classrooms are the most widely used technical resources at a selected school in Plumtree and most survey participants are either familiar with or have been exposed to these methods. Nonetheless, because they lack access to computers, a number of students gave computer-based learning, audio, and video cassettes low ratings. Others believe that, given the advancements in emerging technology, audio and video are outdated.

4.5.1 Consequences of adopting different technological tools in T&L of Physics

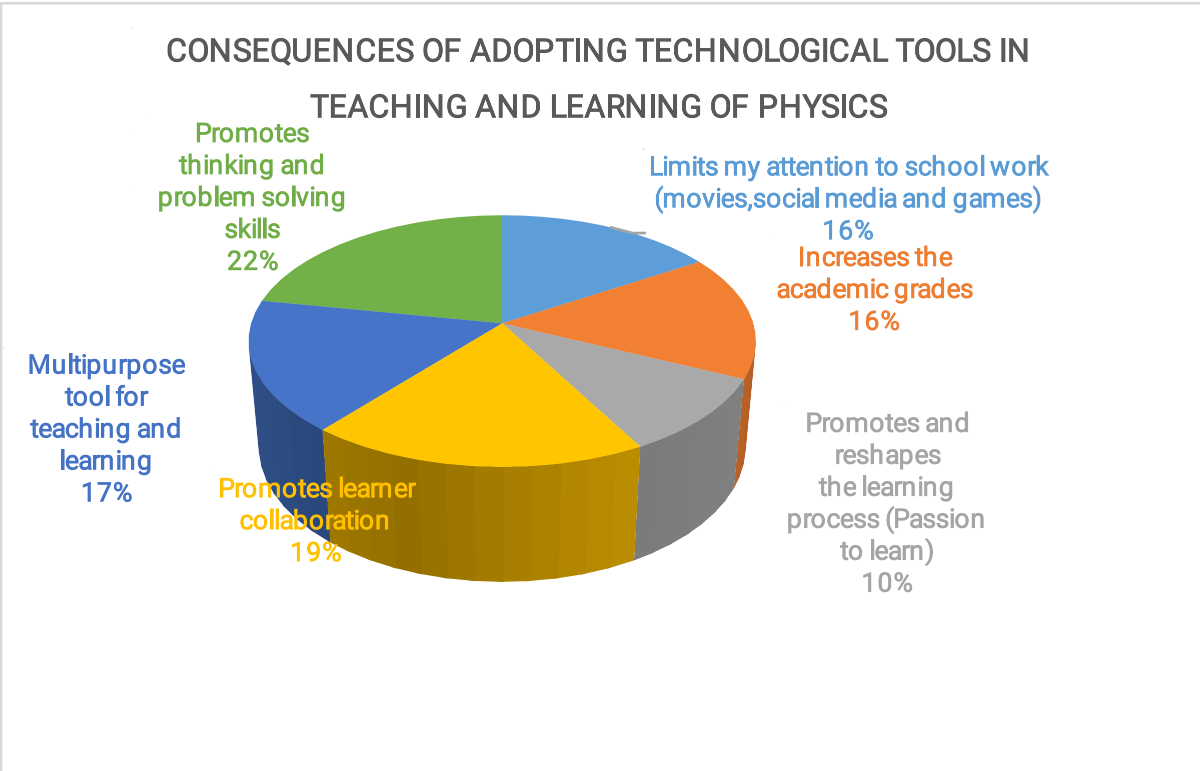

Figure 4. 5: Effects of technological tools

The impact of technology instruments on student learning is depicted in Figure 4.4 above. Twenty-two percent of research participants shared their perspectives on how technology enhances critical thinking and problem-solving abilities, while 19% said it fosters student collaboration and 17 percent said it serves as a versatile instrument for education. While 16% of participants concurred that raising academic standards while diverting students' attention is a good idea, 10% felt that technology enhances and transforms the learning process.

The aforementioned findings suggest that getting input from educators, parents, students, and other stakeholders might yield important information on how well technology is used in the classroom. Overall, the data indicates that technology contributes to increased learning motivation, improved problem-solving skills, and increased curricular engagement. These specific findings are consistent with those of Li (2016), who noted that favourable benefits of technology have been seen in a number of nations, including increased student engagement with the subject matter and improved exam scores for physics students.

4.5.2 Comparison of approaches of integrating technology in teaching of Physics

Mobile learning

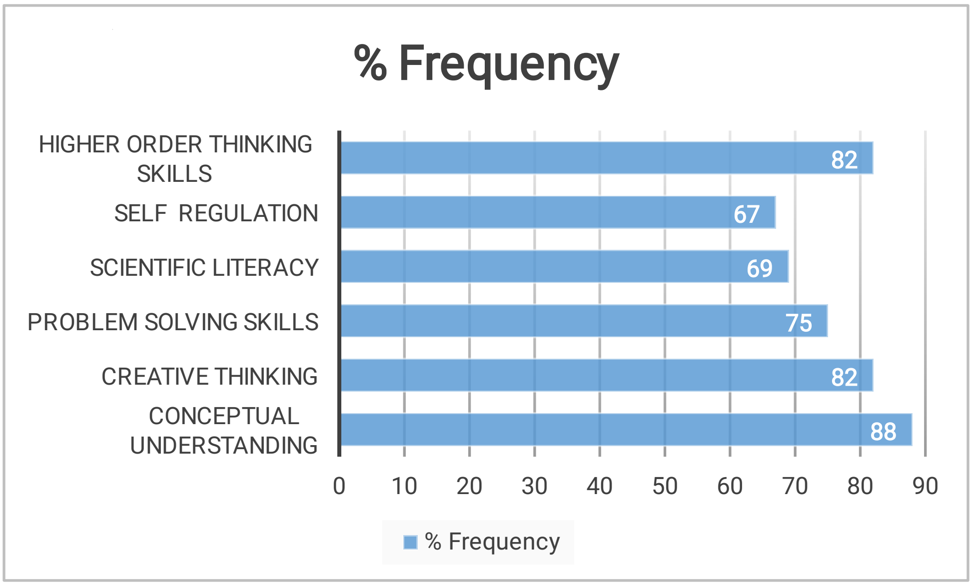

Figure 4. 6: Effects of mobile learning in Physics education

The perceived benefits of mobile learning in Physics education are depicted in Figure 4.4. It is evident that 82% of research participants said that mobile learning encourages creativity and higher order thinking skills (HOTS). Furthermore, as Figure 4.4 makes richly evident, 67% of research participants said that mobile learning fosters self-regulation, while 69% of study participants said that mobile learning fosters scientific literacy. According to 75% of research participants, mobile learning fosters problem-solving abilities, and 88% of participants said that mobile learning helped them grasp concepts.

It is possible to see how the examined technological effects support the growth of education when students actively participate in creating their own virtual learning environments in response to new curriculum requirements. These results are consistent with Li (2016) who said that students can use smartphone apps to engage with Physics subjects at their own pace and while on the road. Because mobile devices are so widely used, learning can take place outside of traditional classroom environments.

4.5.3 Simulations/Project based learning

Lesson observation results

Table 4. 4: Student responses from evaluation forms

Item measure	YES	NO
Motivation in the process of teaching and learning	82%	18%
Following the in-class assessment, teachers give feedback.	84%	16%
Participation in the process of teaching and learning	95%	5%
All students participate in the evaluation process.	75%	25%
Sufficient ICT resources	64%	36%
Frequently integrates ICT during lesson	69%	31%

(Source: Raw data, 2024)

The student answers from the assessment forms are displayed in Table 4.4. The purpose of the forms was to compile the tasks and results that instructors complete while integrating technology into their lessons. Table 4.4 demonstrates that, despite the fact that simulations are conducted, 64% of the respondents express dissatisfaction with the lack of information communication technology (ICT) resources available for educational purposes. The frequency with which technology is integrated into teaching and learning is one of the lowest ranked items (69%), according to the results.

Table 4. 5: Observation findings of Physics simulations using projector and YouTube

Item measure	%YES	% NO
Setting learning goals	100	0
Engaging students in active learning	75	25
Classroom motivation	80	20
Carrying out practical work and providing feedback	89	11
Meeting the learning objective	82	18
Pattern of assessment		
Closed	27	73
Open	73	27
Look at past knowledge	69	31
Assessment (Quiz)	Average score	
Group	36	
Individual	29	

(Source: Raw data, 2024)

The results of the Physics simulation conducted in the classroom utilising a projector and YouTube are displayed in Table 4.5. The findings show that the facilitator achieved all of the learning objectives. 75% of students are actively learning, 80% of students are motivated in the classroom, and 89% of students receive practical work and feedback. The assessment pattern for closed and open assessments was 27% and 73%, respectively. Comparing group simulation teaching and learning (T&L) to individual assessment, the former shown to be much more successful.

These results, taken as a whole, suggest that ICT can enhance student learning and guarantee more effective teaching strategies. Through the online test, the three Rs of teaching and learning that is reading, writing, and arithmetic were successfully assessed. These results are in line with the findings of Hove (2017) who reported that teachers favoured using both written and oral question-answer formats to evaluate students' learning outcomes for the theoretical portion, whereas the ICT lab was used for the practical test.

4.5.4 Online collaborations

Table 4. 6: Result findings on online collaborations

Item	**% Online**	**% Offline**
The physics learning materials are delivered effectively.	34	64
The teaching materials for teaching physics are easily understandable.	25	75
Students can easily understand and complete the assignments given by the teacher.	15	85
There has been an increase in student motivation to participate in physics lessons.	41	59

(Source: Raw data, 2024)

The results of online collaborations regarding the efficiency of technology in O' level

Physics teaching and learning are displayed in Table 4.6. When compared to online assignments, 85% of students indicated they could comprehend and complete them more readily. Similarly, 75% of students said that Physics teaching materials are easier to understand offline, compared to 25% who said they could only do it online. Once more, 59% of participants concurred that students are more motivated to participate in physics studies when they attend offline classes.

Some qualitative responses from study participants supporting these findings are given below:

AD5 stated that: *“I am aware that when we are without internet access, we frequently have to do a large number of school assignments offline and we normally carry oit the tasks in pairs or groups to assist each other.”*

89M echoed that: *“Whatsapp, in my opinion, is always a simple venue for me to impart my knowledge on. Compared to other technological resources that require a high level of knowledge to offer, it is not complicated. Positively, with so many students owning smartphones these days, education is more accessible than ever.”*

GT7 agreed that: *“Since Physics is a practical science, I like to relate everything I teach to actual circumstances. When I don't use videos to explain a concept, I engage every student in a hands-on practical exercise. Students are able to exchange ideas in this way. Their attention is drawn in by the direct involvement, which also makes it simple for them to remember what they have learned.”*

DW3 highlighted that: *“Technology is not a problem for me. I combine my methods of instruction and learning. Though I personally prefer face to face tutoring. The teacher and students communicate directly, which frequently makes it quite easy to understand things that are unclear. There are no WiFi network outages involved. Education is provided to all in an equally equitable manner.”*

It is evident from the research findings in Table 4.6 that there is a significant difference between the online and offline physics learning processes. When compared to internet learning, the offline physics learning system performs substantially better. Teachers who engage in in-person instruction also prefer to teach offline. The present results are consistent with those of Arukaroon & Krairit (2017), who found that the majority of teachers had trouble explaining Physics equations online as well. These issues make it more difficult to apply physics equations and result in less efficient calculating methods. Additionally, students' enthusiasm for taking part in the online physics learning process is declining.

4.6 Attitudes and perceptions towards using technology in the classroom

The open-ended responses were comparatively grouped, evaluated, and displayed as follows. The following anonymous names will be used:
According to students' responses to the qualitative data, teaching and learning are made more difficult by some facilitators' lack of experience integrating technology. However, some students now focus solely on a small number of technological tools and resources, while others use technology for non-academic uses. The majority of interviewees emphasised how their concentration on online games, films, and novels had a negative impact on their academic achievement. The student-to-computer ratio can occasionally impede students' interest in the subject, and educators who do not own personal computers frequently have limitations when it comes to organising and preparing lessons.

Another participant reiterated the statement that whatsapp platforms and overhead projectors are frequently used to illustrate the numerous topics covered in class. They admitted that employing the same integration strategies in physics classes is becoming tiresome. Many of them eventually become disinterested and lose focus in class. Several participants expressed the opinion that some educators are less confident in their capacity to successfully incorporate technology into their physics lessons.

Interviewee XD4 purported that *"Reconditioning the sensory aids through live online* *instruction and hearing a voice distinct from the teacher's helps develop critical thinking and problem-solving abilities in Physics."*

Interviewee XD4 purported that: *"Since I'm not a technology expert, I'm becoming hesitant to try out new teaching strategies or resources that can improve physics students' understanding."*

DF6 stated that: *"Positively, it improves my understanding and application abilities."*

DW2 noted that: *"Most students use the internet for non-educational purposes during lessons, which distorts their attention."*

VBN stated that: *"Lack of resources (ICT) restricts information accessibility, particularly for less fortunate students. Nowadays, most parents find internet and WiFi connectivity to be pricey."*

JK9 purported that: *"Because it gives teachers access to a multitude of tools and data that can improve our teaching methods, technology integration is crucial."*

DR5 supported that: *"The management team should, in my opinion, outfit the school laboratories with computers so that every student can work directly with them and have plenty of opportunity to practise the material being taught using the relevant programmes."*

The results of the study demonstrate that participants' perceptions of the use of technology in teaching and learning are mixed when it comes to the outcomes of the students. According to recent research about the effect of age on attitude towards computers, younger people tend to have more positive views towards utilising them than their older counterparts (Saripudin, Rohendi, & Abdullah, 2020). Yudah (2020) reports that his research also showed that students who received education in ICT had significantly more positive opinions than students who did not receive any computer instruction. According to Saripudin, Rohendi, and Abdullah (2020), any child may learn any subject as long as it is given to them correctly and at the appropriate time.

4.7 Discussion

The study of the results was used to evaluate how well technology worked in O' level Physics T&L. Subsequently, research has demonstrated an increasing connection between schooling and technology. One effect of this connection is that, as technology has become more capable and accessible, the amount of technology used in regular educational activities has increased at an exponential rate. Refocusing the research's broad objective by analysing the effects of particular technological tools or resources on student learning outcomes, comparing various methods of incorporating technology into teaching practices, and assessing teacher attitudes and perceptions regarding the use of technology in the classroom were some of the main driving forces behind the study.

The use of data instruments and descriptive statistics was used to assess the impact of particular technological tools or resources on student learning outcomes. To determine how well eight technological tools affected student learning outcomes, an assessment was conducted. These include projectors, computers, web-based learning, virtual classrooms, wireless and mobile technology, e-networks for content delivery, audio or video cassettes in addition to emails, CD-ROMs, and iPods.

Projectors, wireless and mobile technologies, and web-based learning were all positively scored, indicating that they have a favourable impact on student achievements, according to the data that was interpreted. Their academic performance and studies are improved by them. The study's findings demonstrate how projectors make it simple to show visual aids in the classroom. They facilitate the process by which educators can impart knowledge in a way that is more dynamic and captivating. Students may comprehend difficult ideas more clearly and retain knowledge more efficiently as a result of this. Students may learn at their own pace and convenience thanks to mobile technology, which gives them access to educational resources whenever and wherever they are. Once more, personalised learning experiences catered to the needs of specific students are made possible via web-based learning.

The information gathered supported the conclusions of Demir & Akpinar's (2018) study, which suggested that mobile apps have become more and more common in physics education. He made reference to apps that provide quick access to formulas and explanations for common physics problems, such as PhyWiz and others, and that provide interactive simulations and self-assessment quizzes, such as Pocket Physics. While Lage, Platt, and Treglia (2019) dispute this, web-based learning allows students to access lectures, assignments, and course materials via an online platform. Students can also use message boards or discussion forums to interact with teachers and other students. According to Karniawati, Simamora, and Zain (2021), the internet, skill, and lack of finances are other variables that restrict the effectiveness of technical instruments.

The analysis also gave audio, video, and computer-based learning low ratings. These findings suggest that the participants may be encountering difficulties in igniting the beneficial impacts of the technology instruments they were using. It's possible that some individuals think traditional classroom training is more interesting than computer-based learning, audio, or video cassettes. There could be no way to communicate with peers and teachers in real time with these tools. This may make it more difficult for students to participate in class discussions, raise questions, and seek clarification. Qualitative data supporting the findings further emphasised that a lack of internet connectivity in schools, shortage of computers, and unfamiliar computer-based programmes are the main causes of the challenges in Physics teaching and learning. According to a 2015 study by Steurle, Hamilton, and Stecher, individualised computer learning can improve high school students' academic performance, however kids may require appropriate support when studying independently.

Mobile learning, project-based learning, and online collaborations were used to compare different methods of incorporating technology into Physics teaching techniques. The results of the study showed that while aiding students' conceptual understanding, mobile learning in Physics T&L promotes creativity and higher order thinking. Additionally, it was discovered that mobile learning promotes problem-solving skills, scientific literacy, and self-regulation. Overall, our results suggest that mobile learning in physics instruction can be an effective means of stimulating students' creativity and higher level thinking. Students can interact more interactively and practically with physics principles by using mobile devices, which provide them the freedom to experiment and explore various ideas. In physics education, mobile learning, according to Hashim & (2020), stimulates students' critical thinking and creativity in addition to helping them gain a greater knowledge of the material. According to Lage, Platt, and Treglia (2019), mobile learning is a useful tool for getting students involved in the learning process and inspiring them to think creatively about how to solve problems and apply what they have learned. A total of 90% of students in the Netherlands and 83% of students in the US use their cellphones for social media, according to Mohamedhoesein (2017). In their daily lives, students connect via text messages, emails, posts on social media, and other online media on a range of platforms (Ha, Joa, Gabay, & Kim, 2018).Social media sites like Facebook, Instagram, WhatsApp, Telegram, Twitter, and Telebay are the most common ways that students communicate (Ha, Joa, Gabay, & Kim, 2018; Maweu & Yudah, 2020).

The results of the observations showed that project-based learning and simulations encourage student participation, motivation, and teacher feedback. Additionally, student response evaluation questionnaires showed that there is a lack of technology resources for teaching and learning at the school under investigation. Because not everyone has access to sufficient resources, ICT integration in teaching and learning is uncommon. With this approach, students engage on real-world projects that are focused on technology. Thomas (2014) found that project-based learning enhances students' creativity and critical thinking skills in high school. Lage, Platt, and Treglia (2019) state that this kind of education can be especially successful in assisting students in acquiring critical abilities that will aid them in their future employment. Students can see the significance and relevance of what they are studying by applying theoretical information to real-world scenarios through simulations.

For the observation lesson, there were two types of assessments: open-ended and closed-ended. But the instructor gave greater attention to open-ended evaluation. Because open-ended assessments let students show their learning in a more unique and creative way, the lesson had a big influence in this area. It promotes effective communication, critical thinking, and problem-solving abilities. Additionally facilitating a deeper comprehension of the subject matter, this kind of evaluation aids in the development of conceptual links amongst pupils.

Through the use of individual and group quizzes, the usefulness of technology was evaluated highly. There are differences in the effects of group and individual quizzes on teaching and learning. The results showed that group quiz assessment outperformed solo quiz evaluation in terms of impacting student outcomes. This indicates that group quizzes are a helpful teaching tool for encouraging engaged learning in the classroom. It creates a sense of community in the classroom and promotes student participation and engagement. Group quiz evaluations, according to Jarosievitz (2017), can encourage student cooperation and teamwork. Students are encouraged to collaborate, exchange ideas, and gain knowledge from one another. Lekhu (2016) hinted that students can improve their self-discipline and autonomous study skills by taking individual quizzes. It enables students to concentrate on their own advantages and disadvantages without depending on other people.

Evaluating research participants' attitudes and beliefs regarding the use of technology in the classroom was the final goal. It was discovered that poor learner outcomes were caused by the facilitators' inexperience in integrating technology. In addition, there is a shortage of resources in the school where the study is being conducted, a lack of focus, and the majority of students use the internet during class for non-academic purposes, which causes attention distortion. Positively, technological integration enhances students' comprehension and application skills.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The research project is summarised in this section of the chapter, which also provides an overview of the project's progress and a list of the study's findings. There shall be a presentation of the main research findings along with suggestions. Recommendations are based on the results and thorough realisation of the observations. This chapter highlights areas that require more investigation

5.2 Summary of findings

The main goal of the study was to evaluate how well O' level Physics is taught and learned using technology. To be more precise, the study aimed to evaluate the effects of technological tools on the learning outcomes of students at a selected school in Plumtree, compare the efficacy of various methods for incorporating technology into teaching practices, and determine the attitudes and perceptions of teachers regarding the use of technology in the classroom.

The research project began with a problem statement and testing objectives on the effects of technology on O' level Physics instruction and learning. To show how this research related to past studies, an overview of the literature review that connected it to the empirical studies was drawn up. After that, information was gathered, examined, shared, and discussed.

A summary of the results showed that there are positive and negative ratings for the impact of technology resources. The study participants disclosed that projectors, wireless and mobile technologies, and web-based learning had a favourable effect on the academic achievements of students. The results also showed that some participants thought traditional classroom training was more engaging than computer-based learning or audio and video cassettes.

A summary of the results also showed that discipline, scientific literacy, and problem -solving skills are all enhanced by mobile learning. It was found that there were insufficient technology resources for teaching and learning at the institution under investigation. The quiz, which was administered both individually and in groups, provided substantial learning outcomes and was a highly effective way to evaluate the effectiveness of technology. Additionally, it was felt that most students were not paying attention in class because they were using the internet for non-academic purposes, which is a distraction.

5.3 Conclusions

After the data was assessed and interpreted, the following findings were drawn:

5.3.1 The impact of specific technological tools or resources on student learning outcomes

The findings showed that web-based learning, wireless and mobile technologies, and projectors had the greatest effects on the learning outcomes of students when it came to certain technical tools. A portion of the results indicate that computer-based, video, and audio-based learning were likewise rated poorly in the analysis. Several key findings showed that many students ignore textbooks and other learning materials, and that facilitators do not have access to enough modern software and technology tools for teaching and learning physics that engages students in a meaningful way. It can be feasible to conclude that although technology helps students become more motivated to learn, develop their problem-solving abilities, and get more involved in their education, here are hidden issues that restrict its usefulness.

5.3.2 Comparing approaches to integrating technology into teaching practice

However, the majority of study participants were found to be aware of the effects of different strategies for incorporating technology into instruction. Different approaches to integrating technology into Physics teaching practices were discovered, including online collaborations, project-based learning, and mobile learning. Higher level thinking and creativity are encouraged in physics education through mobile learning. However, the findings of the observations demonstrated that teacher feedback, student participation, and motivation are all enhanced by project-based learning and simulations. The methods used for learning physics offline and online differed significantly. The offline physics learning system works noticeably better than online learning. The three resources that were selected are greatly valued for their ability to educate and learn. As they are used, they also have benefits as well as drawbacks. It will take work, either individually or in a group, to transform the difficulties into advantages for raising student performance.

5.3.3 Teacher attitudes and perceptions towards using technology in the

classroom

Participants in a study on the usefulness of technology in Physics T&L believed that the impact of the lesson delivery is always determined by the teacher's lack of technological skills. The findings also showed that teachers without personal computers usually face difficulties in planning and structuring their classes, and that the student-to-computer ratio can occasionally hinders students' interest in the subject. It was recommended that two ways to help students strengthen their critical thinking and problem-solving skills in Physics are to recondition the sensory aids through live online instruction and to hear a voice different from that of the teacher.

5.4 Recommendations

Due to the increased adoption of technology in secondary schools, facilitators have been looking in the ICT world for adaption strategies that fully embrace the role that technology plays in teaching and learning. In light of the research problem and findings, I propose that;

- Teachers ought to have confidence in the productivity of technology. All of the teaching methods needed for discipline, class management, and lesson delivery must be used by a skilled teacher. Because of this, facilitators ought to be in charge of technology; therefore, strict guidelines like internet passwords and page blocking must be implemented before classes start.

- In the event that resources are limited facilitators can utilise the limited technology accessible to benefit every learner, such as projectors, discs, power points, and hand outs

- To effectively teach Physics, facilitators should receive training on the use of ICT, utilising the TPACK model and other relevant tools.
- To improve the use of e-learning in Physics teaching and learning, education stakeholders should fund the provision of various resources, such as computers, projectors, solar panels, and generators.

References

Agyei D.D. (2020). Integrating ICT into Schools in Sub-Saharan Africa: From Teachers' Capacity Building to Classroom Implementation. *Education and Information Technologies,*1-20. DOI: 10.1007/s10639-020-10253-w

Anderson, M., & Jiang, J. (2018). Teens, social media & technology 2018. *Pew Research Center, 31*, 1-10.

Ariffin, T. (2017). Gender differences in computer attitudes and skills. *Jurnal Pendidikan, 30*, 75 -91.

Arukaroon, B., and Krairit, D. (2017). Impact of ICT usage in secondary-school students' learning in The Case of Thailand. International Journal of Web-Based Learning and Teaching Technologies (IJWLTT), 12(2), 21-42.

Awan, F., & Gauntlett, D. (2013). Young people's uses and understandings of online social networks in their everyday lives. *Young, 21*(2), 111 - 132.

Babbie, E.R., & Mouton, J.(2018). The practice of social research (14th ed.). Oxford University Press.

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

Creswell J.W., & Poth C.N.(2017). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Sage Publications

Demir, K., & Akpinar, E. (2018). The Effect of Mobile Learning Applications on Students' Academic Achievement and Attitudes Toward Mobile Learning. *Malaysian Online Journal of Educational Technology, 6*(2), 48-59. https://doi.org/10.17220/mojet.2018.04.004

DeWitt J, Archer L & Moote J (2019). 15/16-year-old students' reasons for choosing and not choosing physics at a level. *International Journal of Science and*

Mathematics Education, 17:1071–1087. https://doi.org/10.1007/s10763-018-9900-4

Ghavifekr, S., and Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education
and Science, 1(2), 175-191.

Ha, L., Joa , C., Gabay, I., & Kim, K. (2018). Does college students' social media use affect
school e-mail avoidance and campus involvement?. *Internet Research, 28*(1), 213 - 231.

Hashim, S., & Muda, W. H. N. W. (2020). Students'intention to share information via social media: A case study of COVID-19
pandemic. Indonesian Journal of Science and Technology, 5(2), 236-245.

Hamari,J.,Koivisto,J.,&Sarsa,H.(2014).Does gamification work?--A literature reviewof empirical studieson gamification.Proceedingsofthe47thHawaiiInternationalConferenceonSystemSciences.

Hoye SR (2017). Teachers' perceptions of the use of technology in the classroom and the effect of technology on student achievement. PhD dissertation. Clinton, MS: Mississippi College. Available at https://www.proquest.com/docview/2014475053?pq-origsite=gscholar&fromopenview=true. Accessed 10 December 2019

Jarosievitz B (2017). Modern physics teaching resources and activities. In Pixel (ed). *Conference proceedings: New perspectives in science education* (6th ed). Padova, Italy: Webster srl.

Karniawati , N., Simamora , R., & Zain, B. T. (2021). Information communication and technology for political communication ethics. International Journal of Computer in Law
and Political Science, 1, 21-26.

Lage, M.J., Platt, G.J., & Treglia, M.(2019). Inverting the classroom: a gateway to creating an inclusive learning environment.Journal of Economic Education, 31(1), 30-43.

Li, Y.W., (2016). Transforming conventional teaching classroom to learner-centered teaching classroom using multimedia-mediated learning module. *International Journal of Information and Education Technology*, 6(2):105–112. https://doi.org/10.7763/IJIET.2016.V6.667

Leedy, P. D., & Ormrod, J. E. (2014). Practical research: Planning and design. Pearson.

Lekhu MA (2016). Physical science teachers' self-efficacy beliefs on conducting laboratory experiments. *International Journal of Educational Sciences*, 14(1-2):102–109

Means,B., Toyama,Y., Murphy,R., Bakia,M., & Jones,K.(2013). Evaluation of evidence-based practices in online learning:A meta-analysisand reviewofonlinelearningstudies.Washington,D.C.:U.S.DepartmentofEducation.

Marshall C., & Rossman G.B. (2016). Designing qualitative research (6th ed.). Sage Publications

Maweu, G., & Yudah, O. (2020). Utilization of Social Media Platforms among Information
Science Students at University of Kabianga. *Open Access Library Journal, 7*(3), 1-11.

Merriam, S.B., & Tisdell, E.J.(2015). Qualitative research: A guide to design and implementation (4th ed.). Jossey-Bass.

Mohamedhoesein, N. (2017). The use of ICT by second-year college students and its relation with their interaction and sense of belonging. *Open Review of Educational Research, 4*(1), 177-191.

Neuman, W. L., & Robson, K. (2014). Basics of social research: Qualitative and quantitative approaches. Pearson Education.

Pane, J. F., Steurle, E., Hamilton, L. S., & Stecher, B. M. (2015). Student academic performance through ICT. Continuedprogress, 32(1), 40-43

Riyanto, Y.,& Muhammad, N. (2021). The effectiveness of distance

teaching and learning activities in primary schools. Indonesian Journal of Multidiciplinary
Research, 1(1), 1-6.

Saripudin, S., Rohendi, D., & Abdullah, A. G. (2020). Developing information technology in
open courseware: From movements to opportunities in Asia. Indonesian Journal of Science and Technology, 5(3), 308-320.

Silverman, D. (2016). Qualitative research: Issues of theory, method and practice. Sage.

Thomas, J.W.(2014).A review of research on project-based learning.San Rafael, CA: Autodesk Foundation.

Valavicius, E., & Babravicius, K. (2018). Knowledge of ICT of Secondary School Graduates.
Informatics in Education, 11(12), 257 - 269.

Yin, R.K. (2018). Survey study research and applications: Design and methods (6th ed.). Sage Publications.

DATA COLLECTION TOOLS

Appendix A

Questionnaire for Students

Introduction

Dear, respondent

This questionnaire is addressed to O' level Physics learners and seeks information on the effect of technology in teaching and learning of Physics. Your thoughts on how technology can best be used in teaching and learning are deeply valued. Participants ought not to take more than 20 minutes to complete the questionnaire.

Section A

Demographic Attributes (*Please tick the option(s) that applies to you*)

1. Gender

Male ☐ Female ☐

2. Age

14 yrs and below ☐ 15yrs ☐ 16yrs ☐ Above 16yrs ☐

3. Are you familiar with ICT resources for teaching and learning of Physics? Yes ☐ No ☐

a. List those used at your school…………………………………………………………………
b. What is their impact on your learning outcome……………………………………………………………………….

4i. Most of the Physics lessons you are currently studying are

Completely online ☐
Through the traditional method, face to face ☐
Through models and real objects ☐
Blended, where some components of the study are done online ☐
All of the above ☐

SECTION B

B1. Please indicate by ticking the number that corresponds with your response.

Key

SD- Strongly Disagree **D**-Disagree **NS**- Not Sure **A**-Agree **SA**-Strongly Agree

Rate the level of the impact of each technological tool or resource as used at your school for student learning outcomes

No	Theme	SD	D	NS	A	SA
Web based learning	Promotes collaborative learning and knowledge creation	1	2	3	4	5

Projector	I get to concentrate and understand better when a projector is used	1	2	3	4	5
Computer based learning	They provide so many sources that assist me to work at my own space of time					
Virtual classrooms	Improves student learning and participation	1	2	3	4	5
Content delivery via e-networks	Powerful tool because I can access and disseminate electronic material	1	2	3	4	5
Wireless and mobile technology	Provides a convenient communication method and easy access to information	1	2	3	4	5
Audio or video tapes	Allows me to hear the teacher's voice, tone and emphasis in understanding feedback provided	1	2	3	4	5
Emails, CD-ROM, I-pods	Platform for learning experience and it improves my reading and learning habits.	1	2	3	4	5

a. In your own words, state the consequences of adopting these technological tools in teaching and learning of Physics………

b. To what extent has the students' understanding ability improved or decreased ever since you adopted the use of technology in learning of Physics?
Huge increase☐ Slight increse ☐ Decrease ☐ Remained the same☐

c. What are the potential barriers or challenges that teachers and students face

when integrating technology into their physics teaching practices?...
....
....
....

B2. Compare at least three technology tools or resources and comment on their integration in teaching practices of Physics at your school

No.	Approach	%Effectiveness
i.	Example: Social media integration	
ii.		
iii.		
iv.		
v.		

a. **Complete this table**

Item	**% Online**	**% Offline**
The physics learning materials are delivered effectively.	34	64
The teaching materials for teaching physics are easily understandable.		
Students can easily understand and complete the assignments given by the teacher.		
There has been an increase in student motivation to participate in		

physics lessons.		

a. What are the benefits of online and offline teaching and learning styles…… ……… …………………………
b. Which technological tool that has most improved your learning outcome and comment…… ……… ………

B3. a. What attitudes and perceptions towards using technology in the classroom at your High School……… ……………………………………………………

b.What has changed in your learning outcomes since the integration of technology in Physics instruction…… ……… ….

c. What are the outcomes of teaching and learning of O' level Physics without technology and resourcs skills ?.. ....

Appendix B

Interview Guide for teachers

1. What effects does the application of particular technology tools or resources have on the physics learning outcomes of students?

2. How do you deliver your Physics lessons?

3. Which technological resources or tools are most frequently employed in physics teaching, and how do they improve student learning outcomes?

ii. Lets compare 3 favorable technology tools or resources that you use or is favoured by your students in teaching and learning of Physics.

4. How do the attitudes and opinions of teachers and students towards the use of

technology in physics education affect the way it is implemented and how successful it is?

5. What are the advantages and difficulties that educators see when incorporating technology into their physics lessons?

6. How might technology be included into physics classes in an efficient manner to increase student interest?

ASSESSMENT TOOL

Student evaluation form

Kindly complete the form for teaching and learning of Physics using technology integration. Tick were amplicable.

Item measure	YES	NO
Motivation in the process of teaching and learning		
Following the in-class assessment, teachers give feedback.		
Participation in the process of teaching and learning		
All students participate in the evaluation process.		

Sufficient ICT resources		
Frequently integrates ICT during lesson		

Assessment guide for the observer

Kindly complete the form for teaching and learning of Physics using technology integration. Tick were amplicable.

Item measure	%YES	% NO
Setting learning goals		
Engaging students in active learning		
Classroom motivation		
Carrying out practical work and providing feedback		

Meeting the learning objective		
Pattern of assessment		
Closed		
Open		
Look at past knowledge		
Assessment (Quiz)	Average score	
Group		
Individual		