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A Research Project Submitted to the Department of Science and Mathematics

By

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**TOPIC: THE IMPACT OF INSTRUCTIONAL MEDIA AND TECHNOLOGY ON
BIOLOGY LEARNING ACHIEVEMENT OF ORDINARY LEVEL LEARNERS AT
RUJEKO HIGH.**

In partial fulfilment of HBScEDBz Programme

2024

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DEDICATION

To my family, who have been my pillar of strength and inspiration throughout this research journey.

Your unwavering support, encouragement and patience have meant the world to me.

To my friends and colleagues, who have provided valuable feedback, guidance and motivation.

Your contributions have enriched this research and helped shape its outcome.

To the educators and learners at Rujeko High school who have participated in this study , thank you for sharing your experiences , insights and perspectives. Your contributions have brought depth and meaning to the research.

This research is dedicated to all those who strive to harness the potential of instructional media and technology to enhance teaching and learning to the ongoing conversation about the effective integration of technology in education and inspire future research in this field.

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ABSTRACT

Title: An investigation into the impact of instructional media and technology on Biology learning and achievement of Ordinary Level learners at Rujeko High school

This study investigated the impact of instructional media and technology on Biology learning and achievement among Ordinary Level learners. A mixed methods approach was employed, combining both quantitative and qualitative data collection and analysis methods. A survey questionnaire was administered to two of the Biology teachers and an experimental design involving a control group and an experimental group were conducted with twenty eight learners which was used to investigate the impact of instructional media and technology.

The findings revealed that instructional media and technology have a positive impact on learners' understanding, engagement, motivation, and achievement in Biology. Teachers' perceptions indicated that instructional media and technology enhance learner - centred instruction, promote collaborative learning and facilitate assessment and feedback. Learners reported increased interest and enjoyment in Biology lessons, and enhanced skills in critical thinking and problem -solving. The study recommend the integration of instructional media and technology into Biology education to improve learning outcomes and achievement. It also highlights the need for teacher training and support, infrastructure improvement and continuous evaluation and improvements of instructional media and technology resources.

Key words: instructional media, technology, Biology education, learning achievement, Ordinary Level learners.

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CHAPTER 1: INTRODUCTION

1.1. INTRODUCTION

The study will look on the impact of instructional media and technology on students' academic performance at Ordinary Level at Rujeko High. The researcher has noted a low pass rate in the subject Biology at the school. The school's infrastructure such as laboratories, classrooms and storerooms are well equipped with science materials and science related texts. However, the learners are lagging behind in understanding of concepts in Biology as seen by the low pass rates. This has led to this study.

1.2. BACKGROUND OF THE STUDY

Biology is one of the core science subjects offered in most secondary schools in Zimbabwe. It is a subject that permeates all other science subjects and therefore, it's knowledge and skills when required and applied in any society can bring about rapid growth and sustainable development for example in the field of Agriculture, Health among others. Biology is defined as the natural science that is concerned with the study of life and living organisms including their growth, origin, evolution, distribution and taxonomy. (Sarojini, 2011).

Researchers Abdurrahman (2019), Atadoga and Lakipini (2013) and Salisu (2015) found that persistent low achievement in Biology is attributed to teacher's instructional strategies in science education among others. The traditional teaching method is the oldest method of teaching that does not involve the use of modern technology in the classroom during teaching and learning situations.

The Zimbabwean government has adopted a policy that advocates for children's rights and one being the right to education. This encompasses all children below the age of 18 and it's an Inclusive policy that no one should be left behind despite their background, physically able or physically impaired. Learners are having difficulties in grasping concepts in Biology, this is being seen by

the low pass rates in both Midyear Examinations and final year public examinations. It is with great concern that the researcher wants to closely analyse the impact of instructional media and technology on academic achievement.

The researcher will adopt a mixed methodology in this study. Both qualitative and quantitative approaches would be suitable for the investigation. Qualitative methods involved are questioners or survey to collect data on learner's perceptions and attitude, achievement tests to measure learning outcomes. Statistical analysis for example correlation to examine relationships and differences between the use of instructional media and technology on academic achievement. Qualitative method to be used is the observation of classroom instruction and technology use.

Furthermore, the Heritage based curriculum framework for primary and secondary education (2024 to 2030) encourages collaborative learning and promotes the use of innovative teaching methodology. It embraces the integration of technology and encourages educators to employ a variety of teaching strategies that cater for diverse learning styles. With this in mind the study will examine the relationship between media and technology and academic achievement.

The word 'instruction ' is the act of teaching or passing information unto others while 'media ' is any material or equipment that conveys information from a source to a receiver or vice- versa. In the past, instructional media was called teaching aids. It was observed that these aids are sources of knowledge and motivation to learners, sources of generating new ideas and sources of in depth thought. The history of instructional media can be traced back to the development of technology, which is a gradual process that started from the

Stone Age, through the book and chalk age and finally the mass communication age. According to Adewoyin (2004), the period of Stone Age marked the beginning of visual aids such as stones, pebbles, sticks and cowries which were used to enhance effective learning and communication.

Also, some educators like Socrates (497-399BC) and Plato (428-349BC) made their marks in dealing with issues relating to the right methods of instruction to employ, the sequence to be followed and the type of evaluation to be adopted. The book and chalk age started in the year 1450 AD through publication of educational media. Cornelius (1592-1670) advocated for the use of many textbooks with illustrations and pictures. According to Adewoyin (2004) the first visual aid textbook for children was called 'Orbits pictures ' which means the world in pictures.

The advent of science and technology in communication ushered in the mass communication age. The development in telecommunication led to the invention of radio, television, telephone, internet and other modern telecommunications systems which made education accessible to millions of listeners. According to Ivowi (2003) the growth of a nation is highly dependent on the citizenry's degree of scientific and technology literacy.

Kay (2008), instructional materials stimulate the student's desire to learn. It assists learning process by making assimilation and memorization of materials easy. Also, it helps to hold attention, include greater acquisition and, as well as objectives which may be in accessible to many students. Instructional media and technology make learning available to a wider audience, control the pace of learning, promote better understanding and help overcome physical difficulties in presenting the subject content. Instructional media and technology are an aid to teaching and learning. It makes learning interesting, easy and amusing. It makes learning more effective. (Clark, 1997).It

brings clarity and creates recognition that allow them to have a realistic hand and a total knowledge of the subject Biology.

1.3 STATEMENT OF THE PROBLEM

Learner academic achievement at Ordinary Level Biology is poor at Rujeko High school as seen from the low pass rates at both the school' s local examinations as well as the National Examinations . Since products from the school are the potential clients for institutions of higher learning, there is need to upgrade the way in which the subject is taught. The integration of instructional media and technology in educational settings has become increasingly prevalent, particularly in the teaching of science subjects such as Biology. Despite the potential benefits, there remains a significant gap in understanding how these resources specifically impact the learning and achievement of Ordinary Level learners. The traditional teaching methods being used at Rujeko High school may not effectively engage students or facilitate deep understanding of complex biological concepts. In contrast instructional media and technology such as multimedia presentations interactive simulations, and online resources have the capacity to enhance student engagement, foster collaborative learning, and improve conceptual understanding . However, the extent to which these tools influence academic achievement and learner motivation in Biology remains under-explored . This has led the researcher to come up with the following research questions and a research hypothesis is also, indicated below in 1.4 . According to Heinrich, Molenda and Russell (1993) effective media is a way of learning that engages learners, clarify complex concepts, promotes active learning, enhance retention, supports diverse learning styles, provide feedback and facilitate assessment.

1.4. RESEARCH QUESTIONS

1. What is the impact of instructional media and technology on Biology learning and achievement?

2. How does the use of instructional media and technology affect students' understanding of key Biology concepts?

Research Hypothesis

Ho: There is no positive relationship between instructional media and technology usage and student's academic performance in Biology.

Hi : There is a positive relationship between instructional media and technology usage on student's academic performance in Biology.

1.5. AIMS AND OBJECTIVES

1. To provide recommendations for integrating instructional media and technology into Biology education to enhance learning outcomes.
2. To examine the role of technology - enhanced instruction in promoting deeper understanding of complex Biology concepts.
3. To examine the relationship between instructional media and technology usage and student's academic achievement in Biology.

1.7. SIGNIFICANCE OF THE STUDY

This study will have much significance on the following people. First and foremost, the findings of the study will be of much significance to students, researchers and teachers in secondary schools. This is so because the report of the study will serve as a good reference document to this group of learners when conducting a research on the impact of instructional media and technology on learning and achievement.

Again, the study has much significance on the government in Zimbabwe. This is so because, it will serve as a source of information to the government that the non -provision of instructional media and technology provides basis for low pass rates that are found in Ordinary Level Biology within the country. Furthermore, the study will be significant to parents, this is so because when conducting parents - teachers meeting the issue of provision of instructional media and technology might be raised and this will serve as a good reference document in providing solutions.

1.8. DELIMITATIONS OF THE STUDY

The investigation focuses on Ordinary level learners at Rujeko High school from form 3 students who study Biology as a subject. There will be examination of instructional media and technology that is used at the school. The research is limited to concepts that are offered in the Ordinary Level Biology syllabus. Questioners, tests and surveys are the data collection methods to be used by the researcher. The investigation will be carried out in a single term timeframe. The sample size will be 30 participants. There is an assumption that there is equal access to technology at the high school. The investigation is to be carried out in English.

1.9. LIMITATIONS OF THE STUDY

The study has a small sample size because there is only one class that takes Biology as a subject at Ordinary level. There is limited geographic representation because within the district schools that offer Biology are only four and there are not close to each other which is a limiting factor to the researcher. There is probability of a biased participant selection. Reliance on self- reported data, reliability tools as well as measurement errors are some of the limitations of the study. The researcher has limited control over extraneous variables. There is a single group design of thirty learners and no other comparison group. Presence of technological limitations such as unequal

access to devices or the internet. Technical issues during data collection as well as limited functionality of instructional media or technology.

The study focuses on specific Biology topics, Photosynthesis and excludes other Biology topics. There is limited age range (Ordinary level learners) and limited diversity in participant demographics. Timeframe limitations for example a short study duration of a single academic term. Researcher bias, investigator's assumptions or experiences influence data collection and analysis.

1.10 DEFINITION OF KEY TERMS

➤ Impact

a powerful effect that something, especially something new, has on a situation.

➤ Instructional media

Briggs (1997) defines instructional media as the tools and materials used to facilitate teaching and learning processes. It encompasses a wide range of formats, including text, audio, video and interactive technologies which can enhance the effectiveness of educational experiences.

➤ Technology

Refers to the application of scientific knowledge for practical purposes. It encompasses a wide range of tools, machines, systems and methods that are used to solve problems, enhance efficiency, and improve the quality of life.

➤ Biology

According to Campbell and Reece (2017) biology is the scientific study of life and living organisms, encompassing various aspects such as their structure, function, growth, evolution,

distribution, and taxonomy. It explores the complex interactions between organisms and their environments, as well as biochemical processes that sustain life.

➤ **Learning**

Acquiring knowledge and skills and having them readily available from memory so you can make sense of future problems and opportunities.

➤ **Achievement**

Something accomplished, especially by superior ability, special effort, great courage.

1.11 SUMMARY

This chapter has highlighted the background of the problem that has led to the study, which is low academic achievement at Ordinary level Biology at Rujeko High school. The researcher has noted that the low pass rate is due to the teaching and learning aids which are being used at Rujeko High school. Significance of the study was explained as well as the delimitations and limitations of the study. Key terms which include impact, instructional media, technology, Biology, learning and achievement were defined.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1. INTRODUCTION

The thrust of this chapter is to review literature related to the impact of instructional media and technology on Biology learning and achievement of Ordinary level learners at Rujeko High.

2.2 THEORETICAL FRAMEWORK

Two theories that support this study are the Social Cognitive Theory (SCT) and the Cognitive Load Theory (CLT). Social Cognitive Theory is a psychological theory that explains how people learn and develop behaviors, attitudes, and knowledge through observing and interacting with others, Bandura (1986). This theory posits that learning is a cognitive, observational and socially mediated process. Social Cognitive Theory outlines that learning is an active process, not passive. Also, it supports the idea that observational learning is more effective than trial and error learning. Bandura (1986) further explains that the social environment influences behavior and learning, supporting the use of media such as charts. Another core principle of the theory is that people have control over their own learning and behavior.

HOW FACILITATORS CAN APPLY THE THEORY INTO TEACHING AND LEARNING

Teaching strategies which include the use of media and technology as well as classroom management. Media influence behavior and attitude of the learners. Teachers use technology to provide observational learning experiences. Facilitators use SCT principles to manage classroom behavior. These include strategies such as learning journals, group projects, role playing, video demonstrations as well as classroom discussions. By incorporating these strategies, teachers can create an environment that supports student learning, motivation and self-efficacy aligning with the principles of social cognitive theory. The social learning theory by Rotter (1954) also supports SCT.

APPLICATION OF THE SCT INTO THE CLASSROOM

Students learn by observing teachers, peers and multimedia resources, Bandura and Walters (1963). Facilitators model behaviors, attitude and strategies for students. Teachers use technology to provide observational learning experiences. Also, facilitators use SCT to inform differentiated instruction strategies. CT fosters a positive learning environment, it also supports diverse learning needs, for example slow learners get to grasp concept through the use of various media such as videos. Sweller (1988) outlines that Cognitive Load Theory (CLT) is a psychological theory that explains how the human brain processes information and learns new knowledge. CLS posits that learning is influenced by the amount of mental effort required to process information.

Key components of the Cognitive Load Theory (CLT) include Cognitive Load, the mental effort required to process information. Working memory: The limited capacity to hold and manipulate information in short - term memory as well as Long Term Memory. The storage and retrieval of According to Chandler and Sweller (1991) there are three types of cognitive load these are intrinsic load, extraneous load and germane load. Intrinsic load is essential to understanding the material. Extraneous load is unnecessary mental effort. Germane load involves mental effort devoted to learning, Mayer (2001).

IMPLICATIONS FOR INSTRUCTION

1. Segmenting: breakdown complex information into manageable chunks.
2. Scaffolding: gradually increase complexity.
3. Visual aids: use diagrams, charts and images to reduce cognitive load.
4. Clear instructions: minimize extraneous load
5. Practice: promote automation.
6. Feedback: provide timely and relevant feedback.

CLT benefits: improved learning efficiency, enhanced retention, increased understanding and reduced cognitive overload.

The facilitators apply CLT in the classroom by focusing on specific, measurable goals. Activate prior knowledge to reduce cognitive load. Progressive disclosure, reveal information gradually. Provide opportunities for practice and feedback. CLT accommodates individual differences through the following ways.

Differentiated instruction, tailor instruction to individual needs. Learning styles: incorporate visual, auditory, kinesthetic approaches. Support for struggling students provide additional scaffolding. By applying CLT in the classroom, teachers can reduce cognitive overload, enhance learning efficiency, improve retention, increase understanding, support diverse Cognitive Load Theory benefits students by improving comprehension, increased confidence, enhanced problem - solving skills, better retention and reduced frustration. It benefits teachers by improving instructional design, enhanced teaching effectiveness, increased student engagement, reduced instructional time as well as improved assessment outcomes. By incorporating CLT into instructional design and teaching practices educators can create more effective learning environments that support student success.

2.3. INTEGRATION OF TECHNOLOGY IN EDUCATION

Technology provides instant accessibility to information, which is why its presence in the classroom is so vital. Smart phones , white boards , projectors , TV screens, microphones , computers , cameras and tablets are already omnipresent element of everyday life for students and

teachers alike. It's only natural that the use of technological devices in the classroom are explored to create meaningful learning experiences for students of all ages. Utilizing different types of technology in the classroom, including a virtual classroom, creates learners who are actively engaged with learning objectives. The implementation of technology also creates pathways for differentiated instruction to meet the unique needs of students as individual learners within a broader classroom climate.

Integration of technology in education creates engaging learning environments. Technology has a positive impact on student engagement. It can help educators create exciting, engaging and memorable lessons. Needless to say, higher engagement makes pupils more motivated and makes lessons more enjoyable for both students and teachers. The use of technology in education can truly grab students' attention. While traditional teaching methods are typically effective at engaging some students in a classroom. Integrating Educational technology into their pedagogy can help educators engage every student in the class.

Technology in education prepares students for the future. Additional digital learning helps students improve those invaluable digital skills which are fundamental in modern life. Students can learn some extremely important skills by using technology in education with the rapid rate of technology innovation, simply being able to adapt to new technologies is an invaluable skill in itself. Technology can also improve communication and collaboration at schools. That could be collaboration amongst students or communication between students and teachers through an accessible or even anonymous platform.

According to Anazifa (2022) , learning using technology can enhance learning. Computer technology used with the appropriate pedagogical strategies can be used to assist learners in

understanding biological concepts and processes . Using computer in teaching also gives greater access to information. It also promotes students critical thinking and problem solving. Moreover it gives them meaning to learning. Hence , integrating computer technology in learning biology can enhance student's achievement. In the biology classroom, teachers can adopt visualization and a projection screen to explain and illustrate the biology concept and also using simulation to explore phenomenon when activities and materials cannot be duplicated. ICT adds values to learning in terms of reaching parts of the curriculum that other teaching methods do not , for example students of senior high school are able to study by comparing and contrasting the model of protein and nucleic acid by using 2D and 3D representation using animation.

Learning biology incorporating ICT can influence and sustain student's attainment, ICT based - learning environment can help students to understand and interpret data and provide them to focus on developing conceptual standing. (Thereby promoting students' cognitive development, increasing students self- management and tracking their own Research stated that learning biology on the topic human movement systems with Moodle become more fun. Another research also added that using of e- learning facilities by students in the course of Human Anatomy Physiology increased activity of learning, and student's attitude towards human physiology and anatomy course.

Anazifa (2022) goes on to say that there are two strategies that can be used to teach biology, synchronous and asynchronous. During synchronous teaching, teachers use video conferencing platforms to carry out face to face learning virtually with students. During asynchronous teaching, students learn biology by watching recorded lectures, watching laboratory work videos, reading materials and doing assignments . Synchronous courses provide online learning environments that are very interactive and use web conferencing products, while in asynchronous courses provide

learners with a flexible environment that is self-paced with learners accessing course content using a variety of tools such as CD-ROMS streamed pre-recorded or video web recordings and podcasts .

Popular platforms used in synchronous teaching are Goggle Meet and Zoom. The virtual class link on Google Meet can also be used multiple times and can also be scheduled in advance. Anazifa (2022) goes on to say that another feature of Goggle Meet that supports learning is the video recording feature which enables learners to access the learning video recording anytime. In addition, there are also chat and raise hands feature that help create interaction , for example by asking or answering questions during the learning process. In asynchronous online learning platforms used include Google Classroom, Microsoft Team and LMS. These platforms are facilitated by teachers in order to manage their content coverage. They can upload the pre-recorded learning videos, learning materials in various formats (doc , pdf or power point), assignments and exams . However one can also combine these platforms with messaging application such as WhatsApps in order to organize students during the learning process.

WHAT DOES TECHNOLOGY INTEGRATION MEAN IN EDUCATION?

Integration of technology in education simply refers to the use of technology to enhance the student learning experience. Utilizing different types of technology in the classroom creates learners who are actively engaged with learning objectives. The implementation of technology also creates pathways for differentiated instruction to meet the unique needs of students as individual learners

within a broader classroom climate. According to Januszewski and Molenela (2000) iPads, cellphone, smart boards and social media are educational technology that fosters students' learning and motivation.

2.4.EXAMPLES OF HOW TECHNOLOGY IS USED IN EDUCATION.

Interactive whiteboards: also known as a smart board, these large interactive displays have a variety of applications. They can be used as a simple touchscreen display where teacher can annotate, for example connected multiple devices to create interactive quizzes, polls and tasks.

MOBILE DEVICES, TABLETS AND LAPTOPS

Internet - enabled devices such as laptops and tablets are a great way for students to work in the classroom. They can be used to support independent research and fact - checking or create more engaging classroom activities like quizzes. Tablets can also encourage student feedback to help teachers provide the support they need. Devices are at the very core of technology in education. To provide a level playing field for all students, schools must, where possible, provide reliable devices that have all the functionality required for the lessons being delivered.

LEARNING MANAGEMENT SYSTEMS (LMS)

An LMS is a digital platform that stores educational materials. They became particularly important for teachers during the pandemic, allowing them to distribute materials to students remotely. However, they also provide a place where educators can manage the curriculum and course content more effectively.

PROJECTORS AND TV SCREENS

While projectors have been around for some time, they are continually advancing in terms of quality and functionality. As well as displaying multimedia content to engage classes, they can be used to facilitate collaboration and group projects. Similarly, TV screens facilitate multimedia content within the classroom, including video and text.

MICROPHONES AND SPEAKERS

Audio equipment is vital for larger teaching environments, such as sports halls and assembly theaters. For example, in schools where there is a large number of students enrolled for Biology, the facilitators can make use of microphones and speakers. It maintains student engagement and are particularly helpful for students while hearing impairments or those with English as a second language.

3D PRINTERS

Primarily, 3D printing can be used to create models that allow a more hands - on approach to learning. That could be organs in Biology as part of a STEM laboratory.

HD and 360, degree cameras

Cameras are a great tool in schools they can be used as a way to improve teaching and learning. By recording lessons schools can obtain valuable resources for staff training not to mention providing a better experience for remote learners.

REMOTE LEARNING

Technology was a lifeline for education during COVID-19 lockdowns, when it facilitated remote learning for students of all ages. Going forward, it can still play an important role. That could be for those who can't make it to the classroom for whatever reason or just all pupils benefiting from engaging homework assignments through purpose - built applications.

BLENDED LEARNING

Blended learning is a practice that combines technologies like those above with face to face environment where teachers and students are physically present. Conventional classroom methods are also integrated, creating a ' best of both worlds ' approach. According to Koehler and Mishra (2009), at the heart of good teaching is three core components: content, pedagogy and technology as well as relationships among and between them. All pedagogical activities are strategies that address the preplanned objectives derived from the content. Comprise knowledge related to biology facts, concepts, principles, laws and theories that teachers should master to guide students learning. Students are prepared to undertake further studies and eventually build careers in scientific fields such as medical sciences and related fields, pharmaceutical sciences, environmental biology, biotechnology, plant and animal science and food sciences among others. Within many branches, biology plays a prominent role in 21st century society. This, the role of biology in the school curriculum is cardinal and permeates almost all science related courses. Moreover, biology knowledge can help solve many social problems related to health, poverty, food shortages, and crop production environmental conservation.

By considering these roles, effective instruction in biology is crucial. Indeed, teacher's quality in pedagogical approaches and content knowledge is crucial for the positive outcomes of biology curricula. The teaching and learning process, which requires increased student involvement and

higher learning levels (application, synthesis and evaluation), relies on media, including technology. Thus, Information Communication Technology (ICT) is a catalyst for change, and multimedia Integration can tremendously change existing learning principles. Considering this, scholars have asserted that new media system is interrupting traditional educational paradigms. Therefore, educationists argue that effective teaching and learning are impossible without digital pedagogy.

A strategy emphasized in effective biology instruction is the use of multimedia. Multimedia technology is a crucial aspect of ICT that presents information digitally using different media such as text, audio, video and other media. Multimedia is a multisensory initiating ability that stimulates multiple senses in the audience at a time, including the visual, aural, and tactile senses. Because individual learners have sensory preferences to perceive information from other senses, using multimedia makes teaching effective.

Moreover, not only text and images but audio, video and animation make a concept easier to understand. Technology integration creates an adaptive, interactive, and relevant learning environment in a dynamic classroom in the digital era. According to Cartoon (2022), technology-based biology instruction can become more dynamic and responsive to student needs, opening up opportunities for critical skills development, global collaboration and student preparation for a challenging future.

According to Ranasinghe and Leisher (2009), integrating technology into the classroom begin when a teacher prepares lessons that use technology in meaningful and relevant ways. Technology should assist the teacher in creating a collaborative learning environment. Teachers need to have appropriate training on how to use the computer for personal use (ie word processing, etc.) and

with students in the classroom Burkholder,1995, Hignite and Echternacht , 1992) . The instructor who has learned to integrate technology into existing curriculum may teach differently than the instructor who has received no such training. The difference in classroom technique and the greater extent of technology use should have a positive effect on teacher and student attitudes. According to Musingafi and Chadenanga (2014) information prepared on a computer could be better projected for larger students using power point projector. The PowerPoint presentations could be used in the classroom for supporting student learning by combining computers and a projector to display slides for illustrating a lesson. Koc (2005) articulates that the integration of technology into curriculum means using it as a tool to teach academic subjects and to promote higher order thinking skills of the learners.

For technology adaptation to be successful, teachers must be willing to change their role in the classroom (Hardy, 1998) . When technology is used as a tool, the teacher becomes a facilitator and learners take a proactive role in learning, this is supported by Preston (2015) who states that educational technology allows students to use computers, mobile devices and web tools to learn about science.

2.5. EFFECTIVENESS OF INSTRUCTIONAL MEDIA IN SCIENCE EDUCATION

Instructional media is a tool used in the learning process to convey material, information and communicate with students to achieve learning effectiveness. The use of instructional media is also Instructional media are all the things the teachers make use of to aid the learners in their learning process, they are the means used to bring about effective teaching and learning. According to Obara and Okoh (2005) instructional strategies and materials are defined as ' all the things the teacher utilizes to interactively enhance, motivate and facilitate teaching and learning in an attempt

to ensuring the achievement of a set of objectives. The effectiveness of instructional materials and strategies depends upon the manner and degree to which they meet the needs of the teacher and students. Instructional strategies and materials are selected based on the principles of provision of accurate materials that will enrich and support the curriculum taking into consideration the interest, abilities and maturity levels of the students. Buseri and Dorgu (2011) points out that teachers need to be encouraged in every way possible to use instructional strategies as it makes learning more concrete and meaningful. Teaching brings about understanding, it involves the teacher, the learner and subject matter and teaching materials. Therefore to bring about learning the teacher engages in certain activities such as talking, demonstrating and give instruction etc. , all these are the various ways to bring about learning (Adediran , 2014).

Different instructional media strategies need to be used by teachers to ensure students centered method in the classroom for creativity, innovative and critical thinking purpose in students. According to Adediran (2014), effective teaching in high schools should emphasize the use of activity - oriented method and instructional strategies that will make students achieve their learning objectives. Psacharolous (1985) observed that it is not just the provision of teaching and learning resources that matter but also their proper and effective utilization. Instructional media plays a crucial role in enhancing Biology education.

TYPES OF INSTRUCTIONAL MEDIA

- a. Visual media (images, videos and diagrams)
- b. Interactive media (simulation, games, virtual labs)
- c. Audio visual media (animations, podcasts)
- d. Text - based media (e- books, online resources)

Effectiveness of Instructional Media in biology education contribute to development of critical thinking and problem-solving skills (Kozma, 2003). According to Lowe (2004) effective instructional media leads to better visualization of biological processes. This is supported by Mayer (2009) who propose that effective instructional media in Biology contribute to enhanced understanding of complex concepts. Cepeda et al (2006) effectiveness of instructional media leads to increased retention and recall. According to Bloom's Taxonomy (1956) instructional media supports higher order thinking.

HOW DOES INSTRUCTIONAL MEDIA ENHANCE BIOLOGY LEARNING?

Visualizations: interactive 3D models illustrate complex structures for example cells and molecules. Animations demonstrate biological processes for example photosynthesis and mitosis. Videos showcase real- world applications. Instructional media and technology supplement traditional textbooks. Interactive diagrams and illustrations clarify complex concepts. Audio narrations and podcasts provide additional support.

2.6. IMPACT OF MEDIA AND TECHNOLOGY ON ACADEMIC ACHIEVEMENT

Media and technology usage have positive impacts on academic achievement. When a facilitator does not have adequate textbooks to give to the students, they can make use of E- books which are easily accessible. Technology provide students with access to a wide range of resources, such as online textbooks, videos and virtual labs, which can help them deepen their understanding of biology. This is particularly beneficial in a country like Zimbabwe where access to traditional learning resources may be limited. This is supported by Moyo (2017) who notes that there is

improved access to educational resources. Textbooks for biology as well as revision books can be easily shared amongst the learners.

Technology allows for personalized learning experiences tailored to the individual needs and learning styles of students. This can help student's better grasp biological concepts and retain information effectively, according to Nyathi (2019) this leads to better retention and recall of information. Learners can use the following examples of media and technology, computers and laptops, mobile phones and tablets. Internet and online resources. At times radio and television channels that offer Biology lessons can also be used by learners so that they grasp concepts. Educational software and applications. However there are negative impacts which can be encountered, since Rujeko High falls in a rural type of setting sometimes there is limited access to technology (Mudyiwa , 2015) because of few boosters. Media and technology lead to enhanced engagement. Interactive multimedia tools and simulations provide students with a hands-on learning experience, making biology more engaging and interactive. This can help students better understand complex biological concepts and processes. Technology also provide students with access to a wide range of resources, such as online textbooks, videos and virtual labs, which can help them deepen their understanding of biology. This is particularly beneficial in a country like Zimbabwe where access to traditional learning resources may be limited.

Technology enables students to collaborate with their peers, teachers and experts from around the world, fostering a collaborative learning environment. This can help students develop critical thinking, problem- solving and communication skills also instructional media and technology provide students with the flexibility to learn at their own pace and time, enabling them to revisit topics, review materials and practice skills as needed. This can help students achieve better learning outcomes in biology.

2.7. CATEGORIZATION OF INSTRUCTIONAL MEDIA

According to Odianwu and Azubike (1994), instructional tools are classified into three main groups, visual (sight), audio (sound only) , and audio - visual aids (combinant of sound and vision) .

Audio includes radios, cassettes and gramophones. They support instruction through hearing.

Visual consists of maps, samples, images, charts, etc. They support instruction through sight, visually, students appreciate the significance of notions, ideas and details. Audio- visual is a combination of audio and visual tools Sulaimain (2013) points out that these include televisions and videos.

2.8. BARRIERS TO THE USAGE OF INSTRUCTIONAL MATERIALS IN THE LEARNING PROCESS

There are many barriers to the usage of instructional media. Ema (2010) insists that these barriers fall into two categories, and they are Extrinsic and Intrinsic barriers. Extrinsic has to do with access, time, support services, resources and training. Intrinsic has to do with: attitudes, beliefs, practices and resistance. These concepts and practices impact in one way or the other on the level and regularity of utilization of instructional resources in class. Insufficient level of understanding can lead to rejection and discontinuance of its use because of the stress, strain and frustration likely to be encountered. It is highly recommended that flyers or book let serving as guides should accompany any instructional material works in the instructional process. Every technology or material used in class is subject to the teacher's control. The level of the teacher's creativity and performance skills determine the level of success or failure of the activities, this is supported by Kwasu and Ema (2015). The type of material to be used should vary according to the grade level of the learners and the subject matter to be studied. In whatsoever form and level of usage the facilitator must know how and why they should be used.

Hew and Brush (2007) concurs by stating that they are potential barriers to the implementation of technology. These include insufficient resources, including inadequate access to technology and planning time. Incomplete administrative support or school planning. Perceptions that technology is inconsistent with the traditional culture of the subject area, Biology. At times the facilitators have a negative attitude towards the usage of technology. Lack of knowledge about skills related to specific technologies. Technology - supported pedagogy, and technology - related classroom management and focus on using technology for computer - based testing rather than teaching and learning.

2. 9.STRATEGIES TO OVERCOMING BARRIERS

The school should develop a shared vision and technology integration plan, overcome resources constraints by for example, introducing technology into one or two subject areas at a time and creating a hybrid technology setup in classroom that involves cheaper computer systems. The school should also provide teachers with ongoing encouragement and professional development and aligning technologies to state curriculum standards (for example technology supported project-based learning aligned with state learning objectives).

2.10. CHAPTER SUMMARY

The chapter covered the views and contributions made by several scholars on the impact of instructional media and technology on Biology learning and achievement. It also highlighted the barriers faced by schools in the implementation of instructional media and technology.

CHAPTER 3: RESEARCH PARADIGM, DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter shall deal with the research design and methodology for the study. It embarks on the research design which involves the population, sample, sampling techniques as well as the data collection instruments to be used. The chapter will also highlight the data presentation and analysis techniques to be used by the researcher.

3.2. RESEARCH DESIGN

According to Oxford Advanced Learner's Dictionary of Current English (1986; 720) research is defined as “systemic investigation undertaken in order to discover new facts, get additional information). This is supported by Kothari (2004) research is an original contribution to the

existing stock of knowledge making for its development. The systemic approach concerning generalizations and formulations of a theory is also research.

A research design is the plan or framework used to conduct a research study. It involves outlining the overall approach and methods that will be used to collect and analyses data in order to answer research questions or test hypothesis. Leedy (1997) defines research design as a plan for a study, providing the overall framework for collecting data. Macmillan and Schumacher (2001) define it as a plan for selecting subjects, research sites and data collection procedures to answer the research questions.

The researcher opted for a positivist approach. Positivism is the belief that knowledge can be obtained through objective observations and measurements. It assumes that answers can be found by carefully measuring and analyzing data, particularly numerical data. The type of paradigm manifests in methodologies that make use of quantitative data and oftentimes (but not always adopt experimental or quasi- experimental research designs. As a result, studies with a positivist research philosophy aim for objectivity, generalizability and replicability of findings.

3.3.QUANTITATIVE RESEARCH METHODOLOGY

Van der Merwe (1996) define quantitative research as an approach aimed at testing theories, determining facts, demonstrating relationships between variables and predicting outcomes. It is a systematic investigation that primarily focuses on quantifying relationships among variables through the collection and analysis of numerical data. The following are key characteristics of quantitative research

Objective measurement: it relies on objective measurements and statistical, mathematical, or numerical analysis of data collected through various means such as surveys, polls and experiments.

Generalization: the findings aim to be generalizable across larger populations, allowing researchers to draw broader conclusions from their data.

Causality and Relationships: quantitative research designs can be descriptive, establishing associations between variables, or experimental which aims to establish causality by manipulating variables. Statistical analysis: it employs statistical methods to analyze data.

3.4. Population

The population of this study comprises of the Administration, Head of Department Biology, teachers and learners from Rujeko High school. Population is a statistical term that designates the pool from which a sample is drawn for study. Lewis and Thorn hill (2009) define population as the complete set of cases or group members that are of interest to the researcher. Any selection grouped by a common feature can be considered a population. The target population of this study is likely to provide more informed and considered responses to the sought information on the impact of instructional media and technology on Biology learning and achievement. The target population is three biology facilitators, twenty-four form three Biology learners, three administration members.

3.5.SAMPLE AND SAMPLING TECHNIQUES

Kombo and Tromp (2005) state that sampling is choosing a certain quantity of subjects among the targeted population with the aim of representing that population. Simple random sampling shall be used. Simple random sampling technique helps to ensure that every individual in the organization has an equal chance of being selected at first. This helps to limit biased selection of a sample and make the data collected more valid and reliable. Rujeko High was selected among

the schools in Mazowe District that offer Biology as a subject. The school is within close proximity to the researcher . The school was selected as it has a densely populated class of Ordinary level learners, which makes it easier to have a control group as well as an experimental group.

3.5.1. SAMPLE SIZE

The sample size is the subset of the entire targeted population. The sample size involved in the study is as follows:

RESPONDENT	NUMBER
HOD Biology.	1
Teachers.	1
Learners.	28

The learners are 14 girls and 14 boys from form three Biology class.

3.6.0. RESEARCH METHODS

3.6.1. QUESTIONNAIRE

The researcher has opted for the following data collection methods, questioners are to be used to collect data information. It shall be used to investigate the relationship between instructional media and technology usage and student's academic performance in Biology. A questionnaire is a form containing a set of questions especially addressed to a statistically significant number of subjects and is a way of gathering information for a survey. For the purpose of this study the questionnaire is to be given to the Head of Department, Biology as well as the school head and deputy head for the purpose of gathering quantitative data on student's usage of instructional media and technology.

3.6.2. ACADEMIC PERFORMANCE DATA

Academic performance data refers to the quantitative and qualitative information collected regarding students' educational achievements and progress. This data is crucial for educators and researchers as it provides insights into student learning outcomes, instructional effectiveness and areas needing improvement. Academic performance data encompasses various metrics that reflect students' learning and achievement levels. Common forms of this data include: test scores, grades, attendance records, behavioral data as well as course completion rates.

3.6.3 ACADEMIC PERFORMANCE DATA SHALL BE USED TO ANALYZE THE ACTUAL ACADEMIC PERFORMANCE METRICS.

The research design shall show how Instructional media and technology impact student's retention and transfer of key Biology concepts. The test scores from the control group as well as the experimental group shall be compared.

3.6.4. EXPERIMENTAL DESIGN

Experimental design is a systematic approach used in research to collect data in a controlled and objective manner. It involves planning how to conduct an experiment to ensure that the results are valid and reliable. The primary goal of experimental design is to establish cause - and - effect relationships between variables by manipulating one or more independent variables and observing the effect on a dependent variable. For this study the researcher chooses the true experimental design type of research method, since it involves an experimental group and control group. Each participant has an equal chance of being placed in any group, which helps to eliminate bias and increases the likelihood that the groups are comparable at the start of the experiment.

3.7.DATA VALIDATION

Data validation means checking the accuracy and quality of source data before using, importing or otherwise processing data. Any type of data handling task, whether it is gathering data, analyzing it or structuring it for presentation, must include data validation to ensure accurate results. This is supported by the Data Governance Institute (2020) which agrees that data validation is the process of checking data for errors, inconsistencies, or inaccuracies, and ensuring that it meets specified criteria or requirements.

3.8. RELIABILITY

American Psychological association (2020) defines data reliability as the completeness and accuracy of data as a measure of how well it can be counted on to be consistent and free from errors across time and sources. The more reliable data is, the more trustworthy it becomes.

3.9. DATA PRESENTATION AND ANALYSIS PROCEDURE

Saunders (2007) highlighted that data presentation entails organizing, processing and summarizing large amounts of data into small easily understood instruments like tables, graphs, histograms, bar charts and pie charts.

3.9.1. DATA ANALYSIS

Data analysis is the process of inspecting, cleaning, transforming and modelling data to extract useful information, inform conclusions, and support decision - making. It involves using various statistical and analytical techniques to identify patterns, trends, relationships and correlations within datasets (ISO, 2015).

In the study, the data analysis shall encompass organizing collected data, categorizing, finding explanations of the data. After data collection the researcher shall recheck the data for comprehensiveness of the questionnaires then compile the data. The academic performance data, in the form of test scores shall be tabulated and compared using T test or Pearson correlation

statistical methods. For the purpose of the study there shall be two groups the control group as well as the experimental group which shall be compared. One group shall be taught using traditional method and the other group, instructional media and technology. Quantitative data will be tabulated and analyzed using simple frequencies, percentages and means. The findings will be used to make recommendations on the impact of instructional media and technology on Biology learning and achievement.

3.10. DATA COLLECTION PROCEDURE

According to Babbie (1995), data collection procedures are the measures taken and processes in data collection in a research. These are procedures and measures that the researcher has to take so as to be able to collect data on the impact of instructional media and technology on Biology learning and achievement at Rujeko High school. The researcher shall distribute questionnaire to the HOD Biology, the school head and deputy head. Twenty-four learners which include twelve females and twelve males shall partake in the experimental design. Afterwards learners will be tested, academic performance data in the form of test scores shall be analyzed using independent T- test or Pearson Product Moment Correlation. The findings shall determine the impact of instructional media and technology on Biology learning and achievement.

3.11. ETHICAL CONSIDERATIONS

The respondents shall be assured that the information accessed in the course of the study would be protected from unauthorized persons and that information obtained would be used for academic purposes only.

3.12. CHAPTER SUMMARY

This chapter dealt with the research philosophy adapted for the study. It embarked on the research design which involves the population, the sample, sampling techniques and data collection

instruments used. The chapter also dealt with data presentation and analysis techniques used by the researcher.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1. INTRODUCTION

This chapter focuses on the presentation, interpretation, analysis and discussion of data gathered on the study of the impact of instructional media and technology on Biology learning and achievement of Ordinary level learners at Rujeko High school. Data was gathered through questionnaires, pre- test and post- test from teachers and learners. This chapter will present data on the findings on the demographic situation, instructional media and technology usage, effectiveness of the Instructional media, challenges faced by teachers and support expected. The

results of the pre- test and post- test that were administered to the learners will be presented. The research questions that will be analysed, presented and interpreted are:

- i) What is the impact of instructional media and technology on Biology learning and achievement?
- ii) How does the use of instructional media and technology affect students' understanding of Key Biology concepts?

•CONTEXTUAL DATA

4.1.1 RESPONSE RATE

The researcher was granted permission by the school administration at Rujeko High school. There are two teachers who take Biology learners at the school and they responded to the questionnaires given. A total of twenty- eight learners took part in the research study.

TABLE 4.1A. SHOWING RESPONSE RATE FOR QUESTIONNAIRES

Respondents	Questionnaire dispatched	Questionnaire returned	Response rate
Department of Biology 2 teachers	2	2	100%

A high response rate of 100% in a research study is generally considered desirable, as it can increase the reliability and validity of the findings (Bryman , 2016) . A high response rate can increase the representativeness of the sample, reducing the risk of non - response bias (Groves et

al . ,2013) .Shadish et al (2002) goes on to say that a high response rate can enhance the generalizability of the findings to the larger population , increasing the study's external validity. Since the teachers involved in the study teach biology for both O and A levels at the school for 23 years they have a wide range of experience, therefore they can give enough feedback on the impact of instructional media and technology on Biology learning and achievement.

TABLE 4.1B SHOWING GENDER DISTRIBUTION OF PARTICIPANTS

GENDER	NUMBER
Male	14
Female	14
Totals	28

In the study the participants for both the control group and Experimental group each have an equal selection of gender. 7 boys and 7 girls representing the control group as well as 7 boys and 7 girls representing the experimental group. According to Cohen et al (2018) , the selection of learners for a research study is a crucial aspect of research design, as it can significantly impact the validity and generalizability of the findings. The researcher used convenience sampling, selecting participants from a readily available population , learners at Rujeko High who take Biology as a subject. Etikan et al (2016) states that the convenience approach can be efficient and cost effective. The participants voluntarily chose to take part in the study . The researcher explained the significance of the study to the learners and they were eager to take part.

The researcher ensured a balanced gender representation by selecting equal numbers of boys and girls for both groups. This can help minimize potential gender biases and ensure that the findings are more generalizable. The use of instructional media and technology might help bridge the achievement gaps between boys and girls in Biology, as both genders may benefit equally from the interactive and visual learning experiences .

4.1.2. •STUDENT DEMOGRAPHICS

Age

- Mean age : 16.2 years
- Range. : 15-18 years

Frequency distribution

- 15 years : 20%
- 16 years : 40%
- 17 years. :30%
- 18 years : 10%

Gender

- Male : 50%
- Female: 50%

Ethnicity

- African 100%

Prior Academic Achievement

- Mean Biology grade : 68%
- Mid year (2024) Pass rate in Biology 65%

Access to Technology

- Owns a smartphone: 74%
- Has access to a computer at home 30%
- Has access to the internet at home : 25%

4.1.2. DEMOGRAPHIC DATA OF TEACHERS

Basing on the respondents, both of the teachers have Degrees in Education, one in Biology and the other a BSc (Chemistry and Biochemistry). Both of the respondents have 23 years of teaching experience. One takes Ordinary Level learners and the other teachers both Ordinary and Advanced level Having qualified teachers at a school has significant implications for the achievement of learners. Hanushek (2011) notes that teacher quality is a critical factor influencing student learning outcomes. Qualified teachers are more effective in improving student learning outcomes, including academic achievement, attendance and graduation rates (Goldhaber and Brewer 2000) . Qualified teachers are better equipped to implement curriculum effectively , ensuring that students receive a high -quality education that prepares them for success as supported by Wiggins and McTighe (2005) . Furthermore qualified teachers are more effective in managing classroom behavior, creating a positive and respectful learning environment that promotes student achievement. The researcher witnessed a high level of organized learners who were eager to learn during the research study this was due to the discipline instilled in them by their teachers.

4.1.3. INSTRUCTIONAL MEDIA AND TECHNOLOGY USAGE

Respondents highlighted that they use the following

- a. Textbooks
- b. Charts
- c. Diagrams
- d. Printer
- e. Computer
- f. Laptop
- g. Overhead projector
- h. Multimedia presentations
- I. Laboratory equipment
- j. Laboratory specimen

There is a wide range of instructional media and technology usage at Rujeko High school. However textbooks are used more frequently than other instructional Technological tools such as overhead projectors , laptops and computers are not frequently used because of lack of skills .

4.1.4. USAGE OF INSTRUCTIONAL MEDIA AND TECHNOLOGY DURING LESSONS

Based on a scale of 1 to 5, where 1= Rarely and 5=Almost Always both respondents gave a rating of 3. This shows that some types of instructional media and technology are not used on a regular basis and the study will give the teachers the impact of using instructional media and technology on a regular basis when teaching learners at Rujeko High school.

**FACILITATORS RESPONSES ON TEACHING AND LEARNING MATERIAL
AVAILABILITY**

The researcher noted that the respondents indicated that the use of electronic media technology, to a large extent effectively improves students learning and academic performance. One of the respondents commented that the use of instructional media and technology has increased the understanding of concepts by the learners. On a scale of 1 to 5, where 1= strongly disagree and 5= strongly agree, all the respondents gave a scaling of 5 on how Instructional media and technology has improved student learning outcomes in Biology.

**TABLE 4.1.C. SHOWING THE AVAILABILITY OF TEACHING AND LEARNING
MATERIAL AVAILABILITY**

PHYSICAL FACILITIES	5	4	3	2	1
Equipment in biology laboratory is sufficient for learner's population			✓		
Teaching & learning materials textbook/ student ratio is good			✓		
Biology teachers guide sufficient				✓	
Materials such as charts, chalk board, diagrams are adequate	✓				

Computers and internet are commonly utilized in learning		✓			
There are sufficient biology reference books	✓				

TABLE 4.1 .D.SHOWING THE RESPONDENTS PERCEPTION ON THE EFFECTIVENESS OF INSTRUCTIONAL MEDIA AND TECHNOLOGY TOOLS ON PERFORMANCE OF STUDENTS

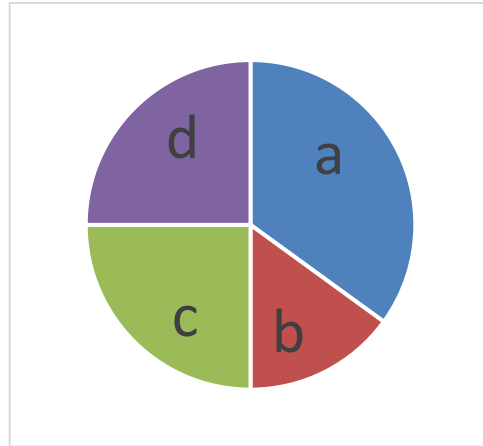
Instructional media and technology	Not at all	Lower extent	Large extent
Textbooks		✓	
Charts and diagrams		✓	
Power point projector			✓
Overhead projector			✓
Multimedia presentations			✓
Laptop		✓	
Computer		✓	
Laboratory equipment specimen			✓

The facilitators at Rujeko High school agreed that to a lower extent textbooks, charts , laptop and computer have an effect on student's academic performance. However some technological tools such as overhead projectors and multi media presentations have an influence on learners academic performance.Laboratory equipment and specimen both have an impact on student performance. For example on the teaching of the topic Photosynthesis, learners are able to grasp concept if they carry out experiments in the laboratory.

4.1.E. CHALLENGES FACED BY FACILITATORS WHEN USING INSTRUCTIONAL MEDIA AND TECHNOLOGY IN BIOLOGY LESSONS

Key

- a. Technical issues e.g electricity
- b. Time constraint
- c. Limited resources
- d. Lack of training

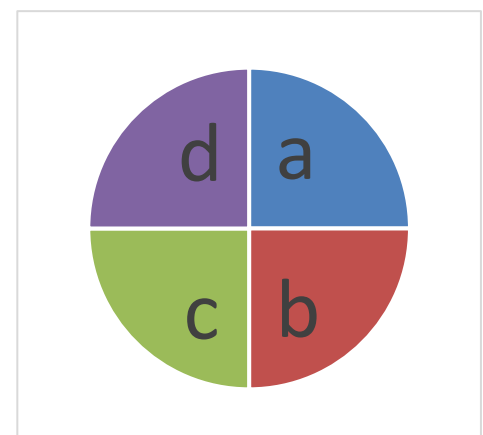


The researcher has noted that the facilitators are facing power cuts at the school . Electricity is used in the biology laboratory, used in the classroom when having PowerPoint presentations. At times the facilitators need to print handouts for the students but fail to do so because of shortage of power supply. Since the Biology syllabus is widely spread, the facilitators can make use of social media platforms such as WhatsApp during the weekend inorder to cover the syllabus . At Rujeko High school there is a shortage of resources such as microscopes . The ratio of students to microscope needs urgent attention.

4.1.F. SUPPORT NEEDED BY FACILITATORS INORDER TO EFFECTIVELY INTEGRATE INSTRUCTIONAL MEDIA AND TECHNOLOGY INTO BIOLOGY LESSONS.

Key

- a. Professional development



- b. Technical support e.g installation of solar system
- c. Access to resources
- d. Collaboration with colleagues e.g from IT department

The respondents elaborated that there is need for training especially on how to use technological equipment such as overhead projectors. Another teacher indicated the need for solar powered system at the laboratory. One of the respondents highlighted the importance of teaming up with IT department in some sessions so that lessons are conducted smoothly without flaws.

4.1.6. DATA PRESENTATION OF LEARNER'S PRETEST AND POST- TEST

- Differences in Pre-Test scores between the Control group and Experimental groups.
- Test scores from Control group indicate a mean of 16.5. Whereas the experimental group obtained a mean of 16.3. These results show that both groups had been treated the same, no variables were used.
- Differences in Post test scores between the Control and experimental groups
- Test scores from Control group indicate a mean of 17.8 whereas the experimental group obtained a mean of 26.7.
- A total of fourteen learners were selected for each group. The post - test was administered after one week and the scores are given as above.

4.2. ANALYSIS AND INTERPRETATION

Analysis

According to Anderson (2015) data analysis is the process of extracting insights and meaningful information from data. It involves using various techniques, tools, and methods to examine data sets, identify patterns, trends and correlations, and draw conclusions based on the findings.

4.2.A.RESEARCH QUESTION 1: What is the impact of instructional media and technology on Biology learning and achievement?

DATA COLLECTED FROM QUESTIONEERS

The researcher has observed that teachers at Rujeko High school use technology such as laptops, printers, overhead projectors and PowerPoint presentations when conducting their lessons. This is supported by Guan et Al (2018) who supports the combination of more than one media type such as text (alphabetic or numeric), symbols, images, pictures, audio, video and animations, for the purpose of enhancing understanding or memorization. The effective integration of technology into the classroom requires teachers to have the necessary skills and knowledge. Training programs for teachers on technology usage are essential to ensure that teachers can effectively use technology to support student learning. Teachers should have opportunities to practice using technology in a supportive environment. According to the US. Department of Education (2010) workshops and conferences such as face to face training sessions that provide hands - on experience and opportunities for collaboration should be implemented by the ministry. Also, one - on -one support and guidance from experienced educators or technology specialists, Koehler and Mishra (2009) .

Data obtained from the questionnaires show that since the teachers have 23 years experience there are likely to be familiar with various instructional media and technology usage, enabling them to integrate the instructional media and technology into teaching. Seasoned teachers likely have a deeper understanding of how to design engaging lessons which helps them to better incorporate instructional media and technology to support student learning. However on the questionnaires, Section 2 number 3, the teachers highlighted that their equipment in the biology laboratory is not sufficient for learners' population. Also the textbooks available do not have sufficient teachers' guides. Furthermore the teachers answered that on a scale of 1 to 5, they rank 3 on the use of instructional media and technology when conducting Biology lessons.

DATA COLLECTED FROM LEARNERS TESTS

4.2.B. ANALYSIS OF RESEARCH QUESTION 1 : What is the impact of instructional media and technology on Biology learning and achievement? As seen from learners' Tests (Pre and Post). 80% of learners from Rujeko own a smartphone and sometimes the teacher makes use of a Social media platform, WhatsApp to send notes and homework assignments to the learners. Since only 30% of the learners have access to a computer at home, the teacher had to make use of the smartphone so that information is disseminated to a large audience. The researcher, with the assistance of the teacher selected 14 learners who have smartphones at home and they were taught online by the researcher, since it was the experimental group, the researcher wanted to make sure that the group could watch the video alone whilst at home. The learners were given a week of preparation time so that they could familiarise themselves with the video as well as PowerPoint presentations on the topic Photosynthesis before they wrote a Post - test. The results from both the Pre-Test and Post Test are summarized below:

It can be seen that mean from the Pre- test scores was 16.5 and 16.3 from control and experimental groups respectively. When the researcher used video and PowerPoint on the experimental group during the post- test, mean went up to 26.7. This shows that when instructional media and technology was used learners were able to grasp concepts in the topic Photosynthesis more than when only traditional media of chalk was used as seen on the control group their mean improved from 16.5 to 17.8.

CONCLUSION OF THE RESEARCH FINDINGS FROM RESEARCH QUESTION 1:

What is the impact of instructional media and technology on Biology learning and achievement . Teachers at Rujeko High school use a variety of teaching aids which include visual media and textbooks . However at the school there are electronic media tools such as overhead projectors, laptops and computers but the teachers are facing power shortages . One of the teachers indicated that there is need for training on how to use gadgets like overhead projectors. Research findings from the learners indicated that there are 80% of learners who own cellphones . The teachers can make handouts for the remaining 20% so that all learners have access to educational Results from the Pre Test and Post Test show that the teachers at Rujeko should make use of instructional media and technology on a regular basis inorder for the learners to grasp concepts in Biology.

4.3. ANALYSIS OF RESEARCH QUESTION 2: How does the use of instructional media and technology affect students' understanding of key Biology concepts?

4.3.A.DATA COLLECTED FROM QUESTIONEERS

- From the data obtained from the questioners the teachers answered question 4 : Which Instructional Media and technology tools do you use most frequently? The following were the responses : textbooks, charts, diagrams, computer , multimedia presentations and projectors. These influence student understanding of biology concepts.
- The researcher asked the facilitators how they integrate instructional media and technology into Biology lessons when they were answering question 7 . The teachers answered that they make use of online lessons on WhatsApp social media platform and have online lessons and discussions every Saturday inorder to cover the lengthy biology syllabus.
- Teacher's perceptions on the impact of instructional media and technology on student understanding, engagement, motivation and achievement. From Research Question 5 , open ended answer. One of the teachers answered that technology helps students develop a deeper understanding of biological concepts, leading to better academic performance. Another teacher indicated that student motivation is improved improves since the use of visual aids facilitate understanding of abstract concepts.

The respondents highlighted that when instructional media such as textbooks, teachers guides, diagrams and charts are used during the teaching and learning process to a lower extent there is some improvement on the academic achievement of learners as compared to when overhead projectors, presentations, laboratory equipment and laboratory specimen are used. To a large extent there is a remarkable improvement on the learners understanding of concepts. This is supported by Inwood (2013) who posits that laboratory specimens provide students with real - world examples of biological concepts, making learning relevant and engaging. This is supported by Wandersee and Eitel (2017) who notes that laboratory specimens help students develop a deeper understanding of biological structures and their functions.

4.3.b.DATA COLLECTED FROM LEARNERS FROM RESEARCH QUESTION 2 : How does the use of instructional media and technology affect students' understanding of key Biology concepts?

The researcher observed that during the lesson which was followed by a Post Test, learners who were exposed to Instructional Media and technology in the form of PowerPoint presentations and a video were active participants during the lesson. This showed that there had a better understanding of complex biological concepts. This was seen by the marked improvements in the test scores from Pre Test and Post Test scores .

CONCLUSION OF THE RESEARCH FINDINGS FROM RESEARCH QUESTION 2 : How does the use of instructional media and technology affect students' understanding of key Biology concepts?

Information gathered from the questionnaires indicated that teachers at Rujeko High school use charts , diagrams , textbooks and other electronic media tools to enhance student understanding of key Biology concepts. Teachers indicated that they make use of online lessons in the form of a WhatsApp group which they use on Saturdays inorder to cover the lengthy biology syllabus.Information gathered from the tests written by the learners indicated that the experimental group which was exposed to a 3D video , got better scores as compared to the control group. The researcher has observed that teachers should make use of a variety of instructional media and technology inorder for learners to grasp complex concepts in biology.This can be attributed to the

control group's test scores which slightly improved because of the traditional teaching method used .

4.4. DATA INTERPRETATION

According to Kotler and Keiler (2016), data interpretation is the process of assigning meaning to data, identifying patterns, trends, and relationships, and drawing conclusions based on the analysis. It involves using various techniques, tools and methods to extract insights from data which can inform decision making, solve problems and drive business or organizational success.

4.4.A. DATA INTERPRETATION OF RESEARCH QUESTION 1: What is the impact of media and technology on academic achievement of learners

After conducting a study on the impact of instructional media and technology on academic achievement the researcher obtained the following results in the Pre- test: Control mean of 16.5 and SD of 2.59. Experimental mean of 16.3 and SD of 2.56 with a sample population of 14. Afterwards a variable was used on the experimental group which was a video on the topic Photosynthesis. The control group was treated to a traditional method of teaching and obtained a mean of 17.8 and SD of 1.56, the experimental group obtained a mean of 26.7 and SD of 1.86 with a sample population of 14. The research used a two- sample t- test to see if there is a statistically significant difference between them. Test hypothesis: H_0 the use of instructional media and technology has no impact on Biology learning and achievement. H_1 the use of instructional media and technology has a positive impact on Biology learning and achievement.

Data summary:

Pre-Test

Control Group

Mean (m_1) = 16.5

Standard deviation (SD) = 2.59

$n_1 = 14$

Experimental Group

Mean (m_2) = 16.3

SD2 = 2.56

$n_2 = 14$

Post test results**Control Group**

Mean (m_3) = 17.8

SD3 = 1.56

$n_3 = 14$

Experimental Group

Mean (m_4) = 26.7

SD4 = 1.86

$n_4 = 14$

Statistical calculations

Pre- Test Analysis (Control vs Experimental)

Calculating t- statistic

$$t = \frac{m1-m2}{\sqrt{\frac{SD1^2}{n1} + \frac{SD2^2}{n2}}}$$

$$t = \frac{16.5 - 16.3}{\sqrt{\frac{2.59^2}{14} + \frac{2.56^2}{14}}}$$

$$\therefore t = 0.205$$

Conclusion

The Pre- test t- statistic of approximately 0.205 suggests that no significant difference between the Control and experimental groups before the variable was used.

Post-Test Analysis

(Control Vs Experimental

$$t = \frac{m3-m4}{\sqrt{\frac{SD3^2}{n3} + \frac{SD4^2}{n4}}}$$

$$t = \frac{17.8 - 26.7}{\sqrt{\frac{1.56^2}{14} + \frac{1.86^2}{14}}}$$

The post-test t- statistic of approximately -13.71 indicates a statistically significant difference showing that the experimental group performed much better after the intervention with the video.

Comparing critical value from the t- distribution table with df = n1+ n2 -2 = 26 for both tests at 0.05 significance level. The researcher concludes that instructional media and technology has an impact on the academic achievement of Therefore we reject H0.

The above results show that there is a positive impact between the use of instructional media and technology and academic achievement. Meaning that instructional media and technology has an impact on the academic achievement of learners at Rujeko High school. This is supported by Murphy and Bakia (2010) who outline that usage of instructional media and technology can lead to improved student outcomes, including increased academic achievement and retention rates. According to Mean et al (2010) instructional media and technology can increase access to educational opportunities, particularly for students who may not have had access to them. Instructional media and technology can enhance student engagement and motivation, this is supported by Hativa (2013) who notes that usage of instructional media and technology leads to increased academic achievement. This can be seen from the results of the test scores. When a 3D video was used on the experimental group their results increased.

According to Buseri and Dorgu (2011) teachers need to be encouraged in every way possible to use instructional strategies as it makes learning more concrete and meaningful. However facilitators are encouraged to use various types of instructional media which include visual media such as images, videos and diagrams. Interactive media which include simulation, games and virtual labs. Audio visual media such as animations and podcasts can also be integrated into the learning process. There is also text - based media which include E- books and these bridges the gap when there is shortage of textbooks.

4.4.B: INTERPRETATION OF RESEARCH QUESTION 2: How does the use of instructional media and technology affect students' understanding of key Biology concepts?

The Test scores of the learners indicated in 4.1.2 show that when an independent variable was used thus a video, contributed to an increase in learners test scores after the administration of an independent variable. Also, on the Control group there is a slight increase in their marks, from 16.5 mean up to 17.8 mean. The slight increase was due to the usage of the traditional teaching method of chalk and talk which was used a week before by the researcher on both groups the control and experimental. The findings suggest that the use of instructional media and technology has a positive effect on student's understanding of key Biology concepts. Furthermore the researcher has observed that when the chalk and talk method is accompanied by textbooks and diagrams there will be a remarkable improvement on the learners level of understanding especially when the school does not have access to technological tools.

4.3. CHAPTER SUMMARY

The main focus of this chapter was data presentation, interpretation and discussion. The data presented was gathered through questionnaires and tests. The researcher used tables, pie charts to present data. The data obtained revealed that there are some challenges being faced by the Biology Department at Rujeko High school which includes shortage of electricity which needs to be solved through the installation of solar powered system. The researcher also observed that the usage of instructional media and technology has a positive impact on Biology learning and achievement as well as affect students' understanding of key Biology concepts. The next chapter gives summary of findings, conclusions and recommendations.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. INTRODUCTION

The research is intended to study the impact of instructional media and technology on Biology learning and achievement of Ordinary Level learners at Rujeko High. This chapter consists of the sum up of the research. It includes the findings that are drawn from analysis, interpretation, conclusions and suggestions for further studies .

5.2. Summary of the research project including constraints

The major purpose of this study was to investigate the impact of instructional media and technology on Biology learning and achievement of Ordinary Level learners at Rujeko High School in Mazowe District of Mashonaland Central Province in Zimbabwe. The study has highlighted the background of the study, statement of the problem, research objectives including the research hypothesis, significance of the study and delimitations of the study and definition of key terms in Chapter 1.

The study focused on related literature review. Theoretical framework on the usage of instructional media and technology on academic achievement were given. Benefits of using instructional media and technology were given as well as challenges faced by facilitators when using instructional media and technology were explained. The study also focused on the different categories of instructional media. The summary of the chapter was drawn .

The design of the study was both quantitative and qualitative. Research questions were raised and research questions were tested using T- test. From the results of analysis discussed in chapter 4.2

and 4.3 , the study shows that there is a significant difference between the achievement of students taught using instructional media and technology and those taught by traditional method.

5.3. CONCLUSIONS

Instructional media and technology when fully implemented is different from the traditional teaching - learning process . It is determined in this study that usage of instructional media and technology has a positive impact on learners' attitude towards biology. The following conclusions are drawn:

1. Instructional media and technology are an effective teaching and learning strategy that enhances biology students academic achievement.
 2. Instructional media and technology promote students interest and motivation in biology, leading to improved academic performance.
 3. Instructional media and technology helps learners grasp complex concepts in Biology thereby improving academic achievement and performance.
- The study has shown that the use of instructional media and technology has a positive impact on student performance. When instructional media and technology are used in biology learning students not only enjoy the lesson but also their level of understanding improves .We therefore Reject H_0 and conclude that there is a positive relationship between instructional media and technology usage and student's academic achievement.

IMPLICATIONS FOR THE STUDY

The evidence of the study suggest the following:

EDUCATIONAL IMPLICATIONS

1. Effective use of instructional media and technology can lead to better understanding and retention of Biology concepts, resulting in improved academic performance. Interactive media and technology can increase learner motivation and participation, making Biology lessons more enjoyable and interactive.
2. Technology can facilitate personalized learning experiences, allowing teachers to tailor instruction to individual learners' needs and abilities.

PRACTICAL IMPLICATIONS

1. Teachers may require training to effectively integrate instructional media and technology into their teaching practices.
2. Rujeko High School needs :
 - to invest in infrastructure, such as computers, tablets, and internet connectivity, to support the use of instructional media and technology.
 - There may be a need for the development of high-quality, Biology-specific instructional media and technology resources.

5.4. RECOMMENDATIONS

Based on the findings and conclusions of this study, the following recommendations were made :

- The problem of shortage of textbooks can be resolved by using e- books as well as handouts with relevant notes from the facilitator.
- Provide teachers with ongoing training and support to develop their technology skills , ensuring they can effectively integrate technology into their biology lessons.

- Teachers should utilise multimedia instructional packages such as videos, simulations and interactive diagrams, to enhance student engagement and understanding of complex Biology concepts.
- There is need for the school administrators to source adequate funding from the government and non governmental organizations to purchase instructional media and technology tools.
- In order to improve the effectiveness of Integrating technology into Biology learning there is need to pair teachers with experienced educators who can provide guidance and support.
- Teachers should select technologies that are relevant to biology learning and engage students, such as simulations and games.
- Administration members should encourage collaborative learning through technology such as online discussions.
- SDC and parents should organise for the purchase of laboratory equipment, textbooks and install solar system at the school so that the problem of power supply shortage is curbed.
- Education Policy implementors should encourage the use of instructional media and technology in Biology learning so that public examinations pass rates are improved at national level leading to more students being enrolled into tertiary institutions that offer courses such as Nursing , Medicine, Pharmacy, Veterinary Science, Agriculture among others which need knowledge in the subject .
- Inspire comparative studies to evaluate the effectiveness of different instructional media and technology approaches in Biology education.

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APPENDICES

APPENDIX 1: LETTER OF INTRODUCTION TO RESPONDENTS.

SAMED

P Bag 1020
BINDURA
ZIMBABWE

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

 BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: 15-10-2024

TO WHOM IT MAY CONCERN

NAME: MUNZVENGA ESTHER N REGISTRATION NUMBER: B2257738

PROGRAMME: HBSc EdBz PART: 2.2

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

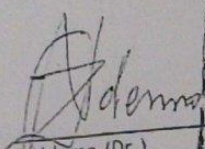
The student has to undertake research and thereafter present a Research Project in partial fulfillment of the BACHELOR OF SCIENCE EDUCATION programme. The research topic is: DEGREE BIOLOGY

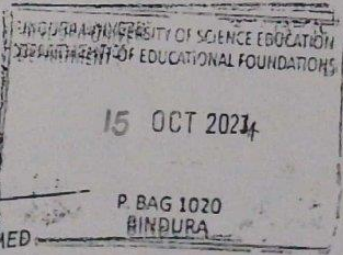
AN INVESTIGATION INTO THE IMPACT OF INSTRUCTIONAL MEDIA AND TECHNOLOGY ON BIOLOGY LEARNING AND ACHIEVEMENT OF ORDINARY LEVEL LEARNERS AT RUJEKO HIGH SCHOOL

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

Your co-operation and assistance is greatly appreciated.

Thank you


Zindemo (Dr.)
CHAIRPERSON - SAMED


15 OCT 2024
P BAG 1020
BINDURA

APPENDIX 2: TEST FOR LEARNERS

Form.....

Gender.....

Test for Form 3 Biology learners

Topic: Photosynthesis

Section A

Multiple Choice Questions

1. What is the primary function of chlorophyll in photosynthesis?

- a) To absorb water
- b) To release oxygen
- c) To absorb light energy
- d) To synthesize glucose

2. Which of the following is a product of photosynthesis?

- a) Carbon dioxide
- b) Oxygen
- c) Glucose
- d) Water

3. What is the equation for photosynthesis?

- a) $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- b) $6\text{CO}_2 + 6\text{O}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O}$
- c) $6\text{H}_2\text{O} + 6\text{O}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{CO}_2$
- d) $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 - 6\text{O}_2$

4. Which part of the plant cell is responsible for photosynthesis?

- a) Mitochondria
- b) Chloroplast
- c) Nucleus
- d) Cell wall

5. What is the role of stomata in photosynthesis?

- a) To release oxygen
- b) To absorb carbon dioxide
- c) To regulate water loss
- d) To control temperature

6. Which wavelength of light is most effective for photosynthesis?

- a) Red
- b) Blue
- c) Green
- d) Ultraviolet

7. What is the by-product of light-dependent reactions?

- a) ATP and NADPH
- b) Oxygen and glucose
- c) Carbon dioxide and water
- d) Chlorophyll and carotenoids

8. Which type of photosynthesis occurs in plants that live in arid conditions?

- a) C3
- b) C4
- c) CAM
- d) C2

9. What is the function of the Calvin cycle?

- a) To produce ATP and NADPH
- b) To synthesize glucose
- c) To release oxygen
- d) To absorb carbon dioxide

10. Which of the following is a limiting factor of photosynthesis?

- a) Light intensity
- b) Temperature
- c) Water availability
- d) All of the above

11. What is the effect of increasing light intensity on photosynthesis?

- a) Decreased rate
- b) Increased rate
- c) No effect
- d) Negative effect

12. Which part of the leaf is responsible for gas exchange?

- a) Cuticle
- b) Epidermis
- c) Mesophyll
- d) Stomata

13. What is the role of chlorophyll in photosynthesis?

- a) To absorb light energy
- b) To release oxygen
- c) To synthesize glucose
- d) To regulate temperature

14. Which type of photosynthesis occurs in plants that live in tropical regions?

- a) C₃

- b) C4
- c) CAM
- d) C2

15. What is the overall equation for cellular respiration and photosynthesis?

- a) $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- b) $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
- c) $6\text{H}_2\text{O} + 6\text{O}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{CO}_2$
- d) $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 - 6\text{O}_2$

16. What is the purpose of the light-independent reactions?

- a) To produce ATP and NADPH
- b) To synthesize glucose
- c) To release oxygen
- d) To absorb carbon dioxide

17. Which of the following is not a product of photosynthesis?

- a) Oxygen
- b) Glucose
- c) Water
- d) Carbon dioxide

18. What is the role of the thylakoid membrane in photosynthesis?

- a) To absorb light energy
- b) To synthesize glucose
- c) To release oxygen
- d) To regulate water loss

19. Which of the following is a characteristic of C4 plants?

- a) High water efficiency
- b) Low light intensity

- c) High temperature tolerance
- d) All of the above

20. What is the purpose of photorespiration?

- a) To produce ATP and NADPH
- b) To synthesize glucose
- c) To release oxygen
- d) To reduce water loss

Section B

Short Answer Questions

1. What is photosynthesis and what are its importance in the ecosystem.
2. Explain the function of stomata in photosynthesis.
3. Describe the role of chlorophyll in photosynthesis.
4. What are the reactants and products of photosynthesis?
5. Outline the main differences between light dependent and light - independent reactions.

APPENDIX 3: QUESTIONER FOR BIOLOGY FACILITATORS AT RUJEKO HIGH SCHOOL

SECTION 1: DEMOGRAPHICS

1a. What is your highest qualification

- Diploma in Education
- Degree in Education
- Masters in Education
- Other.....

b. What is your teaching experience in Biology?

(Open-ended answer)

Example: 5 years

2. What level do you teach? (Check all that apply)

- Ordinary Level
- Advanced Level
- Both

SECTION 2: INSTRUCTIONAL MEDIA AND TECHNOLOGY USAGE*

3 a. Is equipment in Biology laboratory sufficient for learners population?

b. Is the number of textbooks including Teachers Guides sufficient?

3c. How often do you use instructional media and technology in Biology lessons?

(Scale: 1-5, where 1 = Rarely and 5 = Almost Always)

Example: 4

4. Which instructional media and technology tools do you use most frequently? (Select all that apply)

- Textbooks, Charts and Diagrams
- -Printer, Computer, Laptop and Projectors
- Educational software eg E- books
- Online resources
- Interactive whiteboards
- Multimedia presentations
- Virtual labs

SECTION 3: PERCEIVED IMPACT

5. How do you think instructional media and technology have impacted student engagement in Biology lessons?

(Open-ended answer)

Example: "Instructional media and technology have increased student engagement by making lessons more interactive and visually appealing."

6. To what extent do you agree that instructional media and technology have improved student learning outcomes in Biology?

(Scale: 1-5, where 1 = Strongly Disagree and 5 = Strongly Agree)

Example: 4

Section 4: Challenges and Support*

7. What challenges do you face when using instructional media and technology in Biology lessons? (Select all that apply)

- Technical issues eg Electricity .
- Limited resources
- Lack of training
- Time constraints

8. What support do you need to effectively integrate instructional media and technology into Biology lessons? (Select all that apply)

- Professional development
- Technical support eg installation of solar powered system

- Access to resources
- Collaboration with colleagues

SECTION 5: FUTURE DIRECTIONS

9. How do you envision using instructional media and technology in Biology education in the next 5 years?

(Open-ended answer)

Example: "I plan to incorporate more virtual reality and gamification elements to enhance student learning experiences."

10. What resources or support do you think are needed to sustain effective use of instructional media and technology in Biology education?

(Open-ended answer)

Example: "Regular updates on emerging technologies and pedagogies, and access to relevant resources and training."

11. Do you incorporate technology into Biology learning? Give examples.

12. What percentage of learners have access to a smartphone or a computer at home?