

BINDURA UNIVERSITY OF SCIENCE EDUCATION



**FACULTY OF SCIENCE EDUCATION
DEPARTMENT OF EDUCATIONAL TECHNOLOGY**

IMPROVING BIOLOGY LEARNING THROUGH ONLINE RESOURCES AT NYAHUNI ADVENTIST HIGH

BY

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
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ABSTRACT

As in our everyday lives, we use digital elements as part of formal and informal education. To serve the educational purpose well, a research is desirable to identify and measure their characteristics. This study focuses on improving biology learning through online resources. Pragmatism case study was executed using mixed methods to solicit data from biology students at Nyahuni Adventist High and biology teachers at Nyahuni Adventist High. Using Krejcie and Morgan (1970) method, a sample size of 36 students learning biology at Nyahuni Adventist High was used for the questionnaire and from Nyahuni Adventist High, only 5 biology teachers were for the interview guide. Enhanced conceptual understanding, increased engagement and motivation, accessibility and flexibility are the impacts of the use of online resources in biology learning at Nyahuni Adventist High. Findings from the study showed that WhatsApp learning aligns with top biology grades, while YouTube learning shows moderate improvement in biology grades. Moreover, the use of educational websites was found to be linked to lower performance in biology. The study recommends that secondary schools should invest in digital infrastructure to ease the integration of online resources. More so, the current study calls for supportive policies from the ministry that standardize the use of online resources while safeguarding against misuse at secondary schools. Further research should therefore focus on other secondary schools in both rural and urban schools on the impact of online resources in improving biology learning for generalisation of results. Also, the study can be replicated using Advanced level biology students and biology teachers to gain more insights into the contribution of online resources towards the improvement of biology learning.

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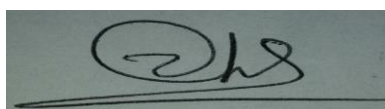
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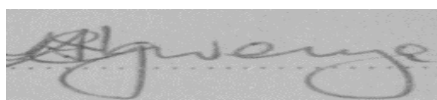
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1 CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

As the landscape of education continues to evolve, it is crucial for educators to stay abreast of the innovative strategies and approaches in order to effectively prepare students for the complexities of the 21st century.

1.2 1.2 Background to the Study

Our current era has witnessed tremendous and comprehensive development in technology and an explosion of knowledge in all aspects of life. New technologies has led to progress and development to a large degree, as it has become used in all areas of life, and also contributed to the enhancement of the educational process. Education is not a commodity and must not be for sale to the highest bidder nor should it be privatized. Science education is very important to the development of any nation. The advances in science have influenced the rate of economic development of nations, improved the quality of life in most parts of the world, and provided solutions to some major problems and needs of societies.

With the increasing ubiquity of digital devices and the proliferation of internet connectivity, the field of education has been undergoing significant transformation driven by advancements in technology. The integration of online learning tools and resources into traditional classroom settings has become a hallmark of this transformation, offering new opportunities to enhance the teaching and learning experience. In particular, the domain of science instruction has witnessed a paradigm shift, with science teachers leveraging digital platforms to engage students and foster a deeper understanding of complex concepts.

Biology deals with the study of living organisms, their living environment and interactions between living beings and the environment (Agoritsa, Vlachopoulos and Martina, 2021). Biology encompasses various biological processes and organisms described in the textbooks, but these cannot be seen by the naked eye. Therefore, it becomes difficult for the students to comprehend biological subjects only by reading textbooks or through traditional class lectures. Practical classes play a very important role in clarifying the theoretical portion. However, it is expensive to maintain a biology laboratory in the schools.

Most secondary schools around the world neither have a dedicated biology teacher nor do they have a dedicated biology laboratory (Basilotta-Gómez-Pablos, Matarranz, Casado-Aranda, and Otto, 2022). In Bangladesh, 63% of secondary schools have a science laboratory, whereas 75% of secondary schools have online classroom and 73% of schools have internet connection. In England, as it is likely to be the case elsewhere, biology teachers are tasked with teaching about sex determination in humans. In Brazil, official documents have reflected the importance of using online resources in education. In this context, the use of online learning tools and resources holds immense potential to reshape the landscape of science instruction, particularly within the domain of biology subject.

Online learning tools and resources encompass a range of digital platforms and materials that enhance educational experiences. These tools provide interactive simulations, multimedia content, and dynamic visualizations, fostering engagement and comprehension. They enable students to access information at their own pace and support various learning styles for enhanced learning experiences (Akram, Abdelrady, Al-Adwan and Ramzan, 2022). As students increasingly access education remotely, online tools offer flexibility and accessibility, enabling self-paced learning and efficient exam preparation. These resources are pivotal in shaping modern education, fostering improved comprehension and knowledge retention.

1.3 Statement of the Problem

The integration of online learning tools and resources into biology education holds great potential in Zimbabwe. However, the perceptions of secondary school students regarding the effectiveness of these tools remain underexplored up to date. This study addresses the gap by investigating how students perceive the integration of online tools in improving their biology learning. With complex topics like genetics and ecology, biology education faces challenges, and online tools could offer dynamic visualizations and interactive platforms. The influence of students prior technology exposure, digital literacy, and socio-economic backgrounds also plays a role. Understanding these perceptions is vital for designing effective technology-enhanced learning strategies and cultivating a culture of engaged learning. In light of these considerations, the present study seeks to explore the perceived effectiveness of online learning tools and resources in enhancing biology learning among secondary school

students in Zimbabwe, thereby shedding light on the potential of technology-enhanced learning to transform science learning.

1.4 Research Objectives

This research was guided by the following research objectives:

- i. To study the types of online resources in biology learning
- ii. To identify the role of online resources in biology learning
- iii. To give recommendations for effective integration of online resources in biology learning.

1.5 Research Questions

- i. What are students perception on the types of online resources in biology learning
- ii. How do students perceive the role of online resources in biology learning
- iii. What are the recommendations for effective integration of online resources in biology learning

1.6 Significance of the Study

Specifically the findings of this research are significant in terms of the following:

1.6.1 Educational Significance

The education fraternity is provided with a framework for intensifying biology learning through online resources. This research discovers how online resources can be embraced in secondary schools and provided an already tested and proven conceptual framework viable for the improvement of biology learning. This research contributes to the literature on biology learning since it progresses the generalizability and applicability of online resources in a new context of secondary schools.

1.7 Delimitations of the Study

This section presents the delimitations to the study.

1.7.1 Geographic Scope

This study was delimited to the secondary schools offering biology subject in Mashonaland East province only. It excluded other secondary schools offering biology in other provinces of Zimbabwe.

1.7.2 Time Scope

The research focused on primary data collected from the period of August 2024 to June 2025.

1.7.3 Sample Frame

The study is limited to the secondary school students learning biology at Nyahuni Adventist High in Murehwa. The population involved in the current study focused only on biology students at the secondary school.

1.8 Limitations

The limitation to the study was that of confidentiality in secondary schools since the students considered it as sensitive information. To overcome the limitation, the researcher sought authority to conduct the study first from the secondary school headmasters. Moreover, access to information was the other limitation as the biology secondary school students were ever busy with their school work. To overcome this limitation, the researcher continuously gives gently reminders to biology secondary school students to fill in the research instruments.

1.9 Definitions of Terms

This research defined the vital terms as follows;

i. Biology

Is the study of living organisms.

ii. Online Resources

Any resource available on the Internet in an online educational environment (Sudakova, Savina, Masalimova, Mikhaylovsky, Karandeeva and Zhdanov, 2022)

iii. Secondary School

Is an educational institution that provides education, building upon primary education and preparing students for further education or the workforce?

1.10 Organization of Study

Chapter 1 provides the introduction, the context in which the research was conducted, the core of the research problem as well as the objectives. The contribution of the chapter was to introduce readers to the issue being studied. Chapter 2 presents the strides made in the area of which was researched and established the knowledge gap this research closed. The contribution of this chapter was obtaining an overview of the current knowledge on the topic under study. Chapter 3 presents the steps followed to answer the objectives and the contribution of this chapter was to give research legitimacy. Chapter 4 presents results and discussions. The contribution of this chapter is to report the findings of the research. Last but not means least,

Chapter 5 presents summary, conclusions and implications and the contribution of the chapter is to tie up arguments put forward and solidifying the research work.

1.11 Chapter Summary

In summation, the research background, statement of problem, objectives, significance, delimitations and limitations was looked at in this chapter. Chapter two which follows reviews existing literature underpinning this research. Chapter three will give the research methodology whilst chapter four will detail results and discussion. The final chapter five will give summary, conclusions and implications.

2 CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the available literature on online resources and biology learning. The chapter looks at the theoretical and empirical literature on the research area. The conceptual framework is also presented. A discussion of the gap analysis is presented, followed by the summary of the chapter.

2.2 The Concept of Biology Learning

Biology is the study of life and living organisms, encompassing a vast range of disciplines that examine structure, function, growth, distribution, evolution, and other features of living organisms (Abercrombie, Hickman and Johnson, 2017). It is the science of life. Biology learning involves understanding the principles of life, from the smallest molecules to complex ecosystems, emphasizing interconnectedness, evolution, and the dynamic nature of living systems. The field deals with all the physicochemical aspects of life.

2.3 The Concept of Online Resources

In general, web pages and documents on the internet that provide useful information are known as online resources. Any resource available on the internet in an online educational environment is an online resource (Sweileh, 2021). It might be audio or video lessons, interactive exercises or exams, or documents providing links to other web sites. The content of online resources has the possibility of being updated in real-time. In this way, students can acquire knowledge that is entirely up-to-date and relevant. Moreover, they allow students to learn at their own time and at their own pace. The types of online resources which this study will focus on are WhatsApp groups, educational websites and YouTube.

i. WhatsApp

WhatsApp learning can be done remotely and it plays an integral role in education. Video conferencing is an example which can be done using WhatsApp learning. WhatsApp learning leverages on use of audios, videos and messages as the primary mediums for delivering educational content. This offers a multisensory experience that integrates visuals, audio, and potentially interactive elements to enhance engagement and comprehension (Sablic, Mirosavljevic and Skugor, 2021). It is a form of asynchronous online learning. This online learning resource involves watching videos, listening to audios and reading messages sent to advance students' skills.

ii. Educational Websites

Educational websites are online podiums intended to provide learning materials and resources to users of all ages. These websites can include a wide range of subjects and learning styles, giving all from interactive lessons to online courses and educational videos eg. Khan Academy, Quizzlet, TED ,Teacher Tube and Cousser. They can be precise to organizations like schools or universities, or they can be general platforms giving diverse learning chances. Educational websites encompass a wide range of resources and can take various forms, including podcasts, audiobooks (Omariba, 2022). Educational websites enable a personalized learning experience to students. They play a fundamental role in eLearning to students, offering numerous benefits that enhance learning experiences and outcomes from students (Chen, Wang, and Wang, 2022).

iii. YouTube

YouTube has become popular to date. YouTube are virtual spaces on the internet where students can listen to discussion on topics of interest with each other in real-time (Muhibbuddin, Muliwana and Djufri, 2021). YouTube lessons can be audio based or video based. To use this type of online learning resource, students just need to search the topic of interest online platform and listen to the lessons. This online learning resource allows the information to flow in real-time, which is incredibly important in the education process. Furthermore, YouTube keep student conversations alive. According to Coban, Bolat and Goksu (2022) it also affords other students to get an opportunity to get perspectives from other students on particular topics of the subject thereby increasing chances to pass by getting better

perspectives from others. Additionally, the other benefit of YouTube is that it is useful to students and cost free to them.

2.1.1 Impacts of online resources in biology learning

i. Enhanced Conceptual Understanding

Online resources such as simulations, animations, and virtual labs have been shown to improve students' grasp of complex biological processes. According to Sezen Vekli and Çalik (2023), web-based biology learning environments (WBLEs) have a moderate positive effect on academic performance, particularly when the digital tools align with the nature of the biology content. These tools help visualize abstract concepts like mitosis, gene expression, and ecological interactions, which are often difficult to convey through traditional instruction.

ii. Increased Engagement and Motivation

Digital platforms often incorporate multimedia elements and gamification, which enhance student motivation and engagement. Nabiem Akpen et al. (2024) found that interactive features such as discussion forums, quizzes, and videos significantly improve student participation and learning outcomes in online biology courses. These tools promote active learning and foster curiosity, which are essential for scientific inquiry.

iii. Accessibility and Flexibility

Online resources provide students with the flexibility to learn at their own pace and revisit challenging topics. Isma'il and Lukman (2023) reported that senior secondary school students in Nigeria perceived online tools as effective in enhancing their biology learning. The ability to access content anytime and from any location is particularly beneficial for students in remote or underserved areas.

2.1.2 Challenges and Limitations

i. Digital Divide.

Despite the benefits, unequal access to technology remains a major barrier. Isma'il and Lukman (2023) highlighted that many students in Zamfara State, Nigeria, were unable to fully utilize online resources due to limited access to smartphones, internet connectivity, and restrictions on device use during school hours. This digital divide exacerbates educational inequalities.

ii. Lack of Practical Experience

While virtual labs simulate experiments, they cannot fully replicate the tactile and procedural skills gained through hands-on laboratory work. Hallyburton and Lunsford (2013) emphasized that biology, being an experimental science, requires physical interaction with specimens and equipment to develop essential scientific skills.

iii. Teacher Preparedness

Effective integration of online resources depends on teachers' digital literacy and pedagogical skills. Nabiem Akpen et al. (2024) noted that inadequate training among educators can hinder the successful implementation of online learning tools, leading to reduced student engagement and suboptimal learning outcome.

Online resources have significantly enhanced biology learning by improving conceptual understanding, engagement, and accessibility. However, challenges such as the digital divide, lack of hands-on experience, and insufficient teacher training must be addressed to maximize their effectiveness. Future efforts should focus on equitable access, professional development, and blended learning approaches that combine digital tools with traditional methods.

2.2 Empirical Literature Review

In Israel, Slakmon (2024) studied WhatsApp for pedagogy in secondary education. As a case study of technology implementation, the author employs virtual ethnography and interviews with supervisors, developers and teachers to examine all significant pedagogical initiatives in Israel's high schools that utilise WhatsApp. The study found that using WhatsApp broadens and diversifies classroom instructional practices, including shifts towards more dialogic teaching, but at the same time, traditional communicative assumptions, conservative school modalities, power structure and epistemologies are maintained. This research adds to the body of knowledge by conducting a study in secondary schools in Zimbabwe.

Yeboah and Nyagorme (2022) investigated learners acceptance of WhatsApp as teaching and learning tool in distance higher education in sub-Saharan Africa. Correlational design was employed by the study. Questionnaires were used to collect data from 273 undergraduate and post-graduate diploma distance students in Ghana. The results showed that WhatsApp learning facilitate performance and support learning. However, the current study seeks to add by a research in Zimbabwe to establish if the results are the same.

Tekin, Izci, Guner and Turhan (2025) studied the role of YouTube in laryngeal anatomy learning. Using the search engine of the platform, we searched for relevant videos using various keywords. Their results showed that YouTube could be accepted as a fully sufficient source regarding larynx anatomy, and the videos with sufficient technical features may contain highly useful anatomical content. The current research extends the findings by providing insights on the usefulness of YouTube in biology learning.

In Canada, Lee, Meyers and Milner-Bolotin (2024) studied science learning in YouTube comments on science videos embedding movie references. Using constructivist grounded theory, the study compared comments on two videos. The outcome of the study was that

YouTube may facilitate knowledge exchange and collaborative learning in the comments. The current study extends the knowledge on the use of YouTube in biology learning within the Zimbabwean secondary schools.

Another study in Canada by Rissanen and Costello, (2023) studied the effectiveness of interactive online tutorials in first-year large biology course. Effectiveness of the tutorials was evaluated using quantitative methods and quasi-experimental design to compare the student learning results between the control year (without educational websites) and the year when educational websites were offered. Results of the study show that the educational websites were an effective means of providing supplementary assistance to students as well as fostering a gain in students' levels of engagement with the course. Since the study was done in Canada, the current study is done in Zimbabwe.

2.3 Research Gap

In the past decade, online learning has become popular within universities and colleges and they have adopted similar technology for supporting such. While several studies have looked at online learning resources within a higher and tertiary education context (Slakmon, 2024; Yeboah and Nyagorme, 2022; Tekin et al., 2025; Lee et al., 2024 and Rissanen and Costello, 2023), they, did not look directly at the use of online learning resources for biology learning improvement. To the researchers' knowledge, there are no studies to date that explore secondary school student perceptions of the use of online learning resources in biology learning. This virgin research inclines to close the gap in shedding light on improvement of biology learning at secondary schools through online resources.

2.4 Chapter Summary

This chapter looked at the theoretical, conceptual and empirical literature underpinning this research. The chapter that follows (Chapter 3) presents this research methodology which was employed in carrying out this research. It entails the research philosophy, research paradigm, research design, target population, sampling methods, research instruments, data presentation and analysis methods, reliability and validity tests as well as ethical considerations of the research.

3 CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This section gives an outline of the research methodology used to achieve the objectives of the research. The relevant justifications for the chosen research techniques are also discussed. The methodology is derived from the literature review that has been carried out.

3.2 Research Design

As mentioned by Kanaki and Kalogiannakis (2023) exploratory research design is used when trying to find out what is happening in a given situation. According to Sekaran and Bougie (2020) explanatory research design is focused on establishing the cause and effect between variable using statistical analyses. Since the current study seeks to develop a new online resources framework for improving biology, exploratory research design was adopted to detail the situation currently under study. Furthermore, due to the need to establish the nature and the size of the contribution of online resources to improving biology learning, explanatory research design was also relevant. Hence, the current study relied on a mix of the two research designs that is the exploratory and explanatory research designs. A mix of the two designs was relevant for the current study in line with the pragmatism research philosophy which the study followed.

3.3 Sample and Sampling

As for sampling, the current research employed first stratified random sampling thereafter, simple random sampling technique was utilized to derive a sample that was investigated.

3.3.1 Stratified Random Sampling

Stratified random sampling is a technique of sampling that comprises the separation of a population into smaller sub-groups known as strata (Ghauri, Gronhaug and Strange, 2020). The research first employed stratified random sampling by putting secondary school biology students into strata's of Form 1 upto Form 4, to allow coverage of all biology students at

Nyahuni Adventist High. The justification for the sampling method is that all the secondary school biology students in the strata's were represented in the sample.

3.3.2 Simple Random Sampling

Thereafter, simple random sampling technique was utilized to derive a sample to investigate from the sub groups. The sample was then selected from the subgroups utilizing a table of random numbers. Since the secondary school biology students were put into subgroups as per their level at secondary school, simple random sampling was employed to accurately represent members from each level class at Nyahuni Adventist High. The benefit of using the technique to derive the sample was as asserted by Gupta and Gupta (2020) that a member from the heterogeneous sub groups had an equal probability of being selected.

3.3.3 Population and Sample Size

The target population for the study was all Form 1 up to Form 4 biology students learning at Nyahuni Adventist High. 10 students from Form 1, 10 students from Form 2, 10 students from Form 3 and 10 students from Form 4 doing biology were targeted for the study. Hence, the target population for this study was 40 biology students at Nyahuni Adventist High. The sample size for this study was calculated using Krejcie and Morgan (1970) who came up with a table for determining sample size for a given population for easy reference. According to Krejcie and Morgan (1970) table, the sample size for a population of 40 is 36; hence the sample size for this study was 36 biology students at Nyahuni Adventist High.

3.4 Methods / Instruments / Tool of Data Collection

Data in this research was solicited in two phases whereby in the first phase, quantitative data was gathered using closed ended questionnaire. In the second phase, open ended interview guide was used to solicit qualitative data.

3.4.1 Questionnaire

In phase one, data was collected using a quantitative approach in which biology secondary school students were asked to complete a close ended questionnaire. The questionnaire was consisting of four sections, the first one seeking biographic data of biology students as control variables. The second section was seeking students' perception on the usage of online resources in biology learning; third section how students perceive the role of online resources in biology learning; fourth section students perceived challenges that hinder effective integration of online resources in biology learning. A closed ended questionnaire was used because they help in obtaining measurable and quantitative data (Meister, 2018).

3.4.2 Interview Guide

In phase two, a qualitative approach was used as only 5 biology teachers at Nyahuni Adventist High were interviewed using an open ended interview guide. As summarized by Queiros, Faria and Almeida (2017) an interview guide simply is a list of questions that need to be covered in the interview with respondents. Various questions relating to the variables of the research were posed to the interviewees and responses were recorded on a voice recorder. Since the questionnaires used were closed questions which do not allow room for respondents to give other views, open ended interview guide was used to allow room for probing. The interviews enabled the researcher to get reliable and valid measures in the type of verbal responses from biology teachers.

3.5 Data Collection Procedures

Primary data was solicited from biology students and biology teachers at Nyahuni Adventist High. The researcher wrote a letter to seek permission to carry out the research from the Headmaster. After granted the permission, the researcher distributed the closed ended questionnaires to biology students and conducted interviews with 5 biology teachers only. The researcher attached outline segment with the instruments to clarify the focal purpose of the research. Encouragement was made through gentle reminders to biology students to fill in the instruments for a week.

3.6 Data Analysis

The data collected used closed – ended questionnaire was fed into the Microsoft Excel 2013. Quantitative data was presented in tables and graphs. The findings from the interviews were thematically analysed. Qualitative data was presented in form of summaries written under the research objectives as themes.

3.7 Ethical Consideration

Research integrity is doing a research honestly, ethically, and responsibly, ensuring that findings are trustworthy (Kanaki and Kalogiannakis, 2023). Cronbach's Alpha test was conducted to measure the reliability of the questionnaire. For the interview guide, subsequent revisions by reframing the interview guide questions to make them more understandable was done to ensure reliability. Further, pilot study for the questionnaire was done to ensure its face validity. Also, for the interview guide, a suitable place to conduct interviews which was at the school was used so that each student feels relaxed to upsurge the chance for them to answer questions openly and honestly. This research was driven in strict accordance with the ethical

considerations of Bindura University of Science Education academic ethics policies and guidelines. To ensure credibility of the research, the researcher was honest throughout the research process and ensures anonymity issues to respondents as research ethics. More so, this research ensured quality and integrity of the research; ensure that the participants participate voluntarily; avoid harm to the participants; and show that the research was independent and impartial. Moreover, all sources that were contacted in the research were acknowledged, the researcher avoided plagiarism throughout the research.

3.8 Chapter Summary

This chapter described, in detail, the research methodology used in this research and gave justifications for the choice of methodology that was followed. Chapter four focuses on results and discussion.

4 CHAPTER 4: PRESENTATION OF FINDINGS

4.1 4.1 Introduction

This chapter highlights both quantitative and qualitative results that were obtained through questionnaires and interviews respectively. The responses gathered from the questionnaire were analyzed quantitatively using Microsoft Excel 2013. This study sampled 36 potential respondents to the questionnaires. A total of 36 responses from questionnaires were received, constituting 100% response rate. Also, the 5 biology teachers were interviewed guaranteeing a 100% response rate as well. The results are illustrated in table 4.1 below.

Table 4.1 **Response Rate**

Respondents	Distributed	Collected	% Response Rate
Questionnaire	36	36	100%
Interview Guide	5	5	100%
Average Response Rate			100%

Table 4.1 shows the results and the number of participants in the research. Biology students managed to return all questionnaires. 5 biology teachers attended the interviews. This is indicated by a 100% response rate for both questionnaires and interview guide. An average of 100% response rate was received which makes data more valid.

4.2 Demographic Data

The purpose of demographics is to ascertain whether research participants are well versed with the concepts under study. The demographic information of respondents is presented in table 4.2 as follows.

Table 4.2 **Demographic Profile of the Sample**

Characteristic	Variables	Frequencies	Percentages %
Gender:	Male	15	41.67
	Female	21	58.33
Age Groups:	12 – 13 years	13	36.11
	14 - 15 years	12	33.33
	16 - 17 years	9	25.00
	18 years and above	2	5.56
Level of education:	Form 1	11	30.56
	Form 2	11	30.56
	Form 3	7	19.44
	Form 4	7	19.44

The majority of biology students are females as shown by 58.38%. Majority of the biology students range from 12 years to 13 years as shown by the highest percentage of 36.11% as can be seen in Table 4.2 above. This infers that biology students participating in this study are still beginning to study the subject at Nyahuni adventist high since they are Form 1. The large number of respondents was Form 1 and Form 2 as shown by the 30.56%. This is because some of the students are joining the subject from primary school as compared to Form 3 and Form 4 as there will be some dropouts on the subject.

4.2.1 The Effects of Online Resources in Biology Learning

This section presents the role played by online resources in biology learning in secondary schools. The results are presented in the graph below.

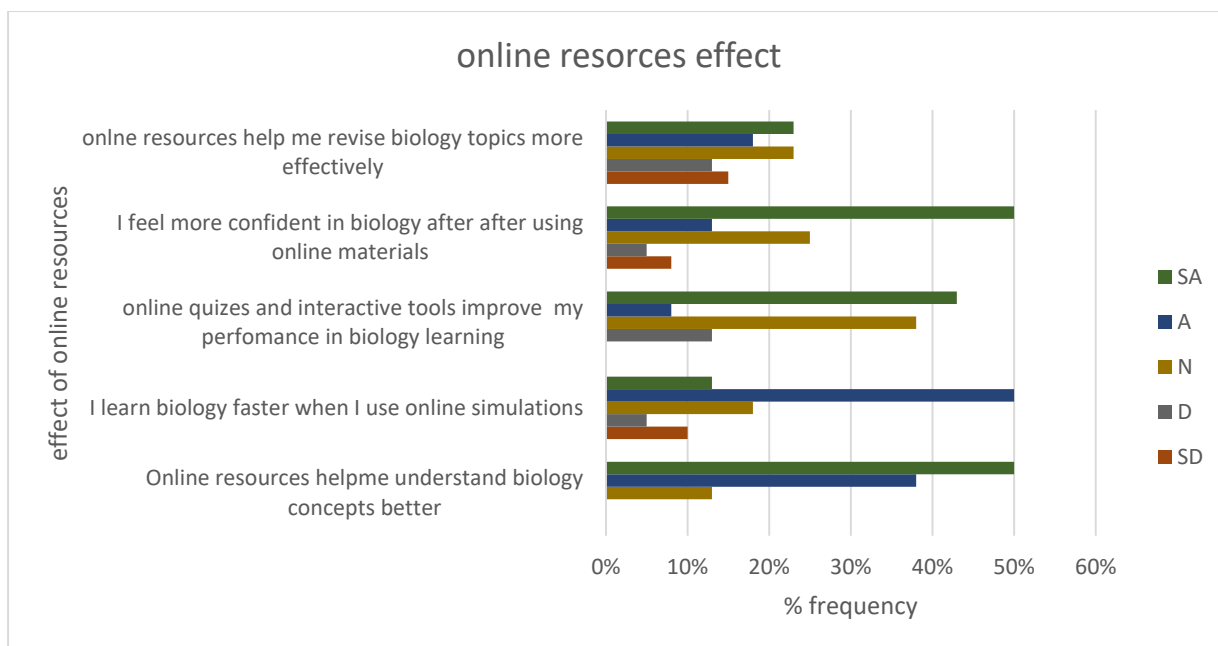


Figure 4.1 effect of online resources.

88% of students agreed or strongly agreed that online resources helped them understand biology concepts better. 63% of students agreed or strongly agreed that online simulations helped them learn biology faster. 51% of students agreed or strongly agreed that online quizzes and interactive tools improved their performance in biology, while 38% were neutral. 63% of students agreed or strongly agreed that they felt more confident in biology after using online materials. 41% of students agreed or strongly agreed that online resources helped them revise biology topics more effectively, while 23% were neutral and 28% disagreed.

4.7 ACADEMIC IMPACT.

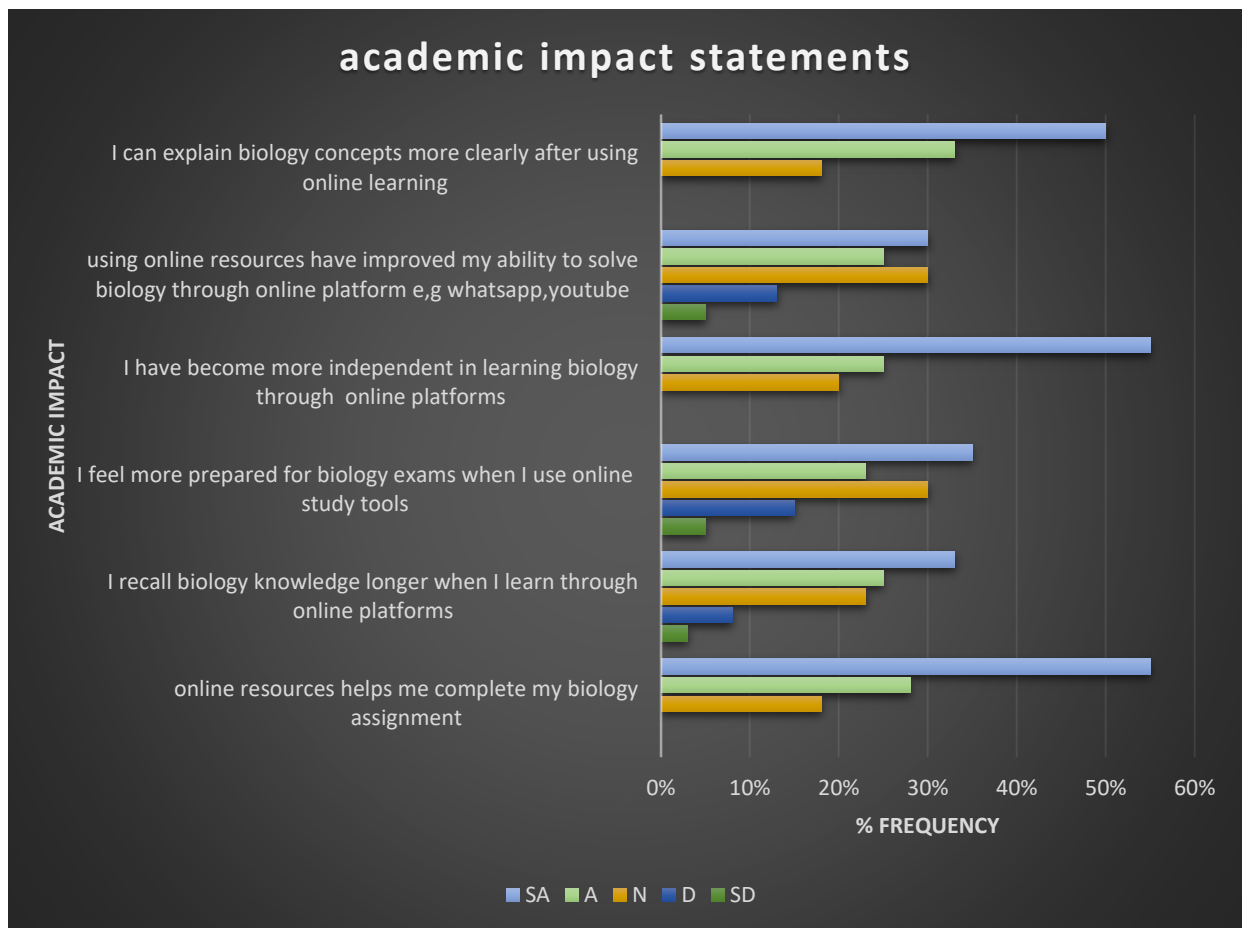


Figure 4.2 Presentation of academic impacts of using online resources

The study investigated the academic impact of online resources on biology learning among secondary school students. The results showed that: 83% of students agreed or strongly agreed that online resources helped them complete biology assignments. 58% of students agreed or strongly agreed that they recalled biology knowledge longer when learning through online platforms. 58% of students agreed or strongly agreed that they felt more prepared for biology exams when using online study tools. 80% of students agreed or strongly agreed that they had become more independent in learning biology through online platforms. 55% of students agreed or strongly agreed that using online resources improved their ability to solve biology problems. 83% of students agreed or strongly agreed that they could explain biology concepts more clearly after using online resources.

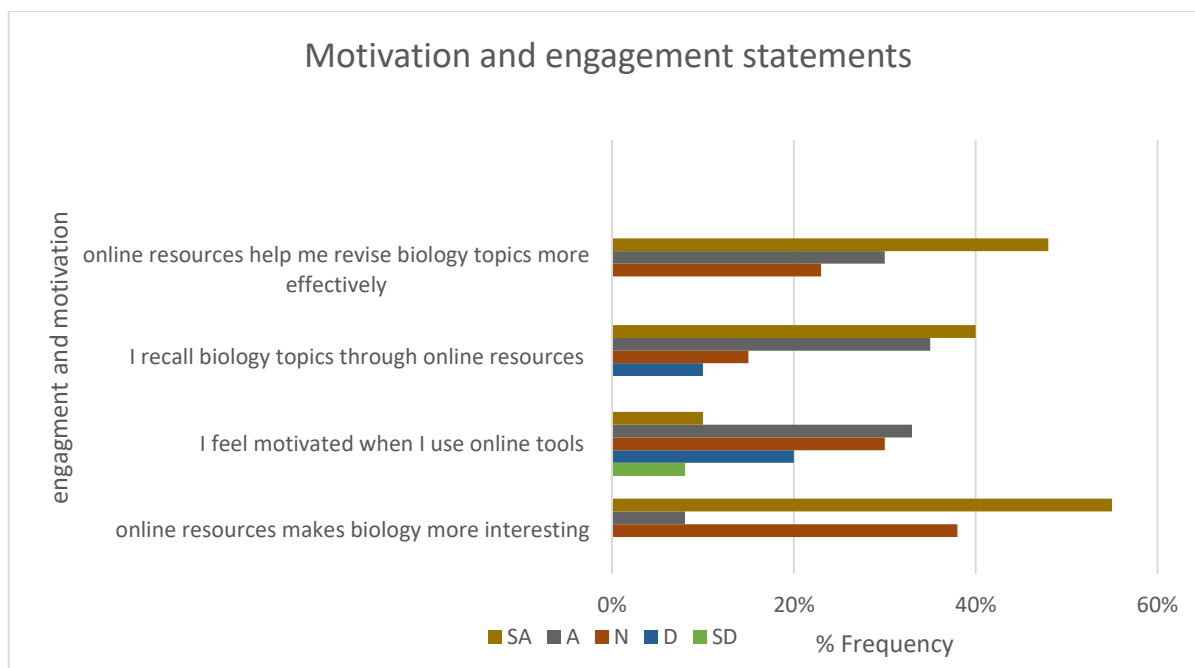


Figure 4.3: Motivation and engagement.

The study investigated the impact of online resources on student engagement and motivation in biology learning. The results showed that: 63% of students agreed or strongly agreed that online resources made biology more interesting. 43% of students agreed or strongly agreed that they felt more motivated to study biology when using online tools. 75% of students agreed or strongly agreed that they could recall biology topics through online resources. 78% of students agreed or strongly agreed that online resources helped them revise biology topics more effectively.

4.3 SECTION B: TEACHER RESPONSES TO IMPACT AND CHALLENGES OF ONLINE RESOURCES

Insights are gathered from teachers to explore their views on the impact and challenges of online resources

i. Impact of online resources

"I've seen that online resources, especially interactive features like discussion forums, quizzes, and videos, have significantly improved student participation and learning outcomes in biology. Students are more engaged and motivated, and they're able to grasp complex concepts better through these interactive tools." **Participant 4**

This response aligns with the literature of Nabiem Akpen et al.(2024) Which that suggests interactive features in online biology courses can enhance student participation and learning outcomes.

ii. Challenges of online resources.

Another teacher responded to the following on challenges faced by learners:

“Some students have struggled with online resources, and I've noticed that they can be ineffective for students who lack access to reliable internet or devices. This can lead to lost learning opportunities and frustration for students who can't keep up. “ **Participant 2**

This response reflects the challenge of online resources being ineffective for some students, which aligns with the report's findings of (Ismail & Lukman 2023)

Following is teachers' response to challenges

"One challenge I've faced is that biology is a hands-on subject that requires physical interaction with equipment and specimens. Online resources can't fully replicate this experience, and I worry that students might miss out on developing essential practical skills." **Participant 5**

This response reflects the idea that biology, as an experimental science, requires physical interaction to develop essential skills, which aligns with emphasis of (Hallyburton & Lunsford, 2013)

4.4 Chapter Summary

This chapter presented the findings of a study investigating the impact of online resources on biology learning among secondary school students. The results showed that online resources had a positive impact on student understanding, academic performance, engagement, and motivation. The majority of students reported that online resources helped them understand biology concepts better, complete assignments, recall knowledge, and feel more prepared for exams. Additionally, online resources were found to make biology more interesting, improve student engagement, and enhance revision effectiveness as well as challenges which includes lack of essential skills to online experiments and ineffectiveness of online resources.

5 CHAPTER 5: DISCUSSION OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings from the study, draws conclusions based on the analysis, and provides targeted recommendations to enhance the use of online resources in biology education at the secondary level. It also suggests directions for future research.

5.2 DISCUSSION OF FINDINGS

According to table 4.1, it is suggested that online resources have a positive impact on biology learning among secondary school students. The majority of students reported that online resources helped them understand biology concepts better, learn faster, and feel more confident in the subject. Online simulations and interactive tools were also found to be effective in improving student performance. However, the results for revising biology topics were less conclusive, with a smaller proportion of students agreeing that online resources were effective. Overall, the study highlights the potential benefits of incorporating online resources into biology education, but also suggests that further research is needed to optimize their use and address any limitations.

With reference to table 4.2, the findings suggest that online resources have a significant positive impact on the academic performance of secondary school students in biology. The majority of students reported that online resources helped them complete assignments, recall knowledge, feel prepared for exams, and become more independent in learning. Additionally, many students agreed that online resources improved their problem-solving skills and ability to explain biology concepts clearly. These results highlight the potential benefits of incorporating online resources into biology education, such as increased student autonomy, improved retention of knowledge, and enhanced understanding of complex concepts. Overall, the study provides evidence that online resources can be a valuable tool in supporting student learning and academic success in biology.

Table 4.3 findings suggest that online resources have a positive impact on student engagement and motivation in biology learning. The majority of students reported that online resources made biology more interesting and helped them recall biology topics and revise more

effectively. However, the results for motivation were less conclusive, suggesting that further research is needed to understand how online resources can be used to enhance student motivation. This aligns with the findings of Nabiem Akpen et al. (2024) who found that interactive features such as discussion forums, quizzes, and videos significantly improve student participation and learning outcomes in online biology courses. Overall, the study highlights the potential benefits of incorporating online resources into biology education to enhance student learning outcomes.

Interviews

The findings of this study suggest that online resources have a positive impact on student learning outcomes in biology. Teachers observed that online resources, particularly interactive features such as videos and quizzes, improved student understanding and engagement with biology concepts. This is consistent with the literature that highlights the benefits of interactive online tools in enhancing student participation and learning outcomes.

However, teachers also faced challenges in using online resources, including issues with access to reliable internet and devices, and the limitations of online resources in replicating hands-on laboratory experiences. These findings highlight the need for educators to be aware of the potential limitations of online resources and to develop strategies to address these challenges.

Despite these challenges, teachers reported that online resources had a positive impact on student academic performance and motivation. Students were more engaged and motivated when online resources were used, and teachers noticed an improvement in student grades and test scores. Overall, the findings suggest that online resources can be a valuable tool in supporting student learning and academic success in biology, but that educators need to be aware of the potential challenges and limitations.

The study also highlights the importance of ensuring equal access to online learning materials for all students. Teachers reported taking steps to ensure that all students had access to devices and internet connectivity, and providing alternative materials for students who lacked access to online resources. This is crucial in ensuring that online resources are effective in enhancing student learning outcomes, and that no student is left behind.

Overall, the findings of this study suggest that online resources have the potential to enhance student learning outcomes in biology, but that educators need to be aware of the potential challenges and limitations. By understanding these challenges and developing strategies to address them, educators can harness the benefits of online resources to improve student learning and academic success.

Online tools like WhatsApp groups learning, YouTube and Educational websites positively impacted student comprehension and interest in biology learning. Teachers appreciated the visual and interactive nature of online content but expressed concerns over insufficient training and lack of digital infrastructure. Students were not motivated to learn biology when digital content was incorporated into lessons, especially through multimedia and gamified platforms. The results underscored the growing relevance of digital pedagogy in science education and the need for institutional support to facilitate its adoption

Although many students had access to smartphones and the internet, bandwidth limitations and the cost of data often restricted consistent usage. In urban schools, students reported better access compared to their rural counterparts. Lessons that incorporated animations, virtual labs, and educational videos led to significantly higher engagement. Students retained information better and showed improved performance in assessments.

5.3 Conclusions

This study investigated the impact of online resources on biology learning among secondary school students. The findings from the questionnaires administered to learners revealed that the majority of students perceived online resources as effective in enhancing their understanding, engagement, and motivation in biology. The results also showed that students reported improved recall of biology topics and more effective revision when using online resources.

The interviews with teachers further supported these findings, with teachers observing that online resources improved student understanding, academic performance, and engagement. However, teachers also highlighted challenges in using online resources, including issues with access to reliable internet and devices, and the limitations of online resources in replicating hands-on laboratory experiences. Despite these challenges, the study concludes that online resources have the potential to enhance student learning outcomes in biology, and that

educators can harness the benefits of online resources by developing strategies to address the challenges and limitations. Overall, the findings suggest that online resources can be a valuable tool in supporting student learning and academic success in biology, and that educators should consider integrating online resources into their teaching practices to enhance student learning outcomes. By doing so, educators can provide students with a more engaging, interactive, and effective learning experience that prepares them for success in biology and beyond.

5.4 Recommendations

Based on the study's findings, the following recommendations are proposed:

i. For Educational Institutions

Invest in Digital Infrastructure: Schools should prioritize equipping classrooms with internet connectivity, interactive whiteboards, and content projection tools. **Supportive ICT Policies:** Develop policies that standardize the use of online resources while safeguarding against misuse. **Teacher Incentives:** Encourage innovation in teaching by offering recognition or incentives for educators who demonstrate effective use of digital tools.

ii. For Teachers

Continuous Professional Development: Teachers should engage in on-going training in digital pedagogy, content creation, and blended learning models. **Collaborative Planning:** Form teaching communities where online lesson plans, digital tools, and best practices are shared.

iii. For the Government and Policy-Makers

Curriculum Integration: Include online resources as core components of the biology curriculum with assessment strategies that account for digital learning. **Public-Private Partnerships:** Partner with tech companies, NGOs, and telecommunications providers to supply affordable internet and digital devices to schools.

iv. For Students and Parents

Digital Literacy Campaigns: Promote awareness and training on how to navigate online learning tools safely and effectively. **Encourage Responsible Use:** Educate students on balancing online learning with physical activities and minimizing distractions from entertainment media.

5.5 Suggestions for Further Research

Comparative studies between rural and urban schools on the impact of digital biology instruction. In-depth research on the cost-effectiveness of various online tools. Longitudinal studies that assess the long-term academic performance of students exposed to sustained digital learning environments.

5.6 Summary of the Study

The purpose of this study was to investigate how online resources can be integrated into secondary school biology instruction to improve learning outcomes. Using a mixed-methods approach, both qualitative and quantitative data were collected through surveys, interviews, and analysis of student performance. The research focused on identifying the types of online resources available and the impacts associated with the use of online learning resources. In summary the impacts for use of online resources in biology learning were enhanced conceptual understanding, increased engagement and motivation, accessibility and flexibility are the impacts of use of online learning resources in biology learning. Lastly, it was found that, Whatsapp groups learning aligns with top biology grades, while YouTube learning shows moderate improvement in biology grades and the use of educational websites is linked to lower performance.

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7 APPENDIX

My name Nothando Pio, a student researcher from **Bindura University of Science Education (BUSE)** with registration number **B2223206B**. I am currently conducting a study titled:

"Improving biology learning through online resources at Nyahuni High. This research seeks to understand how technology-enhanced learning tools such as educational apps, simulations, digital textbooks, and online resources affect the way students learn and teachers deliver Biology. Your experiences and perspectives are crucial in helping educators improve teaching strategies and make science education more interactive, accessible, and effective. I kindly invite you to participate in this study by completing a short questionnaire and/or engaging in an interview. All responses will remain **confidential** and used solely for academic purposes. Your honest feedback will contribute to meaningful advancements in science education at our school and beyond. By ticking **"Yes,"** you voluntarily agree to participate in this study. Your honest responses will be greatly appreciated. If you select **"No,"** thank you for your time, and your participation will end here.

☐ **Yes, I agree to participate**

☐ **No, I decline to participate**

Appendix 1: STUDENT INTERVIEW GUIDE

SECTION A: DEMOGRAPHIC INFORMATION

(Questionnaire for Students)

1. Tick the gender that applies to you:

☐ Male

☐ Female

2. Select your age range:

☐ 14 years and below ☐ 15–16 years ☐ 17 years and above

3. Select your current level of education:

☐ Form 1

☐ Form 2

☐ Form 3

☐ Form 4

SECTION B:**Statement to reflect effect of online resources on biology learning.**

(5-point Likert Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

Statement	1	2	3	4	5
Online resources help me understand biology concept better.	☐	☐	☐	☐	☐
I learn faster when I use simulations and videos in biology.	☐	☐	☐	☐	☐
Online quizzes and interactive tools improve my performance in biology.	☐	☐	☐	☐	☐
I feel more confidence in biology after using online materials eg. YouTube ,Whatsapp ,Educational websites such as Khan academy, teacher tube etc.	☐	☐	☐	☐	☐

Statement to reflect student engagement and motivation.

(5-point Likert Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Statement	1	2	3	4	5
Online biology resources make more interesting.	☐	☐	☐	☐	☐
I feel more motivated to study to biology when I use online tools.	☐	☐	☐	☐	☐
I recall biology topics through online resources eg digestive system.	☐	☐	☐	☐	☐
Online resources help me revise biology topics more effectively.	☐	☐	☐	☐	☐

Statement to academic impact.

(5-point Likert Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Statement	1	2	3	4	5
Online resources help me to complete my biology assignments.	☐	☐	☐	☐	☐
I recall biology knowledge longer when I learn through online platforms eg when I use whatsapp.	☐	☐	☐	☐	☐
I feel more prepared for biology exams when I use online study tools.	☐	☐	☐	☐	☐
I have become more independent in learning biology through online platforms. Using online resources have improved my ability to solve biology through online platforms.	☐	☐	☐	☐	☐
I can explain biology concepts more clearly after using online learning.	☐	☐	☐	☐	☐

Appendix 2: TEACHER INTERVIEW GUIDE

SECTION A: DEMOGRAPHIC INFORMATION

1. Tick the gender that applies to you
 - ☐ Male ☐ female
2. Tick the age group that applies to you
 - ☐ 30 years and below ☐ 31-40years ☐ 41-50 years ☐ 51 years and above
3. Select your level of qualification
 - ☐ combined science ☐ biology ☐ physics
 - ☐ chemistry
 - ☐ Others specify.....

SECTION B: BACKGROUND AND EXPERIENCE QUESTIONS

1. Can you briefly describe your experience in biology teaching?
2. What levels or grades of students do you currently teach?
3. How familiar are you with using online resources?

SECTION C: IMPACT ON PUPILS LEARNING QUESTIONS

1. In your observation how have online resources affected learners understanding of biology concepts?
2. Have you noticed any improvement in learners' academic performance due to online tools?
3. Do learners seem more engaged or motivated when online resources are used?

SECTION D: NEGATIVE IMPACTS

1. What challenges have you faced in using online resources for biology instruction?
2. What kind of support or training have you received or (would like to receive) to use online tools effectively?
3. How do you ensure that all students have equal access to online learning materials?