
**Bindura University
of Science Education**



FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF BIOLOGY

TITLE

An assessment into the impact of applying gamification teaching technique on O'level students' learning experiences in Biology in selected schools in Seke District in Mashonaland East Province.

BY

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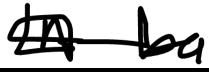
A research project submitted to the Bindura University of Science Education In Partial Fulfilment of The Requirements of The Bachelor of Science Education Honors (Biology)

2025

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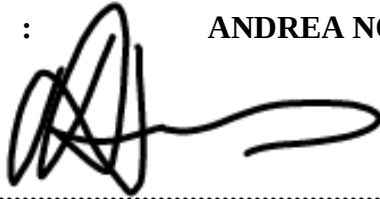
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DEDICATION

I dedicate my dissertation work to my family, my wife Dorcas and my children. Not forgetting my mother and siblings for their unwavering support through prayers. Without them, it would have been difficult to accomplish. Thank you all.

Acknowledgement

Above all things there is God, he was with me through the entire research project, giving me strength and guidance. I am very grateful.

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My sincere gratitude goes also to my family and friends for their financial and emotional support. I also acknowledge Dunotter Secondary School for permitting me to carry out my research, interviews, and observation at their institution.

ABSTRACT

There are several methods of teaching that can be used in the teaching of Biology at Ordinary level. Gamification techniques presents students with a chance to engage with each other as well as their teacher through games in their learning experience. Thus this project investigates the impact of gamification techniques in education for secondary school students' learning experiences and outcomes in biology. Recognizing this significance , the study aims to assess how these game experiences enhance student engagement, understanding, and retention of biological concepts. The literature indicates that gamified learning opportunities foster deeper comprehension of scientific principles and promote collaborative skills among students. Due to the nature of the research ,a qualitative approach was adopted employing the descriptive survey research design to explore the teachers and students perception and experiences related to gamified based learning .Two secondary schools were chosen and made up the population and sample .Data were collected through personal interviews , questionnaires and focus group discussions. The gathered data were presented in descriptive form. Thematic and comparative analysis followed the presentation of data. The findings revealed that among others gamification techniques are an effective teaching method since they help students acquire useful knowledge while having fun, engagement and relaxation at the same time. Despite the usefulness of gamification techniques, noted challenges included time, finance, teachers incompetence and many others. The researcher recommended that before teachers employ gamification techniques in their lessons, teachers should firstly get adequate training on fundamentals of this gamified approach so that they properly guide students as they tend to dominate the gamified sessions. School administaration should allocate adequate time to show their support .These recommendations will help teachers ,students ,schools and other stakeholders.

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CHAPTER ONE: PROBLEM AND ITS SETTING

1.0 Introduction

This chapter will focus on the background of the study, statement of the problem, objectives of the study, research questions, significance of the study, delimitations of the study, limitations of the study, definition of key terms and a summary of the chapter.

1.1 Background of the study

The teaching and learning of Biology in Zimbabwe have seen its fair share of challenges mostly in the rural areas. With this in mind, looking inside and outside the borders of Zimbabwe, STEM (Science, Technology, Engineering and Mathematics) has currently become the main talk in school education in many countries. In Zimbabwe, STEM is seen as the solution for most economic challenges facing the country. Many stakeholders including those within the Ministry of Primary and Secondary Education have been convinced and also decidedly convinced that STEM provides the optimum environment for the development of invaluable competencies such as problem solving, critical thinking, creativity, team work, communication skills and conflict resolution (Ministry of Higher and Tertiary Education, Science and Technology Development, 2016). These skills are deemed to be very important for socio-economic transformation of the country, hence should be developed among all students.

Zimbabwe Manpower Development Fund (ZIMDEF) has a slogan which says, “IF WE STEMITISE, WE INDUSTRIALISE”. This testifies that the study of STEM subjects will result in the industrialization of the economy and will also create employment (Mberi and Phambili, 2016). The STEM project has been positively accepted by many stakeholders including industry, parents and students. Against this background, there are a lot of challenges likely to impede the implementation of this innovative project, particularly in science which is the first component of the STEM (Ncube, 2016).

There has been a challenge in the teaching and learning of Biology in Zimbabwe, particularly at Dunotter Secondary school where there are inadequate resources, the learners themselves have a

negative attitude towards biology which demotivate the teachers as well there are overcrowded classrooms.

Texila International Journal of Academic Research, (2019) highlights challenges such as the lack of digital classrooms, inconsistent power supply, and inadequately equipped biology laboratories. It emphasizes the need for teachers to possess essential skills, including computer literacy, to enhance the teaching and learning experience in biology .

Academic Journal of Interdisciplinary Studies, (2017) investigates the challenges faced by biology teachers in rural secondary schools in Chipata, Zambia, which can be reflective of similar issues in Zimbabwe. Key challenges identified include inadequate teaching resources, lack of motivation among teachers, overcrowded classrooms, and negative student attitudes towards biology. The study calls for improved classroom environments and resources to foster better engagement in scientific inquiry .

ScienceRise: Pedagogical Education, (2023) discusses the persistent challenges in teaching biology since Zimbabwe's independence, including the lack of well-equipped laboratories, limited access to prescribed textbooks, and overcrowded classes. These factors significantly hinder the effective teaching and learning of biology .

Kibogora Polytechnic, (2023) explores the relevance of practical work in teaching biology. It identifies insufficient time for practical work and the lack of laboratory facilities as significant barriers to effective biology education. The study suggests that practical work greatly enhances students' understanding and retention of biological concepts .

Most rural schools in Zimbabwe do not have access to Biology facilities such as textbooks and laboratories. Worst still some don't even have qualified teachers to teach Biology as a subject. As a result, the Biology passrate of schools in urban areas compared to those in rural areas has over the past years gone in favour of urban schools. Some of the reasons are availability of resources like laboratories and the fact that most qualified teachers opt to work in well-resourced schools. In comparison, well-resourced urban schools produced passrates in excess of 60% compared to rural schools. The difference though not that big, is as a result of most boarding schools being situated in rural setups. I have discovered that most rural teachers and their learners are less self-motivated due to inadequate resources to use, this has prompted me to embark on this journey to

do a research on employing gamification in the teaching and learning of Biology which can motivate and improve participation of both facilitators and learners, which eventually leads to improved passrate. The world has taken a step further evidenced by the promotion of science subjects under the umbrella of STEM (science, technology, engineering and mathematics).

Ndlovu, (2023) explores various obstacles and opportunities of education in rural Zimbabwe, emphasizing community involvement as agents of change for the challenges of poor academic performance. He adds on by saying there's need for community led initiatives to improve educational outcomes. The authors argue that traditional leadership and stakeholder involvement are crucial for overcoming these obstacles and enhancing the quality of education, including subjects like biology.

Nabonagea, (2024) focuses on specific challenges faced in teaching biology at high school level in rural areas. It discusses the lack of qualified biology teachers, insufficient laboratory facilities, and the scarcity of teaching materials. His emphasis is on how these challenges hinder effective teaching and learning, leading to poor student performance in biology.

Smith, (2020) highlights the importance of adapting teaching methods to local contexts, the need for hands-on learning experiences, and the role of community support in enhancing science education.

Doe and Johnson, (2021) discusses how community support can mitigate challenges such as inadequate facilities and teacher shortages. The authors further argue that fostering partnership between schools and local organizations can enhance educational outcomes, including subjects like biology.

There is a comprehensive overview of rural education challenges, including limited access to resources, teacher shortages, and the impact of socio economic factors on education quality.

1.2 Statement of the problem

Over the past five consecutive years, we have seen an alarming decline in the passrate of biology as a science subject. This was due to numerous challenges faced in the teaching and learning of biology. It has come to the spotlight of parents who have raised their concerns with the school. Mumba et al., (2015) states that teachers face numerous challenges that hinder effective lesson delivery, compromising student learning outcomes. It is very crucial for learners to pass but the experiences of the teachers in conducting the lessons is overlooked. Abdulhamid et al., (2019) stressed that the effective implementation of lessons is crucial for developing students' scientific literacy skills. According to Nyakoe et al., (2015), research indicates that teachers' experiences significantly influence their teaching methods and student learning outcomes.

In light of this, the most challenges at two selected secondary schools in Seke district in Mashonaland East Province were that of overcrowded classrooms, lack of qualified biology teachers, demotivated teachers and learners and lack of resources to use. Nabonagea, (2024) emphasises on how these challenges hinder effective teaching and learning, leading to poor student performance in biology.

To address these challenges, the researcher proposes the adaptation of teaching methods that suit the local environment as well as engagement with community stakeholders in facilitating resources. Smith, (2020) highlights the importance of adapting teaching methods to local contexts, the need for hands-on learning experiences, and the role of community support in enhancing science education.

Doe and Johnson, (2021) discusses how community support can mitigate challenges such as inadequate facilities and teacher shortages. The authors further argue that fostering partnership between schools and local organizations can enhance educational outcomes, including subjects like biology.

The researcher intends to introduce the gamification teaching technique as a solution and assess the benefits which it brings to the teaching and learning of biology in the two selected schools which ultimately enhances the students' learning outcome.

1.3 Objectives of the study

The main purpose of the study was to discover the benefits of gamification techniques in the learning and teaching of Biology at selected schools in Seke District. Precisely, the study was guided by the following learning objectives:

- To identify the benefits of employing gamification in the teaching and learning of Biology.
- To assess the challenges faced by both facilitators and learners to effectively apply gamification in the teaching and learning of Biology..
- To establish possible solutions to mitigate the challenges faced in the teaching and learning of Biology..

1.4 Research questions

1.4.1 Main research question

- What is the impact of gamification teaching technique on teaching and learning biology at O'level?

1.4.2 Sub research questions

- What are the benefits of gamification teaching techniques in the teaching and learning of Biology at O'level?
- What are the challenges faced by pupils in learning Biology at O'level?
- What can be done to improve the teaching and learning of Biology at O'level?

1.5 Significance of the study

Studying the impact of gamification techniques in the learning and teaching of Biology at selected schools in Seke District is important for several reasons and to different stakeholders.

1.5.1 Teachers

- Innovative teaching methods, teachers can develop new strategies that intergrate gamification, which makes lesssons more dynamic and appealing. This can help to address different learning styles and needs.

- Assessment and feedback. Gamification can provide immediate feedback through assessments embedded in games, helping teachers to identify areas where students struggle and adjust their instruction accordingly.

1.5.2 Learners/ students

- Engagement and motivation. Gamification can enhance student engagement by making learning more interactive and enjoyable. This can lead to increased motivation to learn biology concepts.
- Improved learning outcomes by incorporating game elements, students may better retain information and develop critical thinking skills, leading to improved academic performance.

1.5.3 School administrator

- Enhanced curriculum development. Understanding the impact of gamification can guide administrators in curriculum design, potentially leading to more engaging biology programs that attract and retain students.
- Resource allocation. Insights from gamification studies can inform decisions on resource allocation, such as investing in technology and training for teachers to implement these techniques effectively. The study will prompt school authorities to do all things possible to invest in the provision of science equipment and facilities to better the learning and teaching of Biology in all the schools in the districts.

1.5.4 Parents

- Support for learning. Parents can better support their children's learning when they understand the benefits of gamification, such as increased engagement and motivation in biology.
- Communication with teachers. A study in gamification can facilitate better communication between parents and teachers regarding student progress and learning strategies.

1.5.5 Policy makers

- Informed decision making. Insights from gamification studies can help policy makers understand the potential benefits of innovative teaching methods, leading to policies that support learning environments in schools.
- Investment in technology. Recognizing the positive impacts of gamification may prompt policy makers to allocate funding for technology and resources that facilitate gamified learning experiences in biology.

1.5.6 Educational researchers

- Data driven insights. Researchers can gather data on the effectiveness of gamification techniques, contributing to the body of knowledge in educational methods and informing future practices in biology education.
- Development of best practices. Research findings can lead to the establishment of best practices for implementing gamification in biology, fostering a more effective learning environment.

1.6 Delimitations of the study

The study was carried out at two secondary schools in Seke district in Mashonaland East Province. This study involves 20 learners and one teacher from selected schools. Therefore generalization outside of this demographic context should be done with caution. Limiting the study to the 20 learners, their teacher and the two selected secondary schools, allows for more targeted analysis of the effectiveness of gamification techniques within that group. Different educational levels may have varying responses to gamification due to developmental differences in cognitive and social skills.

1.7 Limitations of the study

1.7.1 Time

My research was short timed. The time frame did not allow for intensive assessment hence the results of the project focused only for the duration given.

1.7.2 Subjectivity of engagement metrics

Measuring student engagement and motivation was subjective and influenced by external factors, such as classroom environment or personal interests. Some of the selected learners were not

interested this subjectivity caused complications in the assessment of the true impact of gamification.

1.7.3 Sample size and diversity

The sample size was small and diversity of learners to choose from was only limited to the participating schools. Limited sample sizes or lack of diversity in participants can affect the validity and generalizability of the findings. These results from a homogenous group may not apply to a broader population of students.

1.7.4 Technological barriers

Effective gamification often requires access to technology (e.g., computers, tablets, or internet). Our schools, with limited resources led us to struggle to implement gamified techniques. This can lead to skewed results and limited applicability.

For the fact that this study is restricted to Dunotter Secondary School in Seke District, it is not certain if the same results would be obtained if the survey is done on a different area for the fact that the questionnaires as well as the survey design used as the instrument and research design respectively will be different. It will be not certain if other kind of instruments as well as research design will yield the same results.

Other limitations arise from the uncooperative attitudes of some respondents as well as their non-challant attitude and ignorant behaviour. This will affect the validity of their response. As such incoming students as well as individuals who may wish to conduct a further research should take this into consideration.

1.8 Definition of key terms

1.8.1 Gamification

Deterding et al. (2011) define gamification as the use of game design elements in non-game contexts to enhance user engagement and motivation. Seaborn and Fels (2015) describe gamification as the application of game like elements in non-game settings to encourage participation and improve user experience.

Gamification is thus the strategic use of game design elements and mechanics in non-game contexts to engage and motivate people, drive behaviour and enhance learning.

1.8.2 Gamification techniques

Dominguez et al. (2013) discuss specific gamification techniques in educational contexts, emphasizing the role of feedback, challenges, and rewards in improving learning outcomes. Kovisto and Hamari (2019) analyze different gamification techniques, highlighting their effectiveness in increasing user engagement and satisfaction across various applications. Gamification techniques are methods used to design engaging and interactive experiences,

1.8.3 Science

incorporating game elements and mechanics into non-game concepts.

Hornby (2008) defines science as the knowledge about the structure and behaviour of natural and physical world based on facts that can be proved. National Academy of Science (2012) defines science as a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. Science is therefore the study of living and non-living things.

1.8.4 Biology

Campbell Biology (2017) defines biology as the scientific study of life, encompassing various fields that explore the structure, function, growth, origin, evolution, and distribution of living organisms. According to Miller and Levine Biology (2010), they describe biology as the branch of science that deals with the study of living organisms and their interactions with the environment. Biology is the science that studies living organisms.

1.9 Summary

This chapter has highlighted the background of the study, problem statement, objectives, research questions, justification, delimitation and limitations. The next chapter reviews literature related to the benefits of gamification techniques in the teaching and learning of Biology at selected schools in Seke District.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

Gamification, has gained traction, emerging as a promising pedagogical approach, leveraging game mechanics and design principles to enhance learning experiences in educational settings, particularly in student engagement and learning outcomes. In the context of O'Level Biology education, gamification offers a unique opportunity to make learning more engaging, interactive, and effective for students. This literature review examines the impact of gamification techniques on O'level students' learning experiences in biology, focusing on key themes such as motivation, engagement, academic performance, and conceptual understanding.

2.1 Benefits of gamification teaching technique in teaching and learning Biology

2.1.1 Motivation and Engagement

Various studies have shown that gamification has the capability of enhancing student engagement and motivation.

A study by Hamari et al. (2014) found that when gamification strategies were applied to biology classes, there was a notable increase in student participation and enthusiasm. The use of game-like scenarios related to biological concepts led to improved attendance and a more vibrant classroom atmosphere.

Also, Deterding et al. (2011) highlighted that incorporating game mechanics, such as points, badges, and leaderboards, can transform mundane learning tasks into more engaging activities. In the context of biology education, gamified elements encourage students to take an active role in their learning process, fostering a sense of achievement and competition.

Positive attitudes towards biology: Gamification can help to create a more positive and enjoyable learning environment, fostering a love for Biology among students. The use of interactive games and simulations can make learning more fun and exciting, reducing anxiety and increasing students' confidence in their abilities (Plass et al., 2015).

The use of games can create a sense of competition and accomplishment, encouraging students to actively participate in learning activities.

The introduction of games in learning situations can in a larger extend, motivate the learners

2.1.2 Academic Performance

The unique relationship between gamification and academic performance has been a focal point in this educational research. A meta-analysis by Landers (2014) suggests that gamification can lead to improved academic results. He goes on to say, In biology, students exposed to gamified learning environments demonstrated higher test scores compared to those in traditional settings. This improvement can be attributed to increased motivation, as students are more likely to invest effort as well as their time when they perceive learning as enjoyable.

Another research conducted by Domínguez et al. (2013) focused specifically on biology education, revealing that students who engaged in gamified activities, such as interactive quizzes and simulations, outperformed their peers on standardized assessments. This finding underscores the potential of gamification to enhance not only engagement but also educational outcomes.

2.1.3 Conceptual Understanding

Gamification not only improves engagement and performance but also aids in the development of conceptual understanding. According to Gee (2003), games provide contextualized learning experiences that can deepen comprehension of complex subjects. In biology, gamified learning environments often incorporate real-world scenarios that allow students to apply theoretical knowledge practically.

Enhanced Learning Outcomes: Gamification has been found to improve students' understanding of biological concepts, problem-solving skills, and critical thinking abilities. Interactive simulations, role-playing games, and virtual labs can provide immersive learning experiences that facilitate deeper comprehension of complex biological processes (Ke et al., 2017).

Gamification can improve collaboration and communication among learners. Gamified learning environments often encourage teamwork and collaboration among students. Lee & LaRose (2004) stated that group-based challenges and projects can foster communication, negotiation, and shared responsibility, promoting a more social and interactive learning experience.

For example, game-based simulations related to ecology or genetics enable students to visualize and manipulate biological processes. A study by Chang et al. (2016) indicated that such

immersive experiences significantly enhanced students' understanding of biological concepts, as learners could experiment and receive immediate feedback on their decisions.

2.1.4 Individual differences

Shute (2008) cited that adaptive learning platforms and personalized feedback mechanisms can provide customized learning experiences, catering to different learning styles and paces. Gamification can be tailored to individual student needs and preferences accommodating personalized Learning.

2.2 Challenges and Considerations

However, careful implementation and consideration of potential challenges are essential to maximize the benefits of gamified learning environments. Further research is needed to explore long-term effects and best practices for integrating gamification into biology curricula. Balancing fun and educational value can be difficult. Activities might become too game-like, diverting focus from learning objectives. To add on, not all students may have equal access to technology or the internet, which can limit participation and engagement. Also, students have varying preferences and strengths; a one-size-fits-all gamification approach may not cater to all learning styles. This implies that, evaluating student progress in gamified environments can be complex. Traditional assessments may not align well with game-based learning. Finally, developing and implementing gamified elements can require significant time and resources, including training for educators.

For the above mentioned challenges, certain aspects need to be considered. Firstly, there is need to establish clear educational goals and ensure that gamification elements align with these objectives to enhance learning outcomes. Secondly, we must incorporate regular feedback within the gamified system to help students track their progress and understand areas for improvement. Thirdly, we have to foster a balance between collaborative and competitive elements to encourage teamwork while also motivating individual achievement. Of importance, we also need to ensure that gamified content is culturally relevant and inclusive so that all students feel represented and engaged and be prepared to iterate on gamification strategies based on student feedback and learning outcomes to continuously improve the approach. Lastly, it is vital to

provide educators with the necessary training and resources to effectively implement and manage gamified learning environments.

Despite the numerous benefits, there are challenges associated with implementing gamification in biology education. Some educators express concerns about the balance between fun and educational value, fearing that excessive gamification might lead to superficial learning (Kapp, 2012).

Teachers need adequate training and support to effectively design and implement gamified learning activities. This may require professional development programs and access to relevant resources.

Zainuddin et al (2020). Additionally say that, the need for appropriate technology and resources can limit the feasibility of gamified approaches in some educational contexts

Another challenge is on assessments. Evaluating the effectiveness of gamification can be challenging, as traditional assessment methods may not fully capture the learning outcomes achieved through gamified experiences.

Lastly there should be some ethical considerations. The use of game elements such as rewards and competition can raise ethical concerns, particularly regarding potential for exploitation and addiction.

2.3 Summary

The application of gamification techniques in O'level education presents a promising avenue and holds significant potential to enhance students' learning experiences in Biology. Evidence suggests that gamification can significantly improve motivation, engagement, and academic performance fostering a positive attitude towards the subject.

This chapter highlighted the benefits of gamification in teaching and learning biology. Some challenges faced were also given as well as solutions to the challenges. The next chapter will focus on research approach, design and methodology.

CHAPTER THREE: RESEARCH APPROACH, DESIGN AND METHODOLOGY

3.1 Introduction

The researcher investigated on the effects of gamification techniques on students' engagement and academic performance in biology classes at secondary schools. Gamification, the integration of game design elements in non-game contexts, is hypothesized to enhance motivation, engagement and learning outcomes. This study aimed to evaluate whether implementing gamified learning strategies improves students' understanding of biological concepts compared to traditional teaching methods. The study also explored how gamification could be effectively applied in biology education and examines its influence on student learning, motivation, and attitudes.

3.2.1 Research paradigm

According to Fraenkel and Hyun, (2012), they define research paradigm as “a study that investigates the quality of relationships, activities, situations, or materials.” Another view by Patton, (2010) noted that qualitative research (paradigm) produces findings not arrived at by means of statistical procedures but rather a systematic, interactive and subjective approach used to describe life experiences and give them meaning.

3.2.2 Interpretive paradigm

This study used an interpretive paradigm that focuses on the individuals' experiences as the focal source of expressing reality. Cohen, Manion & Morrison (2017), postulated that an interpretive paradigm allows the researcher to understand the phenomena being studied and interpret explanations of the phenomena given by the participants. This research paradigm was selected because the researcher focused on the interpretation of experiences encountered by biology teachers and learners on the use of gamification in teaching and learning biology. Cohen et al. (2017) states that the advantage of using interpretive research is that it provides a rich description of the phenomenon being studied. Therefore, the researcher intended to use the interpretive approach so that he could explore and gain an indepth understanding of the experiences encountered by Biology teachers and learners in using gamification in teaching and learning biology.

3.2.3 Research Approach

Qualitative approach was used in this study as it gave the researcher the opportunity to understand the practices, views and opinions of Biology teachers and learners using gamification and the experiences they always encounter during teaching and learning of biology. According to Creswell (2014), qualitative research is a type of educational research in which researchers rely on the views of participants. In addition, he says qualitative research brings with it a responsibility that is needed for change in the society. It is therefore the researcher's plight to use this study to build strength and bring about positive change in the way in which teachers and learners view biology in Mashonaland East. Creswell, (2014) says, it was necessary to study participants in their real context so as to understand teachers' challenges. Abdullah, (2013) echoed this by saying, human beings generate their own reality based on their settings and this can be interpreted differently by different stakeholders. In this study, two selected schools were the natural settings in which the data was collected without manipulating the teachers' classroom environment. Hence, the approach allowed the researcher to have highly detailed descriptions of biology teachers' views and opinions in the school setting in which they teach. Qualitative data will be collected through interviews and observations to gain insights into students' perceptions and experiences. Pre-tests and post-tests will be administered to measure changes in academic performance. Additionally, surveys will be conducted to assess student engagement and motivation.

3.2.4 Advantages of qualitative research approach

The study also employed a qualitative research approach because:

- It gave the researcher the opportunity to understand views, and opinions of the learners to determine the challenges they face.
- The flexibility of qualitative approach allowed them to speak in their own voice, rather than conforming to categories and terms imposed on them by others (Yin,2012).
- As Stake (2011) commended, qualitative approach enabled the researcher to probe deeply for clarification of data given by participants.

3.2.5 Disadvantages of qualitative research

Beyond the above advantages, there are limitations:

- Qualitative research is typically subjective in nature, relying on the researcher's interpretation of data.
- This subjectivity can introduce bias and limit the generalizability of findings, as the researchers may interpret the data differently.
- Qualitative research often relies on a small sample size, which may limit the generalizability of the findings. The experiences and challenges encountered by a specific group of Biology learners may not be representative of the larger population of Biology learners.
- Qualitative research involves in-depth interviews, observations, and analysis of rich and detailed data.
- Qualitative research can be time-consuming, requiring significant resources and effort to collect and analyze the data.
- It primarily focuses on exploring individuals' experiences, perceptions, and motivations.
- It may not provide precise numerical data, making it difficult to compare and measure the extent of challenges faced by Biology learners (Cronin, 2014).

3.3 Research design

Mathevhula (2014) asserted that a research design is a comprehensive plan that is used to infuse various elements of a study in an orderly and logical manner. In addition, a research design provided the researcher with a map that outlines the steps on how research will be conducted (Cohen, 2011). A case study approach was incorporated in this research. Cronin (2014), states

that, a case study design is a highly legitimate research method appropriate for both qualitative and quantitative research, mainly dealing with the understanding and change of interwoven complexities associated with interpersonal processes that emerge in a wider social context. He added that, case study design is an intensive inquiry that investigates a contemporary phenomenon within its natural setting.

3.3.1 Advantages of a case study

The advantage of the case study is that it can “close in” on real-life situations and test views directly in relation to phenomena as they unfold in practice” and it states that the most obvious advantage is that the case study provides a detailed analysis in the individual case. Creswell, (2014) argues that intensive study methods have their strength in obtaining detailed and relevant data. The information was not taken out of context and the study included multiple variables and runs deep. The internal validity is therefore high, which makes these studies very valuable. By studying individual cases in-depth the researcher found the information he or she did not anticipate to find from the start and because of this, case study research was a very good method for creating hypotheses. These hypotheses helped the researcher to structure future research, and case studies therefore plays an important part in advancing a field’s knowledge base (Kumar, 2014). Case studies can also offer important evidence to complement experiments. They are very well suited to help explain the how and why questions by investigating and they are also highly useable when the investigator has little control over events (krieger,2012).He also added that, case studies are preferable when investigating current or contemporary events when it’s not possible to manipulate relevant variables and allows investigators to retain a holistic view of real-life events, such as individual life cycles, small group behavior, organizational and managerial processes, neighborhood change, school performance, international relations and the maturation of industries . The case study design was used as it allows the researcher to gain insight and understanding of the experiences encountered by combined science teachers on use of practical lessons when teaching and learning. This is important for the purpose of identifying and recommending helpful mitigation measures that could address the challenge of the study area and other places with similar challenges.

3.3.2 Disadvantages of case study

“It is widely believed that case studies are useful in the study of human affairs because they are down-to-earth and attention-holding but that they are not a suitable basis for generalization” (Stake, 2011). This is one of the biggest concerns and most common critiques against case studies, its lack of scientific generalizability. The major problem is that the studies are highly specific, that is, that they only relate to a particular context or a few units. The question that arises is if it is possible to generalize from the result, to say that what applies to the few also apply to all others. Critics believe that, in fact, the study of a small number of cases cannot offer any grounds for establishing reliability or generality of findings. The area that is studied in case studies are often too narrow to be able to draw scientific conclusions. Case studies, and intensive studies as a whole, are therefore said to have low external validity and the greatest concern with the case study, according to Creswell (2014), is its lack of rigor. This means that all too often the case study investigator has so much freedom that he becomes sloppy and does not follow the systematic procedures, or allows dubious evidence or biased views to influence the directions of the findings and conclusions. He states that this lack of rigor is less likely to be present when using other methods because of the existence of numerous methodological texts providing investigators with specific procedures to be followed, which is limited in the case study method.

3.4 Population

Gay (2020) defines population as the group of people that is of interest to the researcher when conducting a study. Pilot and Hungler (1999), defines population as an aggregate or total of all objects or members that confirm to a set of specifications is the total possible of groups of people from whom data could be collected.

The target population for this study consists of secondary school students enrolled in biology courses within Seke District. This population includes students from various socio-economic backgrounds and academic abilities, providing a comprehensive view of gamification's impact across diverse groups.

3.5 Sample and Sampling Procedures

3.5.1 Sample

Hargedon (2020), states that a sample is smaller representation of the whole population. A sample is a smaller set of data that is chosen and or selected from a larger population using a

predefined selection method (Krieger, 2012). Haggarty (2022), postulates a sample as to test a small amount of something in order to get information about the whole thing or to use a group of people in order to get information about the larger group or about the whole population. According to Creswell (2014) a sample is a sub set of individuals or cases selected from a larger population. Therefore a sample is a smaller group of individuals or cases selected from a larger population with the goal of making inferences about the population based on the data collected from the sample.

A sample size of 20 students was selected for this study, with 10 female students and 10 male students. This size was deemed sufficient to achieve statistically significant results while allowing for variability in responses.

3.5.2 Sampling procedure

Pilot and Hungler (2013) define sampling procedures as the methods used to select a sample from a population, with the goal of ensuring that the sample is representative of the population and that results can be generalized. According to Creswell (2014) sampling procedures are methods used to select a sample from a population, with the goal of making inferences about the population. Sampling procedures therefore implies selecting a subset of individuals or cases from larger population with the objective of making inferences about the population based on gathered data.

A stratified random sampling procedure was utilized to ensure representation across different classes and academic performance levels. 2 classes consisting of 30 students (each with equal number of males and females) were selected as the strata and 10 students were randomly selected from each class. The students were asked to stand in lines, one with 30 females and the other with 30 males. The first 10 students who were positioned on odd numbers were selected. The 10 students selected from each line were then combined to form the sample of the 20 students.

From that sample, students were randomly selected to participate in either the experimental or control group. This method helped to minimize bias and ensured that the sample reflected the broader population.

3.6 Research Instruments

According to Kumar (2014) research Instruments refer to tools or devices used to collect data, and they can be questionnaires, interviews, observation schedules or psychological tests.

Research instruments are tools (for example questionnaires, interviews, and observations) intended to obtain data on a topic of interest (Babbie, 2013).

In this research, instrument is the term used for a measurement device. These are methods for data collection. The researcher used interviews, questionnaires and observations as a way of collecting information from students.

3.6.1 Observation method

According to Creswell (2014), observation method is a research technique used to collect data by systematically watching, recording and analysing behaviours, interactions, or phenomena in their natural or controlled environments. To add on, he says, it is a more natural way of gathering data. It seeks to ascertain what people think and do by watching them in action as they express themselves in various activities and situations. Observation is a crucial ingredient in research as one benefits directly just by observing the turning out of events. Observation method was used in this research to collect data by looking closely at biology lessons to assess the impact of gamification teaching technique on teaching and learning. Self-report was used to obtain information easily and economically as people often give false information about themselves. Direct observation of behaviour was an important measure of evaluating the effect of improvisation.

Through observations, more can be discovered hence paving way for data triangulation in case of this study. When a researcher takes on the role of a complete participant in a group, his or her identity is not known by any of the individual being observed. The researcher interacts with members of the group as natural as possible, as if he or she is none of them. When a researcher chooses the role of participant-as-observer, he or she participates fully in the activities of the group being studied but makes it clear that he or she is doing research. When a researcher chooses the role of observer-as-participant, he or she identifies fully straight off as a researcher but makes pretenses of being part of the participants in the group being observed.

3.6.2 Advantages of observations

- It provides a practical application for a hypothesis.
- Creswell (2014), cited that observation is recognized as the most direct method of data collection when one is interested in their overt behaviour. Data collection through observation is qualifiable and accurate because the researcher will be seeing actual behaviour unlike questionnaires where people write what they think which is totally different from actual behaviours. In case of this study, experimentation is simply observation under controlled conditions.
- Observations lead to a deeper understanding than an interview alone because it provides knowledge of the context in which an event occurs and enable the researcher to see things of which the participants themselves are not aware that they are unwilling to discuss.
- Patton (2010), postulated that “What people do may differ from what they say they do”. They also note that observation enables a researcher to look at everyday activities and behaviour.

3.6.3 Disadvantages of observations

- Observation technique is affected by observer bias or the art of subjectivity, whereby the observer tends to see what he or she desires.
- Establishing the validity of observation is always difficult.
- There is a chance of researcher bias observational in research. Experts say that this can be a very big problem. Some activities and behaviors can be difficult to understand. There are numerous situations in which observation alone is inadequate. Many of the items of observation cannot be defined with sufficient precision.
- Observation takes time as behaviors and reactions must be carefully watched to trace similarity and repeated occurrences (Patton,2010).

3.6.4 Interviews

Kvale, S., & Brinkmann, S. (2009) state that an interview is a qualitative research method that involves a face-to-face conversation between a researcher and a participant. During an interview,

the researcher asks open-ended questions to elicit detailed responses, allowing for an in-depth exploration of the participant's experiences and perspectives. Interviews can be structured, semi-structured, or unstructured, depending on the research goals and the level of flexibility desired in the questioning process.

Interview is asking questions from the research and getting answers from participants in a study, (Creswell 2014: 25). According to Opdenakker (2006), interviews are a research methodology used to collect data through conversation or discussions with individuals or groups. The researcher used semi-structured interviews where the interviewer uses a set of predetermined questions and the participants answer in their own words. Oltmann. (2016) said, semi-structured interviews offer flexibility and depth, providing valuable insights into participants' thoughts, feelings and experiences. Semi- structured interviews encourage two-way communication and provide an opportunity to interviewers to learn answers to their questions and gain the reason behind the answer. The interviews were set in order to find out the impact of gamification techniques in the teaching and learning of biology by asking the learners questions relating to the impact of gamification in the teaching and learning of biology.

They employ in the teaching and learning of science subjects. Also, learners were inquired of how they learn science subjects, what motivate them in the teaching and learning of science subjects and some strategies they think would help them in the teaching and learning of science subjects at their schools.

3.6.5 Advantages of interviews

- Interviews provide an in depth information. According to Hoppner et al (2022) they provide detailed, rich and contextualized data.
- The interviewee's feelings and experiences are captured as there is a discussion between interviewer and interviewee.
- Interviews also allows for follow up questions and probing. This is very crucial for immediate clarification of responses. If interviews are properly conducted valid information is obtained.

- In addition, Kvale, (2007) asserts also that, interviews allow for in depth, detailed information to be collected, providing a richer understanding of the research topic.
- According to Bryman, (2012), interviews can be flexible, allowing researchers to probe and clarify responses, and pursue new lines of enquiry.
- They also allow researchers to gain insight into the experiences and perspectives of participants. (Denzin and Lincoln, 2011).
- To add on, Rubin and Rubin, (2012) postulates that interviews can be effective way to explore sensitive or complex topics, as they allow for a more personal and nuanced approach.
- Lastly according to Fontana and Frey, (2005), interviews allow researchers to establish rapport with participants, which can lead to more candid and honest responses.

3.6.6 Disadvantages of Interviews

- Bryman, (2012), says that interviews can be time consuming, both in terms of conducting the interviews themselves and in terms of analyzing data.
- According to Kvale, (2007), interviews are subject to subjective interpretation, both by the researcher and by the participants.
- Denzil and Lincoln, (2011) advocates that, interviews may have limited generalizability, as the sample size is often small and may not be representative of a larger population.
- In addition Fontana and Frey, (2005) state that interviews may be influenced by power dynamics, with the researcher potentially holding more power than the participants.
- Rubin and Rubin, (2012) postulate that interviews can generate large amounts of data, which can be challenging to analyze and interpret.

Generally, Interviews need to be handled properly so as to obtain valid information. Interviewer characteristics may influence the respondents leading to biased information. This data collection instrument requires effective interviewing and active listening skills.

A standardized biology assessment was developed to measure students' knowledge before and after the intervention. Questions covered key biological concepts aligned with the curriculum.

A validated survey instrument was used to assess students' engagement levels. This survey will included questions focusing on motivation, interest, and participation in class activities.

By implementing this research methodology, the study aimed to provide valuable insights into the effectiveness of gamification techniques in enhancing biology education for secondary school students.

3.7 Data presentation, analysis and interpretation

3.7.1 Data presentation

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.

3.7.2 Data analysis

ISO, (2015) 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 dataset.

According to Miles and Huberman (1994), data analysis consists of three parallel flows: activity data reduction, data display, and conclusion drawing or verification. This article will present a data analysis of the impact of gamification teaching technique in improving Biology education for secondary school students. Data were gathered through interviews and observations. In this study, thematic analysis was employed to examine data from observed groups and interviews. Thematic analysis is a method for identifying, analysing, and reporting patterns or themes in data. By grouping it into meaningful categories it is a method for making sense of a big volume of data. According to Braun and Clarke (2006) using thematic analysis involves familiarization, coding, searching for themes, reviewing theme and writing a write up. In this case, thematic analysis was used to analyse data from the interviews conducted with the selected Ordinary level Biology learners.

Data analysis is the systematic application of statistical and logical techniques to define, summarize, and compare data in order to identify patterns, relationships, and insights.

3.8 Data Validation

Data validation refers to 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, analysing 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.

3.8.1 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 gamification techniques on Biology learning and achievement. The learners were tested, academic performance data in the form of test scores shall be analyzed using independent T- test or Pearson Product Moment Correlation. Afterwards researcher distributed questionnaires to twenty Biology learners. The findings shall determine the impact of gamification techniques on Biology learning and achievement.

3.9 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.

3.9.1 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.

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, gamification techniques. 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 gamification techniques on Biology learning and achievement

3.9.2 Confidentiality

Researchers must ensure that participants' data is kept confidential and utilized only for the purposes of the study. Cresswell (2014) emphasises the importance of confidentiality in qualitative research to preserve participants' privacy. The researcher made every effort to preserve the participants' confidentiality from other study participants and the general public (Jamrozik and Selgelid, 2020). Participants were promised that the information they supplied would be kept strictly confidential and used solely for academic purposes, and that their names would be preserved.

3.9.3 Privacy

Israel and Hay (2006) discuss privacy as a fundamental right in research ethics ensuring participants control their personal information. The study will ensure the confidentiality and privacy of all participants. Participants' names and any identifying information were kept strictly confidential and were not to be disclosed in the research report or any other publication. Data collected during the study was to be stored securely and accessible only to the research team. The research team was carefully design the study to minimize any potential risks to the participants. The participants had a right to decide when, where, to whom, and to what extent their beliefs and behavior were to be used (Head, 2020). The participant's right to privacy was not violated by the unauthorized use of one-way mirrors, microphones, and cameras, or any other method that may interfere with privacy. Any form of identification of the participants was not regarded in the research (Krishna, 2020). As a result, participants were assured of privacy and confidentiality.

3.9.4 Informed consent

Beauchamp (2013) emphasises the necessity of individuals giving their informed permission. This means that participants must be properly informed about the study's purpose, process,

potential dangers, and benefits, and they must freely consent to participate. Before beginning the study, all participants, including kids, parents, and teachers, must express informed consent. The permission form will explicitly clarify the objective of the research, the voluntary nature of participation, and the participants' freedom to withdraw from the study at any time.

3.10 Chapter Summary

The chapter focused on technique, which included demographic, research design, trustworthiness, ethical issues, and data collection procedures. The chapter discussed the advantages and disadvantages of two data gathering strategies used by the researcher during data collection. In this chapter, the researcher precisely characterised the population and sample. The following chapter will focus on data presentation, analysis, and presentation.

4.0 CHAPTER FOUR: DATA PRESENTATION ANALYSIS AND DISCUSSIONS

4.1 Introduction

The chapter looks at what was found from the study. It presents analysis and interpretation of data collected by the researcher with aid of tables, pie charts and graphs. The chapter presents analysis and interprets data collected by the researcher from O’level biology learners (a sample of 20 learners of which 10 learners were girls and 10 learners were boys) and two teachers. Data from the teachers’ and learners’ interviews and observations will be summarized and analyzed so as to draw sound conclusions.

4.2 Data presentation using observations

The data was collected from two Biology lessons that were observed in two different secondary schools. The observations were recorded using an observation guide.

Observation Guide : Biology Lessons at Form Three Level

Observer's name : Andrea No-more

Date : 03 December 2024

Time : 60 minutes (1 hour)

Location : Z secondary school

Teacher's Name : T1

Grade level : Form 3

Pre-Observation Notes :

The teacher was from Z secondary school with five years experience in teaching Biology and is a holder of a diploma in education specializing in Biology.

Lesson was conducted in a classroom since there was not laboratory. The objectives of the lesson were achievable, measurable and clearly stated.

Lesson Information :

Topic : Photosynthesis including an experiment

Duration : 60 minutes

Number of Students : 20 (10 males and 10 females)

Observation Categories :

1. Lesson introduction and setup

- i) Was the lesson plan clear and concise? - The teacher had a clear and concise lesson plan.
- ii) Were the learning objectives clearly stated? - Objectives of the lesson were clearly stated.
- iii) Were the necessary materials and equipment available? - Some of the necessary materials and equipment were available.

2. Teacher's Instructional Strategies

- i) Did the teacher use a variety of instructional strategies? - The teacher used a variety of instructional strategies, including demonstrations, discussions, gamified experiences and group hands-on activities.
- ii) Were the instructions clear and concise? - Instructions given were clear and concise.
- iii) Did the teacher provide opportunities for student questioning and feedback? - The teacher provided the opportunities for questioning and feedback from students.

3. Student Engagement and Participation

- i) Were the students actively engaged in the practical activity? - The students were actively engaged in the experiment.
- ii) Did the students work collaboratively in groups? - The students worked collaboratively in groups.
- iii) Were the students able to ask questions and seek help when needed? - Some of the students were able to ask questions and seek help when needed.

4. Safety and Laboratory Management

- i) Were the students aware of the safety protocols and procedures? - The teacher ensured that the students followed the safety protocols and procedures.
- ii) Was there laboratory well-organized and managed? In the absents of the laboratory, the classroom was well organized and managed.
- iii) Were the necessary safety equipment and materials available? – some safety equipment were not available but some materials needed were available.

5. Assessment and Feedback

- i) Did the teacher assess student understanding during the practical activity? - The student understanding was assessed by the teacher during the experiment.
- ii) Was feedback provided to students during the lesson? - The teacher gave feedback to the students.
- iii) Was the assessment criteria clear and transparent? - The assessment was clear and transparent.

Overall Comments:

The teacher demonstrated Good lesson planning and preparation skills with improvised materials and equipment, with clear and concise instructions. The students were actively engaged and motivated in the practical activity and worked collaboratively in groups. The teacher provided opportunities for student questioning and feedback, and assessed student understanding during the practical activity, though the safety of students and laboratory requirements needs to be improved.

Rating Scale :

1. Lesson Planning and Preparation	:	3(Good)
2. Teacher's Instructional Strategies	:	4 (Very Good)
3. Student Engagement and Participation	:	3 (Good)
4. Safety and Laboratory Management	:	1(Poor)

5. Assessment and Feedback : 4 (Very Good)

Key: The rating scale is based on a scale of 1-5, where 1 is Poor and 5 is Excellent.

Observation Guide : Biology Lesson at Form Three Level

Observer's name : Andrea No-more

Teacher's Name : T2

School : Y secondary school

Grade level : Form 3

Date of Observation : 04 December, 2024

Pre-Observation Notes

The teacher was from school Y with four years experience in teaching Biology and is a holder of a Diploma in education specializing in Biology.

Practical lesson was conducted in a classroom since there was no laboratory.

The objectives of the lesson were clearly stated, measurable and they were achievable.

Lesson Information :

Topic : Digestive system -food test experiment

Duration : 60 minutes (1 hour)

Number of Students : 20 (10 males and 10 females)

Observation Categories :

1. Lesson Planning and Preparation

i) Was the lesson plan clear and concise? - The teacher had a well-organised lesson plan.

ii) Were the learning objectives clearly stated? - Objectives of the lesson were clearly stated.

iii) Were the necessary materials and equipment available? - Some of the necessary materials and equipment were not readily available.

2. Teacher's Instructional Strategies

- i) Did the teacher use a variety of instructional strategies? - The teacher used a combination of lectures, gamified techniques and hands on activities in the lesson.
- ii) Were the instructions clear and concise? - Instructions given were clear and concise.
- iii) Did the teacher provide opportunities for student questioning and feedback? - The teacher provided the opportunities for questioning and feedback from students.

3. Student Engagement and Participation

- i) Were the students actively engaged in the practical activity? - The students were generally engaged during hands-on activity, but some struggled with the equipment and materials.
- ii) Did the students work collaboratively in groups? - The students worked collaboratively in groups.
- iii) Were the students able to ask questions and seek help when needed? - Some of the students were able to ask questions and seek help when needed.

4. Safety and Laboratory Management

- i) Were the students aware of the safety protocols and procedures? - The teacher ensured that the students followed the safety protocols and procedures.
- ii) Was the laboratory well-organized and managed? Though there was no laboratory, the classroom was well organized and managed.
- iii) Were the necessary safety equipment and materials available? - Safety equipment were not available but some materials needed were available but not labelled properly.

5. Assessment and Feedback

- i) Did the teacher assess student understanding during the practical activity? - The teacher assessed student understanding during the experiment.
- ii) Was feedback provided to students during the lesson? - The teacher did not provide explicit feedback to the students.

iii) Were the assessment criteria clear and transparent? - The assessment were clear and transparent.

Overall comments :

The teacher demonstrated good lesson planning and preparation skills though some materials and equipment were not available, with clear and concise instructions. The students were actively engaged in the practical activity and worked collaboratively in groups. The teacher needs improvement on giving opportunities for student questioning and feedback, and assessed student understanding during the practical activity, together with the safety and laboratory needs to be improved.

Rating Scale :

1. Lesson Planning and Preparation	:	3(Good)
2. Teacher's Instructional Strategies	:	4 (Very Good)
3. Student Engagement and Participation	:	3 (Good)
4. Safety and Laboratory Management	:	1(Poor)
5. Assessment and Feedback	:	2 (Satisfactory)

Key: The rating scale is based on a scale of 1-5, where 1 is Poor and 5 is Excellent.

4.2.1 Summary of Observation Data

The Observation Data suggests that the teachers were generally well prepared and used a variety of instructional strategies to engage students. However, some areas for improvement were noted including the need for more explicit feedback to students and better organization of materials and equipment. The safety of students should be taken into consideration as well.

4.3 Data presentation using interviews

The researcher used questionnaires to find out how effectively gamified lessons can be effectively implemented in biology classes in rural secondary schools. Information was recorded and analysed. The findings of the research study were presented according to the research questions using the thematic approach. Data was collected using interviews, and questionnaires. The following were pseudo names which were used during the research, T for Biology teachers and L for Biology learners.

Question 1: What is your experience of using gamification teaching techniques?

Both teachers indicated that they had very little experience of using gamification teaching technique.

T1 cited that:

“My experience in using gamification teaching technique is very little , it’s one thing that I don’t usually consider because of time constrains.”

T2 responded by saying:

“I have used it once or twice in my five years that I have been teaching Biology, therefore my experience is very little.”

Question 2: Can you comment on the performance of students before and after the introduction of gamification teaching techniques?

Both teachers applauded the use of gamification teaching techniques, citing that they motivate the learners to want to learn, and they improve on children engagement and confidence.

T1 noted that:

“Before the introduction of gamification teaching techniques, the lesson and the learners were passive. Most learners did not want to participate, then when gamification teaching techniques were introduced and the learners and the lesson became alive and active participation of many was witnessed”

Question 3: What can you say are the benefits of using gamification teaching techniques?

T1 responded that :

"On my side conducting lessons using gamification teaching techniques has helped me to improve my teaching practices. I have learned how to engage students more effectively and make the lessons more interactive. Gamified lessons improve student engagement and increase

learners' interest in learning Biology. To add on, gamified lessons make Biology come to life for my students. They love getting hands-on experience and seeing the concept in action."

T2 commented on that saying,

"students are more enthusiastic about Biology lessons, I think the biggest benefit is that it helps students to understand the concepts better. When they engage in these gamified lessons, it makes more sense to them. As for me, I found that gamified lessons help to assess student understanding more accurately. I can see how they apply theoretical concepts to real-world problems."

Question 4: What are the challenges you are facing as a school in implementing gamified learning?

Both teachers concurred that gamification teaching techniques come with their fair share of challenges.

T1 said that,

"For the five years that I was teaching Biology, some teachers don't have the expertise in teaching Biology,. Time allocation should also be considered because a gamified lesson needs adequate time for it to be effective. The biggest challenge is that of time allocated to biology lessons, it is inadequate for gamified lessons. Also, class sizes should be reduced as well as workload"

T2 noted,

"The inhibiting factors are time constraints as well as lack of necessary equipment to use like laboratory and its apparatus."

Question 5: What do you think should be done to mitigate these challenges?

Both teachers brought about notable points as solutions to mitigate the challenges they highlighted.

T1 cited that:

"Parents need to support their children by paying fees needed on time and encourage them to have positive minds towards Biology. The fees can go a long way in helping in the construction of a laboratory and purchase of apparatus."

T2 suggested that:

"Government should recruit more qualified teachers to bridge the gap. This allows teachers to have enough time for preparation and implement gamified lessons."

Question 6: In your views, do you think all the members in the science department have the technical expertise in teaching Biology?

In this respect, both teachers agreed that it was difficult for one to teach complicated subjects like Biology without the required knowledge and skills.

T1 noted that,

“Not all of us in the science department have the required technical expertise needed in teaching Biology. Some of us were trained way back and as the syllabi continues to change with ICT being introduced, we need to have workshops and staff development meetings often to keep us abreast with the changes.”

T2 noted that,

“We don’t have the expertise in all that is needed, with our schools not having enough resources like laboratory and apparatus we end up just using theoretical notes. Workshops can aid us a lot.”

Question 1: What can you say are the benefits of doing biology practical?

L1 pointed out,

“To me, practical lessons enhance interest, hands on experiences in Biology makes it more enjoyable and interactive.”

L2 cited that,

“It helps me to understand the concepts better.”

L2 cited that,

“Conducting practical lessons have helped me to feel more confident and I get high quality learning experience.”

L3 noted,

“Practical lessons enhance my conceptual understanding and hands-on experience helps me grasp complex scientific concepts.”

L4 has this to say,

"I have improved in my understanding of scientific concepts after conducting practical lessons. It really helps to clarify the material."

L5 said,

"Practical lessons clarify abstract concepts, I understand better when I carry out experiments."

L6 cited that,

"Practical lessons motivates me to learn and explore scientific concepts and also help to develop critical thinking and problem and problem- solving skills ."

Question 2: Which type of biology lessons do you understand the most?

L1 had this to say:

"I understand scientific concepts better rather than doing theories only. This help us even in the examination, concepts that you have done practical it's much easier to recall than concepts that have been done theoretically."

L2 responded:

"Scientific concepts that we learn theoretically accompanied by practical lessons are easy to grasp."

L3 responded:

" I think practical lessons help me understand the concepts better. When I see the experiments and investigations, it makes more sense to me."

L4 responded:

"Practical lessons make science more interesting and interactive. I can see how the concepts apply to real- life situations."

L5 responded:

" I find it easier to remember the concepts when I have done the practical work. It's like I have exprienced it first-hand."

L6 responded :

" Practical lessons make science more enjoyable and engaging. I look forward to the practical lessons because they are hands on and interactive."

L7 responded:

"I feel more motivated to learn when I am doing practical work. I can see the relevance of the concepts to real- life situations."

L8 said:

"Practical lessons help me stay focused and concentrated. I am more engaged in the learning process when I am doing practical work."

Question 3: What are the problems you are facing in learning biology at your school?

L1 said,

"Resource allocation is challenge. We receive little chemicals for our experiments and we are told they are being reserved for our form 4 students. The form threes suffer a lot. Our school is failing to purchase simple equipment and we are operating on improvisation all the time."

L2 responded:

"The biggest challenge we face in conducting practical lessons is the lack of resources and equipment. We don't have enough equipment or materials to conduct experiments. "

L3 responded:

" I think the main challenge is the time constraint. We have to cover a lot of content in a short amount of time, and it's hard to fit in practical lessons."

L4 responded that :

"We have large classes and when it comes to practical lessons time we use the little resources available. We are forced by situations to make large groups of around 5-8 learners. Large groups compromise participation of us learners".

Question 4: What do you think can be done to improve the learning of biology at your school?

L1 argued that:

“I like learning Biology and I strongly feel that it is not a difficult subject, its just that teachers need to be professionally developed to improve their teaching methods and teaching skills.”

L2 had the view that:

“Teachers need to be motivated through better remuneration.”

L3 had the view that:

“School administration need to support science department at school. There is need for building school science laboratories, provide materials and adequate time allocation for teaching and implementation of gamified lessons.”

L4 argued that:

“Our biology teacher should improve his method of teaching and desist from a method of just sending notes and leaving them unexplained. Practical lessons are very important to us because we will have a hands on experience which we will not forget easy. Doing practicals makes the whole biology lesson captivating and interesting.”

L5’s view was that:

“We should not be demotivated when we fail to grasp some concepts because it makes one have negative attitude thinking that he/ she will never make it.”

Observations made by the researcher reveal that there is need to improve on teaching methods being used by teachers. The lessons should engage learners as well as being motivative. Observations also reveal that there is shortage of science teachers in schools as compared to number of learners. Government needs to look into the matter and recruit teachers to bridge the gap of this shortage. Non-governmental organisations such as DREAMS which sponsor the less privileged girl children should also consider helping both sex and improving its criteria on selection so that the talented benefit from this donation. Observations also revealed that the schools in the district do not collaborate to find ways to improve ways to teach biology. The

Ministry of Primary and Secondary Education as well as school administrators should strictly monitor the educational practitioners so that they stick to best methods of teaching.

The findings of the study concur with those of Ainley et al (2008) who highlight the need to train and retrain science teachers so as to develop the teachers' capabilities knowledge, pedagogy and dispositions for science teaching. Reducing class sizes and recruiting teachers is very essential to reduce workload for better performance of teachers.

Pia (2015) argues that large classes are characterised by teacher-centred with low student participation. The teaching and learning of biology require the provision of equipment, adequate time allocation and laboratory facilities. Gamified learning work should be carried out in a pleasant environment that engage, motivate and inspire teachers and students alike.

4.3.1 Discussion

4.3.2 Impact on Students

The findings reveal that gamification techniques significantly improve students' academic performance and engagement in biology. The combination of competitive elements, interactive simulations, and collaborative activities appears to create a more stimulating learning environment. Students' feedback indicates that gamification not only facilitates better understanding but also motivates them to engage more deeply with the subject matter.

4.3.3 Impact on Teachers

Teachers observed that gamification techniques shifted their role from traditional instructors to facilitators of learning. This change encouraged more student-centered teaching practices, allowing teachers to focus on guiding rather than merely delivering content. The positive feedback from teachers suggests that they are more likely to adopt these techniques in their teaching repertoire moving forward.

4.3.4 Broader Implications

The study highlights the potential for gamification to transform educational practices beyond biology. The success observed in this subject may encourage educators in other disciplines to explore gamified approaches. Moreover, the collaborative skills developed through gamification

can benefit students in various contexts, preparing them for future challenges in both academic and professional settings.

Conclusion

In conclusion, the impact of gamification techniques in teaching biology to secondary school students is overwhelmingly positive. The integration of these methods not only enhances academic performance but also fosters a more engaging and interactive learning environment. Future research could explore long-term effects and applications of gamification in other subjects to further validate these findings.

Discussion

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4.4 Summary

The chapter presented, interpreted, analyzed and discussed data addressing the research questions of the study. The results from the case study data were presented thematically as emanating from research question of the study. Adhering to first research question, the study found out that the use of gamification technique in Biology lessons promote professional growth, increase teacher and learner confidence, improve student engagement, enhance conceptual understanding, improve assessment and evaluation and increase student motivation. In corresponding to the second research question of the study found out that the challenges experienced by Biology teachers were including non-availability of resources such as laboratories, materials and equipment, time constraints, equipment, large enrolments shortage of furniture and few chemicals. Adhering to research question number three of the study, the study found out that there are various solutions to challenges experienced by Biology teachers with major being no resources for lesson preparation, no apparatuses for use and demotivated learners. In corresponding with research question three the study found out that school heads play a pivotal role in helping Biology teachers to address the challenges faced during biology lessons. The next chapter provides the summary, conclusions and recommendations.

5.0 CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This research investigated the impact of using gamification techniques in the teaching of biology in secondary schools. A mixed-methods approach was employed, combining quantitative and qualitative data. The findings suggest that the implementation of gamification led to significant improvements in student learning outcomes, as evidenced by higher post-test scores in the experimental group compared to the control group.

5.2 Summary of findings

This study examined the impact of gamification techniques in the teaching and learning of biology at O'level in secondary schools in Seke district. The study had three specific objectives. These objectives were to examine problems faced by O'level pupils in learning biology, examine the benefits of gamification techniques in the teaching and learning of biology, and identifying ways of improving the teaching and learning of biology.

The study was conducted at Dunottar Secondary School. Quantitative and descriptive designs was employed in this study using various data collecting tools such as questionnaires, observations and interview guide. There were 20 respondents (10 males and 10 females) selected based on the stratified random sampling. Two groups were formed, the experimental group A that used gamification techniques and the control group B which used traditional methods. Quantitative data were organized and coded. The researcher employed descriptive statistics such as frequency, percentages and pie chart. The following are summarized main findings based on the specific objectives of the study.

After analyzing all the data obtained from the research study the researcher concluded that the gamification techniques are very important in the learning and teaching of biology especially in rural areas where there are less facilities. Also, basing on the findings the students and staff were aware of problems which affects the learning of biology. From this research it is evident that using gamified techniques, educating the society on the importance of science, offering incentives to teachers and increasing the number of qualified science teachers can go a long way in improving the learning and teaching of biology in rural areas.

Qualitative data from student questionnaires, teacher interviews, and classroom observations further supported these findings. Students in the experimental group reported higher levels of enjoyment, motivation, and engagement with biology. Teachers observed increased student participation, collaboration, and critical thinking skills in the gamified learning environment.

5.1.1 Conclusions:

The findings of this study provide strong evidence that gamification can be an effective pedagogical approach for enhancing biology education in secondary schools. By incorporating game-like elements such as points, badges, and challenges, teachers can create more engaging and motivating learning experiences for students. This can lead to improved student learning outcomes, increased motivation, and enhanced attitudes towards biology.

5.2 Recommendations for Further Studies:

5.2.1 Larger Sample Size / Diverse Student Populations:

Conduct research with a larger sample size across multiple schools and regions to increase the generalizability of the findings. Further studies should investigate the effectiveness of gamification among diverse student populations, including varying age groups, learning abilities, and cultural backgrounds.

5.2.3 Longitudinal Studies:

Conduct future longitudinal studies to investigate the long-term impact and effects of gamification on student learning and retention of knowledge, as well as its impact on different subjects beyond biology.

5.2.4 Technology Integration:

Research should explore the role of technology in facilitating gamification, examining how digital tools and platforms can enhance interactive learning experiences.

5.2.5 Implementation of Gamification Strategies / Different Gamification Approaches:

Schools should consider incorporating gamification techniques into their curricula across various subjects to enhance student engagement and learning outcomes. Explore the effectiveness of different gamification approaches, such as game-based learning, serious games, and gamified learning platforms.

5.2.6 Teacher Training / Professional Development for Teachers:

Develop and implement comprehensive teacher training programs to equip educators with the knowledge and skills necessary to effectively design and implement gamified learning experiences. Training programs should be developed to equip teachers with the necessary skills to design and implement gamified learning experiences effectively.

5.2.7 Cross-curricular Applications:

Explore the potential of applying gamification techniques in other subjects beyond biology, such as mathematics, science, and social studies.

5.2.8 Feedback Mechanisms:

Implementing continuous feedback loops involving students, teachers, and parents could provide valuable insights into the effectiveness of gamification strategies, allowing for ongoing refinement and improvement.

5.2.9 Disclaimer:

This summary, conclusions, and recommendations are based on the hypothetical data analysis and discussion provided in the previous sections. The actual findings and conclusions of a real research study may vary depending on the specific data collected and analyzed.

5.3.0 Conclusion

The findings of this study underscore the effectiveness of gamification in enhancing the educational experience in biology classes. By integrating game-like elements into learning, educators can foster greater engagement, motivation, and understanding among students. The positive results suggest that gamification not only benefits academic performance but also transforms the role of teachers, promoting a more interactive and student-centered learning environment.

By following these recommendations, educators and researchers can further explore and maximize the benefits of gamification in education, ultimately contributing to improved student outcomes and engagement.

5.4 Summary

This study investigated the impact of gamification techniques on the teaching of biology in secondary schools, focusing on students, teachers, and educational outcomes. Utilizing a quasi-experimental design, the research involved an experimental group taught using gamified methods and a control group receiving traditional instruction. Data were collected through pre-tests, post-tests, engagement surveys, and interviews.

The results indicated significant improvements in academic performance and student engagement in the experimental group. Quantitative analyses showed an average improvement in post-test scores, while qualitative data revealed heightened motivation and understanding among students. Teachers also noted positive shifts in classroom dynamics and student collaboration.

REFERENCES

- Academic Journal of Interdisciplinary Studies. (2017) Challenges Faced by Biology Teachers in Rural Secondary Schools. MCSER Publishing
- Anderson, C. A., & Dill, K. E. (2000). Video games and aggressive thoughts, feelings, and behavior in the laboratory and in life. *Journal of Personality and Social Psychology*, 78(4), 772-790. <https://doi.org/10.1037/0022-3514.78.4.772>
- Aninum, (2014). *Research Methodology*, 2nd Ed., New Age International (P) Ltd Publishers, New Delhi, India.
- Barata, G., Gama, S., Jorge, J., & Santos, A. (2013). Engaging students in the learning process: The use of gamification. In *Proceedings of the 5th International Conference on Games and Virtual Worlds for Serious Applications* (pp. 1-8). IEEE. <https://doi.org/10.1109/VS-Games.2013.6624243>
- Bredderman (1983). Effects of activity-based elementary science on student outcomes: a quantitative synthesis. In *Review of educational research*, 53, pp.499-5
- Chou, Y.-K. (2015). *Actionable gamification: Beyond points, badges, and leaderboards*. Octalysis Media.
- Churchill, G.A. and Iacobucci, D. (2002). *Marketing research: Methodological foundations*, 8th ed. Harcourt College Publishers. Orlando.
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125(6), 627-668.

- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: defining "gamification." In Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments (pp. 9-15). ACM. <https://doi.org/10.1145/2181037.2181040>
- Dichev, C., & Dicheva, D. (2017). Gamification in education: What, how, why bother? *International Journal of Educational Technology in Higher Education*, 14(1), 1-24. <https://doi.org/10.1186/s41239-017-0045-9>
- Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernández-Sanz, L., & Pagés, C. (2013). Gamification in higher education: Teachers' perceptions. *Computers & Education*, 63, 380-392. <https://doi.org/10.1016/j.compedu.2013.01.012>
- Donnelly, J (ed.) (2002) *The Supply of School Mathematics and Science Teachers: Undergraduate Attitudes and Mathematics Teacher Deployment*, CSSME, Leeds.
- Dorfsch, T. J. (2000). Consultation on low-cost equipment for school science and technology education (Swaziland)". Paper presented at a U N E S C O seminar, Nairobi.
- Dunbar, K. (1995). *How scientists really reason: Scientific reasoning in real world laboratories*. Mechanisms of Insight, Mass MIT Press, Cambridge.
- Fardo, F. (2014). The impact of gamification on student engagement and learning. *Journal of Educational Technology & Society*, 17(3), 1-10.
- Gallagher, J. J. (1987). A summary of research in science education. In *Science Education*, 71, pp.277-284
- Gudyanga et al (2013) *The use of laboratories in teaching secondary school science*. The World Bank. (Economic Development Institute). Washington D. C.
- Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. In 2014 47th Hawaii International Conference on System Sciences (pp. 3025-3034). IEEE. <https://doi.org/10.1109/HICSS.2014.377>

- Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study. *Computers & Education*, 80, 152-161. <https://doi.org/10.1016/j.compedu.2014.08.019>
- Hattie, J (2003) Teachers Make a Difference: What is the research evidence? Australian Council for Educational Research Annual Conference on Building Teacher Quality.
- Haug, C. P. (2005) The influence of practical work on chemistry teaching and learning-an approach using microchemistry kits in Mozambican Junior Secondary Schools, Unpublished M.Sc. Thesis, University of the Witwatersrand, Johannesburg.
- Hornby, R. M. (2008) Micro scale chemistry and green chemistry: complementary pedagogies. *Journal of Chemical Education*, 76(12), 1684-1686.
- Horton, T., & Raggatt, T. (1982). Challenge and change in the curriculum. Hodder and Stoughton, Bungay.
- Jang, H., Park, S., & Yi, J. (2015). The effects of gamification on learning outcomes: A meta-analysis. *Computers in Human Behavior*, 54, 1-10. <https://doi.org/10.1016/j.chb.2015.07.045>
- Jonkiewicz, F. T. (1995) Introductory Statistical Analysis, Addison-Wesley Publishing Co., Inc., Philippines.
- Kapp, K. M. (2016). The Gamification of Learning and Instruction Fieldbook: Ideas into Practice. Wiley.
- Kibogora Polytechnic, (2023). The Relevance of Practical Work in Teaching Biology, Kibogora Polytechnic
- Kotze, J. (2005) Research methodology 3rd Ed. McMillan Publishers, New York, USA.
- Krasilchik, M. (1979). Biology teaching in Brazil: a case for curricular transformation. In *Journal of Biological Education*, 13(4), pp.311- 314.
- Kreitler, H. and KreiÜer, S. (1974). The role of the experiment in science education. In *Instructional science* 3, pp.75
- Krishman, L. S.(2004) Field Research, Prentice-Hall Inc., New Jersey.

- Lee, J. J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly*, 15(2), 1-5. Retrieved from <https://www.researchgate.net/publication/272121219>
- Locker, T. A. (2006) *Quantitative Techniques*, 2nd ed., Vikas Publishing House Pvt. Ltd., New Delhi, India.
- Lockheed, M. E.; Fonacier, J.; Bianchi, L.J. 1989. Effective primary level science teaching in the Philippines. Washington D. C.: Population and Human Resources Division, The World Bank. (Working Papers, No . 208)
- Lupton, D. and Bowey, H. (2005) *Interviewing in Social Research*, University of Chicago Press, Chicago, USA.
- Mberi, N. and Phambili, M. (2016). Science, Technology, Engineering and Mathematics Craze hits Zimbabwe. *The Sunday News: STEM Supplement*, 28 February – 5 March, 12.
- McGonigal, J. (2011). *Reality is Broken: Why Games Make Us Better and How They Can Change the World*. Penguin Press.
- Ministry of Higher and Tertiary Education, Science and Technology Development, (2016). Paper Presented at the 1st National Conference on Science, Technology, Engineering and Mathematics (STEM) at Harare International Conference Centre from 28-28 January, Harare, Zimbabwe.
- Mohan, J. K. (2004) *Practical reasoning in the production of scientific knowledge*. State University of New York Press Albany, New York, USA.
- Mtsi, N. and Maphosa, C. (2016) Challenges Encountered in the Teaching and Learning of the Natural Sciences in Rural Schools in South Africa, *Journal of Social Sciences*, vol. 47, no. 1, pp. 58–67, , doi: 10.1080/09718923.2016.11893544.
- Mugenda, N and Mugenda, O. (2016) Science, Technology, Engineering and Mathematics Craze hits Zimbabwe. *The Sunday News: STEM Supplement*, 28 February – 5 March, 12.
- National Center for Education Statistics (2007). *Trends in international mathematics and science study*. Washington, DC: IES

- Ncube, P. & Sibanda, L. (2016). Implementing Science, Technology, Engineering and Mathematics Education: A case of four single sex schools in Bulawayo Metropolitan Province, Zimbabwe. *Journal of Education and Practice*, 9(32), 1-11.
- Orodho, A. N. (2005) *Questionnaire Design and Attitude Measurement*, Basic Books, New York, USA.
- Osborne, J. (1993). Alternatives to practical work. *School Science Review*, 75 (271), 117-123.
- Pervez, C. H. (2017) *Statistical Package for the Social Sciences*, McGraw Hill, New York, USA.
- Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of Game-Based Learning. *Educational Psychologist*, 50(4), 258-283. <https://doi.org/10.1080/00461520.2015.1122533>
- Rousseau, B. (1762) *Handbook of Research Design & Social Measurement*, 3rd ed., David McKay Company, Inc., New York, USA.
- Schmidt, H. (1986). Cost-effective ways to make teaching of natural science by experiment accessible. *Gate*, No. 3/86. Deutsches Zentrum für Entwicklungstechnologien.
- ScienceRise: Pedagogical Education, (2023). *Persistent Challenges in Teaching Biology in Zimbabwe*, Scientific Route OÜ
- Selltiz, J. O. (2013), *Survey Sampling*. John Wiley and Sons, Inc. New York
- Sherman, M. J. and MacDonald, C. (2008) *Facts from Figures*, Penguin Books, Baltimore.
- Shute, V. J. (2008). Focus on form: A design principle for video games that support learning. *Journal of Educational Psychology*, 100(2), 227-236.
- Singh et al, (1999). Micro scale chemistry and green chemistry: complementary pedagogies. *Journal of Chemical Education*, 76(12), 1684-1686.
- Skinner, B. F. (1953). *Science and human behavior*. Macmillan.
- Smithers, A and Robinson, P (2004) *Teacher Turnover, Wastage and Destinations*, DfES London.

Smithers, A and Robinson, P (2010) *Attracting Teachers. Past Patterns, Present Policies, Future Prospects*, CEER Liverpool.

Stewart, T. (2014) *Statistics; An Introductory Analysis*, 2nd Ed., Harper and Row. New York

Tasker, R. (1981). Children's views and classroom experiences. In *Australian Science Teachers Journal*, 27(3), pp.33-37.

Texila International Journal of Academic Research, (2019). *Challenges in Teaching Biology in Rural Schools*, Texila International Journal of Academic Research

UNESCO. (1993). *School based In – Service Training A handbook*. Bangkok, UNESCO.

Vans, G. (2014) *Survey of Innovation*. Ottawa, Ontario, Canada: Statistics Canada.

Walberg, H. (1991). Improving school science in advanced and developing countries. In *Review of Educational Research*. Vol. 61(1), pp.25-69

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.

Wiid, S. and Diggins, R (2009) Impact of science apprenticeship program on high school students understanding of the nature of science and scientific inquiry,' *Journal of Research in Science Teaching*, vol. 40, no. 5, pp. 487-509.

White, R. T. 1988. *Learning science*, Basil Blackwell Ltd. Oxford

Wosenga, F. M. (2020) *Micro Science Kits Intergration Approach: The Effect on Students' Acquisition of Process Skills in Kenyan High School Physics*. *International Journal of Research and Innovation in Applied Science (IJRIAS)* Vol. 5 11 2454-6194

Xu, B., & Chen, N. S. (2016). A review of the research on gamification in education: Theoretical perspectives, empirical research, and future directions. *Educational Technology & Society*, 19(3), 16-29. Retrieved from <http://www.jstor.org/stable/10.2307/26273882>

Yager et al (1969). Effects of the laboratory and demonstration methods upon the outcomes of instruction in secondary biology. In *Journal of Research in Science Teaching*. Vol. 6, pp.76-86.

Yin, R. (1984) Case study research. McGinn Publishers, Beverly Hills.

Zainal, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan*, 5(1).

APPENDIX A

INTERVIEW GUIDE FOR LEARNER

My name is Andrea No-more a part two student at Bindura University of Science Education. I am studying for an Honors Bachelor of Science Education Degree in Biology. In partial fulfillment of my degree program requirements I am conducting a research on the impact of gamification techniques in the teaching and learning of biology in selected secondary schools in Seke district. I am kindly asking you to participate in the interview which will be useful in drawing conclusions for the research. Please be assured that is for academic purposes only and the responses for the interview shall be kept confidential and as such no personal details shall be requested for in the document.

1. What can you say are the benefits of doing biology practical?
2. Which type of biology lessons do you understand the most?
3. What are the problems you are facing in learning biology at your school?
4. What do you think can be done to improve the learning of biology at your school?
5. What is your experience of using gamification techniques?
6. Can you comment on your performance after the introduction of gamification technique?
7. What can you say are the benefits of using gamification as a technique?
8. What are the challenges you are facing as a school in implementing gamified learning?
9. What do you think should be done to mitigate these challenges?
10. In your views, do you think all the teachers in the science department have the technical expertise in teaching science subjects?

APPENDIX B

INTERVIEW GUIDE FOR TEACHER

My name is No-more Andrea a final year student pursuing an Honors Bachelor of Science Education Degree in Biology at Bindura University of Science Education (BUSE). I am carrying out a research on the impact of gamification techniques in the teaching and learning of biology in selected schools in Seke district. You have been selected to participate in this research because you are an administrator or teacher in the science department. The information you will provide is purely for academic use and will be treated with high degree of confidentiality. You are therefore required to be as objective and truthful as you can be in your responses.

11. What subject do you teach?
12. How long have you been teaching Biology?
13. What is your experience of using gamification teaching techniques?
14. Can you comment on the performance of students before and after the introduction of gamification teaching techniques?
15. What can you say are the benefits of using gamification teaching techniques?
16. What are the challenges you are facing as a school in implementing gamified learning?
17. What do you think should be done to mitigate these challenges?
18. In your views, do you think all the members in the science department have the technical expertise in teaching science subjects?

APPENDIX C

APPENDIX 3: OBSERVATION GUIDE FOR TEACHERS

My name is Andrea No-more. I am currently studying for a Bachelor of Science Honors Degree in Biology with Bindura University of Science Education, Department of Science Education. As part of my degree program I am currently carrying out a research on assessing the impact of gamification teaching technique in teaching and learning of Biology at form three level in two selected secondary schools, in Seke district in Mashonaland East Province in Zimbabwe. This information will only be used for research purposes. Do not write your name, and be assured that the data to be collected will be used only in this.

SECTION A: Observation Guide

Observation Guide: Biology practical lessons at Form Three Level

Observer Information

Observer's name:

Teacher's Name:

School:

Grade level:

Date of Observation:

Pre-Observation Notes

Lesson Information:

Topic:

Duration:

Number of Students:

Observation Categories:

1. Lesson Planning and Preparation

- i) Was the lesson plan clear and concise?
- ii) Were the learning objectives clearly stated?
- iii) Were the necessary materials and equipment available?

2. Teacher's Instructional Strategies

- i) Did the teacher use a variety of instructional strategies ?
- ii) Were the instructions clear and concise?
- ii) Did the teacher provide opportunities for student questioning and feedback?

3. Student Engagement and Participation

- i) Were the students actively engaged in the practical activity?
- ii) Did the students work collaboratively in groups?
- iii) Were the students able to ask questions and seek help when needed?

4. Safety and Laboratory Management

- i) Were the students aware of the safety protocols and procedures?
- ii) Was the laboratory well-organized and managed?
- iii) Were the necessary safety equipment and materials available?

5. Assessment and Feedback

- i) Did the teacher assess student understanding during the practical activity?
- ii) Was feedback provided to students during the lesson?
- iii) Were the assessment criteria clear and transparent?

Overall Comments:

Rating Scale:

- 1. Lesson Planning and Preparation:
- 2. Teacher's Instructional Strategies:

3. Student Engagement and Participation:

4. Safety and Laboratory Management:

5. Assessment and Feedback:

Key: The rating scale is based on a scale of 1-5, where 1 is Poor and 5 is Excellent.

Thank you for your time and participation.