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**Exploring the challenges faced by rural teachers and learners in the use of ICT tools for
the teaching and learning of Chemistry at ordinary level**

BY
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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE
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IN CHEMISTRY EDUCATION

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Release Form

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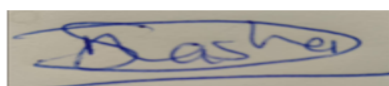
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Dedication

This research is dedicated to my parents and brother for their endless love, support and encouragement throughout my pursuit for education. I hope this achievement will fulfill the dream they envisioned for me.

Abstract

The research project looked at challenges faced by the teachers and students in using ICT tools and software to teach and learn Chemistry at Ordinary level. A case study approach was used. A population of six (6) Ordinary level Science teachers and one hundred and sixty (160) ordinary level Chemistry students. The researcher used a sample size of four (4) teachers and sixty (60) students. The research participants were selected so as to provide information regarding their experience on the use of ICT tools and its use so as to facilitate teaching and learning at their school. Teachers were interviewed so as to get information about the level of ICT tools and software knowledge and skills they held and if they understood their usage. Questionnaires were for the students and it was meant to get information about the students' competency level and to find out if they had the knowledge and skills to use these tools and integrate them in their studies. Observation checklist was also used so as to gather information about how and when the teachers and students used ICT tools and software in teaching and learning process. The research project's major findings were that some teachers lacked the knowledge and skills to use ICT tools to teach. Some teachers had the knowhow but lacked the confidence and the technological expertise of using it in the Chemistry class. The students were ICT competent. The school under study had the appropriate ICT tools but they were not adequate to teach and learn Chemistry. The researcher concluded that Chemistry teachers at the school under study were not well equipped to incorporate the use of ICT into their Chemistry lessons. The students took great care of their studies hence they knew and used ICT tools to learn. Findings showed that the barriers to lack of technology were due to lack of access to the technology, adequate and appropriate resources. The academic and professional recommendations were that since the teachers had limited skills in the use of ICT, staff development for teachers had to be mounted. Teachers' Colleges and Universities should also train teachers' in using ICT tools and make it compulsory to all. Recommendations for further research were that more similar research study needs to be conducted at a wider range so as to reveal the experience of the teachers and students on the challenges they face in the use of ICT tools and software in the teaching and learning of Chemistry at Ordinary level.

Acronyms

CDs	Compact discs
DVDs	Digital video discs
ICT	Information and communications technology
UNICEF	United Nations International Children's Emergency Fund
STEM	Science, Technology, Engineering and Mathematics

Table of contents

Release form	i
Approval form	ii
Acknowledgements	iii
Dedication	iv
Abstract	v
Acronyms	vi
CHAPTER 1: THE PROBLEM AND ITS SETTINGS	
1.1 Introduction	1
1.2 The contextual background of the problem	1
1.3 Statement of the research problem	2
1.4 Research questions	2
1.5 Objectives of the research	2
1.6 Assumptions of the study	3
1.7 Limitations of the study	3
1.8 Delimitations of the study	3
1.9 Significance of the study	3
1.10 Definition of key terms	4
1.11 Acronyms and abbreviations	5
1.12 Organisation of the research project	5
1.13 Conclusion	6
CHAPTER 2: LITERATURE REVIEW	
2.1 Introduction	7
2.2 Importance of teachers' knowledge and skills of ICT tools	7
2.3 Importance of students' ICT competency	8
2.4 Importance of appropriate and adequate ICT tools	8
2.5 Conclusion	9
CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY	
3.1 Introduction	10
3.2 Research design used	10
3.3 Population, Sample and Sampling	10
3.4 Research instruments	11
3.5 Data collection procedures	12
3.6 Data analysis techniques used	13
3.7 Ethical considerations	14

3.8 Conclusion	15
CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION	
4.1 Introduction	16
4.2 Data presentation and analysis	16
4.2.1 What level of knowledge and skills of ICT tools and their use are held by teachers for the teaching of Chemistry.	16
4.2.2 What ICT competencies do students have to help them learn Chemistry?	18
4.2.3 Are there adequate and appropriate ICT tools in the school?	19
4.3 Data discussion	20
4.3.1 Teachers' level of knowledge and skills of ICT tools	20
4.3.2 ICT competency of students	21
4.3.3 Adequate and appropriate ICT tools in the school	21
4.4 Conclusion	22
CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS	
5.1 Introduction	23
5.2 Summary	23
5.3 Conclusions	23
5.4 Recommendations	24
REFERENCES	26
APPENDICES	28
LIST OF TABLES	
Table 4.1: Level of knowledge and skills of ICT tools and their use held by teachers.	16
Table 4.2: Students' ICT competency	18
Table 4.3: Adequacy of ICT tools	19
LIST OF FIGURES	
LIST OF APPENDICES	
Interview guide for teachers'	28
Questionnaire questions for the students	29
Observation checklist	31

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter looked at some critical aspects related to the background of the problem. It also highlighted the statement of the problem, purpose and objectives of the study, research questions and significance of the study and definition of key terms.

1.2 The background of the problem

Over the years, the textbook and the chalkboard had been the two principal teaching instruments for the teacher (Visscher, Wild, & Newton, 2015). With time, radios, televisions and film projectors became the gadgets but they were huge, immovable and lacked portable power sources. The introduction of much smaller and portable information sources like the compact discs (CDs) and digital video discs (DVDs) offered flexibility for the teacher, since one could play them when required, could replay for emphasis and stop when needed to comment (Philip 2015). These offered a better alternative to the radio and TV programs that offered no such controlled usage. However, the impact of these tools in the teaching arena remained low because they offered a limited range of experiences to the learner, that is, only visual and audio experiences (Luenendonk 2019). It was the introduction of the computer that impacted the educational system in a grand way than the rest. This is because while the textbook, radio and television impacted only on either visual, audio and touch of users, the computer provided all experiences at once.

Since the inception of computers into the educational system, educational policies around the world have endorsed their use as teaching aids (Becta, 2016). Most experts now agree that when properly used, the computer and other ICT tools can improve both teaching and learning experiences thus leading to improved educational experiences (Visscher, Wild, & Newton, 2015). This means if properly used in the Chemistry classroom, ICT tools and the internet can be powerful tools towards motivating learners and improving their grades.

The Zimbabwean educational sector introduced a new curriculum in 2015. The curriculum placed a lot of emphasis in the teaching and learning of science subjects like Chemistry, Biology, and Mathematics. An aspect of this curriculum called the Science, Technology, Engineering and Mathematics (STEM) emphasises more on using teaching methods that increase student motivation to take science subjects, as well as enrol in science programmes in

tertiary education (Robson 2017). The implementation and success of both the new curriculum and the STEM depended on the teacher, who is expected to use a variety of teaching methods and concepts to motivate students as well as enhance their understanding of science concepts (Saunders, Lewis & Thornhill 2019). One such method that is advocated for in the new curriculum is the use of Information, Technology and Communication (ICT) tools and the internet would also widen both learners' and teachers' research as well participation and understanding of concepts, Smith, Thorpe & Lowe (2018).

1.3 Statement of the problem

The use of ICT tools in science teaching in Zimbabwe had increased. However, since the inception of the new curriculum and the science, Technology, Engineering and Mathematics (STEM), many schools in Zimbabwe still do not use any of these tools in Chemistry classroom today (Plomp, Anderson, Law & Quale 2015). As for now, there are few published researches that deal with teacher related factors that are delaying or inhibiting the use of ICT tools in Chemistry classes today (Masunungure 2016). This research seeks to fill this gap, by investigating the problems that the teachers are facing in implementing the use of ICT tools.

1.4 Research questions

This research sought to answer the following questions:

- 1.4.1** What level of knowledge and skills of ICT tools and their use are held by teachers for the teaching of Chemistry?
- 1.4.2** What ICT competencies do students have to help them learn Chemistry?
- 1.4.3** Are there adequate and appropriate ICT tools in the school to teach Chemistry?

1.5 Objectives of the research

This study was guided by the following objectives:

- 1.5.1** To identify the level of knowledge and skills of ICT tools and their use held by teachers in the Chemistry classroom at Ordinary level.
- 1.5.2** To identify the ICT competencies the students have to help them learn in the Chemistry classroom.
- 1.5.3** To find whether there are adequate and appropriate ICT tools available in the teaching and learning of Chemistry.

1.6 Assumptions of the study

The research study took the following for granted:

1.6.1 It is the assumption that, computers are available in the school are used for ICT integration in the teaching and learning process,

1.7 Limitations of the study

The research was based on the following weaknesses:

1.7.1 Because of financial restrictions that made it difficult for the researcher to use a larger sample. This was compounded by the fact that the students have financial challenges and relied on hand-outs to carry out the study.

1.7.2 The study restricted the participants to the Chemistry teachers, Chemistry students and school Heads who some of them were dishonest and unwilling to avail information on their ICT competencies. To lessen this, the researcher tried by promising the participants on the discretion of their identities.

1.8 Delimitations of the study

The research was confined to the following physical and conceptual boundaries:

1.8.1 The study targeted only 1 school in Karoi Province, Zimbabwe which had ICT tools for teaching and learning of Chemistry. It also dealt with Chemistry teachers, their students and the Headmaster. These participants were suitable to the study since they could provide first-hand information.

1.9 Significance of the study

Most studies concluded that political and economic problems are to be blamed for the failure of teachers to implement the use of ICT tools in teaching Chemistry. The government as well as international organisations such as UNICEF has made enormous donations with science kits as well as financial donations to try and alleviate these problems. However, teachers are still using the traditional methods, despite both government interventions and economic support. This shows that the problems must be inherent within the teachers. This research is a complementary effort to the government's efforts to promote STEM. This study provided the necessary information for decision makers in the educational field as well as teacher educators on how well to prepare Chemistry teachers for their profession. If teachers can be helped to overcome identified problems, then more learners can take Chemistry as a major at A' level,

and then can enrol in Chemistry related fields such as medicine, radiography and engineering. This study was of scholarly importance because it provided information to fellow researchers regarding a gap in knowledge on why low usage of ICT tools still persists. If these problems can be identified, it becomes easy to address them at school and national level, thus improving the whole educational system of the country.

1.9.1 The findings sought to create awareness among teachers on the importance of using ICT tools to teach and change their attitudes.

1.9.2 Findings helped educational stakeholders in the improvement of provisions of educational materials to secondary school teachers.

1.10 Definition of terms

1.10.1 Chemistry

Pelgrum (2017) defined chemistry as the branch of science concerned with the study of properties of space, time, matter and energy. Chemistry was also defined by Schostak (2018) as a scientific study of the properties and behaviour of matter. It is a natural science that covers the elements that make up matter to the compounds composed of atoms, molecules and ions. Chemistry, the science that deals with the properties, composition, and structure of substances, the transformations they undergo and the energy that is released or absorbed during these processes (Smith et al,2018). Chemistry is a branch of science that deals with the form and properties of matter and substances or the interaction between individuals.

1.10.2 Teacher

A teacher is defined by Clark (2015) as a professionally trained person to formally interpret and implement curriculum requirements in the transmission of knowledge in schools. A teacher, also called a schoolteacher or formally an educator, is a person who helps students to acquire knowledge, competence or virtue. A teacher is defined by James (2015) as a person who helps others too very well. A teacher can also define as a professional whose job is to teach and guide learning. Teacher characterised a person who motivates and play that roles which affecting the teaching and learning process. As defined by Kvale and Brinkmann (2018) a teacher is a person who provides education for people, teaches and gave instructions to the leaders.

1.10.3 ICT Knowledge

Clark (2015) defined ICT Knowledge as understanding of facts of Information Communication Technologies. ICT knowledge is the technology that supports activities involving information and these activities include gathering, processing, storing and presentation of data Gomes (2018). Knowledge is to an enterprise or an individual, the possession of information or the ability to quickly locate it. ICT knowledge is defined as the ability to work with technology, Jhurreev (2018).

1.10.4 ICT Competencies

These are ICT knowledge and skills possessed by an individual. ICT competence is defined as the confidence and critical use of electronic for various purposes. It can be defined as the potential to use ICT tools in various domains, Brayman (2017). ICT competences can also be defined as the confidence and critical use of electronics to enhance communication. In the teaching field, ICT competences include the use of ICT skills in the development and presenting of information Bingimala (2015)

1.10.5 ICT tools.

Masunungure (2019) defined ICT tools as the technology and tools used to transfer information and speed up the communication processes. ICT tools are the set of currently developed technologies that allow more efficient communication of information. ICT tools are devices or objectives used in information and communication technology. ICT tools can be defined as tools that have an input and output and must be able to process with it. In the definition forwarded by Balanskat et al, (2019) ICT tools are tools which can empower teachers and learners, promoting and foster the development of the modern day`s skills needs. Hilbert, Martin (2016) defined ICT tools as the diversity of tools and resources used to communicate, create, disseminate, store and manage educational information.

1.11 Acronyms and abbreviations used in the study

ICT-Information and Communication Technologies

STEM-Science Technology Engineering and Mathematics

1.12 Organisation of the research project

1.12.1 Chapter 1-An overview on challenges faced in the use of ICT tools. This chapter looked at the contextual background of the problem, statement of the research problem also the research questions, objectives of the research, assumptions, limitations and delimitations of the study. The chapter also looked at the significance of the study, definitions of key terms and organisation of the research study.

1.12.2 Chapter 2-Related literature review, in this chapter the researcher covered the challenges, prospects and theoretical framework on the use of ICT tools in the teaching and learning of Chemistry at ordinary level.

1.12.3 Chapter 3-Research design and methodology, this chapter dealt with methodological issues where the researcher discussed and justified the method of data gathering, analysis, study population, sampling techniques, sample size and the research design that were employed in answering the problem under study.

1.12.4 Chapter 4- Data analysis, presentation and discussion, in this chapter data collected using research instruments was analysed and presented. The analysed data were interpreted and discussions of the same presented.

1.12.5 Chapter 5- Summary, conclusions and recommendations, a number of issues were investigated. The issues covered include: the extent of ICT tools used in teaching and learning of Chemistry and the factors influencing the use of ICT tools in teaching and learning of Chemistry. This chapter also covered the summary of the findings. The conclusions and recommendations were also outlined.

1.13 Summary

This chapter focused on assessing the extent to which ICT tools are being used in the teaching and learning of Chemistry. After outlining the research findings, possible strategies that can be used in encouraging teachers and learners in using ICT tools to learn and teach Chemistry. The next chapter dealt with the review of related literature in the form of various studies done by different scholars.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter took a look on literature review on the importance of the teachers' knowledge and skills of ICT tools, students' ICT competency and the appropriate and adequate ICT tools available in schools in the teaching and learning of Chemistry at Chikangwe high school, Karoi.

2.2 Importance of teachers' knowledge and skills of ICT tools

Teachers are key in the success of ICT incorporation in education and they should incorporate ICT in science teaching. Research studies in Australia found that teachers who lacked knowledge and skills to use computers were not willing to incorporate ICT tools in teaching and learning (Newhouse, 2015). The lack of technological know-how is the main problem to acceptance and adoption of new technology by teachers in classroom instruction (Pelgrum, 2017).

Teachers should feel confident in order to adopt any educational technology successfully. They should have the ability to use it in the classroom. Teachers who are inexperienced in using ICT tools will most likely avoid using it in the classroom for the fear of failure. According to Balanskat, Blamire, Kefala., (2018) and Bingimalas, (2016), indicated that limitations in teacher's ICT knowledge makes them feel anxious about using ICT tools in the classroom and thus not confident in using it in their teaching. This is in line with the findings of a study carried out in the United Kingdom by Becta (2016) who found that many teachers who do not consider them to be well trained in using ICT feel fearful about using it in front of a class of students who perhaps know more than they do. Teachers believed that ICT could be used as a pedagogical tool in improving their teaching if there are sufficient resources and infrastructure to support it.

Incorporating ICT in teaching of science help in embracing the functions of planning and preparation of suitable learning activities and their implementation in the classroom (Newton, 2019). Science teachers used a wide range of ICT tools in planning for their lessons and the actual classroom instruction, these software include software, the internet and projectors. Computers should be used to help the teachers and for individual lessons Krishnaswamy(2017). Planning for a lesson involves preparation of schemes of work, lesson plans, teaching notes

and learning activities. Science teachers could use the internet when planning for a lesson to identify and develop learning activities and search for up to date information on the concept or skills they want to teach about (Cohen, Manion & Morrison 2019). Moreover, teachers could use computers to type schemes of work, lesson notes, lesson plans and test assessments which save on planning time as compared when using pen and paper.

2.3 Importance of students' ICT competency

While there are different definitions of competency, as Clark (2015) explained, most of them have two common components. Firstly, they are observable or measurable skills, knowledge and abilities and secondly they distinguish between superior and other performers. Therefore, competency is an individual characteristic that can be measured reliably and that can be used to make differentiation between superior and average performers or between effective performers (Bartram, Robertson and Callinan, 2018). As far as ICT competency is concerned, it can be regarded as the ability to use ICT to retrieve, store, create, present, sort and exchange information (European Commission, 2016). Students who possessed ICT skills can be able to apply the basics in authentic, integrated ways to solve problems, complete projects and creatively enhance their abilities (Barbour & Schostak 2018). As a result of new technologies which were introduced continually, new ICT competencies appear. Therefore, students need to acquire these competencies and different interpretations on adequate ICT competencies.

2.4 Importance of appropriate and adequate ICT tools

Access to ICT infrastructure and resources in schools is an essential condition to the incorporation of ICT in education (Plomp, Anderson, Law & Quale, 2015). Effective embracing and incorporation of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware and software. Obviously, if teachers and learners cannot access ICT resources, then they will not use them. Consequently, access to computers, updated software and hardware are key elements to successful adoption and incorporation of technology (Clark 2015).

Considerable resources have been invested to justify the place of ICT in education since it provided many benefits and gains that can be achieved by students (Jhurree, 2019). For example, Papert (2015) identified the several positive effects of ICT on students and stated that it improves students' motivation and creativity when they are faced with the new learning environments and provided a greater disposition to research and problem-solving. Furthermore,

students became able to produce knowledge, increase their capability to deal with rapidly changing world and gain new skills fostered through technological literacy (OECD, 2016).

2.5 Summary

The literature review covered the significance and challenges faced in the teaching and learning of Chemistry using the different types of ICT tools. It is an account of already published information on the extent of ICT use and it served to acknowledge the works of other researchers which helped the researcher to be aware of the information gap thus the need and importance of this study. The next chapter dealt with the research methodology of the study which helped the researcher to obtain the much needed data.

CHAPTER 3 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter explained how the research was carried out and how the data was gathered. It covered the research design, the target population, sample and the research instruments that were employed in order to gather the data. An explanation is offered on the rationale behind the decision to use the research design employed in the study as opposed to the others.

3.2 Research design used

According to Moore (2018), research design was defined as a strategy, the plan or the structure of conducting a research project. The research design used in this study was a case study. A case study is a research approach used to generate an in-depth, multi-faceted understanding of a complex issue in its real life context. Bryman (2017: 52) described a case study as one which entails the detailed and intensive analysis of a single case. On the outset, the term case is synonymous with a particular location for example an organization. A case study design is concerned with the complexity, characteristics, particular nature and implications of the case in question, in the current research, the challenges faced by teachers and learners of Chemistry in using ICT at a rural school in Karoi. The case study approach was chosen because it keeps the research focused and manageable especially when the researcher does not have time and resources to carry out a research on a large scale.

3.3 Population, Sample and Sampling

3.3.1 Population

Target population refers to the grouping from which the researcher intends to gather information related to the stated problem. The target population included the Headmaster of the school under study, 6 'O' Level Science teachers including the Head of department and 160 'O' Level Chemistry students.

3.3.2 Sample

A sample can be defined as, a smaller group or subset of a total population in such a way that knowledge gained is representative of the total population under study (Cohen et al, 2019). The researcher came up with a sample size comprised of 60 Chemistry students and 4 teachers.

3.3.3 Sampling

The researcher used purposive sampling in the research. Purposive sampling is a sampling technique which the researcher relies heavily on his or her own judgment when choosing

members of population to participate in the study (Black, 2016). Purposive sampling is when researchers thoroughly think through how established a sample population, even if it is not statistically representative of the greater population at hand (Cohen et al, 2019). In this type of sampling, the researcher went to a community (a high school Chemistry Department) on purpose because she thinks that these individuals fit the profile of the people that they needed to reach.

3.4 Research Instruments

The researcher employed the interview schedule, the questionnaire and observation as the research instruments for this study.

3.4.1 The interview schedule

An interview schedule is a list containing a set of structured questions that have been prepared, to serve as a guide for interviewers, researchers and investigators in collecting data about a specific topic (Luenendonk, 2019). The interviewer filled in the questions with the answers received during the actual interview and a schedule was employed. Barbour and Schostak (2018, p.4) argued, implicit in our images of interviews are a number of key concepts listed below that fundamentally impact on their utility as methods to be employed by researchers and these may introduce aspects of bias. The interviews were employed to gathering data from teachers. The role of the interview schedule was to provide a protocol for interviewers to ask and record answers in a consistent way across all participants and to facilitate the process of getting through the interview smoothly and efficiently (Robson, 2015). The researcher used the interviews because she wanted to have a better understanding of the research participants' level of knowledge and skills in the use of ICT tools and software and also their competence level.

3.4.2 The questionnaire

A questionnaire is a research instrument consisting of a series of questions or other types of prompts that aims to collect information from participants (James, 2015). There are several methods in which to obtain questionnaire data, the researcher used email. The questionnaires were sent via email to all participants for them to respond it at their convenience. Graham, (2019) said that a questionnaire allowed a large amount of information to be collected from a large number of people in short period and in a relatively cost effective way. The questionnaires were meant for Chemistry students. The questionnaires were established to the number of

students with computers and those who felt comfortable in integrating ICT in their lessons, the ICT knowledge held and competencies which the students had.

3.4.3 Observation checklist

Observation research is a qualitative research technique where researchers observe participants' on-going behaviour in a natural situation (Empirica, 2018). Observation data collection method is classified as a participatory study, because the researcher has to immerse herself in the setting where her participants are (in the classroom), while taking notes and or recording (Brayman,2016) The researcher observed an on-going class in trying to find out how the teachers and students used ICT tools and software in teaching and learning.

3.5 Data Collection Procedures

These are steps, procedures and strategies for gathering data in this study (Bhandari, 2020). Data collection refers to gathering specific information aimed at providing or reputing some facts (CIromp, 2019), in this study, the following methods were used in collecting the required information, interviews; focus groups, observation and questionnaires. After validation of the instruments, the researcher secured a written permit to the Headmaster of the school under study

3.5.1 Interviews

Structured interviews were used in order to determine the different perceptions of the participants as to the challenges faced in integrating ICT with teaching of Chemistry (Plomp et al, 2015). The interviews were conducted with the teachers only and many of the interviewees gave emphasis on the shortage of ICT equipment at the school. The main reason was that the interviewees managed to provide more information and data needed to answer the research questions of the study (Newton, 2019)

3.5.2 Observations

After being given permission to be in a lesson, the researcher observed how the teacher undertook the lesson from start to end. There was a teacher who used a personal computer or laptop; this is where she stored all the notes for the pupils (Smith et al, 2018). The personal

computer was also used to enhance the learning process by allowing students to watch simulation videos (Schostak, 2018). The screen was very small and students were so many which posed a challenge. The other teachers did not use a laptop. There were also students who brought their own laptops and used them to watch a simulation video which was provided by the teacher.

3.5.4 Administering questionnaires

The questionnaire was the main tool used in data gathering. A questionnaire is a research instrument consisting of items and a prompt for the purpose of gathering information from the participants it included the use of multiple choices and scaled questions (Bajpai, 2016). It generates quantitative information, which can be analysed statistically and endeavours to reduce any bias potentially originating from the researcher or participants (Visscher et al ,2015)of the approved questionnaires were distributed in order to gather relevant data (Saunders et al, 2019). The instruments were retrieved after the students and teachers finished answering. There were a set of two different questionnaires, the one for the students and the other for the teachers. This helped in trying to cover both the student-specific questions and teacher-specific to reduce biased results.

3.6 Data Analysis Techniques Used

The following data analysis techniques were used.

3.6.1 Transcription

Data transcribing process was done using data collected from the interview. The data collected in this study was of a qualitative nature. In qualitative research, the interview is usually audio-recorded and transcribed whenever possible (Bryman 2016, p.482). Each hour of speech was given 2 hours on average during the transcription process. To avoid a huge backlog, it was deemed necessary to make the transcription process an on-going activity as advised by a number of writers on qualitative research like (Bryman, 2019, Lofland & Lofland, 2017, Kvale & Brinkmann, 2018). Transcribed interviews were then categorized in themes for ease of analysis. Each research question formed the basis for which these themes were established. These themes were, how and the extent of ICT use, perceived role of ICT in education,

impediments to ICT use in teaching and learning. This thematic approach of data analysis helped in sorting out which responses from the interview related to which research question (Schostak, 2018). In addition to this, the handwritten notes made during the interviewing process were used alongside the recorded responses. The steps in the transcribing process followed are;

Firstly, the researcher took the interview recorded and listened to it for a time deducing themes and noting them down, recurring themes were insufficient ICT infrastructure at the school and teacher's incompetence towards ICT integration (Papert 2015). Secondly, the researcher used the notes which were taken down during interviews to note important points given by participants. Thirdly, the researcher came up with final theme, documented them in the results document.

3.6.2 Test Scores

During observations, the researcher was given access to go over student test scores. The researcher noticed that some teachers used a personal computer (laptop) to show students videos, online tutorials and simulations to enhance teaching (Krishnaswamy, 2017). The researcher then compared the test scores of that class and the classes which used no ICT at all. The results showed that the class which used ICT had more improved test scores (Luenendonk, 2019).

3.7 Ethical Considerations

The researcher considered the confidentiality of the participants. This means that any identifying information was not made available to, or accessed by anyone but the researcher (Bajpai.2016) Given that there are often small numbers of participants in the research, it is very important to consider how reports are worded to ensure that there is no opportunity for students or teachers to be identified even though the names are not used (Jumai, 2020). Voluntary participation was another factor, which was considered; people participated in the

evaluation free from coercion and were free to withdraw from participation at any time (Manion & Morrison, 2019).

The researcher obtained research permission from the school under study. A verbal permission was also granted from the Head of the school to administer the questionnaire to the teachers and to carry out interviews (Kvale & Brinkmann, 2018). Prior to the data collection process participants were informed about the purpose of the study and were ensured that confidentiality would be maintained for any inform they volunteered during data collection.

3.8 Summary

In this chapter the reasons for adopting a case study research design were discussed. The chapter outlines the procedures adopted for sample selection and research instruments used for the study. The next chapter dealt with data presentation, analysis and interpretation.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter dealt with the presentation and analysis of data collected and the discussion of the research results.

4.2 Data presentation and analysis

This section described the information obtained from the research participants.

4.2.1 What level of knowledge and skills of ICT tools and their use are held by teachers for the teaching of Chemistry?

Responding to an interview question on their level of knowledge and skills in the use of different ICT tools, the teachers revealed the information in the table below;

Table 4.1: Level of Knowledge and skill of ICT tools and their use held by teachers.

ICT Tools and their uses	Knowledge & Skills Level		
	Excellent %	Good %	Poor %
Laptops	50	25	25
Projectors	50	0	50
Videos	75	25	0
Simulations	50	25	25
Smart boards	50	0	50
Internet	50	25	25
Smart Phones	75	25	0
Microsoft Office Software	50	25	25

Table 4.1 above shows that some teachers said they knew a lot of ICT tools including videos, simulations, laptops and smart boards. Through observation it was noticed that some of the teachers only used a laptop in teaching Chemistry. On further probing, the teachers explained

that they are able to use ICT tools but they do not have the knowledge of integrating it in the classroom (Pelgrum, 2017). The respondents said it is difficult for them to identify the exact tool to use to teach a specific concept is matching the ICT tool with the lesson or concept (Visscher, 2015). Of the 4 teachers interviewed 2 did basic computer lessons at private colleges during their spare time and hold certificates. 2 elderly teachers agreed that they had no skills in ICT tools and the other one responded:

“I am too old to adapt to the new teaching styles and I am happy with my own teaching technique”, “I believe in traditional method which let the students touch, feel and learn. I could make interactive lesson without using the ICT tools”

One teacher said that they used WhatsApp in conducting online lessons especially during the COVID 19 pandemic lockdown (Newton, 2019). The findings from the interview question showed that some teachers had ICT skills whilst others did not. Elderly teachers had no interest in implementing ICT in their lessons (Smith et al, 2018).

One teacher who knew and had the skill of using ICT tools had this to say:

“Technological advancement is a part and parcel of the educative process especially now with the COVID-19, as teachers we must just embrace ICT,” It makes you as a teacher to take a fresh look at the way you teach.”

Findings also showed that the teachers had access to ICT tools at school and none had access at home whereas at school there was no time for some teachers to learn how to use these ICT tools (Schostak,2018). Teachers’ competence also showed that most teachers lacked confidence to use ICT in the classroom. Despite efforts made towards the use of ICT in teaching, it was evident from the findings that majority of the teachers were unaware of how to use ICT pedagogically (Plomp, et al, 2018). The researcher also observed that the use of ICT tools provided the teachers an opportunity to be innovative in lesson delivery because they were now using computers to scheme and plan lessons instead of writing in books with a pen (Philip, 2015).

The level of knowledge and skills of ICT tools held by teachers was average.

4.2.2 What ICT competencies do students have to help them learn Chemistry?

Responding to the interview and questionnaire questions on their ICT competencies, the students revealed the information;

Table 4.2: Students' ICT Competency

ICT Tools, Knowledge and Skills	Students Competence Level in %		
	Excellent %	Good %	Poor %
Laptops	49.18	16.39	34.43
Tablets	57.38	11.48	31.15
Smart boards	49.18	19.67	31.15
Projector	42.62	24.59	32.79
Internet	91.80	8.2	0
Word processing	73.77	16.39	9.84
Spread sheet	11.48	27.87	60.66
Smart Phones	100	0	0

4.2.2.1 The questionnaire showed that students knew a lot of ICT tools including projectors, smart boards, tablets, internet, word processing, mobile phones. Most students believed that through using ICT tools in the classroom it motivated and stimulated their interest to scientific ideas and they will get connected to many information sources (Lofland, 2017). Learners indicated that they spend more time working with ICT tools and this allows them to have skills which enhance their ICT competency.

4.2.2.2 Through observation, the researcher noticed that students knew and also used laptops, smart phones and tablets at school in reading and taking notes in the classroom. As shown by table 4.2 above, most of the students claimed they are most able to use and implement ICT into their studies. The use of ICT tools helped improve the students understanding of Chemistry as a subject and it provided them with access to more sources of information and data (Gomes, 2018). None showed any ability at all and a few of students were at ability below average. Therefore, the findings showed that students were ICT competent (Lofland, 2017). Through implementation of ICT in class it helped the students to think critically and independently and

learn how to operate in an information and technology age (Clark, 2015). Data showed that the students were ICT competent and that though some ICT tools were not readily available the students used their own tools and were eager to learn more about Chemistry.

4.2.3 Are there adequate and appropriate ICT tools in the school to teach Chemistry?

Observations at the school under study are revealed in the information on the following table.

Table 4.3: Adequacy of ICT tools

ICT Tools	No. of Students per ICT Tool Ratio	Functionality of the ICT Tool %
Laptop	0	21.15
Desktop Computers	2:1	81.81
Projector	1:61	16.67
Smart Boards	1:61	37.5

Observation showed that the school had various ICT tools including projectors, smart boards, and desktop computers, Microsoft Office software and spread sheet. However, through observing classroom sessions, the researcher noticed that the equipment was not enough for all departments and classes at the school (Becta, 2016). The school had 2 `O` level classes and only one projector for the department. The projector was shared among the classes throughout the day (Bingimalas, 2015). Some teachers ended up not bothering to look for the projector and they would just teach without it. The computers were in the computer laboratory and most times the laboratory was always occupied by other Computer Science students. This left no room for teachers or other Chemistry students who wanted to use the computers to research and or type their assignments (Balanskat et al, 2019). The internet was mostly for the staff and it was at the administration block and the staffroom.

Some time ago the school installed smart boards in every classroom but they were now damaged and the school was not providing any technical maintenance and repairs to fix the boards (Newhouse, 2015). The school had also purchased a laptop for the department of Chemistry but the laptop was only used by the head of department and it was not helping any teaching in the classroom (Smith et al, 2018). Teachers wanted their own personal computers so that they will be able to research online. The school computers were so few; there were 44 desktops to support a school of almost a thousand students.

Therefore, the researcher found out that there are no adequate ICT tools at the school to support ICT integration with Chemistry lessons (Schostak, 2018). The school under study had appropriate ICT tools but they were not adequate to teach and learn Chemistry.

4.3 Data Discussion

This section discusses the data presented and analysed in section 4.2 above.

4.3.1 Teachers' level of knowledge and skills of ICT tools

The teachers had mixed feelings towards the knowledge and skills on the use of ICT tools and software. Some said they wanted to stick to their old fashioned way of teaching. While some welcomed ICT and had the knowledge in using laptops, Internet, projectors, videos, smart phones (Papert, 2015). The latter group was doing online lessons on WhatsApp but they all lacked the skills on how to use it pedagogically because they did not know which applications or software to use so it was difficult for them (Smith et al, 2018). The results showed that the teachers' level of knowledge and skills was average because the teachers had limited ICT tools and software knowledge and skills and lacked pedagogical training on using ICT in the classroom and also lack of confidence. Gomes (2018) relating to a variety of subjects concluded that the lack of training regarding technology use in particular subject areas were an obstacle to using new technologies in the classroom. Also since some teachers wanted to stick to their old ways of teaching, they lacked knowledge and skills to use ICT tools and software in teaching (Newton, 2019).

Research studies in Australia found that teachers who lacked knowledge and skills to use computers were not willing to incorporate ICT tools in teaching and learning (Newhouse, 2015). The lack of technological know-how is the main problem to acceptance and adoption of new technology by teachers in classroom instruction (Pelgrum, 2017). According to Balanskat, Blamire, Kefala., (2019) and Bingimalas, (2015), limitations in teacher's ICT knowledge makes them feel anxious about using ICT tools in the classroom and thus not confident in using it in their teaching. The reviewed literature mirrors the researcher's findings where some teachers did not want to implement or change their way of teaching because they lacked ICT tools knowledge and skills.

4.3.2 ICT competency of students

Students knew a lot of ICT tools for example smart boards, tablets, internet, projectors, word processing, mobile phones etc. the students claimed that they are able to use and implement ICT into their studies (Newhouse,2015). The students' competence level on laptops was 49.18% on excellent, good was 16.39% and Poor was 34.43%. The level on tablets 57.38% on excellent, good was 11.48% and poor was 31.15%. These figures are shown on table 4.2 above. They showed that most students were ICT competent because they took great responsibility for their own learning and worked self-sufficiently in using ICT tools to help them learn (Schostak, 2018).

Empirica (2018) states that students are more encouraged and they take part more actively when ICT based approaches are being used in the classroom. Students who possess ICT skills will be able to apply the basics in authentic, integrated ways to solve problems, complete projects and creatively enhance their abilities (Papert, 2015). This mirrors the researcher's findings that students were ICT competent.

4.3.3 Adequate and appropriate ICT tools in the school

The school under study had various ICT tools and software for example smart boards, desktop computers, Microsoft Office software, spread sheet, projectors etc. though the school had these ICT tools and software they were not adequate for everyone at the school because majority of the equipment was used at the administration's office and the computer laboratory (Smith et al,2018). As shown by table 4.3 above number of students per ICT tool ratio on laptops was 0 and the functionality of the laptops was also 21.15%, desktop computers its ratio was 2:1 and their functionality was 81.81%, projectors' ratio was 1:61 and their functionality was 16.67% and smart boards ratio was 1:61 and their functionality was 37.5%. The results showed that the school had the appropriate ICT tools but they were not adequate to teach and learn Chemistry because all the other relevant ICT tools were there at the school under study but since desktop computers were based at the computer lab and the projectors were few most teachers forego using them and hid behind the unavailability of these to use ICT tools and software (Newhouse, 2015).

Access to ICT infrastructure and resources in schools is an essential condition to the incorporation of ICT in education (Plomp, Anderson, Law, & Quale, 2015). Considerable resources have been invested to justify the place of ICT in education since it provides many benefits and gains that can be achieved by students (Jhuree, 2019). Effective embracing and

incorporation of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware and software (Papert, 2016). Obviously, if teachers and learners cannot access ICT resources, then they will not use them. Consequently, access to computers, updated software and hardware are key elements to successful adoption and incorporation of technology. The literature review is in line with the findings of the researcher were the resources were there at the school understudy but the teachers and learners could not access these ICT tools and software (Newhouse, 2015).

4.4 Summary

In conclusion this chapter outlined data presentation, analysed data and also discussed data based on the findings. Data was presented in form of tables. The next chapter dealt with summary of findings, conclusions and recommendations.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter covered summary, conclusion, and recommendations for the professional and academic development of teachers' and students' knowledge and skills as well as competency level on the use of ICT tools and software and for further research.

5.2 Summary

This study intended to examine the challenges faced by teachers and students in the use of ICT tools in the teaching and learning of 'O' Level Chemistry at a rural high school in Karoi.

The researcher sought to determine the knowledge and skills of ICT tools and software held by Chemistry teachers and students and their competency level, and whether the school had appropriate resources to teach and learn Chemistry.

The researcher used a case study research design. According to Smith, Thorpe, and Lowe (2018) the main purpose of a case study design is to obtain information from a defined set of people so as to generalize the sample results to the population. Four (4) 'O' level Chemistry teachers and sixty (60) Chemistry students were the research participants chosen. The research participants were purposely selected so as to provide information regarding their experience on the use of ICT tools and its use so as to facilitate teaching and learning within their school. The researcher interviewed teachers to get information about the level of ICT tools and software knowledge and skills the teachers held and if they understood the usage and find out their competency level and the challenges they faced in using ICT to teach. The questionnaire for the students was meant to get information about the student's competency level and if they had any knowledge and skills on the use of ICT tools and software and whether they integrated it in their learning. The researcher observed Chemistry lessons in order to gather information about how and when the teachers and students used ICT tools and software in teaching and learning process.

5.3 Conclusions

The research study came up with the following research findings and conclusions:

5.3.1 Data obtained showed that the teachers' level of knowledge and skills on the use of ICT tools and software was average. Some teachers welcomed the use of ICT tools to teach, while some preferred the old teaching ways this was due to their limited knowledge and skills in ICT use, lack of pedagogical training and lack of confidence. It can be concluded that Chemistry teachers at the school under study were not well equipped to incorporate the use of ICT into their Chemistry lessons.

5.3.2 The students were ICT competent and they took great responsibility for their own learning and worked self-sufficiently to help them learn. They knew a lot ICT tools and software and they implemented their knowledge of technology into their studies. It can be concluded that the students took great care of their studies and were very much interested in the use of ICT tools to learn hence they used their own gadgets.

5.3.3 The school under study had the appropriate ICT tools but they were not adequate to teach and learn Chemistry, since the students and teachers had no easy access to these ICT tools. From the research's findings it can be concluded that most barriers in the working of ICT in schools is due to lack of access to the technology and adequate and appropriate resources.

5.4 Recommendations

This section discussed the academic and professional recommendations and the recommendations for further research.

5.4.1 Academic and professional recommendations

The study found that the teachers had limited skills in ICT usage. It is recommended that staff development workshop on ICT usage be mounted for the teachers. More investment should be directed to moving ICT tools to classrooms instead of just in the computer laboratory. Teachers' colleges and Universities which train teachers' should make the use of ICT tools and software training compulsory for all teachers.

The research findings showed that the school under study had appropriate but no adequate ICT tools and software to help facilitate the teaching and learning process. It is therefore,

recommended that more funds are needed from the relevant Ministry to establish at least minimum ICT facilities to enable the school to have these infrastructures for teaching and learning.

5.4.2 Recommendations for Further Research

This study was only carried out at one rural high school, therefore the researcher recommends that a similar study can be done at District or Province level to widely disclose the experience of teachers and students on the challenges they face in using ICT tools and software in teaching and learning Chemistry at Ordinary level.

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APPENDICES

Interview Guide for Teachers

My name is Vimbai Chitsaka I am a student at the Bindura University of Science Education taking a Degree in Science Education. I am doing research on challenges faced by 'O' level Chemistry teachers and learners in integrating ICT with their work.

- i. On a scale of 1 (least) to 5 (most) how do you rate your ability to use ICT tools and software to teach Chemistry at ordinary level?

	Least	Much	Average	More	Most
Projectors					
Laptops					
Word processing software					
Simulation boards					
Mobile phones					
Internet					
Smart note pads & tablets					
Spread sheet & Presentation software					

- ii. On a scale of 1 (least extent) to 5 very high extent) to what extent do you use each of the following ICT tools and software in your Chemistry lessons?

	Least extent	Much Extent	Average	High extent	Very high extent
Projectors					
Laptops					
Word processing software					
Simulation boards					
Mobile phones					
Internet					
Smart note pads & tablets					
Spread sheet & Presentation software					

- iii. What are the challenges of using ICT in teaching 'O' Level Chemistry?

.....
.....
.....

iv. Are you comfortable integrating ICT with your Chemistry lessons?

.....
.....
.....

v. Do you have any knowledge and use of computer application and software?

.....
.....
.....

Questionnaire Questions for the students

My name is Vimbai Chitsaka. I am a student at Bindura University of Science Education taking a Degree in Science Education. I am doing research on challenges faced by ‘O’ level Chemistry teachers and learners in integrating ICT with their work.

All answers in this questionnaire remain confidential.

- i. On a scale of 1 (least) to 5 (most) how do you rate your ability to use the following ICT tools and software to learn Chemistry at Ordinary level?

	Least	Much	Average	More	Most
Projectors					
Laptops					
Word processing software					
Simulation boards					
Mobile phones					
Internet					
Smart note pads & tablets					
Spread sheet & Presentation software					

- ii. Do you think the following suggested challenges hinder the use of ICT in classroom teaching?

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
The unavailability of and access to ICT facilities and resources					
Teachers negative attitude towards the use of ICT					
Lack of or inadequate teachers' competence in using ICT tools and software					
Lack of or inadequate students' competence in using ICT tools and software					

iii. How do you mostly use ICT tools?
 Studying [], Gaming [], Shopping [], Networking []

iv. List at least 5 ICT tools you know:

1.

2.

3.

4.

5.

Observation Checklist

ICT Tools	Usage monitor											
	1	2	3	4	5	6	7	8	9	10	11	12
Laptops												
Desktop computers												
Projectors												
Simulation software												
Smart boards												
Internet												
Smart note pens and tablets												
Presentation software												
Word processing software												
Spreadsheet												
Mobile Phones												

