

**THE ROLE OF TECHNOLOGY IN LEARNERS' ASSESSMENT ACTIVITIES IN
GRADE 10 PHYSICAL SCIENCE IN THE OHANGWENA REGION, NAMIBIA**

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BY

Maria Nankali Nendongo

200015621

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Main supervisor: Dr D. Wolfaardt

Co-supervisor: Dr P.J. Boer

ABSTRACT

Based on the concerns of the differences in performance between school based continuous assessment and national examination marks, the purpose of this study was to determine the role of technology in Grade 10 Physical Science learners' assessment activities in the Ohangwena Region. The study employed a sequential explanatory mixed-methods approach, whereby quantitative data was collected through the distribution of surveys to all schools offering Grade 10 Physical Science in the Ohangwena region, while qualitative data was collected through interviews. Triangulation was used to facilitate validation of data through cross verification of findings from quantitative phase and qualitative phase. The targeted population was all teachers teaching Grade 10 Physical Science in the Ohangwena Region. Ten (10) participants for interviews were sampled using intensity sampling, a type of purposive sampling method. The study concluded that majority of Grade 10 Physical Science teachers in the Ohangwena Region have no access to functional computers making it difficult to use computer-based technologies for assessment. Fewer teachers who have access to computers and internet mainly use only Microsoft Office desktop applications (MS word and MS Excel) for compiling assessment activities and recording marks, and internet for searching assessment related information and downloading shared pre-set assessment activities as technologies for assessment. In addition, it was established that teachers had a belief that technology can ease the assessment process and it can improve frequency and quality of assessment given to learners. The research further revealed that teachers' understanding of computer-based and internet-based assessment was limited. The main challenge faced by teachers were lack of technological skills and unavailability of technological facilities such as functional computer laboratories in schools. The research recommended that subject advisors should consider professional development trainings for Physical Science teachers on the use of technology for

assessment. Further research should also be done to explore suitable technologies for assessment in other subjects.

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DEDICATION

This piece of work is dedicated to my lastborn, Wilka Grace Etugama for she has been part of this study since birth. Her cheerful presence motivated me to work hard and go through when things were tough.

DECLARATIONS

I, Maria Nankali Nendongo, hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.

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ACRONYMS

CAT	Computer Adaptive Testing
DNEA	Directorate of National Examinations and Assessment
ICDL	International Computer Driving licence
ICT	Information and Communication Technology
JSC	Junior Secondary Certificate
LMS	Learning Management system
MBESC	Ministry of basic Education Sports and Culture
MCA	Millenium Challenge Account (Namibia)
MEAC	Ministry of Education, Arts and Culture
MHETEC	Ministry of Higher Education, Training and Employment Creation
MoE	Ministry of Education
NESE	National External School Evaluation
NIED	National Institute of Educational Development
NSPI	National Standards and Performance Indicators
PDF	Portable Document File
UCLES	University of Cambridge Local Examinations Syndicate

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CHAPTER 1: INTRODUCTION

1.1 Orientation of the study

Assessment is a very important activity in executing the curriculum. Njabili (1999) defined assessment as the process of gathering learners' information regarding their progress and performance. Assessment starts with defining the learning objectives and end with recording measurement scores that should be used to determine learners' understanding of the delivered subject content (Miller, Linn & Gronlund, 2012). Assessment tasks include marking homework activities per day per class group, giving activities required to complete the Continuous Assessment (CA) forms, keeping records of written activities' marks, keep learners' individual records and give progress reports to school and parents (Linn, 2008).

As we live in the world of technology, teachers should know “how to use technology as a tool to support learner-centred teaching, continuous assessment, and other forms of interactive learning” (Ministry of Basic Education Sports and Culture & Ministry of Higher Education, Training and Employment Creation [MBESC & MHETEC], 2005, p. 13). Technology offers a wide range of opportunities for teachers (Riel & Becker, 2008; Linn, 2013) such as easy collaborative platforms among teachers (social media groups on internet), self-administered assessment tasks such as tests and quizzes, software applications that allow teachers to mark and record measurement scores faster – and thereby giving opportunities for learners to get more practice in assessment and therefore prepare them for the external examinations.

The Namibian Physical Science subject policy stipulates that a Grade 10 learner should be given one page homework per day of which 70-80% should be marked by the teacher (National Institute for Educational Development [NIED], 2009). There are two types of assessment that Physical Science teachers are expected to carry out; the informal continuous assessment that are not part of

learners' final grading and the formal assessment that is in the form of written marked work that contributes to learners' final mark (NIED, 2009). For formal continuous assessment, a teacher should give at least two practical investigations, two topic tasks and two topic tests per term (NIED, 2009). The maximum amount of assessment activities is unlimited as it is necessary to assess learners, formally or informally and to determine learners' progress for effective teaching.

A list published by the Directorate of National Examination and Assessment (DNEA) shows that there is a significant difference in the Continuous Assessment (CA) marks awarded to Physical Science candidates by most schools in the Ohangwena Region, compared to their scores in the national external Grade 10 examinations (Directorate of National Examination and Assessment [DNEA], 2016a). The table 1.1 shows the number of schools whose marks were adjusted and the range of marks deducted (negative numbers) or added (positive numbers) to their initial individual learners' CA marks as a result of the differences detected between CA awarded and marks obtained in examination in the year 2015.

Table 1.1 Range of marks by which CA is adjusted in Ohangwena region schools in 2015

Range of marks by which CA is adjusted by DNEA	Number of schools
$-20 \leq n < -15$	2
$-15 \leq n < -10$	4
$-10 \leq n < -5$	31
$-5 \leq n < 0$	22
0	15
$5 \leq n < 10$	39
$10 \leq n < 15$	14
$15 \leq n < 20$	5
$20 \leq n < 25$	1
Total	133

Reading from Table 1.1, only 22 out of 133 schools whose learners' Physical Science CAs were not adjusted because no major differences were found between the CA awarded and their overall scores in examination. CA marks for learners at 59 schools were reduced while for rest of the schools' marks were added to adjust the unfairly awarded school based CA marks. This raises concern about the standard and procedures of handling assessment at schools as opposed to the national examination standard. One wonders whether assessment tasks of national standard quality is given, and whether marks are compiled correctly.

Another issue is the limited time on which teachers operate. Physical Science teachers, like other Grade 10 teachers, are faced with time constraint challenges associated with a lot of administrative and subject related work that may leave them with limited time to successfully complete assessment tasks manually. For example, according to The Guidelines for Subject Management in Schools, a document developed to guide the National External School Evaluation (NESE) project, Junior Secondary Certificate (JSC) Physical Science teachers are expected to have an allocation of 90%+ of total teaching periods in the teaching timetable (Ministry of Education, 2009). This means for schools that are following the five-day week cycle, a teacher has to teach 38 out of 43 periods per week while for schools that are following the seven-days week cycle teachers are expected to teach 46 out of 52 periods per cycle, unless the school is overstaffed. Each period has duration of 40 minutes (NIED, 2009). In the year 2015, a Grade 10 Physical Science teacher in Ohangwena region had to teach 42 Grade 10 learners on average per class, along with other class groups with different combinations of other subjects. This leaves them with an average of only one administrative period per day in the school timetable. Despite the limited time, these teachers are expected to effectively perform tasks such as the administration of assessment activities

alongside with other administrative activities such as managing filing systems and lesson planning that do not have allocated space in the school timetable.

Given the discrepancies between school based assessment and national examinations, the need for frequent assessment of learners, the limited time teachers have in their timetables, and the fact that we are dealing with technology oriented 21st century learners, it is necessary to look at technology as an aid in the assessment process. Therefore, this research will look at the role that technology plays in the administration of Physical Science assessment at Grade 10 level. This will be done by exploring the current teachers' practice and determining teachers' needs related to technology that can assist them in setting, marking and recording of assessment activities.

1.2 Statement of the problem

A report by the Directorate of National Examinations and Assessment, (DNEA, 2016a) shows that in the year 2015, there was a significant difference between Physical Science continuous assessment (CA) marks awarded to learners in the Ohangwena Region and their Grade 10 national examinations marks score. The report indicated that the subject's marks were adjusted by deduction or addition of marks in many Ohangwena schools because the CA awarded to learners were not corresponding to their scores in national examination, with some schools getting a deduction of as much as 15 marks from each learner's CA (DNEA, 2016a). In addition, the timetable for Grade 10 Physical Science teachers is too loaded leaving teachers with limited time to plan, administer, mark and record learners' assessment activities (MoE, 2015). A study conducted by Mulvaney (2011) concluded that technology based assessment saves teachers' time in preparing and administering assessment, thereby increasing the frequency and quality of

assessment. Therefore, this research looked at the role that technology plays in the administration of assessment when it is well utilised by the teachers.

1.3 Research questions

This study addressed the following question: What is the role of technology in the administration of JSC Grade 10 Physical Science assessments? This question was split into four sub questions:

1. Which technologies do the Physical Science teachers in the Ohangwena region currently use for assessment?
2. How do teachers apply technology in assessing Grade 10 Physical Science?
3. What are the views of the Ohangwena Region Physical Science teachers on the use of technology for assessment in Physical Science?
4. What challenges do the Ohangwena Region Physical Science teachers encounter in using technology for assessment administration?

1.4 Significance of the study

The results of this research reflect on the current use of technology for assessment by JSC Grade 10 Physical Science teachers and their views on the role of the use of technology in assessing Physical Science as a school subject. This study can inform Ohangwena Educational Directorate's management, subject advisors, school managers and subject teachers on the types of technology currently employed by teachers, the role it plays in terms of effectiveness and give advice on different types of technologies suitable for assessing Grade 10 Physical Science teachers. In addition, identified challenges faced by teachers in using technology for assessment can inform Advisory Education Officers about teachers' training needs and the advice needed in the use of technology in assessing Junior Secondary Physical Science.

1.5 Limitation of the study

The initial plan of this research was to get responses from all Grade 10 Physical Science teachers in the Ohangwena region through self-administered surveys to enable the researcher to sample out 10 active users of technology for assessment for further investigation. Due to higher costs of travelling, the researcher selected the 10 participants through convenience sampling, which did not give all active users of technology for assessment.

Another possible limitation is that, since teachers were not observed using technology for assessment, it is possible that some teachers were not honest in responding to survey questions, such that, they indicated that they were active technology users while they were actually not. This is evident from interview responses, when some teachers were not able to indicate how they use specific technological tools they claimed to have used for assessment.

1.6 Delimitation of the study

This study was limited to the Grade 10 teachers teaching Physical Science in the Ohangwena Educational region. As a result, the information gathered might not reflect the views and practices by Physical Science teachers in other regions.

1.7 Definition of terms

In this study, the following terms are defined as follows;

Assessment: the process of gathering learners' information regarding their progress and performance including class activities, tests and examinations (Linn, 2008).

Continuous Assessment: the system in which the quality of a learners' work is judged by different activities during the year and it is combined with the final examination at the end of the year (Njabili, 1999).

Educational Technology: the study and practice of facilitating learning by creating, using, and managing appropriate technological processes and resources (Prensky, 2001).

Internet: a global computer network providing a variety of information and communication facilities, consisting of interconnected networks using standardized communication protocols (Rennie & Mason, 2004).

Microsoft Office Suite applications – a set of interrelated desktop applications for Microsoft Windows system.

Technology: means Information and Communication Technology (ICT) and refers to any of the technologies used for the handling and communication of information and their use specifically in education including computers and the Internet (MBESC & MHETEC, 2005). For the purpose of this thesis, technology for assessment involves the use of computers and Internet for the purpose of assessing learners and administering learners' assessment marks

Social media: platforms that can be used to engage stakeholder audiences in the form of highly accessible digital technologies such as blogs, podcasts, social networks, wikis and message boards (Ministry of Information and Communication Technology, 2016).

Web 2.0: refers to the second stage of website development, characterized by the change from static web pages to dynamic, allowing greater collaboration among internet users (Dabbagh, & Reo, 2010).

1.8 Summary

This preamble chapter introduced the orientation and problem statement of the study. This includes the introduction of the main research question that is split into four sub-questions as the main guide

to the procedures and completion of the research. The importance of the research was highlighted and limitations and delimitations were pointed out. The chapters ended with the definition of important terms as used in the context of the study.

The next chapter will look at the literature related to the role of technology in assessment of Science education that may be linked to Physical Science as a natural science subject.

CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

Chapter 1 outlined the problem, the orientation of the study and questions that were to be answered through this study. The main research question that needs to be answered is: What is the role of technology in the administration of JSC Grade 10 Physical Science assessments? Before answering the question through the research methodology and findings, the researcher studied the existing literature about the role of technology in assessment of different subjects and how technology for assessment is applied by different educators. Therefore, this chapter summarises the literature in the field of educational technology, specifically the application of technology for assessment purposes as well as research and development related to the use of technology for assessment. At the very beginning, the conceptual framework to which the research is aligned is outlined. The literature is structured into subtopics, giving details of the status of assessment in the current Namibian education system, the trend in the use of technology for assessment with examples of how it is used in different institutions across the globe.

2.2 Conceptual Framework

Assessment is an important component of learning (Linn, 2008; Gardner & Gardner, 2012). There are many theoretical and conceptual frameworks that contribute greatly to assessment and learning of Science such as: social constructivist theory, social cultural orientations theory and the most recent - the conceptual change framework (Duit & Treagust, 2003). However, this research will not only look at assessment as a vital component of teaching and learning Science, but will also look at how technology can be correctly applied and its subsequent role in assessing Grade 10 Physical Science. Therefore, this study is based on the concept of a Paradigm Shift in Educational Curriculum and Assessment.

The concept of a paradigm shift, as originally defined by Thomas Kuhn (1962), states that an old practice should be changed (shifted) to the new practice if it is found that it could not solve new problems (Orman, 2016). A paradigm shift or ‘scientific revolution’ occurs when the old paradigm is unable to deal with an outstanding problem (Gipps, 2007). One significant shift in the education fraternity is the change in teaching methodology from the traditional teacher-centred teaching approach to the modern learner-centred approach. Some researchers such as Chisholm & Leyendecker (2008), concluded that the learner centred approach can help the 21st century learner to understand the Physical Science content better than the traditional methods and therefore the need for shift in teaching strategies. “Learner-centred education is one of the most pervasive educational ideas in contemporary sub-Saharan Africa and elsewhere. It is often accompanied by competency-based discourses and official shifts in curriculum and assessment policy designed to lessen the significance of examinations and enhance the importance of continuous assessment as a means of stimulating learner-centred pedagogies” (Chisholm and Leyendecker, 2008, p.197). Another major shift in schools is the urgency for the integration of Information and Communication Technology (ICT) as a teaching and learning tool, although its implementation in Namibian schools is limited (Simon & Ngololo, 2015). Since we are teaching technology literate learners (Prensky, 2001), there is a need to shift from the use of pen and pencil tests as the only form of formal assessment to the inclusion of technology based assessment and other forms of assessment methods. According to Lubben, Campbell, Kasanda, Kapenda, Gaoseb & Kandjeo-Marenga (2003), traditionally, science learners relied on textbooks as their only reference to factual information but nowadays learners have access to internet and subject related computer based software as additional references. Therefore, the quest for a paradigm shift in our educational

assessment has become obvious due to increased technological developments (National Open University of Nigeria, 2015).

Many institutions have introduced technology to administer learners' assessments (Price, Pierson & Light, 2011). The need to assess with technology is triggered by the integration of technology into teaching and learning towards the end of 20th century (Tsai & Tsai, 2003). Integrating technology into Science teaching has been recognized as one of the "important issues for educational reform and innovations" in recent years (Tsai & Tsai, 2003 p. 43). For instance, the University of Cambridge Local Examinations Syndicate (UCLES) which is well known for providing quality international examinations to many countries (including Namibia for the period 1994 -2004), introduced the Enigma Project, an online examinations project piloted in Singapore in 1997-1998 (Harding & Raikes, 2002). The International General Certificate for Secondary Education (IGCSE) Physics was one of the subjects piloted with the main purpose to see whether a traditional UCLES paper and pencil test could be efficiently administered through a computer. Users (learners) were allowed to answer multiple choice and short answer questions online. Harding and Raikes (2002) further explained that when the university sent out evaluation surveys for learners to rate the technology used, it turned out that 95% of learners liked the user interface used. Only 5% of learners indicated that they do not like it. This is an indication that learners are interested in solving technology based assessment. Another international organisation that promotes technology for assessment is Intel ® Corporation. For over a decade, Intel ® Corporation has developed free online assessment tools as part of global initiatives to support assessment and teaching of 21st Century Skills (Price, Pierson & Light, 2011). These skills are collaboration, digital literacy, critical thinking, and problem-solving that schools need to teach to help learners to excel in today's world of technology.

The education system in Namibia has undergone several reforms since independence to accommodate modern issues such as the integration of technology and other curricular issues that are prerequisite to the realisation of Vision 2030 (Ministry of Education, 2009; Iipinge & Likando, 2012). For example, the Information and Communication Technology (ICT) policy for Education (2005) was developed to answer to the call for a knowledge-based development paradigm, as stipulated in Namibia's Vision 2030 (MBESC & MHETEC, 2005). The ICT policy also looked at the need for teachers to gain knowledge and skills on how to use technology as a tool to support learner-centred teaching, continuous assessment, and other forms of interactive learning through pre- and in-service training for teachers.

In Namibia, curriculum reform has directly affected the assessment of Physical Science as it should abide to compulsory Ministry of Education's policies. These include the National Standards and Performance Indicators (NSPI) for Schools in Namibia and the National Curriculum for Basic Education amongst other education sector policies that resulted from national curriculum reform (Ninnes, 2011, Ministry of Education, 2009, Ministry of Education, 2005) as detailed under section 2.3 below. Reforms in curriculum and assessment is not only happening in Namibia, but different countries have reformed their curriculum to answer to current developmental trends and societal demands. For instance, Science Education in the United States is undergoing change as a result of the 2012 Framework for K-12 Science Education that describes a vision for Science learning and assessment (Pellegrino, 2014). The need for the acquisition of the 21st century skills such as creativity and innovation and working towards skilled Namibian citizens as stipulated in Vision 2030 requires teachers to integrate modern teaching and assessment methodologies including the use of technology for assessment. Therefore, a Paradigm Shift in assessment of Physical Science

is a good choice as conceptual framework to sensitise teachers and educators of the role of Technology for Assessment.

2.3 Assessment in Physical Science

Physical Science is a Natural Science subject, which is perceived as one of the main drivers of the transformation of society and the world (Ministry of Education, 2009). There are many reasons why we should correctly assess learners' performance in this crucial subject. Race (2009) argues that thinking clearly about reasons for assessment helps to clarify which particular methods are best suited for our purposes. In the Namibian context, assessment is done to determine whether or not learners demonstrate the mastery of the stated basic competencies in the syllabi (Ministry of Education, 2010). However, the Ministry encourages that teaching should be learning-driven and not assessment and examination driven. Assessment and examination are to support learning.

Debates on appropriate assessment tools for desired learning outcomes in the natural education field has been going on (McColskey, & O'Sullivan, 1993). For example, Winnie (2004) argues that there are a variety of assessment strategies for teachers to choose from in different aspects of the Science learning depending on the area of Science that is being covered. This means that the assessment tools for performance-based assessment in Science investigations may not be appropriate for Science journal writing, concept maps, portfolios, end of year examinations and so on.

Letina (2015) outlined the traditional method of assessment as mainly summative, a more formal setting and used as the only form of assessment. This is normally done in the form of end of year examinations. This form of assessment was also the same used by the colonial regime in Namibia, whereby the examination marks were the only indicator of learners' performance. Compared to

alternative assessment methods where learners can be assessed both formally and informally (Letina, 2015), traditional methods deprived learners the chance to be assessed in different skills and restricted the teachers to the paper and pencil test. In a more formal context, the term alternative assessment usually implies a shift from traditional assessment in order to achieve higher levels of educational outcomes (Buhagiar, 2007).

2.4 Technologies for assessment

There are many technologies available for education purposes (Mogey & Watt, 1999). Most of these are used for the handling and communication of information and generally referred to as Information and Communication Technology (ICT) altogether. These include computers, audio visual systems, broadcast receiving systems and telecommunication systems, media such as compact discs and video discs, microcomputer-based laboratories, the Internet, virtual learning centres, local and wide area networks (wired and wireless), instructional software, printed media, educational television, voice mail, e-mail, satellite communication, cable televisions, conventional and interactive radio (Ministry of Basic Education Sports and Culture & Ministry of Higher Education, Training and Employment Creation, 2005). Some of these technologies are appropriate for enhancing teaching and learning while others are more suitable for interaction and communication. In this thesis, technology for assessment involves the use of computers and Internet for the purpose of assessing learners and administering learners' assessment marks. Assessment as an important component of teaching (Griffin, McGaw & Care, 2012), is no exception from the use of modern technology as we prepare the 21st century learner to enter the employment market with technological skills. The phenomenon of the use of computer-based technology for teaching and assessment has become unavoidable, given the technologies that learners are exposed to and the convenience its platforms offer.

According to Csapó, Ainley, Bennett, Latour, & Law (2012), technology can be used to improve assessment in at least two major ways: by changing the core processes of assessment and by changing the substance of assessment itself (Csapó et al., 2012). Core processes include the process of developing tests and questions including the use of stimuli such as audio, video, and animations instead of sticking to the traditional text and picture format. It also includes scoring constructed responses on screen, allowing marking quality to be monitored in real time and distributing test results electronically that helps to cut the costs of printing and mailing reports. On the other hand, changing the substance of assessment involves using technology to change the nature of what is tested or learned, in ways not practical with traditional assessment approaches, for example asking learners to experiment with interactive simulation of a scientific phenomenon and then draw conclusions or answer questions based on that (Csapó et al., 2012). This is in agreement with McMillan (2000) who pointed out several technology-based techniques that teachers can use to improve assessment of their learners; teachers can develop computer stored item banks, use computers to generate electronic grading, use computer-adapted testing, and computer-based simulations (McMillan, 2000). In addition, Internet resources and more detailed ways of reporting assessment results are also some of the opportunities that teachers and administrators can use to make assessment easy (McMillan, 2000).

Technology for assessing Science subjects rooted back towards the end the nineteenth century. Kumar & Helgeson (1995) summarised educational technology applications for Science assessment into seven categories: (1) conventional test administration, (2) multiple-choice testing, (3) constructed-response testing, (4) adaptive testing, (5) figural-response testing, (6) simulations, and (7) solution-pathway analysis. Nowadays, these applications have expanded and some are

replaced by more effective ones. Some of the effective technology-based tools for assessment identified by recent researchers (Hopkins, 2017; Esteele, 2015; Shute & Ke, 2012), are:

2.4.1 Learning Management system (LMS)

A learning management system (LMS) is a software application that is designed to manage the administration, documentation, reporting and delivery of educational programs. LMS helps the teacher deliver teaching materials to learners, administer tests and other assignments, track learners' progress, and manage record-keeping (Esteele, 2015). There are different types of LMS software applications that can be purchased at a cost, however, some social media offers free platforms for LMS. Facebook is an example of such network sites. It has a potential for teaching and learning due to its unique built-in functions that offer pedagogical, social and technological affordances (Wang, Woo, Quek, Yang, & Liu, 2012). In a study conducted in Singapore, a Facebook group was used as a learning management system (LMS) to explore the learners' perceptions of using LMS in their courses. The results showed that learners were satisfied with the affordances of Facebook and the fact that fundamental functions of an LMS could easily be implemented in the Facebook group. However, the use of Facebook group as an LMS has certain limitations such that could not support some format files that were to be uploaded that participants did not feel safe as they felt that their privacy might be revealed (Wang, Woo, Quek, Yang, & Liu, 2012).

LMS allows learners to answer online quizzes, either fill in blanks or matching terms to short answers. It makes use of rubrics to assess quality of learners' response in a written paper submitted to the LMS drop box (Esteele, 2015). A study conducted by Simon (2014) shows that some Life Science teachers in Khomas region, Namibia, make use of LMS in their classrooms by displaying teaching learning content on the smart boards due to lack of one to one functional computers for

all learners. The study further indicated that teachers collaborate with one another by sharing notes, although some teachers responded that they were not involved in the development of such teaching materials. This is an indication that LMS is a useful tool for both teaching and assessment purposes in Namibian schools.

2.4.2 E-portfolio

The portfolio acts as a repository for work assigned and completed throughout the year (Price et al., 2011). Electronic portfolio (e-portfolio) is a type of Conventional Test Administration tool (Kumar & Helgeson, 1995). This is a tool that allows learners to collect and organise artefacts in many media types using hypertext links to organise the materials, connecting evidence to appropriate outcomes, goals and standards (Kheng, Ho, Cheng and Ling, 2005). E-portfolios make use of rubrics and results are digitally stored in relation to specific e-learning outcomes (Esteele, 2015). Before deciding to use the e-portfolio, a school has to establish the learning outcomes, the scoring rubrics, the submission format and requirements as well as the authenticity of artefacts. For example in Physical Science, learners can make use of e-portfolios to present their projects for continuous assessment or Science fairs.

In Singapore, the use of assessment e-portfolios was proved to have helped learners to reflect on their experiences within and outside classrooms (Kheng et al., 2005). Similar practice is also adopted in Hong Kong, where portfolios are used within Science classrooms for reports of empirical research and to keep papers that demonstrate an in-depth understanding of fundamental Science principles (Winnie, 2004). Although e-portfolio is not a documented assessment tool in Namibia, the learning objectives in Science are not completely different from other countries, and teachers may just explore its advantages.

2.4.3 Computer-based simulation

Simulations have been in use for many years as a formative assessment tool, to assess performance in hostile practical environments that are difficult or impossible to host lively (Mogey & Watt, 1999). Settings, simplifications and restrictions are programmed into a simulation application, allowing users to control them, while attempting to solve practical experimentation and in the process creating realism. A simulation allows key characteristics or behaviour of a real world object to be demonstrated on a computer system (Shute and Ke, 2012). PhET simulations is one of the accessible online freeware simulations for Science that covers most of the topics in the Physical Science syllabus (Kotoka, & Kriek, 2014). In South Africa, PhET simulations was evaluated to be effective in assessing electromagnetism and other Physical Science topics that are difficult to demonstrate (Kotoka, & Kriek, 2014).

2.4.4 Computer adaptive testing (CAT)

Adaptive testing (AT) is a strategic way of testing, developed to balance the test level given to learners by ensuring that the test given is not too easy or too difficult throughout (Linacre, 2000). Too easy tests may be a waste of time while too difficult tests are likely to produce uninformative results. Adaptive tests are comprised of items selected from an item bank. Questions are chosen to match the estimated ability level of the learner depending on the content covered. If a learner succeeds on answering a question, a slightly more challenging question is presented next, and *vice-versa*, until the learner's ability level is eventually determined (Linacre, 2000). The learner may then be immediately informed of the test-results, if so desired.

With the help of the computer, adaptive tests can be easily administered more quickly and efficiently, with learners' scores displayed immediately at the end of the test. In cases of learners answering questions from different devices, Computer Adaptive Testing (CAT) platform allows

learners to be given different questions of the same level of difficulty at a time. The purpose of CAT is to determine the performance level of learners using the smallest number of questions. That means the pool of questions used in CAT should all be measuring the same thing (Georgiadou, Triantafillou, & Economides, 2006).

CAT works best but not limited to multiple choice questions. This makes it more applicable to Physical Science at JSC level as multiple choice questions contributes 23% to Grade 10 final year examinations (MoE, 2010). In addition, CAT is an effective method of assessing computer-based learning (CBL) that is believed to be an effective teaching- learning method to enhance the quality of Science education in schools (Weller, 1996). This according to Georgiadou, Triantafillou, & Economides (2006) comes with a number of benefits such as the fact that large numbers of scripts can be marked quickly and accurately, learners' response can be monitored and that assessments can be stored and reused.

Despite all the advantages of using Computer for Adaptive Testing, there are some hiccups with this technological use. Comparing to the manual test (pen and paper test), most computerised tests show only one item on the screen at a time, preventing learners from easily checking previous items and the pattern of their responses, two other practices known to be helpful in test answering (Linacre, 2000). In addition, scrolling through multiple screens does not allow side-by-side comparisons. There is also a challenge that teachers who are not computer literate (Simataa, 2015) are not likely to give CAT to their learners and also on the side of learners; those with the ability to manipulate computer keys rapidly may be favoured compared to others.

2.4.5 Computer applications for statistics

This is the most immediately and easily accessible use of technology for the assessment process used in recording, analysis, general storage and management of test and examination results (Mogey & Watt, 1999). A wide range of spreadsheets, statistical packages and database packages are available (e.g. Excel, Lotus 1-2-3, Dataease, SPSS, Minitab, and Access), into which it is easy to enter data manually. The most commonly used spreadsheet in Namibia is Microsoft Excel that comes with Microsoft Office package. At JSC level learners are introduced to the use of spreadsheets through the ICT literacy and Information Communication syllabuses (Ministry of Education, Arts and Culture, 2015), while teachers acquire computer literacy and usage skills from teacher-training institutions and in-service trainings such as the International Computer Driving License (ICDL) programme. In general, statistical applications are more useful to teachers to compile and record learners' marks.

2.4.6 Social media and Online-based group work

Since its introduction, social media has gained credibility over the years as a trusted platform for exchanging expertise among learners and academicians (Dlamini, 2017). In support, Hopkins (2017) argues that learners can easily collaborate with others using social media technologies such as Facebook, Twitter and Snapchat compared to face-to-face chats. This is arguably because they have less fear of crowd and audience. There are various Web 2.0 based platforms online (Greenhow, Robelia, & Hughes, 2009). Common platforms such as Facebook, Twitter, WhataApp, YouTube and Google plus are accessible to some Namibian learners through mobile phones and computers as internet access spread to many Namibian schools (Isaacs, 2007).

In a broader perspective, social media is more than social and text interaction. For example, video presentation platforms, such as Skype, MySpace, Google Hangouts, or Web video conferencing

have allowed instruction to be delivered across great distances (Hopkins, 2017). This also means teachers and learners do not necessarily need to sit in a physical classroom for learning to take place. On the other hand social networking spaces such as chat rooms, and discussion boards is believed to foster learning that reinforces and complements what is taught in traditional classrooms (Tynes, 2007). In addition, videos stored on YouTube and access to prompt responses through interaction with experts can be of great help as sources of information for learners to solve daily assessment activities such as topic tasks.

The use of social media platforms in schools has become unavoidable as more learners get access to internet devices. Learning institutions “today must be more technical savvy than any generation previously as learners not only prefer communication through these mediums, they expect it” (Hopkins, 2017, p. 2). This is triggered by the adoption of social media in everyday life. The use of social media as technology for assessment is associated with advantages including increased collaboration, improved participation, access to content rich resources and usefulness for team projects. These help learners to develop cognitive skills that are consistent with those required in educational settings and perspective-taking skills that are necessary for citizenship in an increasingly multiracial society (Tynes, 2007).

Despite a handful of benefits, some researchers and parenting experts warns on online safety of learners. They argue that, online cyber bullies and predators target social media where adolescents are likely to hangout and parents should prohibit them from access to internet (Tynes, 2007). Other disadvantages of social media and group chats includes lack of control for inappropriate posted content, learners tend to rely on social media for all contact and that they can easily get distracted from intended learning activities (Hopkins, 2017).

2.4.7 Games

Computer games refer to structured or organized computer-based play (Shute & Ke, 2012). Games have emerged as learning and testing tools in the digital age (Prensky, 2001, Shute & Ke, 2012). Learners can either test their knowledge or learn new skills as they engage in subject specialised games as Shute and Ke (2012) put it, “games involve players in forming, experimenting with and adapting playing strategies to solve problems in order to gain rank” (p.47). A study conducted by Marino, Israel, Beecher & Basham (2013) revealed that teachers in the United States who took part in the research responded that games improved the accessibility of the Science content to their learners and contextualized learning in a way that is impossible with traditional curricular material. Learners worked harder to grasp the knowledge required to win the game and emerge victorious. In the same study, learners were asked to play the game *Prisoner of Echo* where players were trapped in a virtual underground maze of caves and challenged to use their understanding of sound waves (e.g., pitch, refraction, reflection) to escape from pursuing robots. Learners who studied and understand the application of sound (a topic in Physical Science), are likely to win the game, gain more points, and in a way the teacher is assessing their ability while they are learning at the same time.

Research findings suggest that video games have the potential to promote critical attributes associated with scientific literacy, however, it is difficult to examine whether these games contribute to learners’ learning since the learning objectives are not always clearly defined (Marino et al., 2013).

2.5 Availability of technology and skills in Namibian Schools

Research concluded that computers and other technologies are available in Namibian schools (Boer, 2012; Simataa, 2015) and to a minimal extent are integrated in the teaching and learning

process (Simon & Ngololo, 2015). Since the introduction of Vision 2030, Namibia has embarked on plans to integrate information and communication technologies into its education systems as part of its effort to become a knowledge-based economy (Wilder, Boer & Meier, 2009). While Simon (2014) concluded that the integration of technology for teaching and assessment is not fully implemented in schools, Davies & West (2014) warn that efforts to critique current use of technology must recognize that not everyone shares a common understanding of the meanings of technology and technology integration in the classroom. For many, technology is synonymous with computer equipment, software, and other electronic devices rather than any educational technology tool, piece of equipment, or device that can be used to help learners accomplish specified learning goals (Davies, & West, 2014).

One device which is readily accessible to teachers and learners is the cellular phone. There has been debates on the use of cellular phones at schools since it gained popularity. Results from recent studies show that a cellular phone is a useful technology device for learning and assessment. A study conducted by Kreutzer (2009) shows that 59.1% of South African learners who participated, have looked for school information on cellular phones the previous day comparing to only 34.8% who looked for school information on a computer. Similar findings were also established in Namibian schools (Simataa, 2015). However, a cellular phone has the power to connect teachers and learners to internet which is a useful tool in assessment and teaching.

Internet is a powerful technological tool that can help learners to do assessment tasks as information on different topics is readily available (Dogruer, Eyyam, & Menevis, 2011, Tsai & Tsai, 2003). This is confirmed by research conducted in different countries about the use of internet in schools. Learners stated that they use internet to read online e-dictionaries, e-encyclopedias and

translation tools to help them write their homework and do their projects (Dogruer, Eyyam, & Menevis, 2011). This is in agreement with Tsai and Tsai's findings that Taiwan learners found it easy to locate answers to a given set of Science questions, comparing to searching in other sources (Tsai, & Tsai, 2003).

Namibian schools are provided with computers and internet through different organisations and government programmes (Isaacs, 2007). Apart from computers, the usage of cellular phones to access internet by both teachers and learners has also gained momentum in schools (Kreutzer, 2009). This makes internet a potential readily available and useful tool in the administration of assessment in Namibian schools.

At national level, the Directorate of National Examinations and Assessment (DNEA) piloted a computer-based marking system administered by Web Score, known as e-marking, to replace the manual pen-marking for JSC national examinations. For the first time, e-marking was applied to mark the JSC Physical Science paper along with Entrepreneurship and Geography in the year 2014. Candidates were required to write their answers on the provided answer lines as directed by the instructions, the scripts were then scanned into a server that was accessible to individual markers (Ministry of Education, 2014). E-marking was evaluated successful and time-saving, but the full project was not implemented due to higher costs. In the United Kingdom (UK) e-marking was criticised for the inability to assess higher-order thinking skills and for lack of access to other parts of a candidate's work that would help corroborate markers' final decisions (Royal-Dawson, 2005). In the UK, the study was conducted using Educational Testing Service (ETS) software called the On-line Scoring Network (OSN) which was very similar to Webscore that was used in Namibia.

2.6 Challenges in using Technology for assessment in Physical Science

There are several challenges for using technologies for assessment:

Lack of computer and technological skills – Some studies have established that many Namibian teachers lack skills in using technology in schools (Simataa, 2015) despite efforts to equip many teachers with computer skills (MBESC & MHETEC, 2005).

Cost – most technologies for assessment requires purchasing of hardware and software. For example the cost of setting up a CAT can be significant as it entails the cost for the purchase of the computer software, hardware, as well as the costs for the creation, set up, and maintenance of a valid and reliable CAT (Papanastasiou, 2003).

Reliability of online content - The use of technology does not come clean, especially online based platforms. McMillan (2000) warns that teachers should be cautious when using technology for assessment and testing as there is a “danger that technology will contribute to the mindless use of new resources, such as using items on-line developed by some companies without adequate evidence of reliability, validity, and fairness, and crunching numbers with software programs without sufficient thought about weighting, error, and averaging” (McMillan, 2000, p. 5).

2.7 Summary

This chapter looked at the literature on the use of technology for assessment and Physical Science assessment requirements in Namibian schools. The use of technology for teaching and assessment is unavoidable as we teach digital native 21st century learners. Researchers across the globe have identified and developed suitable technologies for assessing learners that can also be applied to Physical Science. These developments are supported by the paradigm shift concept which states that an old practice should be changed (shifted) to the new practice if the new practice is proved

to be better (Gipps, 2007). This is applicable to the assessment of Physical Science because several researchers concluded that technology-based applications for teaching and assessment are favoured and work better for both teachers and 21st century learners compared to traditional practices (Estele, 2015). However, the use of technology comes with challenges such as the need to differentiate between reliable and unauthentic online information and computer literacy level of teachers. The next chapter will discuss the research methodology used to answer the research questions listed in chapter 1. This chapter also includes the research design, sampling procedures and the procedures followed to collect and analyse data.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

In the previous chapter the researcher looked at existing literature related to this study. This includes the description of the Paradigm Shift concept as the most suitable conceptual framework, an outline of the required assessment activities in Physical Science and the types of available technologies for assessment applicable to Physical Science activities. Chapter 3 precedes the findings of this research and it explains the methods followed to carry out the research. It starts with the description of the mixed-method as the research design, the population and sampling procedures followed, the procedures used to obtain unbiased data including reliability and validation, and subsequent analysis. The chapter ends with ethical issues considered prior, during and after data collection process.

3.2 Research Design

This research followed the sequential explanatory mixed-methods design. Ivankova, Creswell, & Stick (2006) define the mixed-methods design as “a procedure for collecting, analysing and integrating both quantitative and qualitative data at some stage of the research process within a single study for the purpose of gaining a better understanding of the research problem” (p. 3). A sequential explanatory mixed-methods design was specifically employed because the initial quantitative results informed the secondary qualitative results (Creswell, 2009). In the first place surveys (quantitative) were sent to all Grade 10 Physical Science teachers in the Ohangwena region. Data was then analysed using tables and charts. Quantitative data and their subsequent analysis provided a general understanding of the way technology for assessment is applied to Physical Science in Ohangwena Region schools. Results from analysis of quantitative data was also used to purposefully sample a total of ten teachers for interviews (qualitative). The qualitative

data and their analysis refined and explained those statistical results by exploring teachers' views in more depth.

The research method used is summarised in Figure 3.1 .

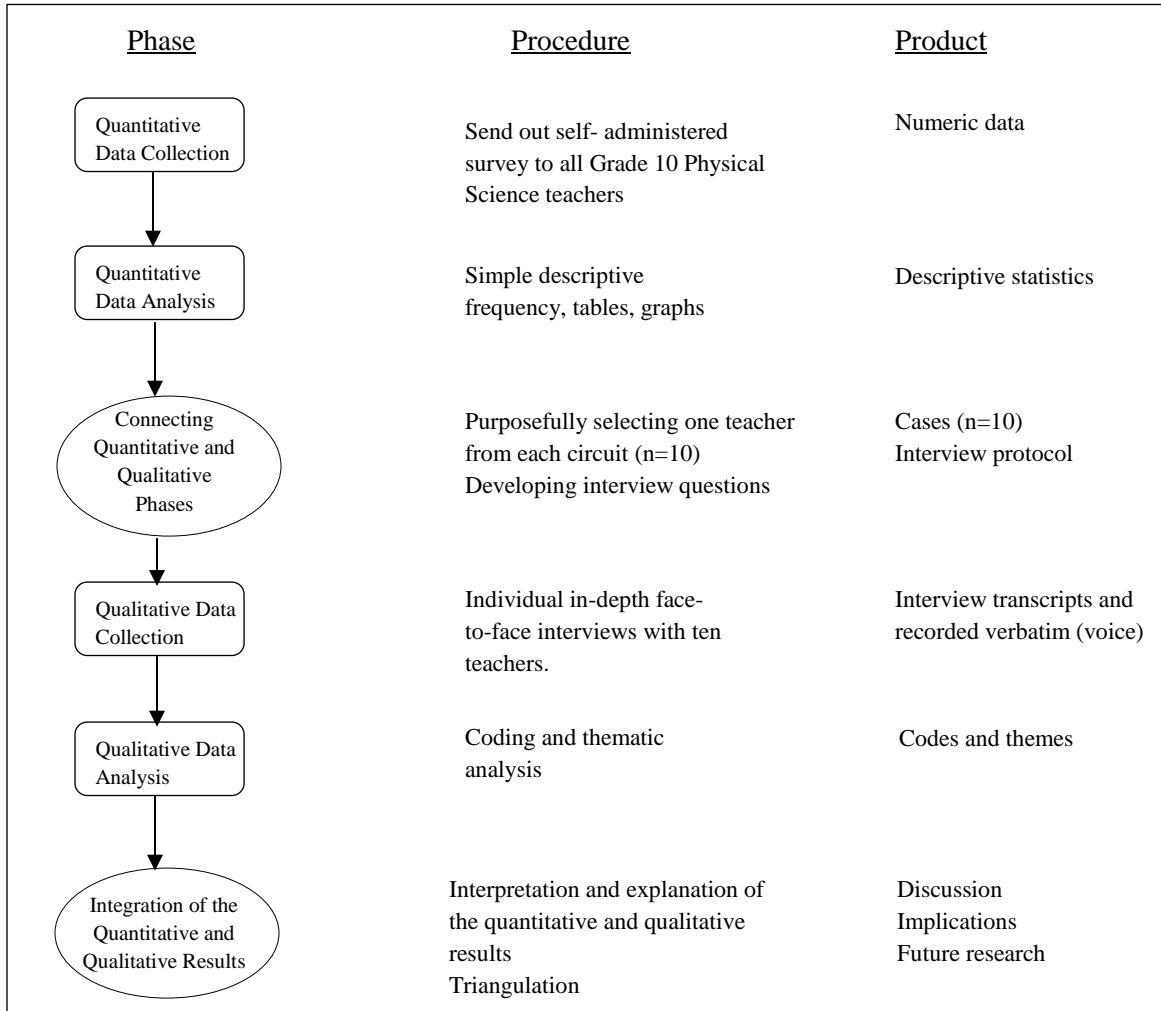


Figure 3. 1 Visual Model for Mixed-Methods Sequential Explanatory Design Procedures

(Adapted from Ivankova, Creswell & Stick, 2006, p.16)

In the model, priority is given to qualitative data by capitalising the word, however in this study both qualitative and quantitative data were given equal value because they supplemented each other. Triangulation was used as results obtained through surveys and interviews were compared and combined.

3.3 Population

According to Gideon (2012), population refers to the large target group of people that the researcher wants to describe and understand. The population of this study was all Grade 10 teachers teaching Physical Science in the Ohangwena Educational Region. In the year 2016, there were 150 teachers teaching Grade 10 Physical Science at 143 Junior Secondary schools in the Ohangwena region (Directorate of National Examinations and Assessment, 2016; Ohangwena Directorate of Education, Arts and Culture, 2017). The researcher focused on Physical Science teachers teaching in the Ohangwena Directorate of Education, Arts and Culture because she interacts with them on day-to-day basis while working as the subject's Advisory Teacher in the region, making it easy for data collection. In addition, the researcher was interested in understanding the way teachers are teaching and assessing the subject to improve regional overall performance.

3.4 Sample and Sampling procedures

Sampling is defined as the process of selecting units from a population that will be used to represent the entire population (Singh, 2007). Since the study followed the mixed-method approach, two methods of sampling were used to obtain samples for quantitative phase and qualitative phase.

3.4.1 *Quantitative phase*

In the quantitative phase, the researcher employed the census sampling method, whereby surveys were sent to the entire population of Grade 10 Physical Science teachers in the Ohangwena Region. This is because the researcher deemed it reasonable to include the entire population of 150 teachers (Andres, 2012) to get actual information on the use of technology for assessment in all schools. Out of the 150 surveys sent, 93 (62%) of the surveys were returned back.

3.4.2 Qualitative phase

Ten (10) Grade 10 Physical Science teachers from ten different schools who indicated in the survey (quantitative phase) that they have access to technology and are using some form of technology for assessment were sampled using intensity sampling method for interviews. This was done because it is practically not possible to interview every teacher in the population (Gideon, 2012). Intensity sampling is a type of purposeful sampling method that seeks “to identify participants who manifest intense forms of the phenomenon of interest” (Hatch, 2002, p.50), in this case, the use of technology for assessment. Purposeful sampling method allows the researcher to select participants who are considered to be typical of the wider population (Creswell, 2009). Teachers who indicated that they have at least used technology for assessment in their teaching time were interviewed to share information related to research sub-questions 2, 3 and 4. Convenience sampling was used to narrow the number of participants to 10. Teachers who had indicated in the survey that they are practically using technology for assessment were interviewed in order of their reachability.

While Patton (2002) argues that the sample size of a qualitative study is determined by the time allotted and resources available, Creswell (2009) recommends that 5 to 25 interviews are enough to obtain feedback for most or all perceptions that lead to the attainment of saturation and study objectives. In this case, since there are ten circuits in the Ohangwena region, ten teachers as participants were deemed a reasonable number so that detailed information could be obtained from each circuit.

3.5 Instruments

Two different instruments were used: surveys (quantitative phase) and interviews (qualitative phase). According to Zohrabi (2013) using more than one instrument heightens dependability and trustworthiness of collected data.

3.5.1 Quantitative phase

For the quantitative phase of the study the instrument used was a self-administered survey made up of Likert scale and closed questions. Likert scale offered a number of possible responses that provided flexibility to participants as they were only required to indicate their stand with a tick and it afforded the researcher greater accuracy in recording their views on the use of technology for assessment (Wilkinson & Birmingham, 2003). Likert scale was also chosen because the researcher saw its noble opportunity to indirectly educate participants who are not active users of technology by introducing different technologies applicable to the assessment of Physical Science. On the other hand, closed questions were chosen over open ended questions for its precision and ability to spell out the response options allowing the researcher to communicate the same frame of reference to all participants (Foddy, 1994).

A self-developed survey was used to get general information from all JSC Grade 10 Physical Science teachers in the Ohangwena region. Ninety three (93) surveys (62%) were received back completed.

The surveys contained data items that enabled the researcher to identify applicable interview participants.

3.5.2 Qualitative phase

In the qualitative phase the instrument used was semi-structured face-to-face interviews with the ten sampled teachers individually. Individual interviews were useful because the researcher

wanted to explore in-depth the experiences and views of individual teachers who indicated that they were using technology when assessing Physical Science learners, by posing questions that seek deeper understanding of how the teachers use technology for assessment including the challenges they face. Creswell (2012) advises that semi-structured interviews should involve a few pre-determined areas of interest with possible prompts to help guide the conversation. The researcher prepared the same questions for all participants but allowed for follow up questions that gave participants an opportunity to shape the flow of information (Wilkinson & Birmingham, 2003).

3.6 Data collection procedure

In the first place, the researcher obtained permission to collect data from schools in the Ohangwena Region. The researcher sent out 150 surveys to individual teachers through circuit office mail for distribution to all schools with Grade 10. To maximise responses rate, a checklist to indicate schools that received the survey copies and a short covering letter explaining the purpose of the research were sent to the resource teachers (based at circuit offices) who helped in distributing surveys into schools pigeon halls and gathered them as they were returned for collection by the researcher. In addition, participants were given a choice to send the completed survey directly back to the researcher's address or to give them to the resource teacher at the Circuit Office for the researcher to pick it up. The process of returning surveys was quite slow, as participants took time to return them thereby necessitating the expense of writing follow-up letters, telephone calls and other means of 'chasing' the participants such as visiting the reachable schools.

In the qualitative phase, ten interviews were conducted. The researcher travelled to schools to reach the participants for face-to-face interviews and in some cases she made appointments with participants for interviews as they visited the regional office for their personal queries. Each

interview lasted for approximately 20 minutes. An audio recorder was used to capture voice during interviews and stored in the computer for further analysis. The 10 interview recordings were transcribed into text for analysis.

3.7 Data analysis

Quantitative data was analysed first, followed by qualitative data. Part of the information from surveys was used to identify participants for interviews. Although the researcher employed sequential explanatory approach during analysis and sampling, the researcher found it helpful to group data per research question and use triangulation to combine data collected through surveys and interviews. According to Creswell (2012), triangulation is a combination of methodologies in the study of the same phenomenon that should be used in the validation process through cross verification from two or more sources. In this research, the researcher presented the two forms of data (qualitative and quantitative) as supporting evidence for results and transformed most the interview data into quantitative form by quantitatively counting the codes from qualitative results to converge them (Creswell, Fetters & Ivankova, 2004).

3.7.1 *Quantitative data analysis*

The researcher first scanned through the surveys per circuit to identify potential participants for interviews. These were the participants who indicated in the survey that they were in possession of at least two technological devices and used computers for at least three types of assessment activities in Physical Science during their teaching experience. Then, descriptive statistical analysis was done using tables and bar graphs. Part of the data was analysed by finding means and simple descriptive frequencies.

3.7.2 *Qualitative data analysis*

In the qualitative phase - coding and thematic analysis was used to categorize and analyze data. Qualitative data analysis began as soon as face-to-face interviews was completed. Hatch's (2002) model of inductive analysis was adapted to synthesize data collected from interviews. This model suggests that qualitative data should be grouped into themes, codes and categories that emerge from the analysis of data as a whole. Research data was presented in the form of tables and grouped into categories and themes.

3.8 Reliability and Validity

Golafshani (2003) defines reliability as the extent to which results are consistent over time and that it represents the population under study, accurately. While reliability rooted from the quantitative research perspective, modern researchers agree that without reliability a research becomes fiction and loses its utility as it lacks vigour and trustworthiness (Morse, Barrett, Mayan, Olson, & Spiers, 2002). On the other hand, validity refers to how well the research reflects the reality it claims to represent (Creswell, 2012). Although reliability statistical analysis could not be run due to the nature of data collected, the researcher took responsibility for reliability and validity by implementing different verification strategies. In the first place the researcher used different data collection methods namely, the survey and face-to-face interviews. Interviews were recorded so that the researcher can play it over and over and then transcribed into text to avoid misinterpretation of results. In addition surveys were sent to all teachers to ensure that the actual stand on the use of technology for assessment in the region is obtained. Sampling for qualitative data was done such that one teacher is interviewed per circuit to have maximum representation and voice from each circuit. Another strategy was sufficient and unlimited timing for responding to interview questions that allowed the researcher to get enough and reliable information. Finally,

data obtained from the surveys and interviews were triangulated to unify the two methods used and to verify reliability.

3.9 Ethical considerations

Before the research was conducted, the researcher obtained ethical clearance from the Research and Publications Committee of the University of Namibia. In addition, the researcher was granted permission to conduct research in the Ohangwena Region from the Ministry of Education, Arts and Culture through the regional Director of Education. The researcher sought permission from school principals to conduct surveys and interviews. In addition, participants were informed of the purpose of the study and their rights were well explained. These included their rights to withdraw from participating in the study without fear of punishment.

In order to ensure confidentiality, the research participants were assured that their identities will not be disclosed and will not appear on any paper work and the information they provided will not be discussed with others except the supervisors. With their consent, participants were assigned pseudonyms names during interviews to protect their identities as their voices were recorded verbatim. After the data have been captured, analyzed and made sense of, the researcher wrote a report in soft copy that is saved in a computer with a security code that is only known to her. The hard copies (surveys) will be destroyed after the thesis has been evaluated.

3.10 Summary of research methodology

This chapter discussed the research methodology employed to gather data for this research. The research followed a sequence explanatory research design to collect information on the role of technology for assessment from all Physical Science teachers teaching Grade 10 in the Ohangwena region. The instrument used were surveys and interviews. The researcher considered a number of

issues to ensure reliability, validity and research ethics. Chapter 2 will look at the actual data collected and its findings.

CHAPTER 4: DATA PRESENTATION AND ANALYSIS

4.1 Introduction

The preceding chapter discussed the research design followed in answering the main research question, which is: *What is the role of technology in the administration of JSC Grade 10 Physical Science assessments?* To answer this question, data was collected using surveys sent to all Grade 10 Physical Science teachers and by interviewing ten of those Grade 10 Physical Science teachers who indicated that they were active users of technology for assessment and they had access to two or more technological devices. Ninety three (93) surveys were returned out of 150 surveys that were sent out. This represented 62% of the targeted population of Grade 10 Physical Science teachers teaching in the Ohangwena Region.

This chapter will present the data collected in line with research questions. Quantitative data from 93 surveys is presented using tables and graphs. Qualitative data from 10 interview verbatim is analysed by identifying emerging themes from verbatim interview transcripts. Although teachers were asked to assign themselves pseudonyms names in the recorded interviews to ensure them of confidentiality, the researcher found it convenient to refer to them as Teacher 1 to Teacher 10.

Since data was collected using two different approaches, it was presented per research question with quantitative data first before qualitative data. Triangulation was used to facilitate validation of data through cross verification of findings from the two methods of data collection used.

To simplify the presentation and for clearer analysis, this chapter is split into sub-headings of research questions, which are;

1. Which technologies do the Physical Science teachers in the Ohangwena region currently use for assessment?

2. How do teachers apply technology in assessing Grade 10 Physical Science?
3. What are the views of the Ohangwena Region Physical Science teachers on the use of technology for assessment in Physical Science?
4. What challenges do the Ohangwena Region Physical Science teachers encounter in using technology for assessment administration?

4.2 Participants' general information

4.2.1 Biographical information

Participants were asked to indicate their respective schools and circuits. This was done to identify missing or unreturned surveys for follow up. The distribution of participants (teachers) who returned the survey instrument per circuit is summarised in Table 4.1 below.

Table 4. 1: Participants per circuit (in counts)

Circuit	Number of participants		Total
	Females	Males	
Eenhana	3	6	9
Endola	6	5	11
Epembe	4	5	9
Ohakafiya	6	3	9
Ohangwena	3	7	10
Ondobe	5	3	8
Ongha	4	6	10
Otunganga	8	3	11
Oshikunde	3	7	10
Okongo	2	4	6
Total	44	49	93

A total number of 93 surveys were recovered from 44 (47.3%) female teachers and 49 (52.7%) male teachers across the region. Copies were received back from all 10 circuits in the Ohangwena Region.

4.2.2 Teachers' qualifications

Table 4.2 below shows a summary of teachers' qualifications and teaching experience in years.

Table 4. 2 Teachers' qualifications and teaching experience (in counts)

Qualification ↓	Years of experience										Total
	0-2 years		3-4 years		5-6 years		7-8 years		9 years plus		
	F	M	F	M	F	M	F	M	F	M	
BETD	3	2	0	1	3	5	3	4	3	6	30
B.Ed	1	2	1	6	3	3	3	4	7	7	37
B.Ed (Hons)	6	4	2	0	2	0	1	3	2	2	22
M.Ed	0	0	0	0	0	0	0	0	4	0	4
Ph.D	0	0	0	0	0	0	0	0	0	0	0
Total	10	8	3	7	8	8	7	11	16	15	93

(n=93)

In Table 4.2, 65 (69.9%) participants indicated that they have teaching experience of 5 years or more compared to 28 (30.1%) who are in the range of 0-4 years of teaching experience. The majority of teachers (37) were in possession of qualifications equivalent to Bachelor of Education (B.Ed), followed by 30 (32.3%) Basic Education Teachers Diploma (BETD) holders. Out of the 93 participants, only 4 (4.1%) female teachers hold a Master of Education (M.Ed) qualification. None of the participants hold a Ph.D. This shows that almost all teachers have gone through teacher training programmes and have had enough opportunity (more years of experience) to use different assessment techniques during their years of teaching.

4.3 Access to technologies suitable for assessment

4.3.1 Findings from survey (Quantitative)

Part B, questions 1-3 on the survey sought responses about technologies for assessment used by Physical Science teachers.

Question B1: *What technological or (mobile) devices do you have access to?*

In the first instance, teachers were asked to choose the devices they have access to. The following graph is a summary of the answers.

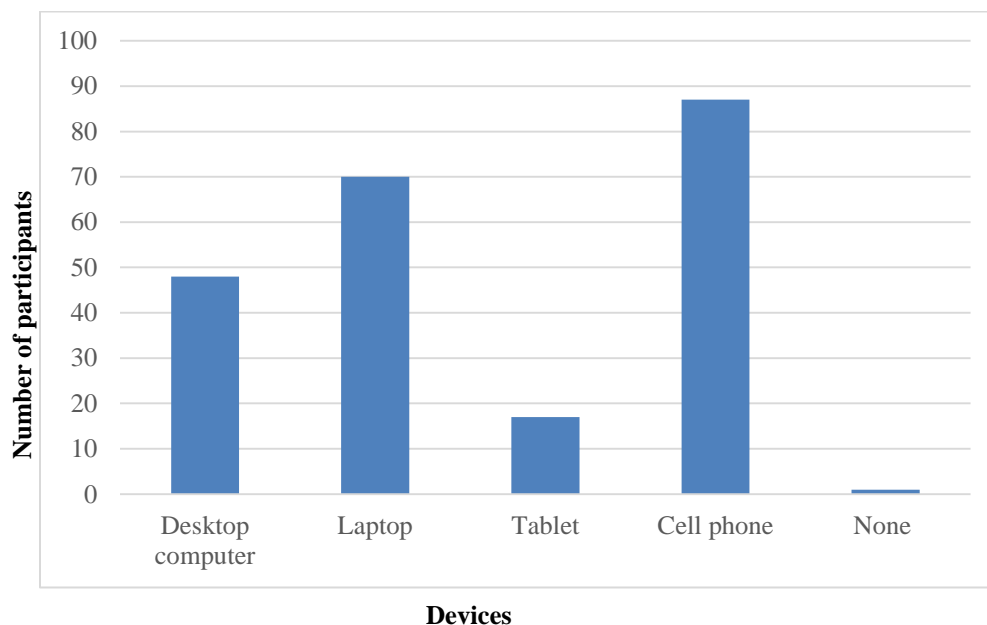


Figure 4. 1: Teachers' access to technological devices

Almost all participants (87 out of 93) indicated that they have access to a cell phone. A significant number (70 participants) also indicated that they have access to a laptop. Only one participant indicated that he has no access to any technological device listed.

Question B2: *Do you have access to the Internet? If yes or sometimes, please indicate how you access it and whether it is private or school funded.*

A significant number of participants, 64 (68.8%), indicated that they have access to internet either through WiFi or Data Package or both. From responses, WiFi is mainly funded by schools while data packages is self-funded on smart phones. Only fewer participants, 29 (31.2%), responded that they have no access to internet.

Question B3: *Do you have a functional computer laboratory at your school? If yes, indicate how many computers are working and how many are not working and the total number.*

The majority of participants, 69 (74%), indicated that their schools have no functional computer laboratories. Twenty four (24) (25.8%) participants indicated that their schools have functional computer laboratories with the number of computers in the individual laboratories ranging from 1 to 40. Table 4.3 shows the quantity of computers available in school laboratories at the 24 schools. Each school was counted once.

Table 4. 3: Number of laboratories equipped with computers in schools

Number of computers in laboratory (range)	Frequency (laboratories)	Cumulative frequency
1-5	6	6
6-10	1	7
11-15	1	8
16-20	7	15
19-25	3	18
26 and more	6	24

Participants/participants indicated that for those schools with laboratories, on average, the laboratories were equipped with more than 15 computers. This shows that for those 16 schools,

learners have better access to computer technology. However, 61.1% of all computers in school laboratories are either not functional or not connected to the internet as shown in Figure 4.2 below.

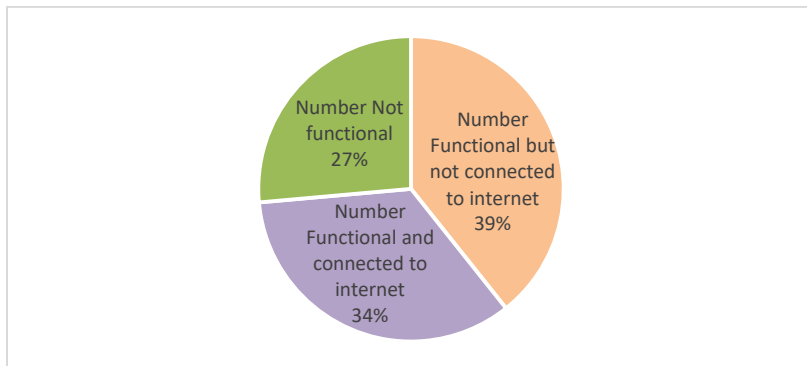


Figure 4. 2: Functionality of computers in school laboratories

For the few schools that had laboratories equipped with computers, teachers indicated that on average, 27% of the computers in the laboratories were not functional, 39% of computers were functional but not connected to internet while 34% were functional and connected to internet.

4.3.2 Findings from interview (Qualitative)

Question 4: Briefly tell me about the type of technological devices you have access to.

Participants mentioned smartphone, Desktop computer, laptop computers, projector, ipad, tablet, scientific calculator, photocopier machine and printer as accessible technological devices. While individuals mentioned three to four devices, every participant indicated that they have access to a smartphone.

4.3.3 Triangulation of findings

Data collected from surveys and interviews corresponded in terms of technological devices accessible to participants. In both cases, almost all (93%) teachers indicated that they have access to portable mobile devices by specifying either smart phone, cellular phone, ipad or tablet.

Although many teachers indicated in the survey that there was no functional computers at their schools, they indicated that they had access to either a computer or a laptop. Other devices that emerged from interviews were scientific calculators, photocopier machines and printers. The majority of teachers (68.8%) indicated that they had access to internet either through school-funded WiFi or self-funded data package.

4.4 Usage of technology for assessment by Physical Science teachers

4.4.1 Findings from survey (Quantitative)

Five survey items (questions) were set to establish how teachers applied technology in assessing Grade 10 Physical Science learners. These were questions 4-5 (under PART B) and PART C questions 1-2 (part PART C). Question B4 determined the types of Physical Science activities teachers use to give learners and the rest addressed the involvement of technology in setting up, answering, marking and recording assessment activities.

Question B4: Which assessment activities do you give to your learners?

Participants were given the choice of ticking more than one activity from pre-determined responses.

Responses are presented in Table 4.4 below.

Table 4. 4: Types of Physical Science assessment activities

Activity	Participants
Written tests	93 (100%)
Other written tasks	93 (100%)
Practical investigations	93 (100%)
Verbal presentations (as classwork)	45 (48%)
Examination	93 (100%)

This table shows that teachers use all types of continuous assessment activities as stipulated in the subject syllabus (MoE, 2010). These are written tasks and tests, practical investigations, topic tasks and end of term/year examination.

Question B5: *Which resources do your learners use to answer the above-mentioned assessment activities?*

Participants were given a list of resources that learners could possibly use to do Physical Science assessment activities. Although presentation application, word processor and spreadsheet are not direct sources of answers to assessment activities, they were given as options because they could assist learners in compiling Physical Science practical investigations. Practical investigations is an important component of assessment that requires individual learners to record and present results of experimental investigations in tables and graphs as part of assessment (Ministry of Education, 2010). Participant’s responses are presented in Figure 4.3.

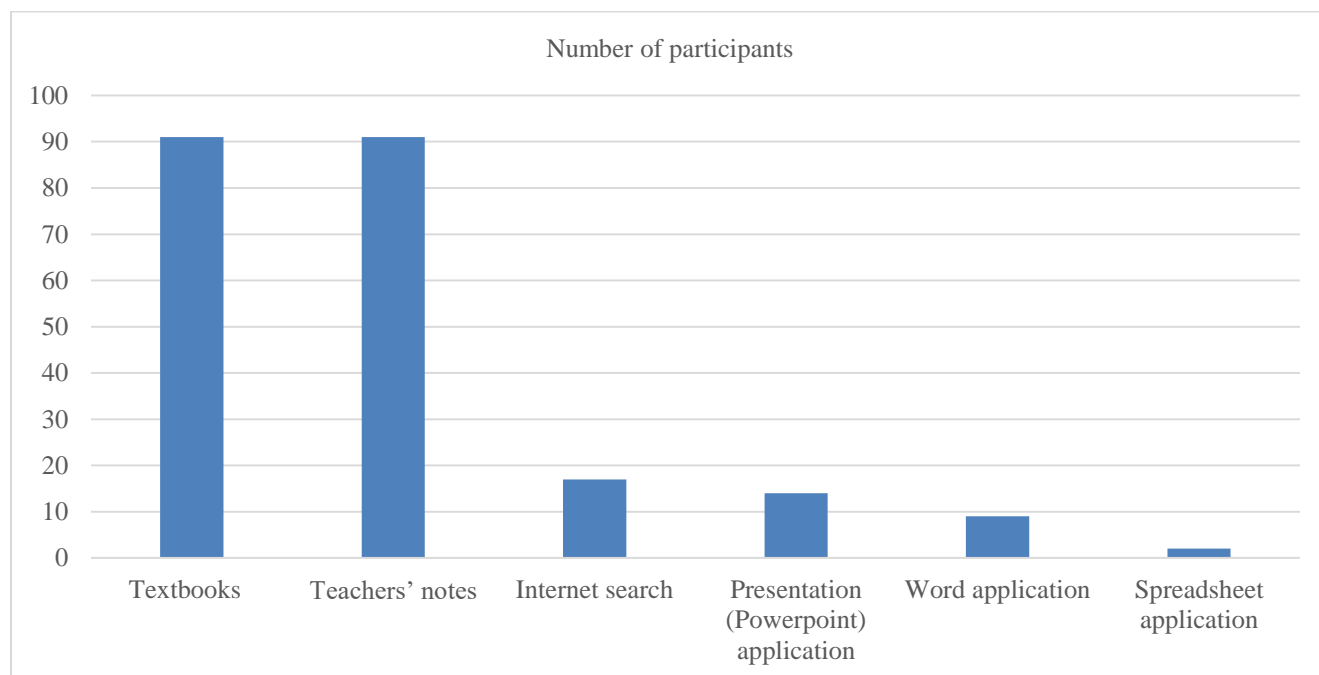


Figure 4. 3: Resources used by learners to do Physical Science assessment activities

From Figure 4.3 it is clear that textbooks and teachers' notes still constitute most of the resources used by learners to do assessment activities in schools as indicated by 90 (96.8%) teachers. Many learners indicated that they search on Internet to get answers to Physical Science assessment activities (18%), while word processors and spreadsheets were used least (3% and 1% respectively). Other resources identified by teachers as resources that help learners to do activities were library (2 teachers), consulting other people (1 teacher), handouts (2 teachers), newspapers (2 teachers) and Encarta (1 teacher).

Question C1: *How often do you (as teacher) use computers for the following purposes?*

Teachers indicated the frequency of using different computer-based technologies when giving and administering Physical Science assessment. Teachers' responses are shown in the table below.

Table 4. 5: Frequency of the usage of computer-based technologies for assessment by teachers

Purpose	Daily basis	Most of the times	Sometimes	Never
Typing questions for written assessment tasks	14 (15.1%)	37 (39.8%)	39 (41.9%)	3 (3.2%)
Searching subject content information	10 (10.8%)	29 (31.2%)	40 (43.0%)	14 (15.0%)
Computer - adapted testing	0 (0.0%)	3 (3.2%)	14 (15.1%)	76 (81.7%)
Computer - based simulations	0 (0.0%)	2 (2.2%)	14 (15.1%)	77 (82.8%)
Online quizzes/ activities	0 (0.0%)	2 (2.2%)	14 (15.1%)	77 (82.8%)
Keeping records of written activities' marks	14 (15.0%)	33 (35.5%)	20 (21.5%)	26 (28.0%)
Issuing of progress reports (database and spreadsheet)	16 (17.2%)	61 (65.6%)	9 (9.7%)	7 (7.5%)

Almost all teachers indicated that they have used computers for assessment of learners at some point in their teaching time. From the table, computers are commonly used for typing learners'

written assessment, searching subject content information for teaching and assessment, keeping records of written activities' marks and issuing/preparing learners' progress reports.

According to teachers' responses, many Physical Science teachers have "never" used the following three internet based computer activities: CAT, computer - based simulations, online quizzes/ activities.

Question C2: *How often do your learners use computers for the following purposes?*

Teachers' responses on learners' use of computers for different purposes is shown in Table 4.6.

Table 4. 6: Frequency of computer usage by learners in assessment activities

	Daily basis	Most of the times	Sometimes	Never
Typing assignment, present investigation data on spreadsheets	0	4 (4.3%)	8(8.6%)	81 (87%)
Searching subject content information to do assessment activities	0	6 (6.5%)	23 (24.7%)	64 (68.8%)
Computer - adapted testing	0	1 (1.0%)	7 (7.5%)	85 (91%)
Watch computer - based simulations	0	2 (2.2%)	23 (24.7%)	67 (72%)
Sharing assessment related information with others online	0	2 (2.2%)	10 (10.7%)	81 (87%)
Discussing assessment activities on social media	0	3 (3.2%)	21 (22.5%)	69 (74%)

According to the teachers, most of their learners never used computers to do assessment activities.

Fewer teachers (4.3%) indicated that their learners use computers to type assessment activities such as homework and practical investigations; 6.5% indicated that their learners use computers to retrieve information to do assessment activities and 3.2% indicated that learners use computers to discuss assessment activities online. None of the teachers indicated that their learners use computers to do assessment activities on a daily basis.

4.4.2 Findings from interview (Qualitative)

During interviews, three introductory questions were posed to understand participants' background knowledge of technology that may be used to understand their usage of technology for assessment.

Question 1: *How long have you been interested in technology for your personal use?*

Question 2: *Can you please share, how you learned and how you started using technology?*

Question 3: *How do you rank your computer/technological knowledge? Motivate your answer.*

All 10 teachers interviewed indicated that they have been interested in using technology for personal use for more than 5 years. However, there was no uniformity in the ways participants acquired their technological skills. Individual participants narrated different experiences.

- Three participants indicated that they learnt technological skills and started using technology when they were still learners at high school, as they were introduced to basic computer literacy.
- Two participants indicated that they learned basic computer skills at training institutions either as introductory Information and Communication Technology (ICT) module or as they typed assignments at university.
- Two Physical Science teachers said they learnt to use technology for assessment on their own as they tried to utilise technological equipment supplied to their schools. For example from Teacher 3 responded as follows; ... *when I was promoted to a Head of Department post in 2007, I was given the office with computer and printer, then I started learning and using the technology equipment.*

- Two participants indicated that they were given in-service training in the use of technology.
- Some teachers indicated that they acquired computer use skills through interacting with knowledgeable fellow teachers.

From verbatim transcripts, participants’ responses on their own ranking of technological knowledge was themed as basic, intermediate and advanced as shown in Figure 4.4 .

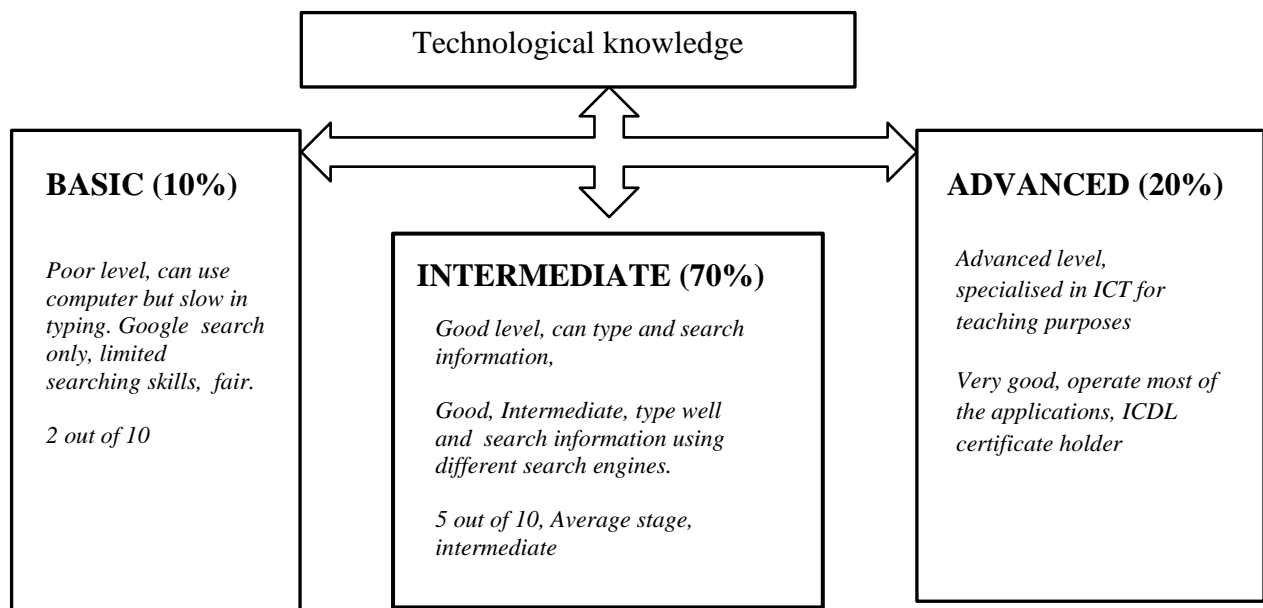


Figure 4. 4: Categories of participants’ technological knowledge

Majority of participants, 70% of the 10 interviewed teachers ranked their technological knowledge as intermediate, 20% indicated advanced while 1 teacher (10%) said he ranked himself at basic level. This means that the majority of the teachers who participated in the interviews have a good technological background.

Participants were probed to share how they applied technology in assessing Grade 10 Physical Science through interview questions 5-8.

Question 5: *In general, what specific use do you have for the technological devices you mentioned?*

Teachers mentioned a lot of uses, ranging from personal, teaching-learning and assessment. Table 4.7 summarises their responses.

Table 4. 7: Technological devices and their assessment uses

Device	Assessment use
Projector	To project PowerPoint presentations containing diagrams and videos that learners should visualise to answer classwork.
Laptop/ desktop computer	For typing assessment activities, searching for pre-set assessment online, to share assessment with fellow teachers through subject related forums, for keeping and recording marks, for generating learners' progress reports and play presentations and videos.
Smart Cellular Phone/ Tablet	To access assessment information on internet and share activities with colleagues.
Printer/Photocopy machines	To scan images to be fitted on question papers, print out hard copies and duplicate test papers.

From the responses, a computer was identified as the main technological device used for assessment in schools. Other devices such as projectors, printers and photocopier machines are computer peripherals while the use of smartphone was to communicate/share activities with fellow teachers that still need to be transferred to a computer to come up with an assessment task.

Question 6: *How long have you been using technology for assessing your learners?*

Table 4. 8: Duration for using technology for assessment

Length of time in years	Number of participants
3-6 years	5 (50%)
7-8 years	2(20%)
9-10 years	3(30%)

50% of teachers indicated that they have been using technology for 3 to 6 years when assessing their learners; 20% indicated that they have been using technology for 7-8 years while 30% indicated to 9-10 years. Some teachers elaborated to justify the duration of usage of technology for assessment. For example Teacher 10 responded as follow:

I started using technology for assessing my learners in 2009 at previous school when it was equipped with 8 computers at the time and they were all connected to the internet. That is how we get started because we had resources at hand.

Question 7: *You have indicated that, to some extent, you use technology when assessing Grade 10 Physical Science learners. What applications do you use and how exactly do you use it?*

Table 4. 9: Verbatim transcripts on applications used for assessment administration

Respondent	Response
Teacher 1	Applications like <i>MS Excel</i> for recording marks, compiling marks for awards; making progress report cards, <i>MS PowerPoint</i> for presentations, <i>Ms Word</i> for typing notes and assessment activities, <i>internet</i> for downloading and PDF (portable document file) for snapshotting difficult images.
Teacher 2	I use like <i>google chrome</i> for searching on the internet, <i>Microsoft Word</i> for typing and <i>Excel</i> for recording marks.
Teacher 3	Typing their activities and their tests, examinations and also using U-Tube videos from internet to support my presentations. I have a problem to specify the exact types of applications, as I indicated I'm still learning. I use <i>Word</i> for typing and internet to download u tube videos.
Teacher 4	I use <i>Excel</i> for assessment sheets. At one point my subject advisor gave me a soft copy in excel, and I also managed to set my own formulas in Excel to calculate continuous assessment marks. In addition, all the topic tasks and other activities that I give are computerised -typed in words- and printed to make copies. At my current school, my learners have no access to computer lab and we do not have electricity at our school so we cannot use projectors. But, I normally charge my laptop at home, and display to my learners on the laptop screen.
Teacher 5	No specific application but just type a word then information google up that lead to what I really want, example to get information about isotopes.
Teacher 6	<i>Microsoft Word</i> and <i>Excel</i> for typing and to record learners' marks and set their activities.

Teacher 7	I use Microsoft Word for typing tasks, tests and assignments and examinations. I use Microsoft Excel to prepare progress report cards at the end of the term.
Teacher 8	I use Microsoft PowerPoint for presentation, Word for typing and Mozilla Firefox to browse on the internet.
Teacher 9	I use Google to get information online, and MS word for typing, I also use PowerPoint to display pictures sometimes.
Teacher 10	I use <u>internet to receive documents</u> through emails, WhatsApp and for googling. For typing, I use MS Word and Excel for recording marks and issuing progress report cards. For <u>presentations</u> , I use PowerPoint .

Some participants could not specify the applications they use when administering Physical Science assessment, this is shown by for example the response of Teacher 3;

....I have a problem to specify the exact types of applications, as I indicated I'm still learning. I use Word for typing, and internet to download YouTube videos.

The following applications emerged from teachers' responses;

- Microsoft Word for typing assessment activities
- Microsoft Excel for recording assessment marks
- Microsoft PowerPoint for displaying diagrams and other content on a projector
- Google Chrome and Mozilla Firefox to browse on internet (search information, download videos, share assessment activities with others on social media)

Teachers' use of computer for assessment is limited to the use of Microsoft Office Suite applications and browsing with Google and Mozilla Firefox.

Question 8: *What motivated you to start using technology for assessment?*

Interviewed participants pointed out different factors that motivated them to start using technology for assessment. These were:

- There are more benefits when using computers compared to manual work. This clearly emerged from responses that link computerised work to neatness, fastness and more efficiency. This motivated some teachers to learn and start using computers when assessing learners.
- Some teachers were inspired by other colleagues' ways of applying technology. For example Teacher 10 said:

I was really motivated by two young teachers whose lessons I observed during holiday classes which was organised by my region in 2010. They used technology during teaching and assessment in their classes. I was impressed by their ways of preparation of notes, topic tasks, tests and practical investigations. Well typed materials were neat and clear.

- Availability of facilities. Some teachers indicated that they were motivated to use technology when assessing Physical Science learners after their schools were provided with computers and other equipment.

4.4.3 Triangulation of findings

Teachers' responses in the survey showed that their learners relied on textbooks and teachers' notes to do assessment activities. Very few teachers (less than 20%) indicated that their learners also use internet searches and Microsoft Office Suite applications when doing assessment activities. This is in agreement with data presented in Table 4.3 indicating that the majority of learners had no access to computer as their schools had no computer laboratories.

Teachers indicated in the survey that they mainly use computers for typing learners' assessment work, and for searching for information needed to set up assessment activities. According to teachers' responses, many of them "never" gave their learners internet based assessment activities such as CAT, computer - based simulations and online quizzes. This is in agreement with data

presented in Table 4.6 that most of the learners never use computers to do assessment activities. This could be because they had no access to computer laboratories in schools.

During interviews, teachers indicated that they were not trained on using assessment for technology. Some of them indicated that they learned using technologies on their own. This explain their limited usage of technology for assessment. Teachers confirmed the information obtained from survey, that they mainly used computers when preparing for assessment of their learners compared to other technological devices. However, all interviewed participants indicated that they were in possession of mobile phones (smart phones) that they use mainly to communicate with others and share assessment activities and also to search information on the internet.

While most participants (90%) interviewed ranked their technological knowledge as intermediate or advanced, their responses to the types of application they use indicate the opposite. The majority could not clearly specify the technological names of the applications they used for assessment. However, it emerged from both the surveys and interviews that Physical Science teachers in the Ohangwena region mainly use Microsoft Office Suite desktop applications (Word, Excel and PowerPoint) and two search engines (Google Chrome and Mozilla Firefox) to browse on internet.

4.5 Teachers' views on the use of technology for assessment in Physical Science

4.5.1 Findings from survey (Quantitative)

PART C - question 3 on the survey required participants to indicate their views on the role of technology for assessing Physical Science.

Question C3: Please indicate your stand on the following statements:

Teachers were asked to indicate whether they strongly agree, agree, disagree or do not know next to each statement (see the first column of Table 4.10).

Table 4. 10: Teachers' views on the role of technology for assessment (in counts)

	Strongly agree	Agree	Disagree	Do not know
Using technology can ease assessment	46 (49.4%)	42 (45.2%)	1 (1.1%)	4 (4.3%)
Using technology is a good way to support Physical Science learning	48 (51.6%)	43 (46.2%)	0 (0.0%)	2 (2.2%)
Using technology results in better performance of learners	30 (32.3%)	49 (52.7%)	0 (0.0%)	14 (15.0%)
Using technology in assessments prepares learners for examinations better	36 (38.7%)	53 (57.0%)	1(1.1%)	3 (3.2%)
Using technology is not appropriate for assessment, because it makes it more challenging	2 (2.2%)	5 (5.4%)	75(80.6%)	11 (11.8%)
Using technology for assessment can confuse learners as they have to deal with technology	1 (1.1%)	9 (9.7%)	67(72.0%)	16 (17.2%)
Using games for assessment is good way to assess content	14 (15.1%)	47 (50.5%)	18(19.4%)	14 (15.1%)
Physical Science does not lend itself easily to technology	2 (2.2%)	7 (7.5%)	65 (69.9%)	19 (20.4%)
I think e- portfolio is a wonderful assessment technique	12 (12.9%)	23 (24.7%)	7 (7.5%)	51 (54.8%)
I do not believe multiple choice is really testing knowledge	5 (5.4%)	10 (10.8%)	74 (79.6%)	4 (4.3%)

Although the majority of teachers indicated that their learners did not have access to computers (Table 4.3) and that they never used computers for different assessment purposes (Table 4.6), a significant number (85%) agreed the use technology when assessing learners would result in better performance. Teachers (95.7%) also agreed that using technology in assessments prepares learners for examinations better than traditional methods alone. Similarly, 94.6% of teachers agreed that the use of technology could ease assessment in Physical Science.

In agreement with their responses presented in Table 4.5, participants indicated that they were not familiar with internet based assessment tools. The majority (54.8%) responded that they did not know whether e-portfolio is a wonderful assessment technique for Physical Science or not.

4.5.2 Findings from interview (Qualitative)

Questions 10 and 11 in the interview sought teachers' views of the advantages and disadvantages of using technology to assess Grade 10 Physical Science.

Question 10: *In your view, what are the advantages of using technology when assessing the learners?*

A wide range of views were given on the advantages of using technology for assessment in Physical Science. However, some participants focused on the general use of computers only. Verbatim transcripts for participants are shown in Table 4.11.

Table 4. 11: Teachers' views on the advantages of using technology for assessment

Respondent	Main points	Verbatim transcript
<i>Teacher 1</i>	<i>Subject became more interesting to learners and motivate them to perform</i>	<i>The use of computers...well, I can abbreviate it as ABC; which is A- accessibility, B-boredom chasing and C-curiosity. Learners are always curious to see things that they have never seen, for example watching an experiment can help them to answer practical investigations easily. The subject became more interesting and motivate them to perform in the subject.</i>
<i>Teacher 2</i>	<i>Fast, reliable and effective</i>	<i>The advantage is that it is very fast reliable and effective, example when recording (calculating averages and typing)</i>
<i>Teacher 3</i>	<i>Information stored, easy to find, clean ad clear work</i>	<i>Information is stored and became easy to find when needed, and assessment activities look clean and clear with corrected spellings, and more interesting when typed.</i>
<i>Teacher 4</i>	<i>Formal and clean work</i>	<i>A lot of advantages, activities look formal and clean, easy to edit and can easily be retrieved when saved.</i>
<i>Teacher 5</i>	<i>Quick, retrieve information</i>	<i>It is quick, I can retrieve stored information and at same time store information for future use.</i>
<i>Teacher 6</i>	<i>Access quality work, clear than handwritten work, pictures clearer</i>	<i>Technology enables teacher to assess quality work and typed work is clear than handwritten work. Computers</i>

		<i>makes graphs, maps and pictures clearer, easier and possible to illustrate.</i>
<i>Teacher 7</i>	<i>Fast, information always available, get info from distant person</i>	<i>The advantages are; it is fast, information is always available especially with stable internet. You can get assessment activities from a distant person within a short time e.g from sharing on WhatsApp groups and e-mails</i>
<i>Teacher 8</i>	<i>Information, search, internet</i>	<i>The advantage of using technology, one, if we are to use technology, learners get more information as they search on internet making it easier for revision instead of depending entirely on the teachers' notes and textbooks.</i>
<i>Teacher 9</i>	<i>Save time, easy, access to info, well typed=neat</i>	<i>As I said, technology save time and sometimes there is easy access to information, like past examination question papers and tasks set by experts. It makes it is easy to come up with well typed quality question papers.</i>
<i>Teacher 10</i>	<i>Saves time, modify and edit, fast, neat</i>	<i>Technology saves time,.... like we can easily modify and edit assessment tasks, recording of marks is so fast, even on presentations, time is really save. It can also make our work easy and look attractive and neat. It makes lessons and assessment activities interesting to learners and in a way motivate them to do better.</i>

Emerging themes:

A number of advantages emerged. However, participants focused more on the use of computers for typing assessment activities and searching related information on the internet. Some participants indicated that using technology to assess learners is fast, reliable and effective compared to manual work. It also emerged that computerised work like typed topic tasks and practical investigation questions appear neat and clearer to learners compared to handwritten instructions. This, according to teachers, make the subject interesting and motivates learners to perform in an assessment activity.

On their own side, participants indicated that using computers to prepare assessment activities save them time as they can easily retrieve old tests/activities and edit instead of starting over with a new one. They also indicated that access to internet enabled them to share assessment activities with other through emails and social media platforms. Another advantage given was that when setting

up an activity, information such as past examination question papers could easily be accessible by searching and downloading from the internet. This improved the quality of the assessment activities they set.

***Question 11:** In your view, what are the disadvantages of using technology when assessing the learners?*

Some teachers gave the disadvantages of computers and technology in general rather than focusing on technologies related to assessment. For instance Teacher 7 responded as follows:

Sometimes technology can fail people. If there is no electricity there is no much you can do, sometimes the computer can crash due to viruses and information can disappear.

Others pointed out disadvantages related to preparing assessment activities using Microsoft Office suite applications and internet. Some participants such as Teacher 8 indicated that if learners are allowed to search on the internet unsupervised, they tend to get distracted by following social networks and other webpages instead of searching for subject information on the internet

When learners are using internet they tend to get distracted and end up Facebooking instead of searching for subject related information when not well supervised.

Participants also pointed out that learners with poor computer background find it difficult to understand videos and take time to follow if assessment is based on internet downloaded video presentations. In addition, they said, stored information could easily be lost when the computers are infected by viruses or when it is accidentally deleted especially because they did not have all skills needed to backup information and protect computers. Some participants shared that the use of technology heavily rely on electricity and they found it impossible to use technology when the power is off in areas where power outage is frequent. Some teachers acknowledged that while they saw potential improvement of assessment outcome in sharing assessment activities with others,

sharing pre-set assessment activities promotes laziness and increased plagiarism, as teachers tend to rely more on ready-made activities than coming up with their own activities.

4.5.3 *Triangulation of findings*

Data obtained from surveys show that teachers are of the opinion that using technology when assessing learners would result in better performance of learners. In addition they agreed that using technology in assessments prepares learners for examinations better than traditional methods alone. Similarly, they agreed that the use of technology could ease assessment in Physical Science.

Interviewees were asked their views on the advantages and disadvantages of assessment. They pointed out a number of advantages. As they have indicated in the survey, they said typed assessment activities encourage learners to like the subject and believed that it improved the way they approached questions when the questions are clear and diagrams look presentable. Participants also indicated that using computers to prepare assessment activities save them time as they can easily retrieve old tests/activities and edit instead of starting over with a new one. They also indicated that access to internet enabled them to download past examination question papers and it allows them to share assessment activities with other through emails and social media platforms that improves the quality of the assessment activities they give to learners.

4.6 Challenges encountered by Physical Science teachers in using technology for assessment administration

4.6.1 *Findings from survey (Quantitative)*

This research sub-question was addressed under PART C – questions 4(a) and (b) on the survey.

Question C4 (a): *Have you ever received training related to using computer applications for assessment? If yes, indicate in the space - the kinds of training you received.*

Many teachers (75.3%) indicated that they never received training in either general use of computers or the use of technology for assessment. Those that indicated that they received training in technology for assessment wrote down more general courses such as training in Microsoft Office Suite applications, ICDL, Computer literacy and computer studies. None of the participants indicated that they received training in using technology for assessment in Physical Science or in using online based assessment tools. This information can be linked to the poor utilisation of some technology for assessment listed in tables 4.5 and 4.6.

Question C4(b): *This question is based on the training you have mentioned in 4a) above. If your answer is No, please skip this question.*

Fewer participants indicated that they received training in basic computer skills. They indicated that they found it useful and recommended more trainings on computers and also trainings related to technology platforms for assessment.

4.6.2 Findings from interview (Qualitative)

On the problems experienced, participants pointed out lack of equipment as the main problem. This included unavailability of computer laboratories in schools which prevent them to give computer based activities to learners, shared equipment such as projectors and desktop computers, and unstable or no WiFi internet connection. Some teachers also identified computer viruses as challenge because it could damage their computer software, and in the process lose their assessment files. Unreliable power (electricity supply) was also one of the identified problems experienced in Ohangwena schools. On the other hand, teachers indicated that they were

challenged and face problems when they wanted to use some applications such as Excel and advanced MS Word features such as inserting scientific symbols into a text.

While some teachers felt like there was nothing they could do about power failure, some determined teachers like Teacher 4 indicated that he had to charge his computer at home and take it to school to ensure that his learners were not disadvantaged from the use of technology, especially if he had to display videos.

....I normally charge my laptop at home, and display to my learners on the laptop screen.

To overcome the problems and challenges related to computer viruses, teachers responded that they used backups to ensure that their information was not lost. Surprisingly, none of the participants mentioned the use of antiviruses.

Participants indicated that they approach fellow technology skilled teachers for help when they get stuck with the use of technology. This is an indication of teamwork among staff members. Teachers also indicated that they at times get equipment and help from other schools, for instance printers and scanners. Others indicated that they always improvise to come up with alternatives or at times resort to traditional ways of handling assessment.

4.6.3 Triangulation of findings

In the quantitative phase, teachers indicated that they were never trained in the use of technologies for assessment. As a result, interviewed participants said they faced challenges and problems when using applications such as Excel and advanced use of MS Word due to a lack of skills. This could also be the reason why their use of technology is restricted to desktop applications, social media and searching for pre-prepared activities on the internet. A few participants indicated in the surveys that they were trained in computer skills and in their views, they need to be trained in assessment

related technologies. Interviewed participants (qualitative phase), also cited the same problems of lack of equipment in schools. Computer virus attacks and outdated software also surfaced as challenges. Frequent power outages or non-electrification at some schools challenged teachers when using technologies for assessment.

4.7 Summary of findings

This chapter presented data collected using surveys and interviews. Data was presented and analysed using both qualitative and quantitative methods. It was presented per research question, with qualitative data presented and then quantitative data. Triangulation was used to combine the findings from the two research approaches. For quantitative data, information was presented in graphs and tables while for qualitative data verbatim transcripts were translated into emerging themes and summarised. The next chapter interprets the findings, recommendations and conclusion.

CHAPTER 5: INTERPRETATION OF DATA AND DISCUSSIONS ON FINDINGS

5.1 Introduction

Chapter 4 presented findings from surveys and interviews. It started with the presentation of general information about participants to understand their background. Quantitative and qualitative data were grouped and presented consecutively per research sub-question. This chapter will interpret data obtained from 93 surveys and 10 interviews as presented in chapter 4 by discussing each findings against the existing literature and to draw meaning. All participants were qualified Physical Science teachers teaching Grade 10 Physical Science in the Ohangwena Region. Interview participants were sampled from the population of teachers who participated in the survey.

5.2 Accessibility of technology for assessment

Data from surveys revealed that learners at most of the schools (74%) had no access to computers due to unavailability of computer laboratories. This means teachers at these schools could not give computer based assessment activities to individual learners. Only 24 participants out of 93 indicated that their schools are equipped with computer laboratories. Furthermore, statistics showed for the few schools that were said to have computer laboratories (24 schools), on average, 27% of the computers in the laboratories were not functional, 39% of computers were functional but not connected to internet and only 34% were functional and connected to internet. Teachers who indicated internet connection in their school laboratories were mainly those that were teaching at Millenium Challenge Account (MCA)-funded schools. MCA-Namibia, in collaboration with the Ministry of Education funded computer laboratories at 10 schools in the Ohangwena Region in the year 2010, as part of a project aimed at improving the quality of education in Namibia (MCA Namibia, 2014). This means that many learners in the Ohangwena region had no access to internet

and teachers could not give computer and internet based assessment activities such Computer Adapted Testing (CAT) and online quizzes due to unavailability of equipped computer laboratories. The situation of lack of technological equipment is still prevalent as it was concluded by Simon & Ngololo (2015). Simon and Ngololo (2015) conducted a study on the use of ICT in teaching Life Science in Khomas region, and found that many schools in Khomas region reported lack of technological equipment.

Chisholm, Dhunpath & Paterson (2004) compared the unavailability of technological facilities in Namibia to Botswana and Seychelles. In all countries it was found that there were unreliable internet connections that limited accessibility of free-ware off the internet that could remedy the shortage of software applications in rural schools.

Research data also showed that, contrary to the case of their learners, teachers had access to some technological devices that they used to prepare learners' assessment. Data collected from surveys and interviews corresponded in terms of technological devices accessible to participants. In both cases, almost all (93%) teachers indicated that they had access to portable mobile devices enabling them to access internet. They also indicated that they had access to either a school computer or personal laptop and useful computer peripherals such printers and projectors. This means that teachers could use computers to prepare for assessment but many were not able to give computer based tasks to their learners. In isolated cases, a small number of participants indicated that they use projectors to allow learners to visualize displayed questions, images and videos related to assessment activities. Teachers also indicated that they had access to internet through school-funded WiFi or self-funded data package.

5.3 Usage of technology for assessment

Presented results revealed that traditional pen and paper assessment activities were still prevalent in schools. Although teachers used to type tests and other activities using a computer, they had to print them out for learners to answer in pen. It was found that Physical Science teachers in the Oshana Region were not giving computer based assessment to their learners. This could be because many schools had no functional laboratories and depriving learners of access to computers. This is similar to the conclusion made by Chisholm, Dhunpath, & Paterson (2004) who concluded that assessment practices in Namibia was linked to traditional teaching styles whereby traditional tests focusing on the individual level tend to predominate. Assessment had received relatively little attention from the governments compared to basic access issues.

Similarly, this research found that textbooks and teachers' printed notes were still the resources used mostly by learners to do assessment activities in schools as indicated by 90 (96.8%) teachers. Over a decade ago, Luben et al., (2003), also found that textbooks played a major role in Science classrooms in Namibian schools. It was found that textbooks were used for diagrams, to verify factual information, and their questions were used as homework to test knowledge (Lubben et al., 2003).

Comparing to other technologies, internet search was the technology most used by learners (18%) to do Physical Science assessment activities. Teachers indicated that other listed technologies such as Microsoft Word and spreadsheet, computer based software and online presentations were rarely used. This finding was expected because preceding data presentation showed that many learners had no access to computers and internet. In another survey item (question), teachers confirmed that most of their learners never used computers to do assessment activities. Fewer teachers (4.3%) indicated that their learners used computers to type assessment activities such as homework and

practical investigations. Teachers maintained in their responses that only a small number of their learners (6.5%) use computers to retrieve information from internet to do assessment activities, and 3.2% indicated that learners use computers to discuss assessment activities with others online through social media. None of the teachers indicated that their learners use computers to do assessment activities on a daily basis.

On the other hand, teachers indicated in the survey that they mainly use computers for typing learners' assessment work using Microsoft Word, for recording learners' marks using Microsoft Excel and searching for information needed to set up assessment activities. Race (2009) argues that teachers have a wide range of choices to use technology to reduce the burden in assessing Physical Science: teachers can use spreadsheets to produce assessment records, to keep marks on a grid on a computer, and to keep backups of their files on disks for future references.

According to teachers' responses, many of them "never" gave their learners internet based assessment activities such as CAT, computer - based simulations and online quizzes. This explained why learners never did computer based assessment activities.

During interviews, teachers indicated that they were not trained on using technology for assessment or computers in general. As a result, they learned to use technology for assessment in different ways on their own. Despite that, their responses to the types of application they use for assessment indicated that they have little knowledge about computers and technology as they were unable to specify application names correctly. It emerged from both the surveys and interviews that the majority of Physical Science teachers in the Ohangwena region mainly use Microsoft Office package applications and internet searches to prepare assessment tasks such as topic tasks and tests.

5.4 Teachers' views on the use of technology for assessment in Physical Science

While the majority of teachers' responses showed that they were not familiar with many technologies for assessment, in their views, the correct use of technology for assessment would result in better performance of learners in the subject. In addition, the majority (95.7%) agreed that using technology in assessments prepare learners for examinations better than the traditional methods alone. Most of teachers (94.6%) were of the opinion that the use of technology would ease assessment in Physical Science.

From the interviews, some teachers pointed out the disadvantages of computers and technology in general rather than focusing on technologies related to assessment. This indicated that some of them were not familiar with the concept of technology for assessment. A number of disadvantages related to preparing assessment activities using Microsoft Office Suite applications and internet searches emerged. Very few participants related the disadvantages of technology for assessment to the usage by learners. In the teachers' views, learners with poor computer background found it difficult and took time to understand internet extracted materials such as videos and to search for internet based resources to do assessment tasks such as homework. Majority of interviewed teachers complained that their stored information used to get lost due to computer virus attacks and accidental deletion due to limited skills. As a disadvantage, some participants shared that the use of technology heavily relied on electricity, making it impossible to use computers for assessment in cases of power outage. This is a general disadvantage for all types of technologies.

From the teachers' perspectives, the use of internet searches by teachers to retrieve, download or share pre-set assessment activities with others promoted laziness and increased plagiarism, as teachers tend to rely more on ready-made activities than coming up with their own. This was also

the argument of Chisholm et al. (2004) that in Namibia, few teachers were engaged in the development of their own teaching and assessment materials and there was minimal servicing of school level software needs in Namibian schools. This means that the situation has still not improved. However, at the time, contrary to the current findings, Chisholm et al. concluded that teachers in rural areas had no access to internet. This research found that most of the teachers had access to internet either through mobile smartphones or school funded WiFi's.

5.5 Challenges encountered by Physical Science teachers in using technology for assessment administration

In the quantitative phase, teachers indicated that they were never trained in technologies for assessment. As a result, interviewed participants said they faced challenges and problems when using applications such as Excel and advanced use of MS Word due to a lack of skills. This could also be the reason why their use of technology is restricted to desktop applications, social media and searching for pre-prepared activities on the internet. Few participants indicated in the surveys that they received minimal training in computer on different platforms, and in their view, they need further training in the use of technology for assessment.

To overcome the problems and challenges related to computer viruses, teachers responded that they used backups to ensure that their information was not lost. None of the participants mentioned the use of antiviruses to protect computers from virus and malware attacks.

With regard to challenges related to poor skills in technology, participants indicated that most of the times they relied more on experienced colleagues for assistance. Teachers also indicated that neighbouring schools were always ready to share technological devices such as projectors, making it easy for them to borrow when they had a shortage. When they got out of options to solutions to

overcome technological challenges, participants indicated that they had to use manual work for example writing test questions on the chalkboard.

Race (2009) argues that teachers can easily obtain technological advice within their schools as there is always a colleague or administrative staff who is good at technology and in most cases willing to help. In addition, Race (2009) advises that teachers should make use of partners, friends and even young children to help them to verify assessment marks such as checking for addition of marks, and help to record the data to ease their assessment related loads.

5.6 Summary

This chapter discussed the findings of the study and related it to existing literature. Findings were clustered according to research questions to come up with an interpretation of and a link to the research question. This research found that to some extent teachers use technologies when assessing Grade 10 Physical Science. In their views, teachers believed that technologies for assessment can improve the performance of learners in Physical Science. A number of challenges were identified as mitigating full utilization of available technologies for assessing Physical Science. The following chapter, Chapter 6, will summarize the findings and give the conclusion of the study. Recommendations based on the research findings will also be given in Chapter 6.

CHAPTER 6: RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

The preceding chapters 1- 5 discussed the procedures followed to determine the role of technology in learners' assessment in Grade 10 Physical Science in the Ohangwena Region. Chapter 1 outlined the orientation of the study that lead to the statement of the research problem and research questions. The main research question addressed by this research was: What is the role of technology in the administration of JSC Grade 10 Physical Science assessment? This study is significant to educational stakeholders concerned about the improvement of assessment in Physical Science, and the involvement of technology thereof. The chapter ended with spelling out the limitations, delimitations of study, and definition of terms. Chapter 2 discussed the related literature and conceptual framework. The study was based on the concept of a paradigm shift from the traditional methods of assessment to the usage of technology as we assess technologically exposed 21st century learners. Then chapter 3 described the research design employed in the study. The study followed a sequential explanatory mixed method design. In chapters and 4-5 data was presented, analysed and interpreted through discussions linking them to related existing literature findings.

This closing chapter summarises research findings, by explicitly pointing out the answers to the main research question. This chapter further gives recommendations that emerges from research findings.

6.2 Summary of findings

This study concluded that most of the Physical Science teachers in the Ohangwena region find it difficult to use technology for assessment as their schools have no functional computers and for those that have, very few are connected to the internet, making technology less accessible to both

teachers and learners. However the views for the fewer teachers who use technology for assessment is that technology plays an important role in improving learners' assessment activities in Grade 10 Physical Science by improving quality and quantity of assessment activities given to learners. Teachers' responses in the surveys and interviews indicated that they use the following technologies for assessment:

1. Microsoft Word application to type topic tasks, tests, practical investigations and other written assessment activities. Typed assessment activities looks neat and presentable and, in a way motivating learners to answer questions with confidence. Unlike manual work, MS Word allows teachers to use sophisticated options such as to insert symbols and pictures. Although some participants indicated that they encountered challenges when using Microsoft Word, this application dominated in almost all responses as a useful tool. Teachers also indicated that it is easy and quick to edit stored typed activities and give it to learners, thereby increasing the frequency of amount of work given to learners.
2. Microsoft Excel was identified as useful tool for compiling continuous assessment marks and generating report cards. In addition, some participants indicated that their learners use Excel to draw graphs when doing practical investigations.
3. Teachers indicated that they used Microsoft PowerPoint along with projectors to display classwork questions involving images and videos.
4. The study further revealed that internet, though not accessible to learners, plays an important role in preparing assessment activities. Teachers indicated that they use internet to share pre-set activities with others, to download past national examination papers and to access information needed to set up quality assessment activities.

5. Though not in practice, in their views, teachers thought that internet based and computer based assessment activities such as CAT and simulations have the potential to improve assessment in Grade 10 Physical Science.

The use of technology for learners' assessments by Grade 10 Physical Science teachers in the Ohangwena Region were limited to the use of Microsoft Office Suite desktop applications (Word, Excel and PowerPoint) for typing and compiling activities and assessment marks, and internet for sharing assessment activities with fellow teachers as well as downloading pre-set activities and searching related information.

The study further established that teachers and learners were faced with a number of challenges related to the use of technology for assessment. In the first place, it was found that the majority of learners in the Ohangwena Region had no access to technological facilities such as functional computer laboratories. This challenge made it impossible for teachers to give computer based assessment to their learners. However, it was interesting to note that some teachers had come up with initiatives to overcome this challenge. During interviews two teachers indicated that they used initiatives such as displaying content on the screen using the projector and gave learners chances to answer displayed questions by allowing one learner to control the computer at a time. In the second place, it was established that Physical Science teachers never received training nor were they formally introduced to the use of technology for assessment, hence it was found that they had limited skills in computer and technology.

6.3 Recommendations

This research recommends that the Ministry of Education, Arts and Culture should provide functional computer laboratories to schools so that learners have access to computers and internet.

It is also recommended that Senior Education Officers and other subject advisors should introduce Physical Science teachers to different types of technologies suitable for assessment in Grade 10 Physical Science, and provide in-service training to improve their technological skills.

The researcher recommends that other researchers should look at the following:

1. There is a need to conduct similar researches in other regions to come up with a conclusive findings about the role of technology in Physical Science assessment in Namibia.
2. There is also a need to conduct a research on available technologies to improve learners' assessment activities in different subjects.
3. This research focused on teachers as participants. It is recommended that in future similar research should involve learners to get their perspective.

6.4 Conclusion

This study addressed the following question: What is the role of technology in the administration of JSC Grade 10 Physical Science assessments? This question was split into three sub questions:

1. Which technologies do the Physical Science teachers in the Ohangwena region currently use for assessment?
2. How do teachers apply technology in assessing Grade 10 Physical Science?
3. What are the views of the Ohangwena Region Physical Science teachers on the use of technology for assessment in Physical Science?
4. What challenges do the Ohangwena Region Physical Science teachers encounter in using technology for assessment administration?

This research concluded that three Microsoft Office Applications (Word, Excel and PowerPoint) and the internet plays an important role in setting up quality assessment activities, giving more

work to learners, recording marks and sharing activities among Grade 10 Physical Science teachers. From surveys and interviews, teachers indicated that they face two major challenges: unavailability of computers and internet at schools and lack of technological skills among teachers.

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8 APPENDICES

8.1 APPENDIX A: SURVEY

SURVEY (to be completed by JS Physical Science Teachers)

Dear participant,

My name is Maria Nendongo, a Master of Education (Educational Technology) student at the University of Namibia. This survey aims at collecting information about **THE ROLE OF TECHNOLOGY IN LEARNERS' ASSESSMENT ACTIVITIES IN GRADE 10 PHYSICAL SCIENCE IN THE OHANGWENA REGION, NAMIBIA.**

Please answer the survey with honesty as this will help the researcher to get in-depth information about the topic and will also give the accurate information needed to support Physical Science teachers in the region.

Write your school's name and Circuit on the space provided under background information. Due to confidentiality, you are not required to write your name on this survey.

PART A: BACKGROUND INFORMATION

1. Name of School
2. Circuit Name

Where there is a choice, please tick ✓ as appropriate

3. a) Gender: Male Female

b) Experience in teaching Grade 10 Physical Science (in years)

0-2 years	3-4 years	5-6 years	7-8 years	9 years plus
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c) Highest qualification (equivalent):

B.ED	B.Ed	B.Ed (Hons)	M.Ed	Ph.D
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PART B: CLOSED QUESTIONS

Tick as appropriate.

1. What technology or (mobile) devices do you have access to? [Tick as many as apply]

A. Desktop computer

B. Laptop

C. Tablet

D. Cell phone

E. None

2. Do you have access to the Internet? If yes or sometimes, please indicate how you access it and whether it is private or school funded

A. Yes

B. No

C. Sometimes

accessed through (Data package, ASDL/LAN or WiFi) _____

Funded by (self, school or other- specify) _____

3. Do you have a functional computer laboratory at your school? If yes, indicate how many computers are working and how many are not working and the total number.

A. Yes

B. No

Total Number of computers in the laboratory: _____

Total number Functional but not connected to internet _____

Total number Functional and connected to Internet _____

Total number **not** functional _____

4. Which assessment activities do you give to your learners? (you may tick more than one option)

A. Written tests and tasks

B. Practical investigations

C. Verbal presentations

D. Examination

5. Which resources do your learners use to answer the above mentioned assessment activities you give? (tick as many as appropriate)

A. Textbooks

B. Teachers' notes

C. Internet search

- D. Presentation (Powerpoint) application
- E. Word application
- F. Spreadsheet application
- G. Others (specify) _____

PART C: LIKERT SCALE QUESTIONS

1. How often do you (as a teacher) use computers for the following purpose (please tick next to each statement).

	<i>Daily basis</i>	<i>Most of the times</i>	<i>Sometimes</i>	<i>Never</i>
Typing written assessment tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Searching subject content information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computer-adapted testing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computer-based simulations (PhET simulations)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Giving learners Online quizzes/activities (Hot potato, Edmodo, moodle etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping records of written activities' marks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Issuing of progress reports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. How often do your learners use computers for the following purposes (please tick)?

	<i>Daily basis</i>	<i>Most of the times</i>	<i>Sometimes</i>	<i>Never</i>
Typing assignments, spreadsheets and presentations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Searching for subject content information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
For Computer-adapted testing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watch Computer-based simulations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sharing information with others online (e.g via emails and group chats)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Social media (Facebook, WhatsApp, twitter, Instagram etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Please indicate your stand on the following statements;

	<i>Strongly agree</i>	<i>Agree</i>	<i>disagree</i>	<i>Do not know</i>
3.1 Using technology can ease assessment in Physical Science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 Using technology is a good way to support Physical Science learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.3 Using technology results in better performance of learners

3.4 Using technology in assessments prepares learners better to be ready for assessment activities

3.5 Using technology is not appropriate for assessment, because it makes it more challenging

3.6 Using technology for assessment can confuse the learner as they have to deal with technology in addition the content that they have to learn

Using Games for assessment is good way to assess content

Physical Science does not lend itself easily to technology assessment

I think e-portfolio is a wonderful assessment technique

I do not believe multiple choice is really testing knowledge

4. a) Have you ever received training related to using computer applications for assessment?

If yes, indicate in the space - the kinds of training you received.

Yes

No

b) This question is based on the training you have mentioned in 4a) above. If your answer is No, please skip this question.

(Please tick as apply).

	<i>Strongly agree</i>	<i>Agree</i>	<i>disagree</i>	<i>Do not know</i>
The training(s) received were very helpful and enhanced my understanding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I need more trainings related to technology platforms for assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

APPENDIX B: SEMI-STRUCTURED INTERVIEWS

QUESTION	ANSWERS/NOTES
1. How long have you been interested in technology for your personal use?	
2. Can you please share, how you learned and how you started using technology?	
3. How do you rank your computer/technological knowledge? Motivate your answer.	
4. Briefly tell me about the type of technological devices you have access to?	
5. In general what specific use do you have for such devices?	
6. How long have you been using technology for assessing your learners?	
7. You have indicated that, to some extent, you use technology when assessing Grade 10 Physical Science learners. What applications do you use and how exactly do you use it?	
8. What motivated you to start using technology for assessment?	

9. What problems do you experience, if any, in preparing for assessment using technology?	
10. In your view, what are the advantages of using technology when assessing the learners?	
11. In your view, what are the disadvantages of using technology when assessing the learners?	
12. What challenges do you encounter in using technology for assessment administration?	
13. How do you overcome the above challenges?	
14. What assistance do you need to overcome the challenges?	

APPENDIX C: ETHICAL CLEARANCE



ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: FOF/158/2016

Date: 9 December, 2016

This Ethical Clearance Certificate is issued by the University of Namibia Research Ethics Committee (UREC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the Faculty/Centre/Campus Research & Publications Committee sitting with the Postgraduate Studies Committee.

Title of Project: The Role of Technology in Learners' Assessment in Activities in Grade 10 Physical Science Teachers in the Ohangwena Region

Nature/Level of Project: Masters

Researcher: M. N. Nendongo

Student Number: 200015621

Faculty: Faculty of Education

Supervisors: Dr. D. Wolfaardt (Main) Dr. P. Boer (Co)

Take note of the following:

- (a) Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the UREC. An application to make amendments may be necessary.
- (b) Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the UREC.
- (c) The Principal Researcher must report issues of ethical compliance to the UREC (through the Chairperson of the Faculty/Centre/Campus Research & Publications Committee) at the end of the Project or as may be requested by UREC.
- (d) The UREC retains the right to:
 - (i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,
 - (ii) Request for an ethical compliance report at any point during the course of the research.

UREC wishes you the best in your research.

Prof. P. Odonkor: UREC Chairperson

A handwritten signature in black ink, appearing to be "P. Odonkor", written over a horizontal line.

Ms. P. Claassen: UREC Secretary

A handwritten signature in black ink, appearing to be "P. Claassen", written over a horizontal line.

APPENDIX D: DIRECTOR'S PERMISSION



**OHANGWENA REGIONAL COUNCIL
DIRECTORATE OF EDUCATION, ARTS AND CULTURE
DIRECTOR'S OFFICE**

1st Floor Greenwell Complex, Private Bag 88005 Eenhana Tel: 065 – 290 201 Fax: 065 -290 224

Enquiries: Magano Gaoses
Email: mcnotto@yahoo.com
Reference: 12/3/10/1

27 March 2017

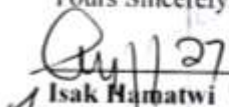
To: Ms. Maria Nendongo
Cell: 0812928092

Dear Ms. Nendongo,

**SUBJECT: PERMISSION TO CONDUCT EDUCATIONAL RESEARCH AT
SCHOOLS AND OFFERING JUNIOR SECONDARY PHYSICAL
SCIENCE WITHIN THE REGION.**

1. Receipt of your letter on the above subject matter is hereby acknowledged.
2. The request has been evaluated and found to have merit.
3. Kindly be informed that permission to conduct research has been granted under the following conditions and requests.
 - The data to be collected must only be used for completion of your studies.
 - It remains your responsibility to liaise with the school principals, so as to make prior arrangements with them before the date of the research.
 - No other data should be collected other than the data stated in the request.
 - The process of teaching and learning should not be hindered in any way at any school.
 - You should share the final report of your study with the directorate.
4. It is trusted that you find this arrangement in order.

Yours Sincerely,


Isak Hamatwi
Director: MoEAC
Ohangwena Region

27/03/2017
27 MAR 2017

APPENDIX E: PRINCIPALS' CONSENT

MN Nendongo (Ms.)
P.O.Box 2437
Ondangwa
msnendongo@yahoo.com
11 April 2017

To:
All JS school Principals
Ohangwena Directorate of Education, Arts and Culture
Att: **All Physical Science teachers (grades 8-10)**

Dear Sir/ Madam

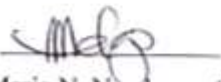
Subject: Academic Research Questionnaire -Educational Technology

My name is Maria Nendongo, a Master of Education (Educational Technology) student at UNAM (part-time). I am expected to conduct an academic research in this field as a partial fulfilment of the requirements for the said qualification. In addition, results of the study will be shared with the regional office to support Physical Science teachers on the usage of Technology for subject handling.

It is on the above ground that I am humbly seeking assistance, with your permission, from all Physical Science teachers in your school to complete the attached questionnaire and return it to the circuit office for collection before or on **26 April 2017**.

The Permission letter from the Director's office is attached.

Thank you


Maria N. Nendongo (0812928092)

cc: The Inspector of Education