

**A Self-Study of a Novice Teacher's Experiences of using
Information and Communication Technology (ICT) in Teaching
Grade 10 Physical Sciences**

By

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ABSTRACT

The purpose of this study is to improve my technological pedagogical and content knowledge (TPACK) in teaching grade 10 Physical Sciences. I use my experiences of ICT in education to understand my current teaching as a novice teacher. To improve my pedagogy through the use of ICT in teaching Physical Sciences Grade 10 learners in the topic Wave Sound and Light. I have obtained feedback on my teaching using ICT through the views of learners and critical friends. The methodical approach used is self-study, as it lends itself to analysis and reflection of one's own teaching. Three research questions guided my study. The first research question was: *How do my past experiences of information and communication technology (ICT) in education influence my teaching pedagogy as a novice teacher?* To address this question, I used memory work, artefact retrieval and pictures to recall my past experiences with ICT. This question helped me look back on my own education, how I learnt to use ICT tools and how ICT was used in my own learning. This reflection made me appreciate having learned how to use ICT at school because I had not been exposed to it at home or in the community. My second research question was: *What are learners' responses to my teaching after the use of information and communication technology (ICT) in Grade 10 Physical Sciences?* Data was generated through questionnaires and interviews for Grade 10 Physical Sciences learners after each lesson in waves, sound or light where ICT had been used. I found that learners' responses fell into four dimensions, which were social, psychological, cognitive and learning styles. From these dimensions, I perceived that the use of ICT stimulated learners' interest, improved their conceptual understanding but it did not guarantee their sustained involvement. My third question was: *How can I learn information communication technology (ICT) pedagogical tools and use them to better teach Grade 10 Physical Sciences?* In answering this question, I reflected on the views of friends who had observed and critiqued my lessons using ICT. Being the main participant, I reflected on my lessons with the help of an audio recording and reflective journal. I then reflected on my growth as a science teacher using ICT, in terms of science-personal knowledge and skills and on education views and perspectives in general.

PREFACE


The work described in this dissertation was carried out in the School of Education, Science and Technology Education Cluster, at the University of KwaZulu-Natal under the supervision of Professor. Nadaraj Govender and Mrs Mary-Anne Good.

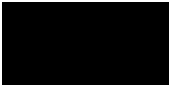
Ethical clearance was granted for this study by the University of KwaZulu-Natal Research Office. The Ethics Clearance Approval number is HSS/1941/018M.

DECLARATION

This study represents the original work of the author except where otherwise indicated and has not been submitted in any form for any other qualification to any tertiary institution.

Where use has been made of the work of others, it has been duly acknowledged in the text.

Signed... .. Date....28 April 2020.....
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Mrs Mary-Anne Good  Date: 28 April 2020.....

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CHAPTER 1 INTRODUCTION TO THE SELF AND TO SELF-STUDY

1.1 INTRODUCTION

As a novice teacher, one of the things that gave me sleepless nights was the poor performance of learners in Physical Sciences, particularly Grade 10 learners. The performance of South African Physical Sciences learners can be compared against international benchmarks such as the Trends in International Mathematics and Science Study (TIMSS), where South Africa has shown the poorest performance among the countries surveyed (Bilbao-Osorio, Dutta, & Lanvin, 2013). On a national level, the Physical Sciences pass rate in the National Senior Certificate in South Africa has been decreasing each year (Heeralal & Dhurumraj, 2016). According to the 2016 National Senior Certificate Diagnostic Report (Department of Basic Education, 2016) there has been a decline in the Physical Sciences pass rate from 67.4% in 2013 to 62% in 2016. This means more and more learners are struggling to reach even the thirty percent pass mark (Keeton, 2010). As a teacher you want to see the learners strive so that you can celebrate their success with them. Sadly, this was not my experience, a few learners experienced success. Poor results are discouraging for the teacher, for the learners and for their parents.

I started my teaching career in a small underdeveloped rural village where the majority of the learners come from IsiZulu speaking communities and families. Among such communities, numerous factors have been implicated for learners' poor performance in Physical Sciences. In South Africa learners are legally taught in their mother tongue until grade 3, thereafter they are taught in English or Afrikaans. This change in language implementation has an effect on learner performance (Ferreira, 2011). Heeralal and Dhurumraj (2016) suggest language of instruction is a barrier because Physical Sciences is difficult to learn for most African learners who speak English as a second language. Most African countries like Botswana, Ghana, Tanzania, Lesotho including Ethiopia which was never colonised continue to use the language of the former coloniser despite the demining outcomes in education (Brock-Utne, 2012). English is the language of international trade especially in science, engineering, and technology which is why most countries like France, Moscow, Brazil (Madhavan & McDonald, 2014) are using English as a language of learning in secondary and higher education (Sua, Raman, & Darussalam, 2007). Other countries like Malaysia

and China have compromised to adopted bilingual model where the home language and English are used to teach science and mathematics in because they feel that children learn science and mathematics better in their language (Sua et al., 2007). On the other hand English is an international language so they have compromised for the bilingual model. This is to keep their native language and also use English. The use of English was to increase standard of English proficiently and decrease the unemployment rate in the fields of science and mathematics due to the lack of English proficiency. Ferreira (2011) suggests solutions to assist teachers that are teaching second language learners like doing more practical work and investigations, using analogies and code switching.

Moreover, most parents of learners in Grades 10, 11 and 12 do not have English proficiency and so are unable to assist their children with Physical Sciences. Other inhibiting factors include educators' lack of content knowledge, their using outdated teaching strategies and the lack of resources (Mji & Makgato, 2006). In this regard, Abdu-Raheem (2015) and Ruijsbroek, Wijga, Gehring, Kerkhof, and Droomers (2015) suggest that there is a strong correlation between children's school performance and their parental education. Furthermore, Baker and Jones (2005) highlight the association between poor performance and low-socio economic background, which indicates that learners from low socio-economic backgrounds are less motivated and negative towards science than those from high socio-economic backgrounds. However, Heeralal and Dhurumraj (2016) suggest that it is not the low socio-economic background as such that influences learners' performance in Physical Sciences but rather it is the contribution of factors such as their background experiences and home resources. Factors such as teenage pregnancy, substance abuse and unstable homes also add to the poor results and performances among learners (Saiduddin, 2003). Other factors in learners' home backgrounds contributing to their poor performance have been noted by Ilomo and Chawanga (2015), such as homes being headed by grandparents or guardians rather than parents, the lack of parental involvement in the learners school and home environment, family size, marital status and parental education.

Physical Sciences is regarded as a challenging subject. Hence the numbers of learners taking Physical Sciences is also diminishing, with some learners changing streams in later years in the hopes of an easier pass or better result in other less abstract subjects (Habibi & Habibi, 2014). Nevertheless, as a Physical Sciences teacher I wanted to believe that I had taught excellently and given my learners the best exposure to the subject. However, I never felt that I was doing

enough for the learners, and I was constantly offering extra lessons.

During my studies for my honours degree, I read a paper by McKinsey and McKinsey (2007) on the world's best performing school systems, where they found that the quality of an education cannot exceed the quality of the teachers. This profound statement greatly influenced my views and beliefs when I started teaching. However, I was comforted by Hattie (2003), who stated that teachers are responsible for 30% of a learner's achievement and the learner's efforts contributes about 50% of their achievement. This comforted me because it partially decreased the stress on me as a teacher in that learner performance accountability was shared by both the teacher and the learners. Learners must, to a large extent also take responsibility for their learning. Nonetheless, as a caring teacher I still wanted to do my best work in my subject.

As a novice, one comes into the teaching profession highly motivated, with so much enthusiasm, so many aspirations and ideas. One of my aspirations was to encourage and motivate learners and to make my lessons and teaching interesting by using ICT in the classroom. There were moments where I would be teaching and I would realize how ICT could fill the gaps or explain things better to the learners, and even for my own learning. At the back of my mind I had thought that ICT would have the potential to stimulate learners' interest and facilitate their deeper conceptual understanding in Physical Sciences. I had been reading on the internet lesson plans from teachers experienced in teaching Physical Sciences to see how they delivered particular topics. I had watched several YouTube videos online to gain a different perspective on various topics. I had already experienced how ICT was used in teaching when I was in high school and in university, it had motivated me to study deeper and learn more widely. I had not, however, adopted ICT as a pedagogical tool, primarily because I did not know how to incorporate or integrate it effectively in my teaching. Yet even though I was constantly thinking about it, I did not use ICT in the classroom.

I have three reasons for not using ICT in the classroom at this early stage of my career. Firstly, a lack of time was the main contributing factor. On the first day I arrived at the school, I was scheduled to have a meeting with the principal. Little did I know that after the meeting I would be facing a class full of energetic learners; I was not prepared at all. I had not even imagined that I would get the job at that school. So, from the start I was in class all day, figuring out how far the learners were with the syllabus. After that, I had so much to learn, to catch up and to do. The learners were behind with the syllabus because they had been without a teacher for two weeks and

so they needed to have extra lessons. I had to put together personal teacher files for all my subjects (Grade 8 mathematics, Grade 9 mathematics, Grade 10 Physical Sciences, and Grade 8 Natural Sciences), start lesson plans for all my classes and complete other general administration involved with being a teacher. Secondly, even though I got support in all the other aspects, I received no mentorship regarding the use of ICT. In general, at the school the use of ICT in the classroom was not a topic of interest among the teachers, either in discussion or their practice. I think the main concern was doing the best you could without complicating things or adding more work over and above the already vast workload. Furthermore, it never occurred to me to seek ICT support since I had not seen or heard of teachers using ICT in their classroom in the school. Thirdly, there was a lack of ICT resources. Although the school had about 10 computers, there was, however, no internet connection. There was only one data projector for the whole school to use and its availability was consequently limited. Thus, the school was inadequately resourced for the use of ICT.

The three reasons outlined above made it difficult for me to use ICT in the classroom. As a novice teacher, I also needed time for the transition from university into the profession (Farrell, 2012). Using ICT requires carefully planned lessons, which would initially take longer to prepare. I was also insecure about successfully incorporating ICT in my teaching because I did not have knowledge of secondary school educational ICT resources that were available, and I did not know how to successfully incorporate ICT in my teaching. Thus, I felt my inadequate knowledge in using ICT as a pedagogical tool would lead to disastrous lessons and would diminish my self-confidence.

I was never completely satisfied with my teaching and felt professionally less competent by not using ICT. This is the main reason why, a year later, I decided to endeavour on this journey of self-study research to scrutinize my teaching using ICT in order to improve my use of ICT as a pedagogical tool. This meant that I would begin to start using ICT in the classroom, reflect on the process and take action on how I could improve my teaching. Furthermore, I would get the views of learners, and critical friends (peers and heads of department) when teaching using ICT. In this study ICT refers to the use of computer applications, mobile technology, recording and communication systems in the classroom (Sánchez, Marcos, González, & GuanLin, 2012). I used a computer simulation called PhET, videos, pictures, PowerPoint and recordings in the classroom.

The first time I remember the work pedagogy was in my training to be part of TEACH SA

in 2013. TEACH SA is an organisation that takes qualified graduates in different fields, gives them pedagogical training and places them in schools to assist with critical subjects like Mathematics and Sciences. The training was an intense week of how to be a teacher. It was assumed that since we are already graduates, we already have content knowledge. We were trained about various methods of delivering content in the subjects and that's when it dawned to me for the first time that being a teacher is more than just knowing. Going forward I became aware of pedagogy. It was helpful when I did a course in my honours year where we went out to schools to do practicals in Primary schools. During my PGCE I was open to the bigger picture of pedagogy and the history behind it. I learnt about Pedagogical content knowledge (PCK) (Shulman, 1986). Going into the field of teaching I was encouraged and wanted to put in place the pedagogical ways of teaching and also to learn more.

Having being taught using ICT and having interest in ICT tools, having been inspired and learnt about pedagogy I wanted to learn about ICT pedagogical tools. Mishra and Koehler (2006) propose that in order to teach using ICT one should have technological pedagogical knowledge (TPACK). In Chapter 1.2.7 I unpack TPACK as the theoretical framework for this study.

1.2 FOCUS AND PURPOSE OF THE STUDY

The purpose of this study is to use my past experiences of ICT in education to understand my current teaching as a novice teacher, improve my pedagogy through the use of ICT in teaching Physical Sciences Grade 10 learners, and to understand and get feedback on my teaching using ICT through the views of learners and critical friends (teachers in the school). I will also engage in a series of reflections to shape and reshape my teaching.

Kosnik, Beck, Freese, and Samaras (2006) state three purposes of self-study for teacher educators: self-renewal, professional renewal and programme renewal. Kosnik et al. (2006) have adapted these purposes to create a model for teachers' own self-study. In the model the three purposes of self-study are specifically, for teacher's personal growth and development, for professional growth and development, and for classroom and school management. These are elaborated upon next.

Firstly, in terms of personal growth and development, as I studied my personal history of learning, it made me aware of my current teaching, my beliefs and values that influence my teaching and I assessed if these aligned with my actions. I moved to a mode of conscious practice

(Samaras, 2002), which means becoming aware of happenings in the classroom and engaging in reflexive practice. I looked at the learners as they walked into the classroom, as they listened, did the activities and searched for deeper meaning in the learner's questions. As I listened to the audio records of the lessons, I gave attention to what I was saying and how I said it and where I could improve. When you are aware, you know yourself better; when teachers know themselves, they teacher better. They also become aware of learners having their own backgrounds and therefore the teachers understand them better and begin to know the misconceptions learners bring into the classroom. As I thought deeper about the learner's questions, I understood their confusion or misconception and looked for way to get them to challenge those misconceptions. Secondly, regarding professional growth and development, most teachers complain that the educational system has taken all authority and power away from the teachers. So they feel powerless as decisions are made for them without their input, about what they must teach and how to teach it (Samaras, 2002). For example, a teacher in South Africa is restricted and has to follow the prescribed annual teaching plan (ATP), which defines the topics that they have to teach, and the particular order and time frame for these. Similarly, as a beginner teacher my lesson plans had to be written in a particular format in an exercise book. Overall, it seems that the only freedom I had was the way in which the content was taught in class. Accordingly, self-study gives teachers back their confidence and power, as the focus is on them and their behaviour in their classroom, with the decisions they make are based on reflection. Teachers have many roles when instruction is designed; they can be artists, architects, crafts people and engineers in planning and presenting their lessons (Habibi & Habibi, 2014).

Lastly, concerning the third aspect of improving classroom and school management, teachers can challenge the way they teach in their own classrooms with the intention of improving their practice. As they share this task with their colleagues whom they invite into their classroom as critical friends, such reflection provides for a communication and collaborative problem-solving network focused on making changes at classroom and school level. Although being a teacher involves multi-tasking, self-study allows teachers to initially pick one aspect of their teaching to focus on and work towards improving. For this study, amongst other aspects of being a teacher, I have chosen to focus on the idea of ICT being used as a pedagogical tool in Physical Sciences teaching. In this study, I invited critical friends into my classroom so that they could share their views about my use of ICT. This approach of enhancing teaching and pedagogy may spread to my

critically engaged friends, who may also undertake self-study. Other teachers from the school may also want to adopt such a teaching strategy, as well as the practice of engaging with their critical friends. A change that starts in one classroom can therefore spread at a department level, to the school level and eventually on community levels, thus improving teaching and learning in education in the long term.

1.3 BACKGROUND INFORMATION

In my years of teaching I have used ICT in doing administration like, lesson plans, setting assessments (using Microsoft Word), analysis of results (using Microsoft Excel), and used the following websites for enhancing my knowledge; YouTube videos, 2Enable (contains SA curriculum materials) and Khan academy. I was not equipped and did not have the confidence to use it in the classroom. In education the use of ICT has become of extreme importance in this growing technological world.

ICT has been praised for getting learner attention and interest, making lessons enjoyable and most importantly improving learner performance (Bester & Brand, 2013). ICT also intercepts places of learning which makes e-learning possible. This poses a challenge to teacher training and curriculum structures (Livingstone, 2012). Teachers have reported not to be trained for the use of ICT (Erdemir, Bakirci, & Eyduran, 2009). Teachers must leave their training adequately prepared for the use of ICT and have resources to implement ICT in their classroom. There has been challenges to the use of ICT in the classroom like, negative attitudes towards ICT (Preston, Cox, & Cox, 2000), teachers reluctant to use ICT (Jones, 2004) and people's inability to use ICT (Gardner, Dukes, & Discenza, 1993).

In South Africa the goal for e-Education White paper is for every learner in the country to be ICT capable by 2013 and for teachers to use ICT in teaching and learning (Department of Education, 2004). Several initiatives have been implemented and there has been varying success in different schools (Isaacs, 2007). South Africa is a growing country and experiences issues of affordability, accessibility, limited electricity supply and lack of infrastructure that has led to the failure of the white paper on e-Education.

The school which the study will be done faces all these problems. I as a novice teacher do not feel that I am prepared to teach with ICT. The initiative to do this study forces me to be resilient

and look for solutions to make the study a success.

1.4 RESEARCH QUESTIONS

There are three research questions that I explored in my study.

Research question 1: *How do my past experiences of information and communication technology (ICT) in education influence my teaching pedagogy as a novice teacher?*

The first question will be answered in Chapter 3 of this dissertation. In that chapter, I have reflected on my learning of ICT and how it was used in my teaching. Reflecting helped me understand how my own experience of learning encouraged me to learn how to use ICT in my teaching. I recall through narratives, my first encounter with a computer in primary school, how I used computers in high school and university. In reflecting on my experiences, I used drawings, photographs, discussion with friends and family, and memory work.

Research question 2: *What are learners' responses to my teaching with information and communication technology (ICT) in Grade 10 Physical Sciences?*

I respond to the second question in Chapter 4. To answer this question, I used anonymous questionnaires and interviews to obtain the views of learners in Grade 10 about my teaching using ICT. In that chapter I explain the sequence of events that took place while I was teaching using ICT for each of the lessons. Reflecting on learners' views helped me understand better my teaching using ICT.

Research Question 3: *How can I learn information and communication technology (ICT) pedagogical tools and use them to better teach Grade 10 Physical Sciences?*

I address the third question in Chapter 5. In answering this question, I reflect on critical friends' views to better understand my teaching. Critical friends helped me understand the importance of collaborating with other teachers. I reflect on my lesson planning and implementation and my learning of the ICT resources used. I audio recorded my lessons to help me remember what took place during the lessons.

1.5 KEY CONCEPTS

The key concepts I focus on are being a novice teacher, Physical Sciences teaching and the

pedagogical use of ICT. These are outlined next.

1.5.1 Conceptualizing a Novice Teacher

A newly qualified teacher, regardless of age, who is within their first three years in the profession is considered a novice teacher (Farrell, 2012). I point out my experiences as a novice secondary school teacher, having recently graduated from the university and why I conducted this self-study. I draw from my past educational experiences especially in university. These memories are still recent, fresh in my mind, and I can still recall them vividly. Since it is recent, I still have resources such as my Postgraduate Certificate in Education (PGCE) course notes, certificates, and photographs. My strong values and beliefs about being a teacher and as a professional were acquired mostly from my university days. These beliefs did not change while I was conducting the study, nor have they changed as a result of my teaching experience thus far. It is important to highlight that as I conducted this study, I still have those beliefs almost unchanged; they have been little influenced thus far by the experience of being in the teaching profession.

I express these feelings because I have heard that in some schools, new teachers come in with so much enthusiasm. They prepare all their scheduled lessons and actually teach earnestly in class but after some time in the profession, they lose interest and become demotivated. So, in the period of conducting this study, not much time has passed since starting in the profession and I still possess the values and beliefs gained from my schooling and university experiences. I was fortunate to start at a school that is functional, supportive and has teachers and staff with strong work ethics. I have learnt much from such a thriving environment. However, the major problem was the lack of motivation and interest from the learners and this made me tired and discouraged from continuing with my initial enthusiasm.

Novice teachers find it hard to adapt from university into the profession. This may be due to lack of support, a shortage of time, and the vast amount of administrative work. Most of them leave the profession in the first five years (Samaras, 2002). According to Farrell (2012), novice teachers experience difficulties because they have to take on two roles at the same time, learning to teach and teaching. They also have the same amount of work and duties as their seniors. My first year of teaching in 2017 was an overwhelming year. I experienced many late nights preparing lessons. I was teaching Mathematics, a subject I was not qualified to teach. It was hard work and having the learners barely passing was disappointing. On many days I thought about changing

careers. If I had not received the support in all the other aspects that are involved in being a teacher, I would have left the profession soon after starting it.

I think it is motivating and beneficial that I am learning ICT pedagogy now when I am still a novice in the profession, and before I get comfortable with traditional teaching methods which may later require my having to change what I am used to and so learn how to teach with ICT. Given the rapid pace at which technology is changing every day, I have no doubt that later it will be more advanced, and I would have so much more to catch up on.

In this study I have focused on teaching using ICT. As (Samaras & Freese, 2006) emphasise, in a self-study it is important to choose one area of interest to focus on at a time, even though there may be other interesting pedagogical aspects worthy of investigation. Physical Sciences as a key concept is focused on next.

1.5.2 Physical Sciences Teaching and the South African Curriculum and Assessment Policy Statement (CAPS)

The subject Physical Sciences has its own aims and objectives and its own value that it adds to the school curriculum. Physical Sciences is an integral part of our lives and we observe and engage in its daily (Pattnaik, Chakradeo, & Banerjee, 2014). As a subject, it is not about memorizing laws, but rather it teaches critical thinking, encourages new ways of thinking, and encourages problem solving (McDermott, Shaffer, & Constantinou, 2000).

Physical Sciences is, however, difficult for learners due to its abstractness. The number of learners changing from Physical Sciences to other streams such as Commerce or Arts suggests that other subjects are not as abstract as Physical Sciences and are perceived as being easier to pass (Habibi & Habibi, 2014). Learners generally perform poorly in Mathematics and Physical Sciences in South Africa and the number of learners succeeding is decreasing (Department of Education, 2001). The Global Information Technology Report shows that, for the quality of science and mathematics education, in 2011 and 2012 South Africa ranked 143rd (second from last) with a score of 2 on a scale of 1-7 (Bilbao-Osorio et al., 2013). The Trends in International Mathematics and Science Study (TIMSS) is a cross-international study which tests the mathematics and science knowledge of Grade 8 pupils in a variety of countries. South Africa participated in 1995, 1999, 2002 and 2011. TIMSS indicated that the international Grade 8 test was too difficult for most South African pupils. A comparison between the results from 1995, 1999 and 2002 shows that

there was no improvement in either mathematics or science over this time period (Spaull, 2013).

Physical Sciences is unique in the set of specialised skills it promotes. The knowledge and skills as set out in the Physical Sciences Curriculum Assessment Policy Statement (CAPS) (Department of Education, 2009) states that Physical Sciences must develop science process skills where, amongst others, learners observe, measure, classify, process and interpret information, solve problems, analyse, synthesize, and formulate conclusions.

The methods of teaching Physical Sciences must aim to build the appropriate knowledge and develop these skills. The methods of teaching are ways selected by teachers to present the content in a classroom so that it can be understood easily by learners. One cannot choose a single method to teach a diverse group of learners, or diverse topics, without considering the environmental teaching context. An appropriate method must be chosen for a specific topic, after determining what the teacher wants to achieve from the lesson. A method that would best deliver the content must be tailored for a specific group of learners in a specific environment, taking into account their cultural and social backgrounds. The capabilities of the learners need to be considered, so that the method chosen can be accessible to the learners at their grade and cognitive level. So a method that worked successfully in one class in a particular environment may be a complete disaster in another class (Pattnaik et al., 2014).

The teaching method must be clear in the lesson plan. A daily lesson plan is essential for effective teaching. It sets out, in an organised manner, the aims of the lesson, the content, the teaching points, any tests and activities. Lesson plans are important because effective learning takes place if the content is organised in a coherent and integrated manner. A teacher who has planned his lessons related to the topic, while considering the classroom resources and context will teach with confidence and minimal anxiety. He or she will foresee any challenges and be prepared to deal with them confidently (Pattnaik et al., 2014).

My self-study is based on Grade 10 Physical Sciences. Table 1.1 below details the content that is to be taught in Grade 10. I decided to begin my study on the topic that would be taught in January, which is the first term, because it would allow me time to work on my research throughout the year. Looking at Table 1.1 under the topics that are taught in Term 1 in Grade 10, I have chosen

Waves, Sound and Light as the topics that I will use for the research, as motivated below.

Table 1.1: Topics taught in Grade 10 Physical Sciences

TERM 1	TERM 2	TERM 3	TERM 4
Matter and materials	Particles substances are made of	Reactions in aqueous solutions	Energy
States of matter and the kinetic molecular theory	Physical and chemical change	Quantitative aspects of chemical change	The hydrosphere
The atom	Representing chemical change	Vectors and scalars	
The periodic table	Magnetism	Motion in one dimension	
Chemical bonding	Electrostatics		
Transverse pulses on a string or spring	Electric circuits		
Transverse and longitudinal waves			
Sound			
Electromagnetic radiation			

My subject advisor has always stressed the importance of teaching Grade 10 learners with care and patience, especially at the beginning of the year. She says that the language used and concepts in Physical Sciences are still foreign to them and teachers often overlook this and underplay the fundamental basics of communication. She added that teachers often rush through concepts as if the Grade 10 learners are already familiar with them. I am aware that transverse waves and longitudinal waves are new concepts to the learners. For many of the Grade 10 Physical Sciences curriculum topics, learners should have encountered the basics earlier in Grades 8 and 9 Natural Sciences. For instance, they should also have learnt some aspects of light in Grade 8 under energy and change. However, they will not have previously been exposed to any aspect of waves or sound. Thus, in the first term in Grade 10, learners would be faced with these conceptually difficult new topics. It is in this context that I decided that this research would take place in January so an exciting way of welcoming them to Grade 10 Physical Sciences would be by using ICT.

I was hopeful that the lessons in which ICT would be used would build learners' commitment to the subject so that they would not want to change to another subject, and they

would realise that Physical Sciences is doable and exciting. ICT would hopefully help learners understand the concepts of waves, sound and light beyond mere rote learning. For example, this topic requires learners to identify the different properties of transverse pulses as well as longitudinal waves (Department of Education, 2009). While these are traditionally taught using static diagrams from textbooks, all these concepts can be demonstrated effectively using ICT simulations, which encourages learners to understand the ideas rather than just memorize the facts (Eyyam & Yaratan, 2014). The view that Physics is a difficult and mathematically challenging too causes learners to be uninterested and demotivated and ultimately leads to their poor results (Janczyk). In order to engage the learners actively, the constructivist learning theory suggests that learners must be confronted with a discrepant event that conflicts with their worlds view and preconceptions. It is often due to poor basic understanding of Physical Sciences that learners revert to their preconceptions, even if they are not in line with the scientific concepts in Physical Sciences. The use of simulations in ICT and the constructivist approach are engaging and effective in promoting learners' understanding of Physical Sciences Thus learners are given opportunities to change their preconceptions (Mirana, 2016).

1.6 METHODOLOGICAL APPROACH

Self-study is a narrative by the researcher; it focuses on the writer's own self and experience (Samaras & Roberts, 2011). A person engages in self-study as a method of research in order to improve their professional practice. Such a researcher has a yearning to improve their practice via reflections and critique from critical friends. It focuses on the researcher's process of thought, their learning, and state of mind before and after the research (Loughran, 2004). According to (Samaras, Freese, Lassonde, Galman, & Kosnik, 2009), self-study research comprises five characteristics, which are firstly personal situated inquiry, secondly critical collaborative inquiry, thirdly improved learning, fourthly, a transparent and systematic research process and lastly knowledge generation and presentation.

Undertaking a self-study in a school setting means having the desire to improve the self and one's practice. I therefore was continuously learning how to use pedagogical ICT with my Grade 10 Physical Sciences class and found out how the learners feel about the use of ICT. In this

qualitative research,

1.7 CONCLUSION: OVERVIEW OF THE DISSERTATION

In this first chapter, I have introduced myself and indicated how I have experienced ICT in my own learning and teaching. I have conceptualized a novice teacher and the overall challenges that I faced as a new teacher, which led to the need to improve my pedagogy in terms of using ICT in my context. I have described the context in which the school is situated as well as the school and the disadvantages it has when it comes to the use of ICT. There is a detailed purpose and focus of the study. Included is a narrated background and rationale for my study. There is a discussion about how my research questions were developed and how they will be answered. Provided is a summary of the methodological approach and the theoretical frameworks that are the cornerstones of the study.

In Chapter 2, I share my understanding of the research methodology, its underpinnings and its appropriateness for this study. There is an explanation on the research settings and all the research participants in detail. I will provide all the self-study practices used to generate data and indicate how they will be analysed. Furthermore, I will discuss the importance of ethics and trustworthiness in self-study.

Chapter 3 tracks how my past experiences affect my current teaching, in order to answer my first research question: *How do my past experiences of information and communication technology (ICT) in education influence my teaching pedagogy as a novice teacher?* I recalled memories of my use of technology growing up in society, my learning of technology in school and how I was taught in school and relating these experiences to my beliefs as a teacher. I recalled these memories using memory work, pictures and artefacts. The events reveal my intrinsic motivation and attraction towards ICT.

In chapter 4 I reported on the planning and teaching process of the topic of waves, sound and light using ICT and

Chapter 5 answers my second research question: *What are learners' responses to my teaching after the use of information and communication technology (ICT) in Grade 10 Physical Sciences?* I present and discuss the views of learners and critical obtained through questionnaires and interviews.

Chapter 6 and 7, answers the third research question: *How can I learn information*

communication technology pedagogical tools and use them to better teach Grade 10 Physical Sciences? In chapter 6 I reflect on general educational views, my Science knowledge and skills and as a science teacher learning ICT.

Chapter 7 is the conclusion to the whole study. I presented my learning gained from engaging in the study in terms of my past experiences, learning of ICT and the self-study methodology. I presented implications for schools and teachers. There is also a discussion about the way forward after I have been through the process of self-study and my personal journey.

1.2 THEORETICAL FRAMEWORKS

1.2.1 Introduction

A theoretical framework is the most important aspect of the research process as it forms the foundation from which all knowledge is constructed for a search study. It serves as support for the rationale of the study, the problem statement, the purpose, and the research questions. as important as it is, this is the aspect that research candidates find the most confusing and difficult (Osanloo & Grant, 2016). “A research framework is a basic structure of the ideas (i.e., abstractions and relationships) that serve as the basis for the phenomenon that is to be investigated” (Lester, 2005, p. 458). In this section I present the theoretical framework that will guide this study, which is technological pedagogical content knowledge (TPACK). I will also explore other ICT theoretical frameworks such as the theory of reasoned action, the theory of planned behaviour, the innovation diffusion theory and technology acceptance model.

1.2.2 The Theory of Reasoned Action (TRA)

The theory of reasoned action investigates the relationship between behaviour intention and behaviour. The theory asserts that our behavioural is driven by our behavioural intentions. Our behavioural intentions are the things that we want to do. These are directly determined by our attitudes and subjective norms towards that behaviour. Our attitudes are based on our beliefs, and evaluations of the outcomes of the behaviour. The subjective norm is whether the important people in that person’s life will approve of that behaviour or not weighted against the person motivation to comply to those people (Montaño & Kasprzyk, 2015). The TRA has been used in the use of ICT (P. Zhang & Aikman, 2007). It has also been used in information systems (Mishra, Akman,

& Mishra, 2014). Success in the theory is in explaining behaviour in volitional circumstances. It is limited in explaining behaviour out of the person's control (Ajzen, 1991). The TRA theory cannot be situated in this study because I am not able to control the availability of ICT tools

1.2.3 **The Theory of Planned Behaviour (TPB)**

The theory of planned behaviour is an extension of TRA, it considers situations where there are factors outside a person's control. Figure 1.1 is a diagram showing the TRA with its attitude and subjective norms relationship to intention, it is extended by the perceived behavioural control making it a TPB. The TRP has an additional factor called the perceived behavioural control which considers if the resources or opportunities available to a person and dictates the likelihood of behavioural achievement (Montaño & Kasprzyk, 2015). The perceived behavioural control is how much a person is willing to try, how much effort they are willing to exert to perform the behaviour (Ajzen, 1991).

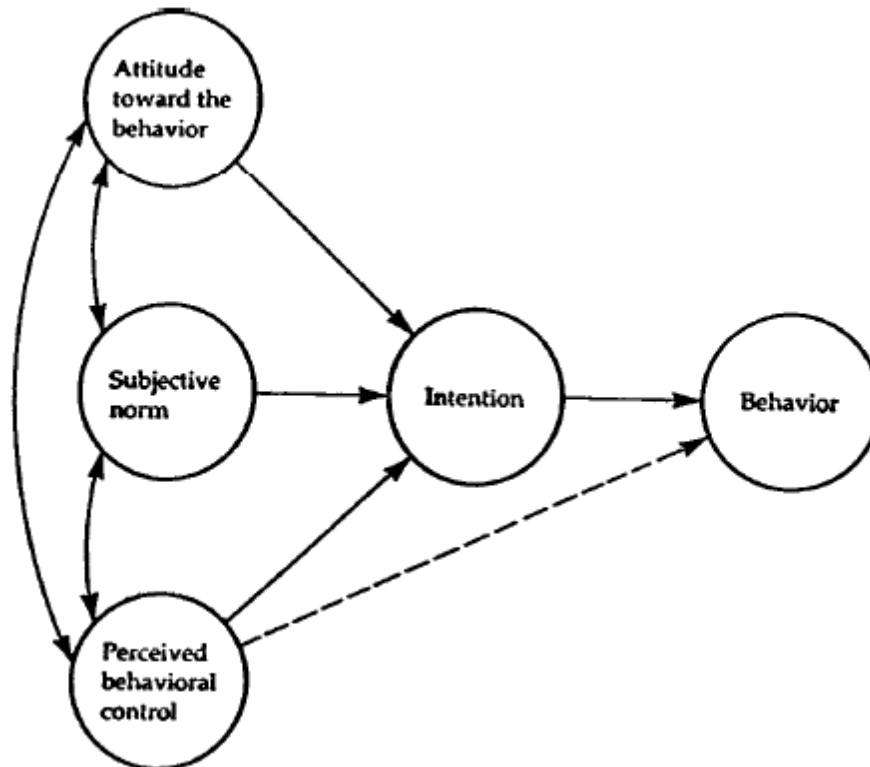


Figure 1.1: TRA and TPB problem (Ajzen, 1991, p. 182)

The TPB has been used in health (Ifinedo, 2017), agriculture (Petrea, 2001), climate change (Masud et al., 2016), social media (Al-Debei, Al-Lozi, & Papazafeiropoulou, 2013) and ICT (Siragusa & Dixon, 2009) The TPB has however experienced criticised on the grounds that intention to use a system is not only limited to the three factors but there may be other unspecified factors that may influence a users' behavioural intention (Ajzen, 1991). Ajzen (2011) proves the theory as immeasurable and thus is limited to be used in this study.

1.2.4 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was first proposed by Davis (1985). It was the first model to be used to predict user's adoption of IS (Davis, 1989). This model is an extension of TRA and RPB, it adds two other variables, perceived ease of use (PEOU) and perceived usefulness (PU) (Davis, 1985). PEOUS refers to the degree to which a person believes

that doing a behaviour would be free from effort (Scherer, Siddiq, & Tondeur, 2019). The extent which a person believes using a system will be easy (Davis, 1989). The PU refers to an extent that a system would enhance their job or task performance (Scherer et al., 2019). This is the degree that the user believes the system would help them do their job (Davis, 1989). The TAM model has been used in various studies for ICT (Irani, Ahmad, Amer, Qutaifan, & Alhilali, 2013; Scherer et al., 2019), due to its robustness and powerfulness (Venkatesh & Davis, 2000). The theory is has been criticised not considering social influence on intention (Venkatesh & Davis, 2000). It falls short of “conceptualizing what it means to accept and integrate technology in classrooms” (Scherer et al., 2019, p. 5), further more “it does not specify which types of professional knowledge about teaching and learning technology teachers must have in order to integrate technology meaningfully”(Scherer et al., 2019, p. 5). The TAM is therefore limited to be used in this study.

1.2.5 The Innovation Diffusion Theory (IDT)

The Innovation Diffusion Theory (IDT) argues that potential users decide to adopt or reject an innovation based on beliefs that they have about the innovation (Orr, 2003). IDT involves the following innovation characteristics: relative advantage, compatibility, complexity and trialability and observability. Compatibility is how the innovation is in line with the potential users’ values, past experiences and needs. Complexity is the ease of use of the innovation by the potential user. Trialability is the degree in which the innovation can be tested before a decision to use it can be made. Observability is how the innovation results can be seen by others. Relative advantage is found to be the best predictor of the adoption of an innovation, is how the innovation is better than the existing idea (Lee, Hsieh, & Hsu, 2011). The theory has been used in various field like IT (Karahanna, Straub, & Chervany, 1999) and ICT (Karahanna et al., 1999). The IDT model was not used in the study as it considers the user trying out the innovation and deciding whether they like it or not (Lee et al., 2011).

1.2.6 Pedagogical Content Knowledge (PCK)

Approaches to teacher education programmes for many years emphasised either knowledge of pedagogy or content knowledge, treating these two as two mutually exclusive domains (Shulman, 1986). In his seminal work, Shulman (1986) argued that having only one of

the two was not sufficient knowledge for a teacher and proposed that they are not isolated domains, but instead a relationship between content and pedagogical knowledge called pedagogical content knowledge (PCK) is essential for effective teaching. The seven content knowledge bases are content knowledge, pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational contexts, knowledge of educational ends, purposes, and values (Shing, Saat, & Loke, 2018). Teaching is complex, it involves these knowledge basis and their interception and be able to deal with uncertainty.

PCK is the integration of content and pedagogical knowledge that has to do with the teacher's understanding of organisation, adaption, and representation of subject matter in order to teach it (Koehler & Mishra, 2009). A teacher must first have content knowledge in order to transfer the knowledge by using good pedagogical methods (Halim & Meerah, 2002). PCK is the knowledge required for delivering the content knowledge in a manner that is easy for learners to understand. It is knowing the most powerful forms of representation for the ideas, the right illustrations, explanations, examples and demonstrations. It goes beyond knowing the content, but also involves organizing it in a coherent manner that will be comprehensible to others. It involves being aware of what preconceptions learners of different ages bring into the classroom and knowing how to deal with those conceptions, as well as realising what makes certain topics easy or difficult (Koehler & Mishra, 2009).

PCK have been extensively been studied by researchers however it has gone un-noticed by many science teachers. Most science teachers have heard of misconceptions but not about PCK (Kind, 2009). Science novice teacher have many knowledge disciplines to nature when they start teaching and they are concerned about not being fully prepared. They do not only have to learn content knowledge but pedagogical knowledge (Hartati, Permanasari, Sopandi, & Mudzakir, 2019). PCK have been studies in various fields of science, chemistry (de Jong, 2000) and science in South Africa (Rollnick, Bennett, Rhemtula, Dharsey, & Ndlovu, 2008), life sciences (Warren & Ogonowski, 1998), and physical sciences (Halim & Meerah, 2002).

Veal (1999) have found that the development happens over time with classroom experience as the most important influential factor. I have witnessed this in my teaching where my classroom management improved over time as I spent time in the classroom and understood the learners better.

1.2.7 Technological Pedagogical Content Knowledge (TPACK)

Mishra and Koehler (2006) expand on Shulman's PCK concept to add another knowledge domain, namely the knowledge of technology. When Shulman (1986) developed his model of PCK, the field of information and computer technology was still in its infancy. Teaching resources such as charts, textbooks or overhead projectors were not considered to be technology but considered merely to be teaching aids. They were simply equipment that teachers commonly used to present information. Nowadays technology is more advanced and is in the forefront of communication, work and learning. Technology in ICT is now seen more as computers and computer software or programmes that were not part of the mainstream teaching and learning resources in 1986. So, even though Shulman (1987) view of PCK still holds true, in these days of exponential growth of technological advancements, technological knowledge should be recognised as a separate component of pedagogical knowledge.

Mishra and Koehler (2006) propose that if a teacher is to teach effectively using technology, they must have knowledge of TPACK which is the combination of three knowledge components (see figure 1.2) pedagogical content knowledge (PCK), technological content knowledge (TCK) and pedagogical technological knowledge (PTK). The relationship between all these components is technological pedagogical content knowledge (TPACK). This study is based on discovering how a teacher can improve their teaching of Physical Sciences.

Content knowledge (CK) refers to the amount and organization of knowledge in the teacher's mind. Content knowledge is beyond the concepts and facts of the domain, it is not only about being able to define and state propositions but being able to explain why the proposition is the truth, why it is important to know and how it relates to other propositions within and out of the discipline, in theory and in practice (Shulman, 1986). Content knowledge is central to TPACK (Rosenberg & Koehler, 2015). CK is a foundation for TPACK, only when a teacher is confident in their CK can they build pedagogical knowledge (Veal, 1999).

Pedagogical knowledge relates to pedagogy, which is defined as the method and practice of teaching. Knowledge of pedagogy is therefore possessing knowledge about techniques or methods to be used in classroom teaching. It considers the target audience, learners’ cognitive and social development, and theories of learning and how they apply to learners in the classroom. (Mishra & Koehler, 2006). It includes knowledge of the classroom, assessment, lesson plan development and student learning (Rosenberg & Koehler, 2015), getting learner attention, recalling previous concepts, and delivering classroom activities (Bibi & Khan, 2017).

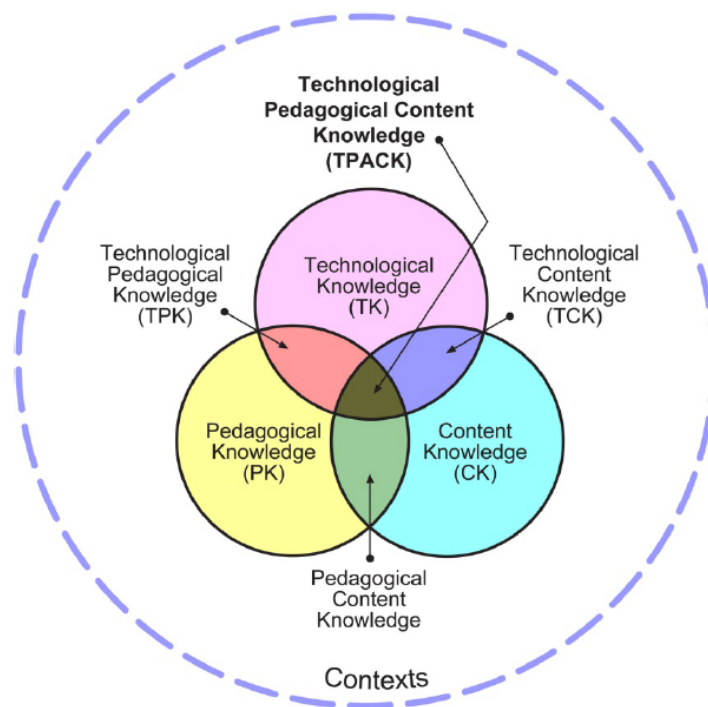


Figure 1.2 A representation of the TPACK model (Koehler & Mishra, 2009)

Technological Knowledge is the knowledge about technologies, from how to use the chalkboard to more advanced multimedia tools such as the internet and digital video, often referred to as ICT (Schmidt et al., 2009). This knowledge requires possession of skills to operate technologies and in the case of digital technologies it includes knowing about operating systems and hardware. The nature of technological knowledge changes and sometimes becomes obsolete as new technologies come about, and existing ones become more advanced. It is important for teachers to

keep abreast of new technologies in ICT if they want to be able to use them for teaching.

Technological Content Knowledge involves the relationship between technological and content knowledge. It is about knowing how the content knowledge can be changed by particular technologies and how technology can affect the knowledge and practices of a discipline. Disciplines such as medicine, history, archaeology and physics have been greatly influenced by the development of technologies that afford representation and manipulation of data in new and fruitful ways. Consider the technique of carbon-14 dating and the influence it has had in the field of medicine and archaeology. The advent of digital computers has played a role in physics and mathematics in helping learners understanding phenomena. Technological advances have offered new ways of understanding of the world, such as viewing the heart as a pump, or a brain as an information processing machine. These advances have afforded fundamental changes in the disciplines (Koehler & Mishra, 2009). Therefore, technological content knowledge is knowing about all these different types of technologies, their different affordances, and the influence they can have on teaching and learning (Mishra & Koehler, 2006).

Technological Pedagogical Knowledge (TPK) indicates the relationship between technology and pedagogical knowledge. It goes beyond knowing the content and knowing how to use technology. It is about knowing how these two interplays, how the use of technology can have an impact on teaching and learning. It is the ability to choose a technological tool for pedagogical use, according to its fitness, and involves knowing the affordances and restrictions of technologies for learning about a discipline.

Technological Pedagogical Content Knowledge (TPACK) is the term used for the interplay between the three components, pedagogy, technology and content. It involves more than the three individual components because it is a point where all these three knowledge areas intersect. TPACK or TPCK, as it was originally termed, may be described as follows:

TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones. (Mishra & Koehler, 2006, p. 1029).

I needed to know what the different types of ICTs can do and how they represent the content so that I may choose those that can best be used to teach each aspect of the topic.

Technological pedagogical knowledge is knowing how to use the ICTs and what they can offer. Pedagogical content knowledge is knowing and understanding the content and how to represent it systematically for the learners to understand. In this self-study I developed my TPACK through learning by doing, by starting to use ICT in the classroom and by preparing lesson plans for teaching Physical Sciences using ICT that developed each aspect of my TPACK. I reflected on the lessons, audio recorded them, obtained learners' and critical friends' views and went back to improve my lesson plans.

Mishra and Koehler (2006) emphasise that the focus of TPACK concerns what skills teachers must have, and not on how to gain these skills. There are a number of ways of developing TPACK. The authors propose learning technology by design, whereby participants engage in a variety of activities that involve using ICT, such as in the Technology Enhanced Communities (TEC) programme in the United States of America. TEC was reported on by Guzey and Roehrig (2009). It creates a learning community that will assist secondary science teachers in developing skills and knowledge for successfully integrating technology for science-as-inquiry teaching. TEC was a year-long programme wherein teachers logged into a website to interact with other teachers and university researchers. The TEC community website allowed teachers to share their experiences with technology tools and inquiry methods as well as their lesson plans. Throughout the programme teachers were encouraged to reflect on their classroom experiences, and their TPACK was developed in this process.

Agyei and Voogt (2012) reported on developing TPACK in Ghana among pre-service teachers by allowing them to work in groups, called design teams, to create a mathematics lesson using a spreadsheet. The pre-service teachers were workshopped on the basics of spreadsheets, mathematics concepts and TPACK. The groups presented others in micro groups and later to a larger group of peers. The pre-service teachers were thus modelling their knowledge of TPACK. Technological knowledge being the knowledge of spreadsheets; technological content knowledge being able to represent mathematical concepts in a spreadsheet, and knowing how to use spreadsheets in teaching mathematics; and technological pedagogical and content knowledge (TPACK) being able to represent mathematical concepts in a spreadsheet for teaching, and knowing how to use spreadsheets in teaching mathematics. Both the studies by Agyei and Voogt (2012) and by Guzey and Roehrig (2009) are similar in that TPACK was developed by doing, by getting feedback and by going back to the drawing board to improve. It is evident that one cannot

sit and study TPACK, it is learnt through active engagement.

How do we measure TPACK or know that we have successfully acquired TPACK? There are five ways listed in literature; self-reported measures, open-ended questionnaires, performance assessment, interviews and observations (Koehler, Shin, & Mishra, 2012). I narrated my journey of developing TPACK throughout the duration of this study. I do however believe there is no end point to this learning, as learning is a lifelong commitment.

TPACK “regards itself as a theoretical framework for understanding teacher knowledge required for effective technology integration”(Shu & Radio, 2016, p. 2). This framework has been used in various field for the development of ICT in mathematics (Niess et al., 2009), English (Shu & Radio, 2016), physical sciences (Cengiz, 2015). This study is based on discovering how a teacher can improve their teaching of Physical Sciences through the use of ICT and understanding their teaching through the views of others. The study is from a teacher’s perspective of what a teacher should know in order to teach using ICT. The knowledge areas for successful incorporation of ICT in teaching are based on the theory of technological pedagogical content knowledge (TPACK). The use of ICT needs to be beneficial and contextual for teaching and learning so this study also draws on how learners actively acquire knowledge from a cultural perspective and hence TPACK will be used in this study.

CHAPTER 2 THE SELF-STUDY RESEARCH PROCESS

2.1 INTRODUCTION

In the previous chapter, I stated the focus and purpose of the study and gave a rationale for wanting to conduct this particular study. I described the research location, background information and the theoretical framework that guides the study. I also gave a brief description of the methodology to be taken. I gave my research questions and indicated how I proposed to answer them using the self-study method.

The fundamental aim of self-study is to improve professional practice (Samaras & Freese, 2006). In this study, as a novice teacher, the aim was to improve my teaching of Physical Sciences in Grade 10 using ICT. Self-study in teaching allows one to solve challenges encountered in teaching through exploring them (Samaras & Freese, 2006). I explored the teaching challenges through planning of lesson and executing them. I identified and solved the challenges through my reflections, my classroom observations during the lessons, views from learners and the views of critical friends after they have observed my lessons. I wanted to improve my teaching through thinking about what has happened and finding ways to solve or fix the challenges encountered and then to repeat the cycle. The process of reflecting is where improvement is achieved, as it allows a teacher to think about what they have done, how they have done it and what they can do to improve (SanGregory, 2009). According to Taylor and Settlemaier (2003, p. 234), “Self-study is very supportive of practitioner research” in which teachers engage in classroom based research for the purpose of improving their students’ learning and for teacher-researchers to critically reflect on their roles as teachers who wish to enhance their teaching. Furthermore, Samaras (2002) explains that self-study is more than exploration of one’s self, the core of self-study is about the knowledge that one gains through this process.

In this chapter, I share my understanding of the research methodology, its underpinnings and its appropriateness for this study. I explain the research settings all the research participants in detail. I provide all the self-study practices used to generate data and how they will be analysed. Furthermore, I discuss the importance of ethics and trustworthiness in self-study.

2.2 RESEARCH METHODOLOGY

2.2.1 What is self-study?

Self-study is a method of research that one engages in, in order to improve one's professional practice. The researcher has a yearning to improve their practice via reflections and critique from critical friends. It focuses on the researcher's process of thought, learning, and state of mind before and after the research (Loughran, 2004). As noted in the previous chapter, teachers experience increasing frustration because they feel that they have no power to change the educational system. Self-study is designed to give power back to the teachers, as it is designed to encourage teachers to take charge of their own reform initiatives by asking questions about their context (Samaras & Roberts, 2011).

2.2.2 The purpose of self-study

The purpose of self-study is to understand and improve one's self and one's practices. It seeks to improve knowledge about one's self, because if I know and understand myself, I can do what I do better. As a teacher my purpose is to uncover my beliefs and understand why I teach the way that I do and reflect on these to improve my teaching in ways that would help the learner better understand the content (Loughran, 2004). According to Samaras and Freese (2006), self-study is for self and professional growth and development as well as school and classroom improvement.

The research methodology used in this study is self-study of teachers. This is a methodology undertaken by a teacher in order to improve their practice (Samaras & Roberts, 2011). According to Samaras et al. (2009), self-study teacher research has the following characteristics: it is a personal situated inquiry, a critical collaborative inquiry, involves improved learning, it is a transparent and systematic process of research and knowledge generation and presentation. Each of these characteristics is discussed further below.

2.2.2.1 *Personal situated inquiry*

Self-study is based on teachers' experiences where they are situated, and in their context,

which is the classroom. Through self-study, they can raise questions about what they observe, do and what happens in the classroom. Self-study gets educators to examine whether their beliefs about their teaching are their lived practice, or if there is a gap between reality and beliefs. This will open a door for professional growth and learning (Samaras & Freese, 2006). The process of self-study is motivated by asking questions about yourself and about your classroom. It gives back power to teachers as they are the direct recipient of the results. In this self-study, I asked questions about my classroom, which is the Physical Sciences Grade 10 classroom. I posed my own questions about my area of focus, which is the use of ICT. Studying my Grade 10 Physical Sciences lessons gave me an insight into my teaching using ICT and helped me be a conscious teacher. It answered many questions such as the following. Are the learners enjoying the use of ICT? Is ICT helping learners to reach the lesson objectives? How am I progressing in my use of ICT? Samaras and Freese (2006) state that as a teacher researcher, you have to be both participant and observer of your own classroom. This implies more than only seeing. One has to be open minded and look at the learners from different viewpoints, at different days of the week, different times of the day, and note how they interact with peers as well as the teacher.

2.2.2.2 Critical collaborative inquiry

Self-study maybe be understood as a study on the self, by the self, and as such it does not involve anyone else. But, contrarily, self-study relies heavily on working with others such as critical friends who will give helpful feedback, and give divergent views. I invited critical friends to observe lessons in which I was teaching using ICT and afterwards to shared their thoughts through an interview. I used their constructive criticism to improve areas of weakness in my teaching of ICT and prepare better lesson plans. Collaborating with others extends one's learning and raises issues one had not been aware of.

Critical friends also work to validate the quality and legitimacy of each other's claims. Data is valid if it can be tracked and where it can be confirmed by someone else. In self-study there is a danger of the researcher to be unintentionally biased so multiple perspectives such as those

provided by critical friends are ways to improve validity of the study.

2.2.2.3 *Improved learning*

The purpose of self-study is to improve the practice of professionals because the more teachers study their teaching, the more they understand it and find gaps in their practice that need improving with consequent improved learning. Improved learning takes place through reflections, because it is through the process of reflecting that the mind engages in thought processes that lead to improvement. Those that undertake such self-study become teachers that are aware of their teaching (Loughran, 2004).

2.2.2.4 *A transparent and systematic research process*

Self-study requires teachers to be honest, open and clear about their questioning, framing of thoughts and questions, revisiting of data and reframing of a researcher's interpretations. This openness shows the reader of the research all the processes that took place and so allows them to see that bias has been minimised, and the data analysis process was fair. It shows that the data is trustworthy and valid. The transparency just like validity is enhanced by critical friends.

Self-study is not an easy process. It is difficult because it places researchers in a place of vulnerability, where their beliefs, and values are open for critique (Samaras & Freese, 2006). When I first presented my proposal to the self-study reflexive researchers' group, I was very nervous. A few days later a voice recording of the presentation was given to us. I could not get myself to listen to the recording. I felt uncomfortable listening to myself, hearing my own voice. With that fear of what I was going to hear, the trembling voice and talking fast. There was some initial resistance in me to accept the process of change if it required listening to that voice recording. Nevertheless, self-study forces one to accept one's own imperfections and to change in order to do better.

2.2.2.5 *Knowledge generation and presentation*

The results of self-study contribute to the knowledge base of personal, professional and school development. The availability of the work in a public space that allows for critique

contributes to the accumulation of pedagogical, content and issue-based knowledge. The hope is that the benefits of the study do not end where it was situated, the classroom, but that it positively affects the wider community. By engaging in reflective practice, I become aware of aspects of teaching that I can share with others and hopefully it can be used for the development of others.

2.3 RESEARCH CONTEXT

This self-study was conducted at a secondary school in a small town on the south coast of KwaZulu-Natal in South Africa, where at the time I was teaching Physical Sciences, Natural Sciences and Mathematics. The school has a mixture of Black (African, Coloured and Indian) learners, with Black-African being the majority at about 95%. The majority of the learners come from the surrounding rural areas, some from the town and some from the shacks that surround the school. There was a mixture of learners from both middle and low socio-economic backgrounds. The school is poorly resourced for ICT.

The school fees are set at R1750 per year, and the school relies heavily on government funding. The school fees are used to pay for extra teachers that are paid by the school governing body, running water, clean flushable toilets and caretakers for the classrooms and grounds. The school is fenced and has 24-hour security guards. One of the main duties of security guards is to search learners when they enter the school premises to ensure they do not come in with weapons or drugs. Like most schools in the area we have a problem of drug abuse, especially marijuana, in the school. We teach at a time where in there currently is an upswing of violence in society, in schools, amongst the learners and between learners and teachers.

2.3.1 Research participants

2.3.1.1 Myself- the novice teacher

The main participant in this study was me. I am a 27-year-old female teacher at a secondary school. I am a novice teacher, who has been teaching for two years. I teach Grades 10-12 Physical Sciences, Grade 8 Mathematics and Grade 8 Natural Sciences. For the study I examined my experiences with ICT, how I had learnt it and how it had been used by my teachers in Physical Sciences and other subjects. I was thus both the researcher and a participant in this study. In such

qualitative research, the researcher is the primary instrument in data collection and analysis: she decides what information to collect and how to interpret that information. It is therefore vital that the researcher understands the issue of ethics and bias (Lichtman, 2012). In a research study, the identity of participants should be protected. In self-study, however, where the study is on the self, there is no such anonymity (Lichtman, 2012).

2.3.1.2 Learners

The other participants of the study were 15 Grade 10 Physical Sciences learners from the school where I am teaching. The majority of the learners from the school were not acquainted with a culture of learning or the need to do well, and so at the outset took little responsibility for their own learning. In this regard, when I started teaching at the school, I was astonished at the number of learners across all the grades who did not do their homework. For instance, frequently I would find that only two learners had done Physical Sciences homework out of classes of 21 to 35 learners. This indicated a lack of interest from the learners. I hoped that the use of ICT would develop their interest in and engagement with the subject and so they would become active learners. I also suspected that gathering data from them would be a challenge, and I therefore attempted to be creative in order to get their full participation.

2.3.1.3 Critical friends

In the study I had formal and informal critical friends. The former were three colleagues whom I had formally requested to observe in my classroom and so had asked them to sign a consent form. They came to my class and answered the critical friend questionnaires. The informal critical friends were those who, unexpectedly, had an impact in the study. These included friends and the self-reflexive group.

2.3.1.4 High school friends

There is a special name for every learner who attended our school, a member. Once a member always a member, which means one will always be a member even if they have left the

school. Our friendship went beyond high school. Two friends from my Grade 10 to Grade 12 classes assisted me in recalling and confirming memories from high school. I reached out to them because we were still close friends and so we were constantly in touch. I needed to recall how we had been taught Physical Sciences and specific ICT tools that were used to teach us. Thandi (pseudonym) is a female friend of mine, who is a now teacher at our high school and tried helping me recover pictures we took during our high school years. Lerato (pseudonym) is another female friend of mine who has good language skills, a good memory and is a critical thinker. When we were in school, she had collected papers and magazines so that she could do crossword puzzles. She assisted me recall some events and I sent her what I had written and asked her to confirm the accuracy of my recall and asked her to help me add more detail. Both friends gladly helped in these recollections of our school experiences.

2.3.1.5 Self-reflexive researchers

The self-reflexive group at UKZN comprised researchers, that is professors, lecturers, and postgraduate students, who specialised in the methodology of self-study. One of the professors is an expert with international status in the methodology. Over the course of the study I presented four times to this group: my research proposal, my proposed methods of data collection and interim findings for the first research question and finally, an overview of the finding for my third research question. Each time I presented my work, the group gave me insightful guidance on self-study methodology.

2.3.1.6 Supervisors

My two supervisors provided the driving force in the study. I avoided presentations, especially if I was being critiqued. Nevertheless, my supervisors believed in me and pushed me to present my draft work despite my reluctance. This made me focus and read more, thus gaining confidence in my study. The supervisors were also influential in guiding me with the methodology, formulating of lesson plans and learning of ICT tools.

2.4 DATA GENERATION

2.4.1 Self-study methods

In this study I used the personal history self-study method to answer the first research question: “How do my past experiences of information and communication technology (ICT) in education influence my teaching pedagogy as a novice teacher?” The personal history method allows the researcher to reflect on their own learning, which may have connections to the research question (Samaras, 2011). Accordingly, I reflect on my learning of ICT and how in the past I had been taught using ICT, by looking back in my life from primary school through to university. I also reflect on how this learning has affected the way in which I want to teach in my classroom.

For my second research question, I used the developmental portfolio self-study method to answer the question: “What are learners’ responses to my teaching after the use of information and communication technology (ICT) in Grade 10 Physical Sciences?” Samaras and Freese (2006) explain that, “A developmental portfolio presents an opportunity to store, catalogue and study your professional growth over a selected period of time” (p. 8). So, this portfolio is where I stored all my reflections, data sources such as learner suggestions, feedback from critical friends and interview transcripts.

I used the developmental portfolio to answer the third research question: “How can I learn ICT pedagogical tools and use them to better teach Grade 10 Physical Sciences?” This method involved recording my progress in learning ICT tools, informal and formal lesson preparations, critical friends’ feedback and post- lesson reflections.

2.4.2 Collecting data in self-study

Table 2.1 below gives an overview on how I will answer the research questions. It gives the specific self-study methods, data generation activities, data sources and how the data will be analysed for each question.

Table 2.1 Data generation methods and instruments

Research Question	Self-study methods	Data generation activities	Data sources	Analysis
1. How do my past experiences of information and communication technology (ICT) in education influence my teaching pedagogy as a novice teacher?	Personal history	1. Reflecting on my past experiences of ICT	1. Photographs 2. Drawings 3.PGCE course material	Narrative
2. What are learners' responses to my teaching after the use of information and communication technology (ICT) Grade 10 Physical Sciences?	Portfolio	1. Conducted conversations with learners and with critical friends. 2. Distributed anonymous questionnaires. 4.Audio record lessons 5. Observed lessons	1. Reflection journal 2. Lesson and interview audio recording. 3.Record learners views	Thematic analysis
3. How can I learn ICT pedagogical tools and use them to better teach Grade 10 Physical Sciences?	Portfolio	1. Taught myself how to use PHET simulations 2. Planned lessons using PHET simulations, videos and PowerPoint presentations. 3. Reflected on lessons, activities and learning. 4. Critical friends observed lessons and gave feedback. 5. Held conversations with colleagues and friends.	1.Lesson plans 2.Reflective journals 3.Critical friends' feedback/ questionnaires 4. Lesson plans	Narrative analysis

2.5 DATA GENERATION TECHNIQUES

2.5.1 Personal narrative writing

I used narrative writing to describe my past experience of ICT to answer my first and third research questions: “How my past do experiences of information and communication technology

(ICT) in education influence my teaching pedagogy as a novice teacher?” and “How can I learn ICT pedagogical tools and use them to better teach Grade 10 Physical Sciences”. I used photographs, drawings, and PGCE course material to recall and record my past experiences and serve as evidence of what had taken place. Personal history or lived experiences are a necessity in self-study. The context of the researcher plays a significant role in how they see the field and belief of practice (Loughran, 2004). Autobiographical writing can be beneficial to others. So instead of asking, “Why would anybody be interested in my unimportant life?” we should rather ask, “What experiences, issues, stories from my life can be of benefit for others?” “What is it, in what I say, that others might recognise in themselves?” or “What can I learn from getting to know myself better?” (Taylor & Settlemaier, 2003, p. 235).

2.5.2 Collaborating with others – critical friends

Self-study could be mistaken for a study undertaken by individuals who are withdrawn from other people, who are only concerned about themselves and the world around them. The term is misleading as it creates an impression of isolating the researcher, as they gather and interpret data solely by themselves (Loughran, 2004). However, self-study is not intended to exclude the input of others. By contrast, the involvement of others is an essential part in self-study and in the critical analysis of data. The purpose of bringing other people in is to gain positive feedback that will be beneficial in reaching the aims of the study and answering the research questions. This feedback must be honest, constructive and encourage the researcher to question how other people may interpret the research (Lunenberg & Samaras, 2011). Other people bring perspectives are perhaps your blind spot. Other people do not see things as you see them, so they may bring in fruitful ideas that you would never have thought of (Samaras & Roberts, 2011). Similarly, Samaras and Roberts (2011, p. 43) outline the benefits of having critical friends in teacher self-study is as follows.

Self-study requires critical collaborative inquiry. Self-study teachers work with critical friends in an intellectually safe and supportive community to improve their practice by making it explicit to themselves and to others through critical collaborative inquiries. Self-study is personal and interpersonal with learning, thinking, and knowing arising through collaboration and feedback from others. Working with colleagues helps extend and

transform an individual's understanding. Critical friends encourage and solicit respectful questioning and divergent views to obtain alternative perspectives, and they work to help validate the quality and legitimacy of each other's claims (p. 43).

Critical friends have been used by self-study researchers and their views have, in some cases, shaped the results of the study and given direction to the study. For example, Chatree Faikhamta, a science teacher, states that, "the second author acted as my critical friend who gave me helpful suggestions and helped me critically reflect on my experiences in this self-study" (Faikhamta & Clarke, 2013, p. 963). In my study the role of critical friends played a significant role in how I viewed my teaching using ICT.

2.5.3 Audio recording of lessons

Video and digital recordings assist in preserving events in their original form. They can be replayed, which helps researchers to remind themselves of events and examine material extensively and repeatedly (Bullough Jr & Pinnegar, 2001). I recorded the lessons where I had used ICT. I listened to these recordings several times after the lessons to gain insight into what had happened in the classroom. In this regard, Masinga (2013) states that:

Being a participant in my own research left me wondering at some points about how much I was missing as I too become involved in the process of finding my own self in self-study within the research. I was able to replay the recording of the sessions after each meeting; in this way, I gained more insight into what was happening and further analysed the responses and the discussions that took place (p.34).

Along these lines, it was therefore vital for me, as an active researcher, to have these recordings for my reflections, which were used during the data analysis.

2.5.4 Class observations

In this study, class observations were done by both critical friends and I. The critical friends acted as passive participants (Spradley, 1980), who were visible in the classroom but did not interact with me or the Grade 10 Physical Sciences learners during the lesson. I had two roles in

the classroom. One was the role of active participant, as I was fully part of the lesson as the teacher. But I was also an observer, noting what was happening in the classroom. The amount of information available for observing in a natural setting was overwhelming so I had to focus on aspects pertinent to the study. Both the critical friends and I focused on my use of ICT in the classroom for the 1-hour lessons.

2.5.5 Lesson plans

I was teaching Grade 10 Physical Sciences, so it was imperative that my lessons and lesson outcomes were aligned with and were guided by the Curriculum and Assessment Policy Statement (CAPS document). The chosen ICTs and activities had to align with the outcomes of the lessons. My lesson planning thus involved a cycle of decision making about which ICT to use to teach each topic and the justification for this, and the classroom activities to undertake. My reflections, audio recording, learners' views and critical friends' and my observations for each lesson informed how my subsequent lessons were planned. These lesson plans reveal the transformation of my practice as I implemented ICT in the classroom.

2.5.6 Reflective journal

Reflection on one's practice is a common theme in self-study. The process of reflection is where change and improvement of one's practice is achieved. It allows teachers to think about what they have done, how they have done it and how it can be improved (SanGregory, 2009). During this process new questions and ideas arise that conflict with their current knowledge and beliefs about their pedagogical practice and so lead to action towards improvement (Loughran, 2004). According to Loughran (2004), in self-study these processes are not reserved for only the individual but are made public for review and critique (Samaras et al., 2009).

I kept a researcher's journal, where I wrote down all my reflections, notes and preliminary ideas on the unfolding, enactment and assessment of pedagogical strategies. In Loughran (2004), this is referred to as a portfolio of reflections, where reflections are defined as: "an intentional act of mind, engaging a person alone or frequently in collaboration with others in interrogating one's teaching, especially a compelling or puzzling situation of teaching or learning to construct an

understanding of some aspect of it” (p. 1077). The act of reflection is, thus, a process of the mind whereby I looked back on my notes, the comments from critical friends, happenings in the classroom and searched for improvements. Loughran (2004) goes on to state that: “Through reflection portfolio makers revisit their own teaching and learning, identify strengths or areas for refinement, critique what succeeded or failed and why, or pursue some aspect of student learning. In this reflective process, teachers uncover the knowledge of the meanings and interpretations they make of their own practices, their refinements of theories, their understandings of what students know and understand, and how they as teachers need to change or try-out new practices (p. 1077).” Therefore, in order to experience change or transformation, I explored what had happened, why it happened, and how my teaching through ICT could be improved.

Kember (1999) classifies these three actions under non-reflexive actions: habitual action is doing something so often, that one does not even think about it. Like riding a cycle. Thoughtful action is thinking about what you are doing but with no intention to change it. Introspection is recognizing something within one’s self whether it is an emotion or an action. He further classifies reflective actions as content, process, and premise reflection. Content reflection is concerned with the what, what we feel, act on and perceive. While process is concerned with the how, this is the method or manner of thinking. Content and process reflection are equivalent in level. In this study both content and process have been used. In chapter three I use content, I reflect on past experiences and identified and reflected on what happened in my past experiences that influence my teaching with ICT. I reflect on my lesson planning and teaching with ICT where I look at how I taught the lesson plans and taught.

2.5.7 Interviews, conversations and questionnaires

Qualitative interviewing is a generic term that describes a group of methods that allow a researcher to have a dialogue with the participants. These methods range from a highly structured interview to one that is completely unstructured. A conversation is considered to be an interview if it is directed by the researcher; being therefore a conversation with a purpose. All interviews must involve thorough advance planning if they are to serve the purpose of collecting pertinent information about a certain topic (Lichtman, 2012).

I used both open in-depth interviews with my critical friends and also formal interviewing using a structured questionnaire with learners. I chose to do open in-depth interviews with the

critical friends in order to allow them to express themselves freely without restrictions about my use of ICT in teaching Physical Sciences in Grade 10. I did not want to limit them with my questions because they are more experienced in their respective education fields. Thus they have been fruitful in my study because this strategy of interviewing allowed me opportunities to explore other issues and ideas with the participants (Bullough Jr & Pinnegar, 2001). I decided to use formal structured questionnaires with the learners because, being less experienced, they needed guidance in communicating their views about my use of ICT in the classroom. Formal questions allow the participants to give views specifically about the topic taught in class using ICT (Bullough Jr & Pinnegar, 2001). I wanted to find out specific information about my use of ICT in the classroom. ICT has been praised for getting learner attention, getting learners involved, improving conceptual understanding and capturing learner interest. In developing the questionnaires, I wanted to get learner feedback about these and also about my use of ICT. I wanted to know if the ICT tool used showed what I meant to show, if I handled the ICT tools well and my confidence in using them.

In answering the second research question, I needed to get the views of learners in Grade 10 about my teaching after having used ICT. I then reflected on these views to order to understand my teaching using ICT through the learner's responses.

To collect the data, learners were given questionnaires (Appendix J) after my use of ICT in class in teaching the topic waves, sound, and light. There were 20 learners in my Grade 10 Physical Sciences class but only 7 returned their parental consent and personal assent forms (Appendices E and F, respectively). Since the learners are minors, consent forms explaining the nature of the study had been given to the learners to get permission from their parents or guardians and an assent form indicating their agreement to taking part in the study.

In order to generate the most meaningful data from learners, specific questions were necessary guide them on what to comment on about the ICT used in class. After the questionnaire responses were collected, I found that the answers given by learners were superficial; some simply answered yes or no. So, I then had to go seek deeper answers during the interviews.

Three of my critical friends came to observe my teaching with ICT, each observing only one lesson. The data from critical friends could have been strengthened by each critical friend observing the whole series of lessons as I used ICT so that they could track my progress. Unfortunately, this was not possible; it was already a challenge just to ask critical friends to use 'free periods' to observe my lessons, and the ones that agreed could only observe one lesson each.

This is the harsh reality of a schoolteacher as not only is everyone busy focusing on completing the syllabus, but ‘free periods’ are scarce and precious. This meant I had to reflect thoroughly on my own progress and get as much from the critique of the lessons that the critical friends observed. For anonymity, I refer to my critical friends as A, B and C. Each of the critical friends sat at the back of the class for the lesson they observed, and was given a questionnaire (Appendix I) to fill in. The data from each critical friend are presented after the profiles of the three critical friends.

2.6 DATA REPRESENTATION

I represented my past experiences using personal narrative in order to answer Research Question 1 of the study, which is to examine how my past experiences of learning with ICT had affected my current teaching practice. Personal history narrative allows one to reflect on one’s own learning in order to find connections with one’s research interest. It allows one to examine who one is as a teacher, find one’s identity, the motivation behind one’s goals etc. (Samaras, 2010). As I narrated the story of my learning of ICT and how it was used when I was taught, I hoped to find and reveal connections related to how I became the person I am today in the classroom. Self-study thus allowed me to understand the origins of my current beliefs about what a classroom should be like and what should happen there when new strategies or transformations take place. I used my personal development portfolio to answer Research Questions 2 and 3. A development portfolio allows one to leave a footprint of one’s project, it allows openness to the public and to critical friends for feedback. This portfolio is where I stored all my reflections, lesson plans and all data collected. It was thus more than a storehouse for data; it was a systematic way of representing data in order to be able to keep track of my progress.

2.7 MAKING MEANING OF DATA

Data interpretation is the process of bringing all the data collected together (Phillips & Carr, 2014). Samaras and Roberts (2011) stress that data interpretation is not a linear process, since it involves going back and forth between collecting and analysing; it is an on-going process. Although qualitative research can be both deductive and inductive, (Lichtman, 2012) notes that it is generally inductive as it is used for examining and getting ideas and feelings of the participants.

In this study I employed narrative analysis, which involves the telling of stories or

experiences from the data (Lichtman, 2012). It is a family of approaches to different kinds of text (Riessman, 1993). Self-narrative can be likened to fiction, but according to Bullough and Pinnegar (2001) there must be a balance between the self and the self-engaged in practice.

In Chapter 3, I used the narrative strategy to tell of my past experiences with ICT and Physical Sciences narrative analysis involves trying to make meaning and understand the story. I told my story while keeping a balance between myself and myself in practice by telling moments in my life that are related to my encounters with ICT. I will analyse this story, problematise it so that it answers my research question two. In telling my story I have used memory work, photographs, drawings and artefacts in order to express the nodal moments to the reader. I used photographs and drawing to assist in recalling my memories of past experiences.

Thematic analysis was used to analyses learners' views and the input from critical friends. Thematic analysis belongs to the family of narrative analysis, however the focus is not on the "what" is said rather than "how" it is said. It involves carefully reading and getting familiar with the data and finding recurring concepts or themes, which are then grouped together (Phillips & Carr, 2014). So, for the learner views and critical friends' feedback, analysis involved me reading and re-reading the data until I was familiar with it and could find recurring themes that could be grouped together.

2.8 ETHICAL CONSIDERATIONS

In educational research ethics are concerned with protecting the well-being and interests of participants; thereby ensuring that they are not harmed by the research. The identities of participants must be hidden as much as possible (Bigger, 2005). To ensure anonymity and confidentiality, the school name and real names of the learners and critical friends were not used. I restricted the use of digital technology to only audio recording, and photographs showing faces of learners were not used in order, to protect their identity.

Participants in the study need to be aware that they will be studied, and they need to give their informed consent (Bigger, 2005). Accordingly, I gave consent letters to the learners' parents or guardians (Appendices D, E and F) and critical friends (see Appendices G and H) explaining the nature of the research and I stressed that their participation was voluntarily. Permission for the

research was also obtained from the school principal (Appendices A, B and C). Ethical clearance from the University of KwaZulu-Natal was also sought and granted (Appendice M).

2.8.1 Trustworthiness and validity

In self-study research, trustworthiness is established by giving very clear and detailed explanations of what *data sources* are used and how data are *generated, represented and interpreted* (Feldman, 2003). In Section 2.2, I explained and gave examples of how I followed each of these methodological guidelines in my self-study research. It is also important to use *multiple methods* to gain a variety of different perspectives on what is being studied (Pinnegar & Hamilton, 2009) and to share my work in progress for feedback from *critical friends* (Samaras & Roberts, 2011). Chapter 2.4 discusses data generation and the different tools that were used in this study. Another important aspect of trustworthiness in self-study research would be to give evidence of how my educational understanding and practice has *changed or improved* through the study (Feldman, 2003). In chapter 6 I reflect on my learnings and how my views have changed as a science teacher, the knowledge, and skills that I learnt and in general educational views. It is also important to use *multiple methods* to gain a variety of different perspectives on what is being studied (Pinnegar & Hamilton, 2009) and to share feedback from *critical friends* (Samaras & Roberts, 2011).

Self-study is a narrative by the researcher, so it is difficult to specify what counts as validity. Because in a self-study, the study cannot be tested by being replicated by other researchers (Pithouse, 2007) as with other research methods. “Validity usually refers to the degree to which a study accurately reflects or assesses the specific topic that the research is attempting to measure” (Feldman, 2003, p. 26). This means that I have to ensure that the research questions of the study are answered. Nevertheless, in qualitative research, trustworthiness of the study can be assessed by the study’s credibility, transferability, dependability and confirmability (Korstjens & Moser, 2018).

2.9 RESEARCH CHALLENGES

The school where I was teaching lost two weeks of teaching time due to the grade 10’s subject streams being changed. This had a tremendously negative affect on my teaching for the

study. I could not fully explore the topic fully using ICT and do all the activities with the learners. According to the CAPS document, the topic of waves, sound and light is supposed to be taught for four weeks. However, due to time constraints I could only allow one week and a half. Therefore, I had to alter my lesson plans by removing some of the previously planned activities and hence there was less time for learners to engage with the content. Consequently, I had to give extra classes and use break times to teach. Despite this extra teaching, the learners were disadvantaged, because I believe that the focus should be on the learning process rather than teaching just to cover the syllabus. This meant that the data to be collected from the study decreased, this data includes response from critical friends and learners, my reflections and audio recordings.

Another problem arose with a change in school leadership. I had started the study in 2018 with the principal having given permission for me to conduct the study and being supportive of my research in the school. But in 2019 when the school principal retired the school changed leadership. The new leadership did not understand the nature of my research and what it entailed and how valuable such research is to education. I was asked to stop doing my research. This resulted in unhealthy relationship between me and the leadership because I continued to teach with ICT, which was seen as being disobedient. Furthermore, one of the teachers in the management team was opposed to the research and had a daughter in my class who influenced others not to participate in the study. I taught the whole class in the same way, but the learner who did not sign the consent forms did not answer the questionnaires and interviews. This led to me having a smaller number of participants in the study than was originally planned. This reduced the learner response data for the study. This meant that the conclusion I had for the learner responses was based on a fewer number of learners and this reduced the reliability of my findings.

A further problem was the school being under resourced, hence teaching with ICT was limited; for example, the school did not have computers with internet access for the learners to use. I addressed this problem by downloading the simulations onto my laptop at home, but then in my lesson plans I was restricted to working with only one group at a time using my laptop. Nevertheless, it did serve its purpose. Simulations can work as a lecture or demonstration, but they work best when learners explore them themselves. This allows them to challenge any misconceptions that they have and build their own knowledge (Eyyam & Yaratana, 2014). My findings are limited to only the lecture method because we did not have a computer for each individual

2.10 SUMMARY

In this chapter I have explained the self-study research process and its appropriateness for this study. I have given a detailed account of the research context, and research participants. I discussed data generation techniques and sources and the analysis and interpretation of the data thereafter. I have given details on how trustworthiness and ethical issues were managed. I have outlined the challenges faced during the study and indicated how I resolved them.

In the next chapter, I discuss my past experiences when growing up in a rural community, my primary school days, high school days and university days, and how these have influenced my views of teaching using ICT. I use photographs, memory recall, and memory drawing to share my experiences.

CHAPTER 3

MY PAST EXPERIENCES WITH ICT

3.1 INTRODUCTION

Climbing Mount Everest is seen as an accomplishment because it is the highest point on Earth above sea level. If a climber wants to climb Mount Everest they have to prepare very well for the climb. Some aspects such a climber would have to work on is their level of fitness, their mental preparedness, and their willingness to complete the climb. Doing this self-study can be compared to climbing a mountain; both in the initial planning stages and during the process. This enduring metaphor can be used to capture my journey through in this study. It seemed difficult because of the challenges that I faced and steep because it required a lot of energy. This is illustrated in Figure 3.1 below.

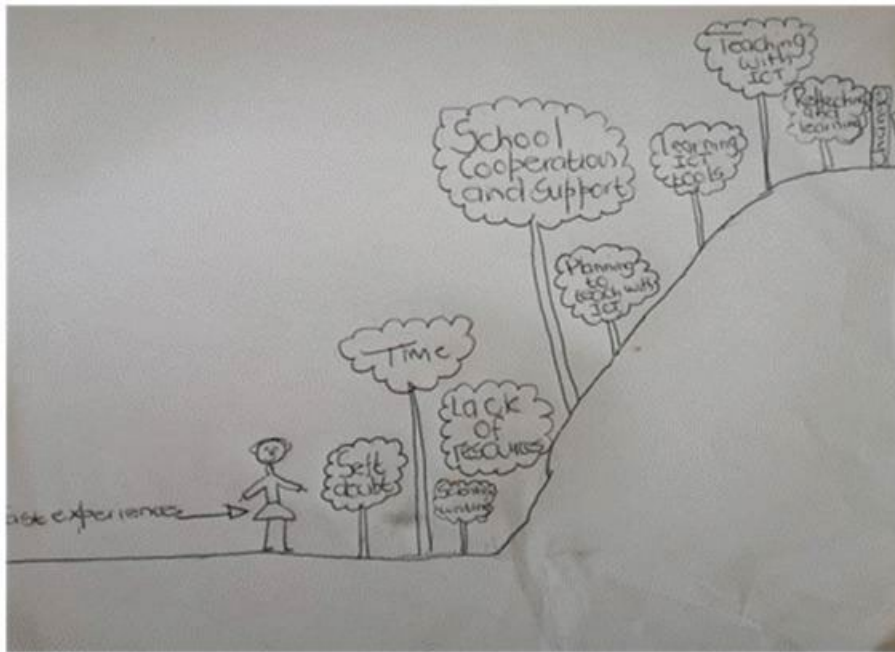


Figure 3.1 An illustration of the mountain I had to climb and the challenges I faced on the way

As indicated in the drawing before climbing the mountain had to go through some experiences, which are my past. As I was climbing up the mountain, I went through obstacles. It is because of my past learnings and experience of ICT that I am able to preserve and go up

mountain which is teaching with ICT. They pushed me to persevere and to overcome challenges. The trees on the mountain represent the challenges that hindered my progress in the study, some of which were described in Section 2.9. The first challenge I came across was with myself, internally; doubting myself. Would I be able to design a study, and actually learn from it? In this regard, I believe that without the challenges of time, I could have obtained better results and learnt more from the study. Another limiting factor of this experience was lack of resources. The study was restricted to lessons of a lecture type, using ICT. As described earlier, the school management were not supportive at all and made it almost impossible to conduct the study at the school. Teaching with ICT takes a lot of planning, I had to spend time planning the lessons. The scariest challenge, which made me feel that I was getting far out of my comfort zone, was teaching with ICT. The last challenge was realising that I had to change after the reflections.

Using the Mount Everest metaphor, once I have reached the top of the mountain, once I have done all the acclimatization climbs and overcome all the challenges, there will hopefully be change within me. After the change, after being on top of the mountain, I have to return down again but I will be a different person because of my experience of having gone through the climb. Just like a person, mountain climbers use tools to assist them along the way. The main tool used by climbers is an oxygen tank because the amount of air, and hence oxygen, decreases with increasing altitude. Even though the climber's body has to some extent acclimatized and got used to breathing the air at high altitudes, the extra oxygen assists them. My oxygen tank was the level of support and encouragement I received from friends, supervisors, and family. It kept me going and encouraged me to keep on. My past experiences shaped my passion for wanting to use ICT, and also encouraged me to keep on learning.

After climbing Mount Everest, a person would share their wonderful experience of the climb with others; they would reflect on how they could have made the climb easier and how they overcome the challenges etc.

In the picture in Figure 3.1 above, I can be seen at the bottom of the mountain, behind me are my past experiences pushing me and I am about to start climbing the mountain. The climb is steep, and it has obstacles along the way, just as I encountered.

In this study the aim is for self-improvement and development, professional development and improvement, and classroom and school improvement (Samaras & Freese, 2006; Samaras & Roberts, 2011). As a novice teacher I wanted to improve my pedagogy using ICT in the teaching

of Physical Sciences through my own reflections, those of critical friends and learners' views. I documented my progress in a development portfolio which allowed me to redraw and reshape myself for improvement. I chose to improve my teaching using ICT because of its many advantages in teaching, especially in the sciences because of the abstract concepts they comprise, ICT models these concepts visually and makes them more understandable for learners (Maharaj-Sharma & Sharma, 2017). The ICTs focused on are MS PowerPoint presentations, videos and PhET simulations. I had developed technological content knowledge for videos and PowerPoint presentations prior to embarking on this self-study but had none related to simulations. I track my progress in learning and acquiring technological pedagogical and content knowledge in these ICT tools as well as well as my ICT pedagogy.

In Chapter 1 I stated the focus and purpose of the study and gave a rationale for wanting to conduct this particular study. I described the location or background information and the theoretical framework that guided the study. I also gave a brief description of the relevant methodology. I gave my research questions and how I aim to answer them using the self-study method. In Chapter 2 I shared my understanding of the research methodology of self-study and its methods, data representation and analysis, as well as the ethical considerations and trustworthiness of the study.

In this chapter, personal history narrative is used to answer the third question of the study, "How can I learn ICT pedagogical tools and use them to better teach Grade 10 Physical Sciences?" I also explore how my educational background has influenced my teaching today.

3.2 MY PRIMARY SCHOOL DAYS

I can remember the funeral very clearly, it was so full of people, and people threw stones at the bus when they did not get space to get on the bus to the burial site. I can remember the coffin going down slowly. He was a good man indeed. Even to this day I am reminded of what a kind, humble person he was. "He was very clever you know", my aunts would say. "He was a surveyor you know" I am told by members of the community and his friends. It was these words that constantly motivated me to get an education. It was soon after my father's funeral that my family left Mnamatha, in the Valley of a Thousand Hills to move to the red soil of KwaXimba (Figure 3.2), Ehlanzeni in Cato Ridge in KwaZulu-Natal (KZN). When I mention my family, I am referring to my grandmother, my aunts and uncles – that was my family, I called my grandmother 'ma',

aunts 'sisi (sister) and uncles 'bhuti'(brother). It's what made sense in my head. These two places, my old home and new environment were not more than 20 km from each other, but Ehlanzeni was more rural, further away from the nearest town, and city life. The soil was red, and made bright clothes dull, in isiZulu-my mother tongue language, it is referred to as 'isibovu' (red sand). Here, it was extremely hot compared to what we were used to.



Figure 3.2. Our **home** at KwaXimba

There were only a few homes with electricity and water. We connected to the electricity supply from the nearest house with a thin wire cable and got water from that house until our home was registered as our own. The electric power was so weak that I remember the light bulb being just a flicker, enough for us to see each other but I could not read under this flickering light. When it rained, the switch would flick off and as young ones, we would go and try to figure out where along the cable it had burnt. This was a tedious task because sometimes it was damaged in more than one place. Each time we would walk to the house where we connected to the electricity supply (which was not close) so that the electricity could be switched off, fix the cable and then go back and to ask for the switch to be put back on. Then we would go home to check if the lights were on, and if not, we started the process all over again. This was a dangerous and laborious process, but I did learn about electricity and how to work with it safely.

The electric power we drew was purely for electric lights. Below the house I have labelled 'egoqweni', which is a place where firewood is placed. We would go out early on Saturday

mornings to gather firewood from the nearest forest. We used the fire to heat water for bathing, and a paraffin stove or fire was used for cooking. There were no phones or laptops to charge. Until 1999 we did not have a television set. It was watched only at night, starting at 8pm to be exact, when *Generations* came on, which was a popular soapie back then and still today. It was that year that one of my uncles got a VCR. This meant that after school or on Saturdays, if he was in a good mood, we could watch Jackie Chan, Van Damme and all those karate movies. My personal favourite was Van Damme's *Blind Spot*. I was amazed by Van Damme's ability to continue to fight even when he was blind. We were the only family at that time to have a VCR, and so the neighbourhood children, and even male neighbours would come and watch. The children would quietly sit on the floor with our legs crossed gazing at the 54 cm old fashioned CRT-TV, while the adult males sat on benches.

The main form of communication in our area was word of mouth. We would generally write letters to invite members to ceremonies we were planning, and us kids would deliver them to all the neighbours, some located quite far away. Even though the neighbours already knew about the ceremony, a letter of invitation was a must or neighbours would consider themselves as not invited. It was rude not to invite all the neighbours if there was a slaughter, so these letters were very important. I was given the task of writing these letters while my grandmother dictated what I was to write. Even though I was the youngest I was considered smart because I knew how to spell and write fast. In this way I developed and practised my writing skills in IsiZulu. Urgent telephone calls could be made at a cell phone network (usually Cell C or Vodacom) that was housed in a recycled shipping container at the bus stop and where we were charged R1 per minute.

It was only in 1999 that the power of quick communication technology was introduced to the community. The community was ecstatic when solar powered prepaid landlines were installed at every house. Gone were the days of walking long distance to deliver a short message. Most frequently, the landlines were used to relay messages from adults who had gone to town to do groceries. In Pinetown, the nearest town from Cato Ridge, there were plenty of phone stands that charged people to make phone calls. The adults would call from these stands to the home landlines telling us children that they were now getting on the taxi so we must make our way to the bus stop, with a wheelbarrow to help to carry the load. Before the landlines, the adults would estimate the time that we would need to be in town and when we needed to be at the bus stop, and, of course, most of the time there were delays, which meant we would wait and play for hours in the sun at

the bus stop. Every time a taxi approached, we stopped what we were doing to see who would get off. If it was not our parents, we would sadly continue with the games we played while we waited. Even with the landlines, many other households in our community broke or misused their landlines, so we ended up being the only family with a landline, which other people used to call. So, to the disadvantage of the children in our family, we, once again, then had the dreaded task of delivering messages, which did not make us happy. Nevertheless, these early experiences offered me opportunities to develop communication skills and experience and appreciate the advantages of communication technologies.

Through all these limitations, this was the life we knew; I knew. I did not complain about it, I did not know that life could be any difference, to me everybody lived like this. I did not get the opportunity to see what else was in the world. The Jackie Chan movies we watched were just movies, the impossible because I knew no one could withstand a spin kick like that. I was not only physically bound to my rural areas but mentally as well. I did not dream of a life any difference.

I do not have classroom memories of my schooling in Mnamatha Primary School where I completed Grade R and Grade 1 before the move to KwaXimba. My new school in KwaXimba was opposite our new family home. I remember my first day at Nomfihlela Primary School in 1998, where I was going to do Grade 2. We were a group of about 50 learners in the class and I sat at the very back. Our teacher asked us what year it was. The class was silent, no one answered, until I proudly raised my hand and answered that it was 1997. I remembered very clearly that the year before in Grade 1 we had been told it was 1997. To my surprise I was wrong. In explaining why I had been wrong, the teacher moved me along on my journey of understanding the concept of time, which is an important concept in Physical Sciences. To me we lived in that year forever. It was all very interesting to me when I first heard it. Traditional methods of teaching were used throughout the school. The classroom had a big chalkboard where the teacher would write clearly with white chalk. The use of corporal punishment was common.

3.2.1 Learning the English language and first experience of a computer

My life changed when my biological mother came on one of her periodic visits. She asked my grandmother if I could come and live with her so she could take me to a multi-racial school. This was five years after the democratic elections in South Africa, which had brought the end of apartheid, after which schools were no longer segregated by race. African schools were poorly

resourced compared to the ‘model C schools’, which had historically been for only white learners and were well resourced. During this period, it was common for African parents who could afford the school fees and transport to move their children to model C schools in the towns with the hope of the child receiving a better education.

I had to travel by bus to school and back. From the bus stop I used to walk in between houses in the suburbs. I got used to dogs coming to the gate to bark, eventually I stopped running, I understood that they have no way out. This opened me up to seeing other forms of life, different shaped houses in a different setting. I got to see how other people lived. I got to see people of other races. I read books, magazines, watched movies, went camping, beach trips. Moving to this school physically removed me from the rural area physically and mentally. I started believing that maybe I could be something else besides getting married and bearing children. Then I wanted to be a dentist.

When I got to Hillcrest Primary School I did not know where to go and could not speak a word of English. I simply followed a line of learners and ended up in a classroom, where I sat quietly at the front while I listened to other learners’ chatter in a language I did not understand. The teacher gave me a handful of pencils. I realised that she wanted me to hand them out, so I did. But I forgot to leave one for myself, so I sat there without a pencil, being unable to ask for one. A while later, two teachers came and talked with the teacher and my name was called. I followed them to another class which was decorated with numbers, alphabets and all other colourful things. It turned out that I had been in the wrong class, Grade 4. I was meant to repeat Grade 3. I did not understand why because I had passed Grade 3 very well, and at the new school they did not know my capabilities. But apparently, it was normal for learners from African schools to repeat the grade when they moved to a model C school.

I have a hard-inflexible Zulu tongue, so it took a while to gain confidence to speak in English, even though I understood the language. My mother and teacher made sure I always had a book to read from the library. In addition, I attended extra English classes at the school. In addition, each year the school had a speech and drama presentation, which I was encouraged to be part of in order to further practise my English. Figure 3.3 shows one of the certificates of participation I received during my second year at the school speaking English. It is evident that I was still struggling, as the comment by the teacher states that I should keep on practising and soon my

English would be fluent and accurate.

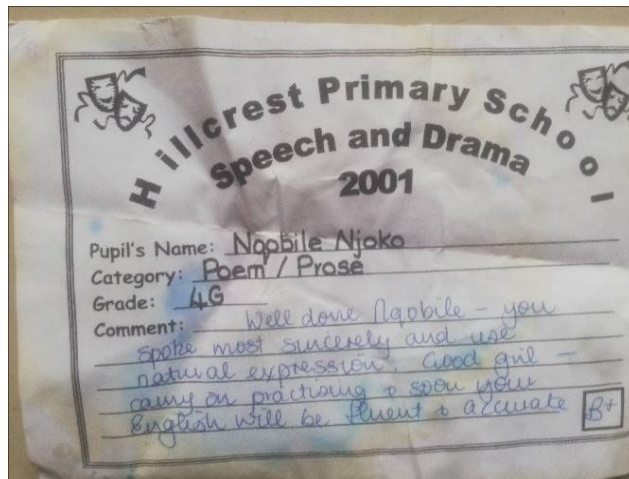


Figure 3.3. My certificate and feedback from participating in speech and drama

English is the language of technology, of trade, of education, of communication, the list is endless. I did not think anything of it back then but learning English played such an important role in my life. I have watched those we went to school within the rural areas struggle in life because of their lack of English proficiency. I helped them with making CVs, writing of motivational letters, knowing very well that even if they were hired, they would not last long in their jobs because of their English. Even though on paper the language of instruction at schools in English, in reality it is not like that for all schools, especially in the rural areas.

Hillcrest Primary School is also where I was first introduced to a computer. I had never seen one before, and I did not know what it was. In my computer teacher's words, "Nqobile is terrified of the computer". Fortunately for me I had a patient teacher who would attempt to speak isiZulu and assure me that the computer would not bite. By the end of the year I was used to the computer and, like other learners, would be excited about our computer lesson where we always had fun. We would line up outside the computer room eager to go inside. Mrs Purple would check our hands if they were clean before going in. We would play on a learning program called Jump Start Adventures and go to all sorts of adventures. By the end of Grade 7 in 2004 I was able to navigate my way around a computer, I could work on most Microsoft Office documents. However, my progress was slower than that of most other learners because the only opportunity I had to explore a computer was during school computer lessons.

Another thing we looked forward to at school, besides computer lessons, were Friday

afternoons. This was a time where we went to the media room to watch a movie. At first, to me it felt weird to be watching movies at school. Were we not meant to be learning? But I actually learnt a lot in those movies, as every movie had a lesson, about which we would debate afterwards. Even though I never participated in the discussions at school I made sure I shared the stories and points of view when I got home. All of this excited me and hyped me up so much because I did not know such things existed. I guess when you did not grow up with something you overvalue it.

3.3 MY HIGH SCHOOL DAYS

When I completed my Grade 7 at Hillcrest Primary School, I moved to Hillcrest High School. To my disappointment, at Hillcrest High School there were no computer lessons, although computers were available at the school library. I had grown fond of the computer, so I spent my break times at the library where I explored the computer by myself. There was freedom to do whatever I wanted without a teacher or a set task. I discovered Microsoft Publisher, with which I could make different types of cards. Now that I could speak English and went to a multiracial school, people gave me attention and credit; possibly more than I deserved. These are my friends from the rural areas, family even. So, when one of my aunts was getting married in 2006, I offered to make the invitation cards for her wedding, using those library computers. Looking back, they were not nice at all, but certainly better than the invitation letters that we use to hand write as children.

It is a wonder that I performed well in Grades 8 and 9, with the distractions around. By then, my friends and I all had cell phones. Mine had been handed down to me by my aunt, as there was no way my mother would buy me one. Communication was so easy and cheap; we did not even need airtime. There was a popular chatting site during 2005 and 2006 called mxit, similar to WhatsApp, and this is where we communicated. All we wanted to do, even in class, was to chat. I remember sitting at the back of the class during Economics and Management Sciences (EMS) and Social Sciences (SS) and chatting with friends on mxit. I found lessons in those two subjects boring, the subjects had copious amounts of notes. But when I tried that with my IsiZulu teacher,

who was more alert, she confiscated my cell phone. I was devastated.

3.4 INANDA SEMINARY – A PRIVATE SCHOOL!

I did well in mathematics during Grades 8 and 9, which afforded me with the opportunity of attending an all-girls private boarding school, Inanda Seminary, from Grade 10 in 2007. Sadly, although Inanda Seminary had computers for the learners, they could be used only during library or computer lessons, which were only once a week or so. I could not go during break times as I had in Hillcrest High School. So, I felt the need for my own computer. I begged my mother for months and even found a second-hand laptop, but I was told to wait; she would buy me a brand new one. Fortunately, that year the school upgraded the computer room, with new computers, WiFi and a computer teacher.

3.4.1 Mrs Ching

I thoroughly enjoyed English lessons by Mrs Ching. She was a young, medium height white lady with hair that she always pushed behind her ears. Mrs Ching always had a laptop and data projector on her desk and a screen. The screen was in front of the chalk board, which was hardly ever used. We used PowerPoint presentations, videos, handouts (poems, cartoons, comprehensions etc.), and she would occasionally show us a colourful picture or a clip on the laptop while we learnt. My favourite lessons were those when we would read a novel then watch the corresponding movie. I remember how we watched the *The Great Gatsby*. Even though I had imagined the scenery while reading the book, the movie took my mind to another place. Inanda Seminary was a Christian school and the ethos of the school was reflected in the way the curriculum was taught and in the daily school activities. Mrs Chin showed us a Christian movie called *Faith Like Potatoes*, the message of which stayed with me and my classmates and it is still my favourite movie today. This was the first time, of many to follow, as we went in the classroom and watched a movie, and still had so much to learn.

3.4.2 My first PowerPoint presentation

We were assigned the task of giving an English oral presentation. I had prepared a PowerPoint presentation in the school computer room and saved it on my memory stick. I was in

the middle of my presentation when Mrs Ching said “Stop!” and rushed out of the door to the office. She came back with the principal. At that point I was not sure what was going on; I thought I was in very big trouble. The principal sat down, and I was asked to start again. At the end I received loud applause, and the principal said, “These are the people we call pioneers”. I knew right then that the content of my presentation was not what had impressed my English teacher away to the extent that she called the principal but rather my use of PowerPoint. I did not think it was anything special back then but now looking at how widely used PowerPoints are I appreciate learning it early in life. Mrs Ching and the principal understood the usefulness, and the importance of knowing how to present using PowerPoint. To them it was a big deal because I was only in Grade 10 and had already developed this skill, without being told.

Twelve years later in 2019, each classroom at Inanda Seminary has a computer with full speed internet, and a projector. The learners and teachers have access to Chromebooks and the use of technology is encouraged in every lesson. Educational app such as Edpuzzle, pear deck, flip grid, quiz iz are being used and makes me envy that I did not have them during my time as a learner at the school. The same principal who had been called to watch my presentation interviewed me in May 2019 for a teaching post in their Science department. I was thrilled to join Inanda Seminary as a teacher, especially at a time when the school is highly resourced with technology. The school has five year ICT objectives (see Figure 3.4 below) that each individual and department must be guided by when using ICT.

This means that teachers strived to use technology in every lesson to achieve these objectives. There were professional developmental session on ICT and teachers engaged in self-directed learning.

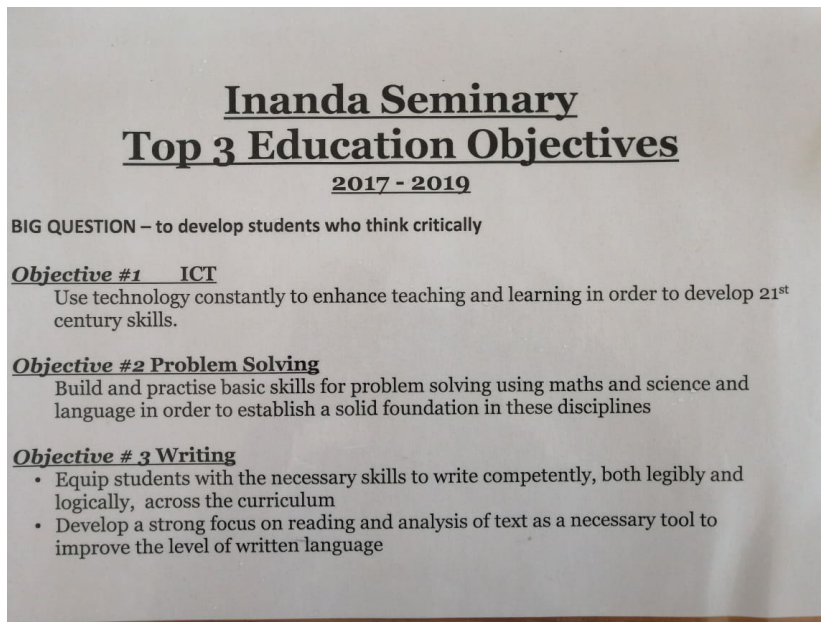


Figure 3.4. Educational objectives of Inanda Seminary

3.4.3 Camera woman

Growing up each community I lived in, had a ‘camera’ man- a photographer. This was a man who went door to door carrying a medium sized camera taking photos of people for R5. He would then come back after a week or two with the printed photos. The wait was unbearable. I was a regular. When I first saw a camera that I could afford I thought it was amazing and with no hesitation bought it. One thing I hated the most about having a camera is that you had pictures of other people but few of yourself. But Figure 3.5 below is a picture of me with my camera taking pictures in the chapel. I bought my first camera for R1000. At that time, around 2009, affordable digital cameras did not take quality photographs like the ones we now have ten years later, but the pictures were definitely of better quality than cell phone pictures at that time. My peers often asked me to take photographs of them and then wanted to have hard copies of their photographs instead of only electronic ones stored on a hard drive, USB drive or somewhere online in the cloud as is done currently. With no way of giving them photographs, I started a photoshop business. I would take photographs of people at school functions, dinners, and other school occasions that we had and for a charge of R5 give them a print of the photograph. Every Friday I would ask a teacher to print the photographs for me. This was kept a secret because I think it was technically not allowed for me to use the school printer and ink. Why did I want to own a camera? I loved taking pictures but growing up it was such a tedious process. When cameras started becoming affordable to me, I

bought one. I still love taking pictures even today, Every time I see something relevant to my teaching I capture it and share it with the learners even if it means going around the class and showing each individual.



Figure 3.5. Picture of me with my first camera taking pictures

3.4.4 My first laptop

I had been begging for a laptop since Grade 10. My mother finally bought me one in 2008, when I was in Grade 11. I used this laptop mostly for music and movies during free time, but also for schoolwork. I bought myself a modem for mobile internet access. I used it to Google information and later on, in Grade 12, it was very useful for downloading past matric papers. Initially I was the only learner in the school who had a laptop at school; another learner had one when I was in Grade 12. The lack of laptops was not only for financial reasons but because laptops were simply not as widespread as today. They were viewed as being necessary for offices and for teachers, but not for learners.

I remember one school open day, a Saturday. This was a day used to market our school, so potential learners and parents are invited to view the school. They get to see all aspects of the school such as the chapel, classrooms and the dining hall. Three or four other girls were sitting with me on my bed in the dormitory and others were kneeling on the floor as we crowded around the computer on my bed. I do not remember what we were doing but one of the parents, who was also an alumna, walked past the dormitory door and saw us. She expressed her concern about our

having laptops and gadgets in school, when we are supposed to be studying. As the owner of the laptop, her comment shredded me inside; making me wonder if I was going to fail. Was this laptop distracting me from my schoolwork?

Looking back, I completely understand her logic. In her days, computers and learning were two completely different things. So, it would be bizarre for a learner to have a laptop at school. But that laptop helped me achieve the matric results that I have, because I was able to download past papers and search the websites for information that improved my conceptual understanding. I got to improve my computer skills, especially in the use of PowerPoint.

3.4.5 Breakfast crunch- The news team

In 2009, my matric year, the school launched a news team that would present news to the school every Friday during assembly. Our assemblies were in the school chapel, every morning we had a 20 minutes service and announcements. Our school was a missionary school and we had an American female reverend, Rev. Susan, who preached the word of God at school – we sang, we clapped, we danced, and we had fun. The chapel had a sound system and speakers, so the sound quality was good. The words of encouragement, positive messages, messages about doing good, and the words of motivational speakers that we received that stay with me, even today. I think that is how the school kept us so disciplined and focused. The school chapel was equipped with a projector, sound system and a screen. Every day without fail the reverend used PowerPoint presentations for her services and displayed song lyrics for us. We sometimes watched a video. I remember one particular video of a man without limbs, Nick Vujicic who was thankful to God regardless of his not having any limbs.

Every Friday news was presented in the chapel for the whole school. Five of us in matric were chosen for the news team, and each of us had a duty based on what we were good at, such as the anchor, sports reporter, and finance reporter. I was the IT person. I was responsible for preparing PowerPoint presentations for each speaker. Having my own laptop helped as we would sometimes work until late at night. This greatly improved my PowerPoint skills as I got to explore different features to meet the needs of the different presenters. The purpose of the news team was to make learners aware of what was going on around us and in the world. As boarders the teachers realised that we were so immersed in our world we had little general knowledge about current affairs. We were at luck because we looked for the news, so we read more and learnt more. When I returned to Inanda Seminary as a teacher in 2019 the school still had a news team. I was proud

to see that, knowing it started with us in 2009. The news team is no longer called Breakfast Crunch but Newsbeat. They also take turns to present the news; this is great because it gives different people the opportunity to grow their presentation skills.

3.4.5 Computer monitor

At Inanda Seminary, unlike the norm in many other high schools, we did not have a prefect system. With a prefect system Grade 12 learners are chosen and given responsibilities like ground duty, tuckshop queues, monitoring late comers etc. These roles fall particularly to those who have already shown attributes of responsibility, leadership and general good behaviour. At the Seminary we did not have this. Instead, every Grade 12 learner was given a duty to perform. Since it was a boarding school, some duties were similar to household chores. I had two duties - I was a computer monitor and a dining hall monitor (see Figure 3.6).

By 2009 Inanda Seminary had a fully equipped computer room with about 20 computers



Figure 3.6: Library and Computer Monitors and Sport and Club Coordinators of 2009 (I am in the third row, first on the left)

and internet access. There were two sessions in the afternoon when learners could book a computer for an hour. As a computer room monitor my responsibilities included my being responsible for this booking list, letting learners in and out during the change sessions, and helping them in the computer room. I was fortunate because I got to stay on a computer for the whole of Friday afternoon for both sessions. It gave me an opportunity to explore the internet because even though I had a laptop, my mobile data was limited. I learnt how to use search engines like Google and watched videos to better understand my schoolwork. I was in matric I got to search career paths, what different universities have to offer and past papers. My friends always laugh at me because I

google just about everything I need to know.

Returning as a teacher now, it is amazing how the school has developed and invested in ICT resources. The learners now have a media centre with Chromebooks, and two other IT labs with Chromebooks that they can use after school. Teachers can book the Chromebooks to be used during lessons.

3.5 MY UNIVERSITY DAYS

University is where my eyes and mind were opened up to the wide uses of technology, not only on campus but in the world. Even though I had experienced technology growing up and in my schooling, I did not understand how important it was, the high use of ICT and the difference uses of it. All operations of the university dependent on it and all my computer skills I had learnt earlier on in my schooling had become beneficial. They made my transition into university less stressful. How did I choose a university for my tertiary studies? In 2008, when I was in Grade 11, the Zenex Foundation, which was funding the bursary for my high school studies, took all the Inanda Seminary girls under the bursary to the annual arts festival in Grahamstown, as it was then, at Rhodes University. Before that, I had never heard of Rhodes University. After the festival I decided that this was the university I wanted to attend. I loved the cold winter weather, the in-residence catering and mostly that Grahamstown was a small town. Rhodes University is also small, with a limited number of faculties, humanities, science and commerce. I did not worry much about what I would be studying as long as I studied at Rhodes and that was how my career path was initially chosen. So, I applied to Rhodes and as a science high school student I was accepted to study towards a Bachelor of Science degree.

On arrival at Rhodes, the house committee welcomed me into the residence and one of the first things I was asked was if I had a laptop; they wanted to connect me to the internet. By then, the laptop that I got two years previously in Grade 11 had not been taken care of and was slow due to viruses, but at least I had one. Having a laptop was the norm, Wi-Fi was an essential. This indication of the importance of computers was just the beginning. Although the computer skills I had learnt throughout primary and high school paid off, I would struggle at times because assignments needed to be typed and submitted online, and presentations needed to be in PowerPoint. The course notes, marks and important announcements were all accessed online.

Other administrative information such as funding status and meal booking was all online. In first year, I took a computer course to enhance my skills, and this was helpful in learning Microsoft Excel, which I now use as a teacher for recording and processing learners' marks.

Besides being taught through ICT, particularly PowerPoint presentations, in the lecture rooms, I used ICT to understand the content of my modules. I first started to use the internet for self-study when there was a meme going around about someone being thankful for Wikipedia for assisting them to get their degree. At that time, I did not even know what Wikipedia was. As much as Wikipedia was not seen as a credible academic source, it did help me understand some concepts. As I was exploring various websites on the internet, I discovered videos. I found that I understood videos better than written material. My favourite site for educational videos became Khan Academy¹ as they had science videos on almost every topic. I used these videos for understanding my subjects, especially microbiology and biology. I struggled particularly with these subjects throughout my studies they involve processes that are difficult to understand through text alone; the videos illustrated the processes and made them easy to understand, especially as the videos were in colour.

3.5.1 PowerPoint presentations

In third year, we had to do group research in microbiology and present our work using PowerPoint. I was shy about presenting in front of the whole Biology department. I felt my English did not sound as good as the English of those in my group for whom it was their mother tongue or of those who had started learning English in pre-school. Talking was not my department but I could work my way through PowerPoint and that became my role in the group.

In my honours year there was, however, no group work. I had to work by myself on my project, and on my essay, and I had to present it on my own. I could not hide behind anyone. In that experience I am so grateful that I only had to worry about being uncomfortable talking in front of the group rather than worrying about not being able to put the PowerPoint presentation together.

¹ <https://www.khanacademy.org/>

Without the latter skill, my life would have been even more difficult.

3.5.2 Referencing and Refworks

Referencing was another aspect of my research project that I struggled with. I had attended workshops on how to find articles online through the school library throughout my undergraduate degree because we did weekly reports in Microbiology and my other courses. But I had attended one workshop on referencing and using RefWorks, which is a computer programme that helps with in-text referencing and creating a bibliography. But the presenter was going too fast and I told myself that I was never going to learn this, so I had avoided the remaining workshops I opted for doing the references myself. But I would constantly lose marks due to poor referencing. My supervisor during my honours year noticed my frustration and advised me to at least use Google scholar to get the correct format for referencing. Although this made my life easier because I could copy and paste the citation to my bibliography, I still had to do in-text referencing by myself.

3.6 TRAINING TO BE A TEACHER

During my undergraduate studies, every year we filled in a survey about our studies where one of the questions asked was whether we would be interested in going into education. My answer was always in the negative until the beginning of my honour's year. This was because in my third year I had volunteered for an outreach programme helping learners with mathematics and science. It was an entry point for me to the world of education. I applied to be part of TEACH SA, which is an organisation that takes mathematics and science graduates and places them into disadvantaged schools. Being under their training taught me about being a teacher. This is where I heard the word pedagogy for the first time. Since we were graduates it was assumed that we had pedagogical knowledge, this made me understand that being a teacher is more than just about knowing. I was interested in learning about pedagogical practices. Sadly, I could not be part of TEACH SA because I had failed a subject and needed to repeat my third year at university. By the end of my repeated third year I had a hard time deciding whether I should do PGCE, TEACH SA or do my honours? I decided on honours in order to deepen my science knowledge. During my honours year I did a course that involved going to schools and doing experiments for the learners. Knowing about pedagogy helped me in this course. In that year, we did "A pollutants

tale” (see Figure 3.7) As a result, my interest in education grew.



Figure 3.7. Preparing to do experiments for the learners in a school and at training for TEACH SA

In 2016, I studied towards a Postgraduate Certificate in Education (PGCE) at the University of KwaZulu-Natal on Edgewood Campus. Again, the word pedagogy came up, numerous times throughout the year. We were learning about being teachers, we already knew the content. I learnt and got inspired to deliver the content in creative ways. In the first week of PGCE before lectures resumed, we were put into groups and we had to deliver a lesson to our group members. The ideas and crops that people came up with were amazing and creative. I saw the same thing again when we went for teaching practise in the schools. We would bring crops and anything from home that could assist teaching and learning. These were not modern ICT tools because the school I was at were under resourced for the use of ICT.

I particularly remember a video on being a great teacher shown to us during the professional development class. Had the lecturer simply given us a list of the attributes of a good teacher, I would never have remembered them. But by showing us a video, she took teachers from all over the world and brought them to us in the classroom. UKZN lecturers generally used ICT in their teaching. As students, we needed to type all assignments on Microsoft Word. I had to be familiar with Moodle, which is the University Learning Management System where I used to get slides and other resources and communication from lecturers. I also used Student Central for registration, and student administrative issues like accessing my fees account.

What I liked the most about Edgewood campus was that everybody there is studying education. This means there were always strong themes about being a teacher emerging whether

it was speaking to people, or seeing posters on different subjects on display, the topic of education was very evident, and I was part of that daily practice.

My PGCE year was where I started to think about what kind of teacher I wanted to be. This is where my values on doing your best as a teacher were instilled (Figure 3.8).

Nqobile Njoko
215078170
Group B
Assessment Task 2
My vision, mission and values

VISION

To become a teacher that mediates learning effectively and successfully on knowledge to the learners

MISSION

To show dedication towards my class by planning and preparing before every lesson and continuously see to expand my knowledge

VALUES

Dedication: To not always miss classes unnecessarily and be punctual. To be willing to assist learners even after hours as this will help those that don't understand in class to grasp the work.

Respect: To listen to the views of the learners and build a good relationship with them as they will also respect me as a teacher. This means discipline and cooperation in the classroom.]

Honesty: To treat all the learners the same with fairness and showing no favoritism.

Excellence: Exceling in the classroom as well as other school activities and be an example to learners to do the same. This means that the learners will be willing to learn and always do their best.

Trust: I want to be able to trust the learners to do their work, like homework or classwork and for them to trust me with their assessment and to be their teacher. Learners may even be able to trust me with their personal problems and seek advice from me, further strengthening our relationship.

Figure 3.8. My vision statement written in 2016 of what type of teacher I wanted to be.

Reflecting on my vision, aim and mission as a teacher, which I put together then I can tell

that as a teacher I wanted to do the best for learners, both inside and out of the classroom. I wanted to use learning mediation tools available in order to help the learners understand the work. I found that in my lesson plans I would include showing the learners colourful pictures related to the concepts I was teaching. I would sometimes plan to bring things from home as well.

3.7 MASTER'S STUDENT AND A TEACHER

I started teaching in February 2017 and I started this self-study in March 2018, just over a year later. In that first year of teaching I encountered challenges, as would any novice teacher. Firstly, because it was my first job, and I had to learn how to interact with people in a professional environment and to be professional myself. During my undergraduate studies I had attended a workshop on the realities of the workplace and although knowing the basics was helpful, but I feel that I really learnt best from experience. Secondly, I had to learn how to be a teacher. In the preceding chapters I have explained the context of the school and the challenges I faced. Through all the challenges and difficult encounters, I experienced there was one thing I could change; my teaching and what takes place inside my classroom. So, I embarked on this self-study. I specifically chose ICT because it was one area I felt was missing from my teaching.

Being a teacher while studying is an extremely difficult task. I specifically say being a teacher and not simply saying working and studying because being a teacher does not end at the office, especially for a new teacher. I needed to stay up late on many nights preparing lessons. Now I also had to find time and energy to do research as well. I struggled to find a balance – and I still do. I had to sacrifice friends and neglect my family; it was a painful process. The joy only came when my learning became evident to me and I could see how I was benefitting from the experience.

In February 2019 I met a new teacher in one of the workshops and it came up that he did not have a laptop. My response was, “How do you survive without a laptop?” Perhaps my response was harsh because each of us have differing experiences, but I could not understand managing without one. As a teacher I use my laptop so much for all my work preparation and administration. I type my lesson plans on it, prepare class lists and marks schedules. The list of tasks on the laptop is endless. Without my own laptop I would need to use the computers at school, which would limit me to working during official school hours. I do not have enough free periods for this. I have had a laptop since high school and therefore struggled to imagine getting work done without it. Being

a teacher without a laptop is impossible for me because I use it every day.

At the school computer illiteracy among the older teachers seemed to have a minimally negative effect on their work. They would write down what needed to be typed, such as examination papers, or write out the marks that needed to be captured, and the rest was done for them by administration staff. But I was uncomfortable teaching with the lack of use of ICT, especially in the classroom. In that year, I felt that my use of ICT had declined, and I was losing touch with the computer skills I once had.

In April 2019 I resigned from my teaching post on the South Coast and moved to Inanda Seminary. This was a difficult decision because I had been advised by everyone not to move. The only person who supported me was my mother. My decision to move was highly motivated by my ICT related study. I would now have an opportunity to teach in a school that was well resourced in terms of ICT. This would be an opportunity for growth in terms of teaching with ICT. So in July 2019 I started teaching at Inanda Seminary and am currently teaching there.

For the first month at Inanda Seminary, I regretted moving because I was filled with self-doubt and did not believe that I would meet the expectations of the school. I wanted to teach with technology, and my dream had come true. I had a computer with internet connection in class, a projector, a document reader, and I could take the learners to the media centre any time to use Chromebooks with Wi-Fi. I had dreamt of all of this, but I found that it was still time consuming, as preparing lessons using ICT requires investing considerable time in preparing slides and finding and downloading appropriate videos. As a result, my progress in preparing my dissertation slowed down. However, in the second month I found that I was coping better and again found time to do my research. I started to enjoy, live and make the most of having my dream come true with regards to being able to teach with ICT.

3.8 CONCLUSION

On reflection, in writing this chapter the most important thing I learnt was that my use of ICT in the past has always been linked to my schooling. Since I grew up in a rural community, where technological advances were few and slow to arrive, my learning of ICT was limited to a school context. This learning made my school days memorable and it is relevant as we are moving into the fourth industrial revolution. I strongly believe that ICT should be used in teaching, not

only as an administrative or pedagogical tool, but also to expose learners to it in order to prepare them for the bigger world. I believe and want to use ICT because it made my schooling days fun and memorable.

Learning how to use a computer, from my first encounter in primary school through to using it in high school and university, played a significant role in my overall learning. Had I not learnt how to use a computer early in my life, I would have struggled to pass my courses, especially in university, because success was dependant on knowing how to use the computer. If ICT had not been used in my teaching, I would not have believed that ICT plays a positive role in teaching and learning and would have been comfortable with teaching without its use.

While writing this chapter, I also realised the extent to which our past experiences affect who we become. I have learnt to respect people and the decisions they make because it is a consequence of their experiences, which may not be the same as mine. We are all a product of our past. Growing up without ICT made me value it and appreciate it because it made life simpler. I also realised that the biggest motivation for wanting to use ICT in the classroom is remembering the young me in a classroom who thought the year did not change, the girl who didn't dream beyond the rural areas. When I remember that girl I want to teach as if I am teaching her and show her the world in a classroom.

CHAPTER 4 ACCLIMATIZATION CLIMB ONE: LEARNING ABOUT PRACTICE

4.1 INTRODUCTION

In chapter one I stated the focus and purpose of the study and gave a rationale for wanting to conduct this study. I described the location or background information and the theoretical framework that guided the study. I also gave a brief description of the methodology to be taken. I gave my research questions and how I aim to answer them using the self-study method. Chapter two focuses on my understanding of the research methodology of self-study and, data representation and analysis. I also stated the ethics considerations and trustworthiness of the study. In the previous chapter I shared my past experiences with ICT, the learning of it and how it was used in my learning in school and at university. In accordance with the focus of this research, in this chapter I will share how my learning of ICT influenced the development of lesson plans, in particular simulations, videos and PowerPoint slides. Using the analogy of climbing Mount Everest given in Section 3.1, this was my first climb. I enjoyed it the most because it involved learning new things and thinking about other possible ways of teaching the topic wave sound and light through ICT tools. I had opened a flood gate for improving my teaching.

4.2 LEARNING OF ICT USED IN THIS STUDY

The first time I heard of the Physics Education Technology (PhET) simulation was in a conversation about teaching strategies with a colleague at a Physical Sciences workshop. I subsequently downloaded the simulation of a wave in a string and then taught myself the basic ideas such as propagating a pulse and a wave, and changing wave characteristics of frequency. Everything else of what the simulation could do I learned by working with my supervisors. I learned how to superimpose pulses, how to use a ruler to show learners the upward movement of a pulse, and how a wave varies with the string tension. I had to practise and constantly play around with PhET in order to increase my confidence before I could use it in the classroom

I had wanted to download videos found online from the school computer onto my own. So ever since I started teaching, I had been asking around from colleagues and friends and researching on Google how to do this. I wanted these videos for my own learning, more than for the learners.

Two years later, I found out how to do it. At the end of 2018, my subject advisor shared with us a link that we could use to download videos, which I used in these lessons. I also learnt from my supervisors that when playing a video one can pause and explain, or even rewind. I also learnt that when teaching with videos one should prepare questions based on the video and have learners answer them afterwards. In that way the learners are focused on what you want them to learn from the video.

I had learnt how to prepare slides for a presentation in high school and had used them for academic purposes from school to my undergraduate studies. I also used PowerPoint to present my proposal and progress for this dissertation. I was therefore familiar with downloading pictures and preparing PowerPoint slides; however, I was not familiar with preparing PowerPoint for the purpose of teaching. Through websites I identified on Google I learnt that the slides should be highly visual, with fewer words or notes and more pictures. In that way they should reinforce what you are teaching by giving representations in the form of pictures or diagrams.

4.3 LESSON PLANNING PROCESS

4.3.1 Introduction

As indicated previously in Section 2.9, at the beginning of the term the school lost two weeks of teaching time. So, I was already challenged for time. According to the CAPS document the topic of waves, sound and light is meant to be covered in 17 lessons over four weeks, but now there would be only 11 lessons. So, I initially prepared 11 lessons to teach using ICT for the Grade 10 Physical Sciences class, as in Appendix K. Even after I had planned for 11, there were other hindrances that disturbed my teaching and learning programme, such as having to attend a Physical Sciences content workshop for three days and participate in moderation for a day. Consequently, I found that I only had five lessons, I had to combine the lessons that I had planned. This is why my implemented lessons differ from the planned lessons. The school had planned an extended programme, wherein the whole school would stay behind for an additional 30 minutes each day. Although during the afternoons when I would see all the Physical Science learners, I extended the time with them to one hour 30 minutes, this time was still not enough. It is possible that I could have used the weekend classes to complete that section of work in the limited time. I also was not aware of the school start of examination date until a week before examinations began. The outcome

was that I ended up having only a week in which to finish the topic waves, sound and light with the Grade 10s, this was 5 lessons. Consequently, in this topic I had to alter my lesson plans, combine lessons, and use strategies that would be fast but effective in teaching this topic. So for instance, where I had planned to do group work for two lessons during which learners themselves would investigate the relationship between wavelength and frequency on the PhET simulation, I opted for simply showing learners the relationship for the wave of a string simulation. I had intended to help learners understand longitudinal waves by their making a paper model themselves, as had been shown to me by my supervisor. Instead I showed them a video. Furthermore, there are calculations from past examination papers that would have been beneficial for learners to do individually in class. Instead I selected a few and worked through them on the board.

Before starting with the lesson plans, I drew a content map for the topic waves, sound and light, as shown in Figure 4.1. This exercise was very helpful because it showed me the overall picture of what I would be teaching. It also showed me how the concepts were linked to each other. While I was teaching, I could therefore track what I had taught and what was coming next. If you know what is coming up in a topic you can prepare learners for it. For example, in lesson one, I required learners to draw pulses because they would need this skill later when they encountered the principle of superposition of pulses and waves. Concept mapping is beneficial for both the teacher and the learner (Vanides, Yin, Tomita, & Ruiz-Primo, 2005). It can be used as a formative tool for teachers. For learners it assists them in three different ways. Firstly, it provides them with the opportunity to make connections between the science concepts being learnt. Secondly it helps them visualize the concepts in a systematic way and thirdly they get a chance to reflect on their own understanding (Vanides et al., 2005). In this regard, Hartmeyer, Stevenson and Bentsen (2018) indicate that the level of sophistication of learners' concept maps indicates their knowledge and understanding of the concepts. So, it is unfortunate that I did not make learners draw concept maps of their own because it would have helped them make connections between the concepts and I would have been able to evaluate their understanding. But concept mapping is a skill that needs time in order for the learners to master how to do it. Concept mapping could have been used as

formative assessment for the learners, however we did not have time.

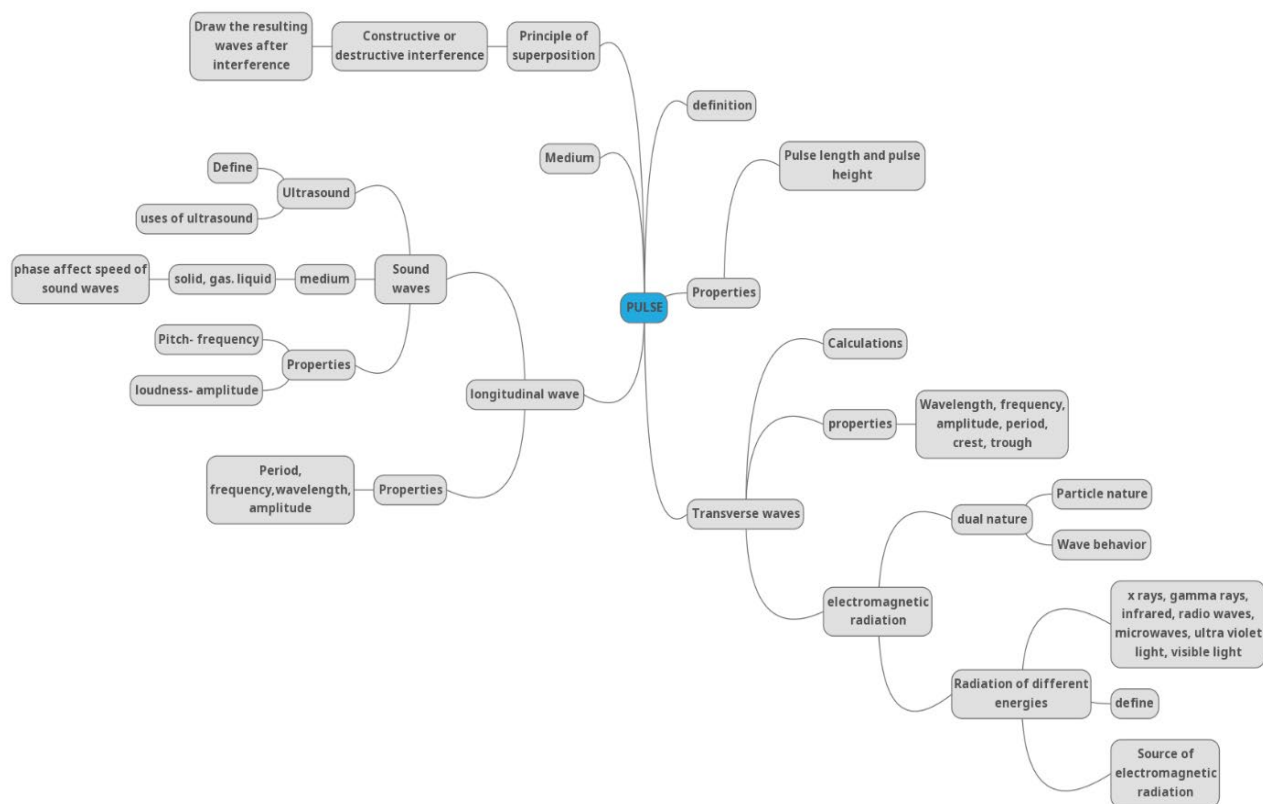


Figure 4.1 Concept map of the content in the topic Waves, Sound and Light

This was my first experience of constructing a concept map before teaching a topic. From now on I will use them, especially for topics that I struggle to teach. I think the process of drawing a concept map improved my content knowledge because, firstly, I then had all the concepts that I needed to teach on it and could make sure that I understood them. Secondly, it improved my conceptual understanding because I could see how the concepts were linked.

Concerning the three chosen ICTs, even though I have understood the theory about them, how to operate them and how to use them in teaching, the biggest challenge was to their strategic use in successful teaching and learning in the classroom. Implementing them was more difficult than planning the lessons. In the next sub-sections I have given an explanation and rationale of how I planned my lessons and explain why I chose the ICTs I used to teach the content, and why I adopted the chosen sequence of teaching and learning events. I will present the lesson plan for

lesson 1, the rest of the lesson plans will be attached as appendix.

4.3.2 Lesson 1

I was very anxious about using ICT for the first time. The previous night I could not sleep. It would not be a normal teaching day for me. I had three big fears. Firstly, how were learners were going to receive my teaching with ICT? I was wondering if technology will let me down or if there will be power problems? What made me the most anxious, however, was the pressure of time. As explained in Section 2.9, I had lost more than two weeks of teaching time. I was more anxious and stressed about the shortened teaching time than from the use of ICT for the first time. Would they understand all this new content in such a short space of time? All these questions bothered me. After the first lesson I felt more at ease, because the learners had received me well.

Table 4.1: Lesson Plan of the first lesson.

LESSON PLAN 1							
NAME OF SCHOOL		EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Pulses	LESSON	
DATE STARTED:				DATE COMPLETED:			
LESSON OBJECTIVES				At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Define a disturbance • Define a pulse, amplitude, pulse length • Define a medium • Draw a pulse and label rest position, pulse length, amplitude 			
PRIOR KNOWLEDGE				<ul style="list-style-type: none"> • Rest position • Application of waves • Cartesian plan • Displacement and speed 			
RESOURCES NEEDED				<ul style="list-style-type: none"> • textbook, slinky 			
TEACHING METHODS				<ul style="list-style-type: none"> • observation, question and answer method, PhET 			
TEACHER ACTIVITIES				LEARNER ACTIVITIES			

<p>Introduction</p> <ul style="list-style-type: none"> Facilitate the discussion of the different types of wave's learners. Here it is important to point out to learners that there are also waves that we cannot see like heat, sound waves and waves in the electromagnetic spectrum. Learners further discuss the application of waves. <p>Main Body (lesson presentation)</p> <ul style="list-style-type: none"> Stretch a slinky spring on a bench. In order to see the movement of single turns clearly, tie short pieces of plastic to some of the turns Have learner one hold the slinky on one end and learner two hold the slinky on the other end. One learner must move their end of the slinky up and down once. Learners observe and record what they saw. Explain to learners that they have just drawn a pulse. A pulse is the simplest part of a wave and it is caused by a single disturbance. The disturbance gives the particles of the medium energy to move across the medium from the rest position to an amplitude. The rest position was the slinky on the bench and the disturbance was created by moving the one end of the slinky up and down. Define a medium as the substance or material in which a pulse will move. Define an amplitude the maximum disturbance of a particle from its rest (equilibrium) position. Draw a pulse on the board showing the, amplitude, rest position and pulse length. Show learners a pulse on PhET simulation. Show them how it is propagated and the properties of a pulse. <p>Main assessment: worksheet</p> <p>PhET simulation: show learners a pulse. Vary the tension and help learner reach a conclusion about the speed of the wave as tension changes.</p>	<ul style="list-style-type: none"> Discuss different types of waves that learners know of. Learners create a pulse using a slinky spring. They must observe and draw what they have seen.
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<p>Measure the properties of a wave</p> <p>Assessment: Facilitate class work</p> <ol style="list-style-type: none"> 1. Draw a pulse with an amplitude of 4 and a wavelength/wave pulse of 2. 2. Draw a pulse with an amplitude of -6 a wavelength/wave pulse of 2. 3. On the same Cartesian plan draw two pulses. One with an amplitude of 2 and -3. 	<ul style="list-style-type: none"> • Draw a graph to show the progression of a transverse pulse in a slinky. Label the axes, pulse length, pulse speed, amplitude, rest position and crest and answer the questions on the worksheet. • Observe • Answer questions. • Conclude relationship about tension and speed <ul style="list-style-type: none"> • Measure amplitude and wavelength. • Draw pulses on a Cartesian plan.
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The objective of lesson one was to introduce the learners to a pulse and its characteristics. We first discussed different types of waves that learners are familiar with. I decided to first discuss this to check learners' prior knowledge about waves. Learners were able to list microwaves, water

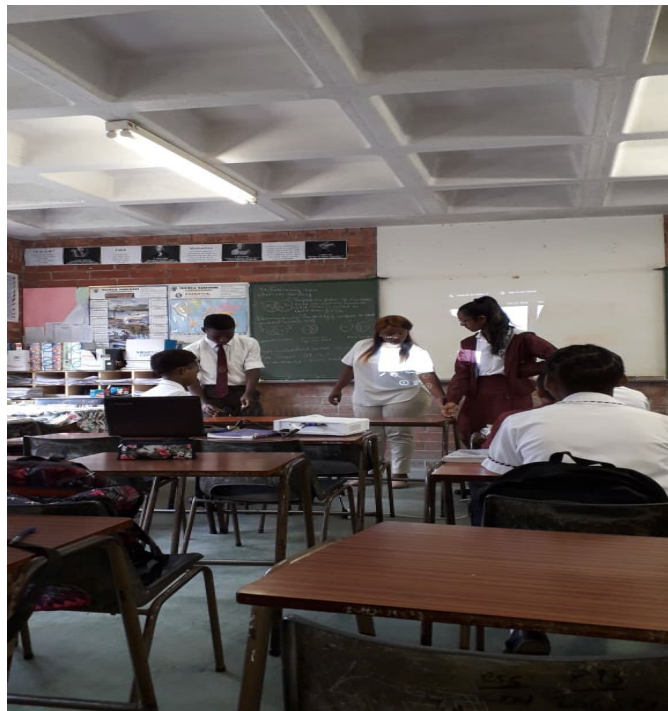


Figure 4.2. Me **and** Grade 10 learners working with the slinky

waves, and infrared. This showed me that learners were aware that some waves are invisible which

they need to understand this for electromagnetic spectrum. I then explained to them that these waves are made out of a small unit called a pulse. Even though they knew and seen some waves they did not know about a pulse.

Two learners propagated the pulse in front of the class using a slinky spring (Figure 4.2). I asked learners to demonstrate the propagation of the pulse because they like seeing their peers in front of the class instead of it always being me. I explained to them the properties of a pulse, the equilibrium position wavelength. Using a slinky to introduce a pulse is also a guideline in the CAPS document. Even though the slinky is a traditional physics resource and not an ICT resource, I decided to introduce learners to pulses and waves through something tangible and familiar. They needed to see it, the medium and its motion, before they saw it on the simulation.

The assessment the learners had to perform involved their drawing and annotating a pulse that they have observed on the slinky and labelling its features. Drawing a wave and a pulse is a vital skill that learners need to learn, as they need to use it later when applying the principle of superposition. Requiring learners to label the pulse allowed me to see if the learners were able to identify the different properties of a pulse. Correct drawing and labelling assured me that the learners understood the concept of a pulse, and their basic properties. Figure 4.3 shows drawings of a pulse by two learners in the class.

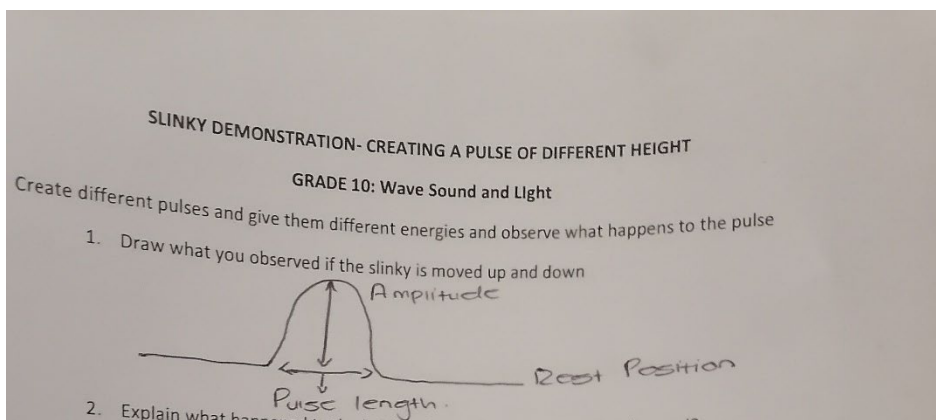


Figure 4.3. Drawing of a pulse by grade 10 Physical Sciences learners.

The learners were able to identify properties of a wave. For example, the amplitude is the vertical distance from the equilibrium position to the highest or to the lowest point on the pulse or

wave and not the horizontal distance from the trough to the crest which is half the wavelength. It is easy to make this mistake when they are only looking at a diagram already labelled for them.

On the PhET simulation, I propagated a pulse by clicking on a button and again showed them the properties of a pulse on the simulation. I did this because even though they understood the properties on the slinky going forward, we would be using the simulation for demonstrations and not the slinky. So, they needed to understand that the properties were the same. They also needed to be introduced to the simulation and how it works. On the simulation, the pulse is most easily generated by clicking a button, we did not vary the energy to get different amplitudes like on the slinky, but we could simply choose the magnitude of the pulse we wanted to make. On the PhET simulation I varied the tension and asked the learners to make a conclusion about tension and speed. The learners were able to see the relationship. When I listened to the lesson audio recording, I heard one of the learners asking another what tension was. When I asked this question, I did not explain tension. I expected them to know it from Grade 9 Natural Sciences. This reminded me not to throw words and terms at learners, especially in grade 10 without explaining the words to them.

The second assessment involved the learners drawing negative and positive pulses on a Cartesian plane. Learners were comfortable with the properties of a pulse as they have seen them when we looked at the slinky, on PhET and also have drawn them. In the first year on my teaching I did give classwork that involved drawing pulses in a Cartesian plane until I saw that examiners often ask learners to draw pulses on a Cartesian plane. Highfliers may do it on their own but the low learners may need to practise first before understanding it. Learners struggled with drawing the x and y axis scales correctly. After explaining it they understood. Learning how to draw a scale correctly will assist them in other graphs as well, like bar graphs, line graphs. In Physical Sciences learners are always asked to draw a graph in paper 1 and paper 2.

4.3.3 **Lesson 2**

The aim of the lesson was to teach the learners about the principle of superposition.

At the beginning of the lesson, while we were revising what we did in the previous lesson, the learners around the school buildings had not yet settled down in their classrooms. There was a lot of noise which was distracting. I was worried because we would be using a video and the environment needed to be quiet so that the learners could hear properly. Luckily, by the time we

got to the video, all the other learners were in their classrooms and it was quiet. In this lesson a video was used in order to explain the terms ‘in phase’ and ‘out of phase’. It is important that learners can identify points on a wave profile that are in phase and those that are out of phase. If they are not able to do this, they will not be able to determine what type of interference was taking place. For learners to conclude whether the pulses that are interfering will undergo constructive or destructive interference, learners need to understand whether these pulses will meet in or out of phase (Figure 4.4). Therefore I felt that was necessary for learners to understand and be able to identify particles that are in and out of phase before looking at the type of interference.

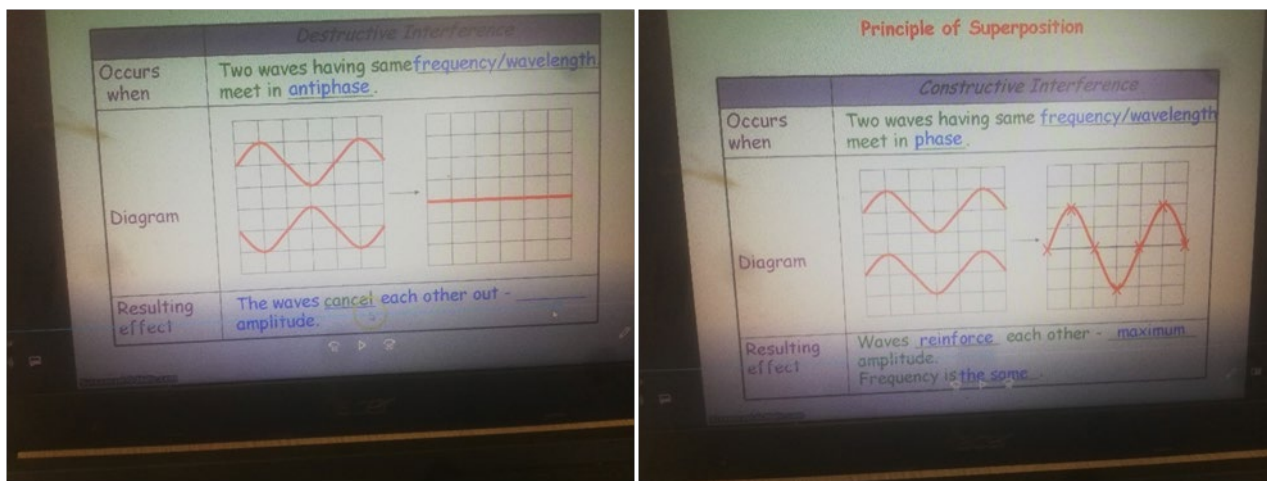


Figure 4.4 A video showing waves that are in and out of phase and the type of interference

The learners have definitions of these concepts (in and out of phase) in their examination guidelines and it is also explained in their textbooks, but I showed them a video to reinforce the idea. The definition from the exam guideline of points in phase is points that are separated by one complete pulse. It is difficult for learners to visualize this and understand what it means in practice. In the video, the animation identified the points in phase and explained that two waves that would completely align if one was underneath the other. This was easier for the learners to understand than a static diagram in their textbooks. The video also showed more than just the type of interference.

Using the PhET simulation, I wanted learners to understand the meaning of the principle of superposition. I wanted them to understand that when the waves are perfectly superimposed the amplitudes of the two pulses interfering are simply added together vectorially. In Grade 10 learners deal with perfectly superimposed waves and waves with different wavelengths are not included.

On the PhET simulation, we measured the amplitudes of the pulses interfering and the resultant pulse. By doing this the learners were also learning how to measure amplitudes.

I then used PhET simulations to demonstrate the two phenomena that can take place during superposition. Learners were able to see the waves interfering constructively, how their amplitudes added up when they become superimposed and how the two pulses then move away from each other. The learners were helping during the simulation, by making measurements and answering questions

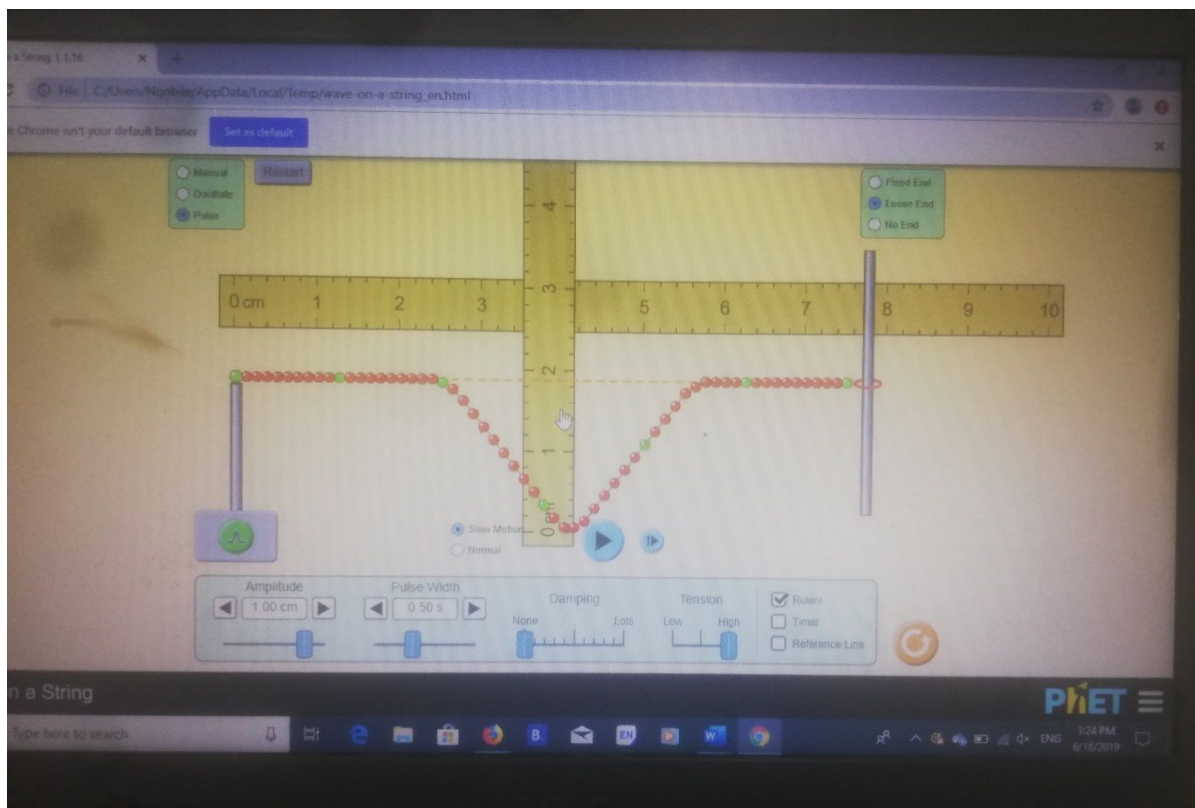


Figure 4.5 PhET Simulation of constructive interference and measurements of amplitude

After the PhET simulation the learners did an assessment where they had to draw two pulses before and after interference on a Cartesian plane. In my previous two years teaching this subtopic, my assessment was based on learners being able to identify the type of interference taking place and knowing what happens to the pulses after they have become superimposed. The learners had understood those very well, but I had seen in departmental papers that examiners also required learners to draw, on a Cartesian plane, the resultant pulse or the pulses that are meeting. This

required learners to draw on a Cartesian plane and indicate the exact amplitudes. So, when planning my lesson, I made sure that this type of question was included in the assessment.

4.3.4 Lesson 3

In this lesson the learners were introduced to a transverse wave, whereas previously we were talking about pulses. I introduced the transverse wave by using the wave in a string PhET simulation. I propagated a wave on the PhET simulation and asked the learners to observe and describe what they saw (Figure 4.6). They replied that they saw many pulses. This was the exact answer I had been looking for. The learners needed to see and understand that a wave is made up of many consecutive pulses. A transverse wave is defined as a wave where the particles of the medium move at right angles to the direction of motion. Learners struggle to understand what a particle is. What size is it? What does it look like? How does it move? The PhET animation illustrates particles in motion.

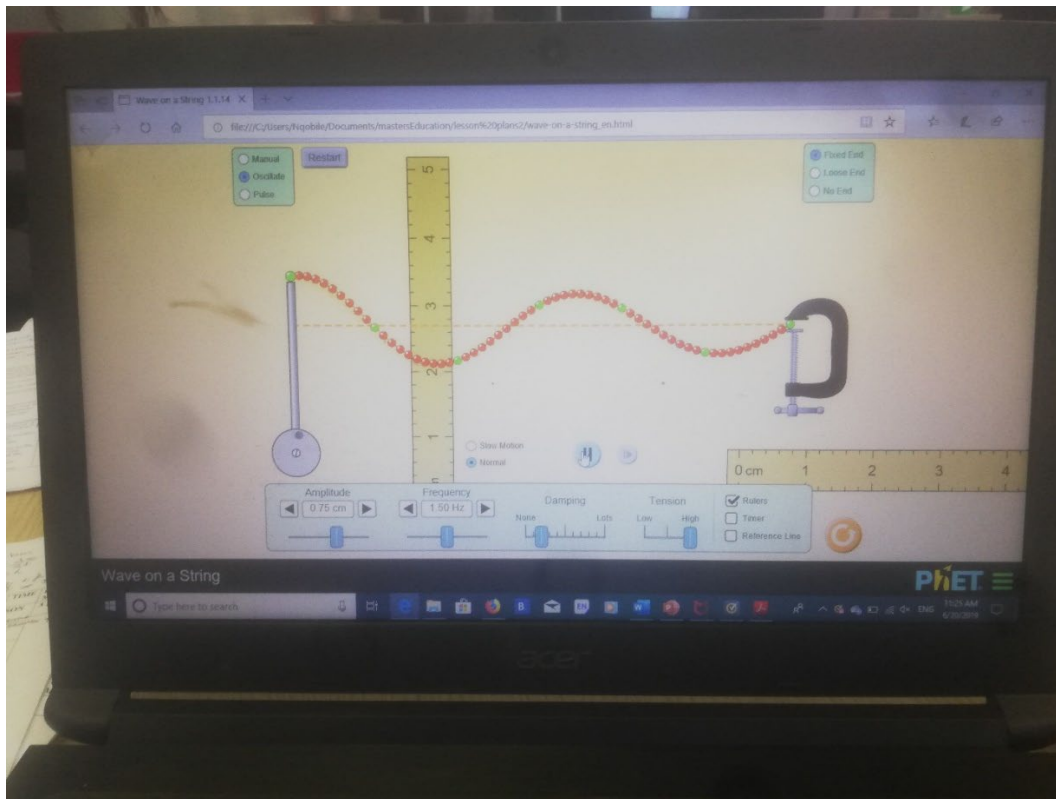
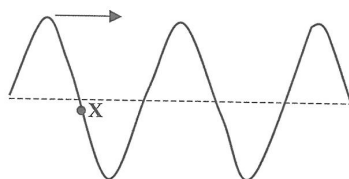


Figure 4.6 PhET simulation showing the movement of particles of the medium

When my supervisor had shown me this through the PhET simulation, I thought it was

amazing. It was something that I was struggling to visualize, and I now could pass it on clearly to the learners. It is hard to understand that the particles of the medium move only up and down while the wave moves forward, when you cannot see this in action. In the lesson I asked learners to concentrate on the green particle on the right-hand side of the ruler. When the simulation was running learners could observe the particle moving up and down while the wave motion was to the right.

1.2 The diagram shows a wave moving from left to right through water.



A cork X, is at this moment ...

- A moving upwards.
- B moving downwards.
- C moving to the left.
- D stationary.

(2)

Figure 4.7 Common examination question on the movement of particles in a transverse wave

Figure 4.7 above shows a typical Grade 10 examination question from March 2019 and 2018. Learners are required to predict the movement of the particle labelled X. The PhET simulation makes it easy for learners to answer this question as they have seen that the particles move vertically up or down, not left or right and not at a slanted angle.

In the previous lesson we saw that waves move. I there is movement than learners needed to see that there will be displacement. Using the simulation, I also showed learners what is meant by displacement and how we measure it with a ruler, and how the stop-clock timer can be used to measure time. We saw that we could measure the time a wave takes to cover a certain displacement. All these were important to understand before learners could move on to problem solving involving calculations. Deciding on how to differentiate between frequency and period for the learners is also difficult. With my previous two classes learners had often confused the two concepts as they are closely related to each other making them difficult to understand. I had to make sure that the learners understood the difference. The method I chose needed to be effective. I showed these concepts using a video which used light bulbs to explain. In the video if the light

bulbs flashed fast, it meant that the frequency was high and vice versa. This was related to waves passing by in a given second. If many waves went by it means that the frequency was high and vice versa. The concept of period was explained in a similar manner. I would explain period as the time taken for one complete wave pulse. This helped learners relate frequency to something they would already be familiar with and which they understood.

Learners had to understand all the concepts so that they could understand how to use the formulae and what values to substitute in problem-solving exercises. I found that learners know the mathematical skills for working with equations, their difficulties lie in is choosing the correct values to substitute. For example, they would insert the magnitude of the amplitude instead of frequency into the formula. This means that in each problem learners fail to read and understand the scenario and data given to them. I told the learners to use the units of the values given to help them distinguish the variables; frequency is in hertz (Hz or s^{-1}) and period is in seconds (s).



Figure 4.8 Me teaching the learners how to do calculations

We did the calculations on the board with the learners (Figure 4.8). Alternatively, I could have written them down on PowerPoint and then done the calculations on the board. However, I wanted us to be focused at one process or tool at a time. I decided to do the calculations on the board because I felt that learners needed to see the whole method. Learners would not understand the whole process if I came with the calculations already done. I wanted to do it as they would

need to do in an examination. As my critical friend C suggested, ICT is good for theory but not applications such as teaching problem solving. I totally agree with her in this case.

I was very stressed on the morning of this lesson. I had planned extra classes, but they were not successful because some of the learners were going to be writing an examination. By the end of the previous week, most learners' minds had already been in examination mode as they were preparing to study for their examinations. Some of the learners did not even come to school on the last few days leading up to the examinations. I hoped that this would not be the case with my Grade 10 Physical Sciences class because we were far from being done with the term's syllabus. With all of this on my shoulders I felt tense and defeated.

Due to limited time I had to remove some activities and combine two lessons. I reminded the learners how the particles of a transverse pulse and waves move. They were reminded of the properties of a pulse and shown the properties of a transverse wave using the PhET simulation. I then showed learners how the number of waves produced increases when I increase the frequency, or vice versa (Figure 4.9). We did this for some time then I asked learners what they observed happening to the wavelength as we increased or decreased the frequency. We reached a conclusion, but we moved on without doing an assessment to consolidate.

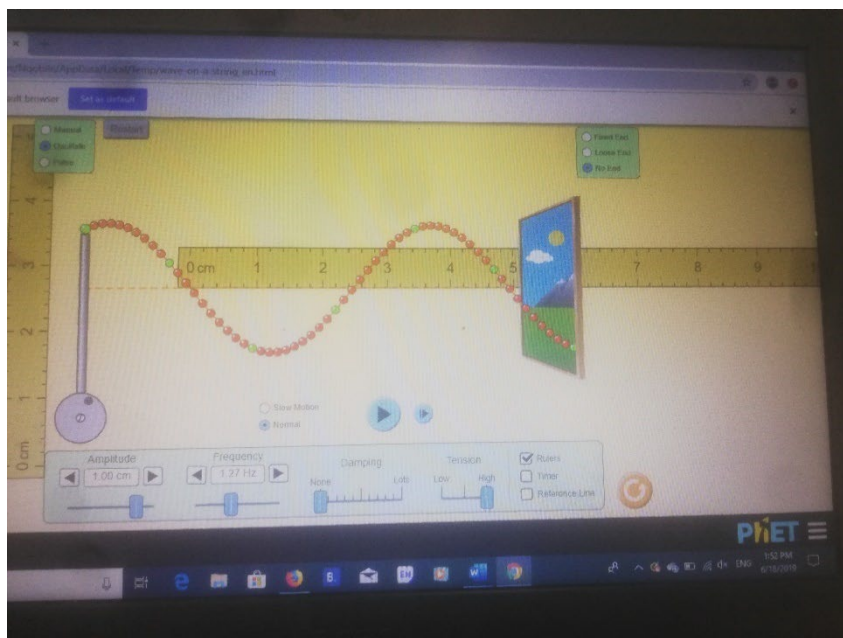


Figure 4.9 The relationship between frequency and wavelength using PhET simulation

I then moved on to the relationships between the wave speed, distance travelled, and time

taken. They started getting confused when I was explaining distance travelled and the time it took the wave to travel. I asked them to relate these two concepts to speed.

I then played a video to clarify the difference between frequency and period (Figure 4.10).

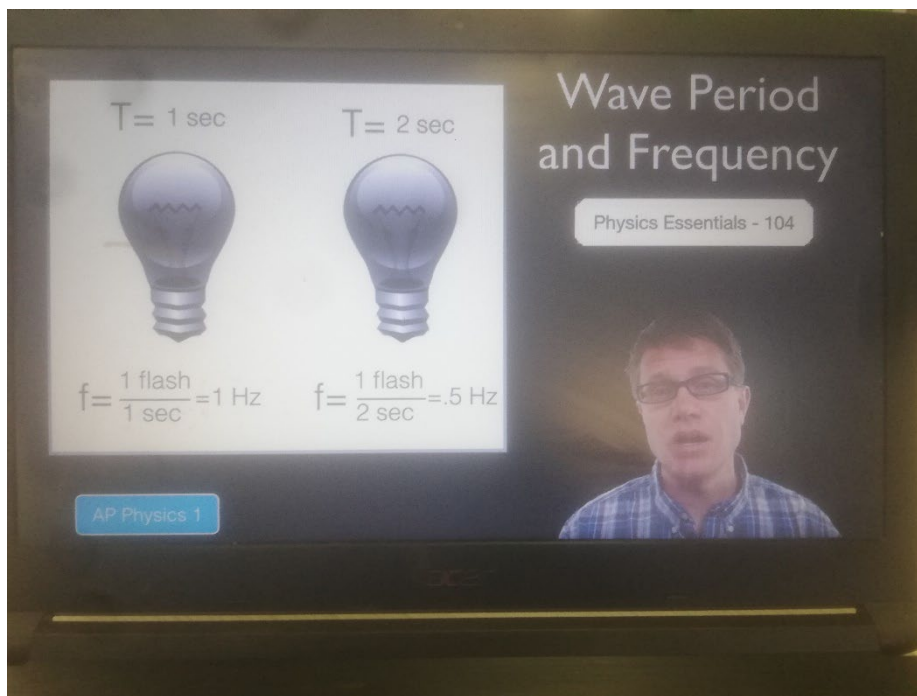


Figure 4.10 video on Period and frequency

The video used something learners have seen before (a flashing light), so they understood it. I think overall in this lesson the learners understood the video more than my explanation using the PhET simulation. I then demonstrated calculations involving speed, frequency and wavelength on the board. I then gave learners calculations to do while I walked around assisting them, and once the time I had given them was up, I did the corrections on the board.

Due to time I had had to combine two lessons. Learners were again shown how the particles of a transverse pulse and wave move. They were reminded of the properties of a pulse and shown the properties of a transverse wave. Learners also observed the distance travelled by the wave and the time it takes. They were asked to relate this to the speed. Emphasis was done on frequency and period. Using PhET simulations, the learners were shown the relationship between frequency and wavelength. Learners were also shown a video to clarify the difference between frequency and

period. The learners were introduced to calculations, which were done on the board.

4.3.5 Lesson 4

In the fourth lesson I wanted to cover the concept of longitudinal waves, applied to sound waves and to practise calculations. The PhET suite of simulations does not have an appropriate simulation for longitudinal waves; only those for transverse waves, so I had to use other ICT resources to teach this concept. The properties of a longitudinal wave are difficult to identify, especially the amplitude and wavelength, as they cannot be directly seen on a static diagram of a longitudinal wave. Consequently, I asked the learners to move their upper body to demonstrate how a longitudinal wave moves. This had been suggested to me by my supervisor. It also helped learners understand the amplitude of a longitudinal wave. I asked them to move their upper body from left to right slightly; this was a small amplitude. Then I asked them to move further from left to right, this was a big amplitude. I then showed learners a video that showed the movement of a longitudinal wave. They could clearly see that it was different from a transverse wave and I explained how the movement of the particles relates to the wave motion. Once the learners understood the movement, I paused the animation and pointed out the properties of a longitudinal wave. I started by doing a demonstration with their bodies over the video because the body movement was for them simple and easy to understand.

I played another video from Bozeman science.com, which showed an animation of the movement of sound waves. I paused the video and asked the learners why the video is about sound waves when we are dealing with longitudinal waves. One of the learners answered that a sound wave is a type of longitudinal wave. In using this second video I wanted to show learners the relationship between amplitude and loudness of sound, and that between frequency and pitch of sound. The learners were able to hear the pitch and see how the frequency changed and hear the loudness of the sound as the amplitude was changed (Figure 4.11). A sound wave is a longitudinal wave and when learners see longitudinal waves looking like transverse waves as illustrated in figure 4.11, they get confused. I had to explain to the learners that a longitudinal wave can be converted to a transverse wave using an oscilloscope.

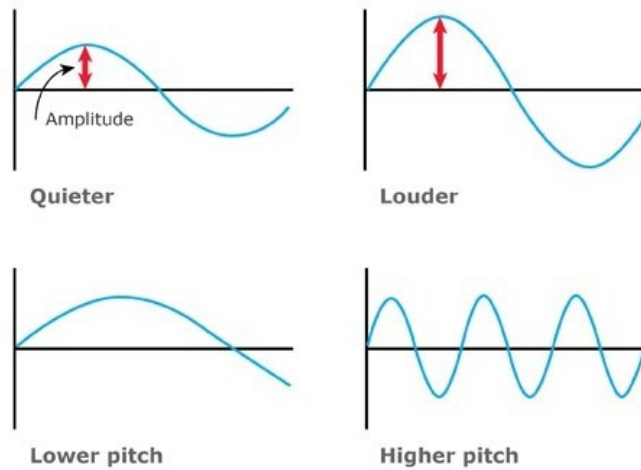


Figure 4.11 Pitch and frequency and loudness and amplitude of sound waves

As much as learners had heard the sounds and understood the relationship to frequency and amplitude, I showed them the illustrations given in Figure 4.11 to reinforce these, also because this is how the relationships will be represented to the learners in assessments. In assessments, they will not be able to hear the sound waves as they have heard them in the video (Wieman, Adams, & Perkins, 2008). As (Ainsworth, 2008) indicates, multiple representations of the same concept encourages learners to develop a more complete understanding of a concept. However, the different representations need careful handling so as to not confuse learners.

The calculations for longitudinal waves and sound waves are the same as those for transverse waves except that the speed of sound of air is taken as a known constant (even though it varies with temperature). I also did these examples on the board.

The beginning of every lesson is difficult because the learners outside the class are very noisy. I always see the Grade 10s in the first period, so there are also late comers. In this lesson I again combined two lessons that I had initially planned into one. I introduced the lesson by playing a video animation from YouTube showing the movement of a longitudinal wave and a transverse wave along a slinky spring.

Learners already knew about transverse waves, so I explained the longitudinal wave in detail using the video animation (Figure 4.12). It is important for learners to understand both types of wave so that they can apply their knowledge of the two in assessments such as examinations.

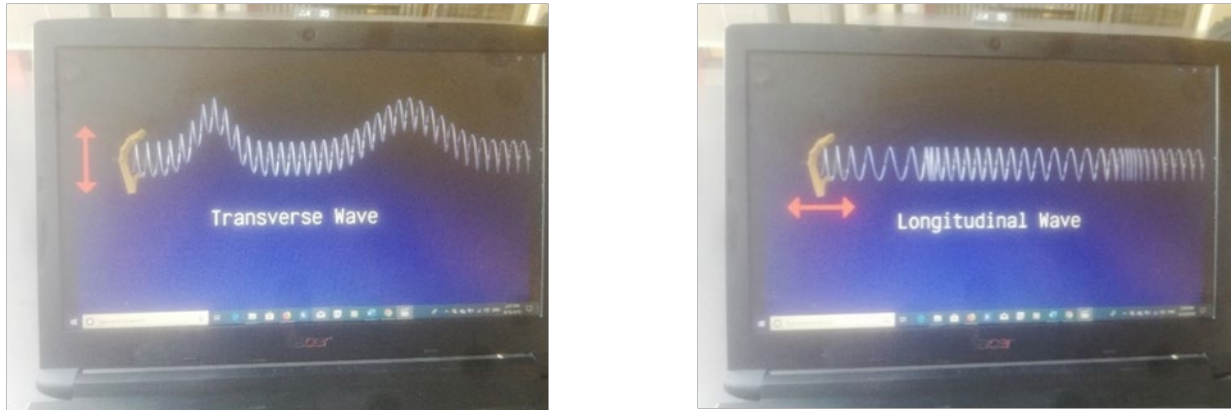


Figure 4.12 Movement of a transverse and a longitudinal wave

The next video I showed was from Khan Academy. It explained the concepts of amplitude and a longitudinal wave. These are easy to visualize and hence understand on transverse waves but are not as obvious on longitudinal waves. I introduced the longitudinal wave with a video which shows how particles move in comparison to the motion of the wave.

I stopped the video at appropriate times to explain a rarefaction and a compression, amplitude and wavelength of a longitudinal wave. This was helpful because the video uses the terms; amplitudes, wavelength, trough and crest which are properties of a transverse wave, which they already knew (Figure 4.13 below). The video relates the loudness of sound to the wave amplitude. After the video, I showed learners a picture using PowerPoint indicating this relationship between the loudness of sound and the amplitude of the wave, and the relationship between the frequency and pitch, as well as the speed of sound in different media.

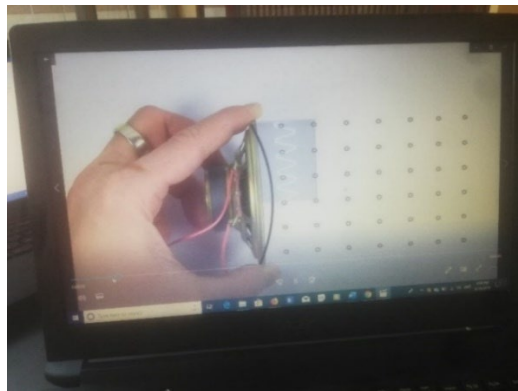


Figure 4.13 Video showing the amplitude of a longitudinal wave

4.3.7 Lesson 5

In the last lesson delivered, I used PowerPoint only to teach about the electromagnetic spectrum and I used the board to show calculations. I used mostly static pictures rather than words on my slides. I was not happy with the picture I had chosen to explain the source of the electromagnetic spectrum (figure 4.14). I wish I had used an animation to show the accelerating charges producing a magnetic field, because my previous Grade 10 learners had difficulty in understanding how the electromagnetic spectrum is created. I do not think this picture that I used was very helpful in assisting with understanding the concept of accelerating charges. It would have been wonderful to get an animation of accelerating charge creating the spectrum. That way learners would see the magnetic and electric charges vibrating at right angles to each other. They would also understand what a charge is and what accelerating means. I have come to realise that since I first started teaching, when I did not spend enough time in developing learners' conceptions of these terms. When, subsequently, they had to define them in an examination, they had forgotten the meanings, which had been merely memorized. They understood the wave nature of light because they have dealt with waves, but the particle nature was difficult. The illustration in Figure 4.15 helped learners to understand something of the particle nature by illustrating the photons as packets of energy found in light. It is said that one picture speaks a thousand words, so I used this colourful picture of the electromagnetic spectrum.

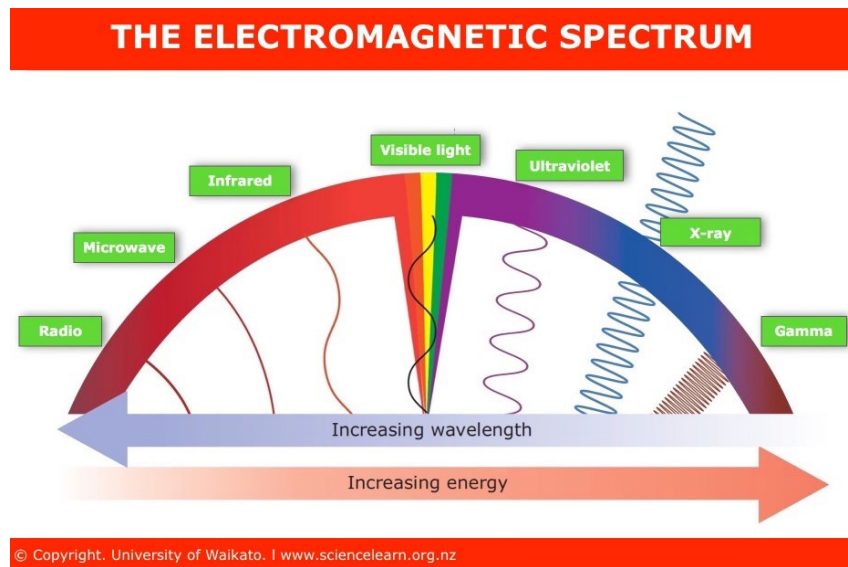


Figure 4.14 The electromagnetic spectrum

This colourful picture was used to draw learners' attention to the electromagnetic wave and give them a representation of it. Using this picture, I taught learners the order of the radiations in terms of wavelength, frequency and the energies involved. The frequency and wavelength of the radiation are both illustrated in this picture. In the centre, the picture shows the dispersion of white light, and we discussed the colours and their energies. I think it was amazing that from one picture we could cover so many concepts. A possible misconception that may be portrayed by this picture is that all the other types of electromagnetic radiation have colour and are visible, because in the diagram the colour spreads along the arch from visible light to the other radiations. I also showed the learners a few other slides, where I had summarised the uses of each radiation. They already have the uses in their textbooks, so I did not dwell much on that. I did not have to rewrite what they already had.

When I started teaching, I struggled to understand the dual nature of light. I had to read thoroughly over the past two years to improve my understanding of it. I was assisted by the National Education Collaboration Trust (NECT)² content document shared on Google Drive by our Physical Science subject advisors. NECT is an organisation dedicated to improving education especially in critical subjects in South Africa. The documents include resources such as lesson plans, activities and topic tests, teacher training guides etc. I especially did not understand where these photons were, and how many photons were there? Nor did I understand how the energy of the photon relates to the energy of that light. I had to be careful not to get learners confused in the way that I had been.

I first showed learners the picture on the left of Figure 4.15, where they saw light as a transverse wave with the properties of a transverse wave, which they already knew from an earlier lesson. The only difference is that light waves travel at a constant speed in air or a vacuum. The particle nature of light is represented by the balls of photons at the bottom of the image. These photons possess energy, which can be calculated using Planck's constant and the frequency of the light ($E = hf$).

² <http://nect.org.za/>

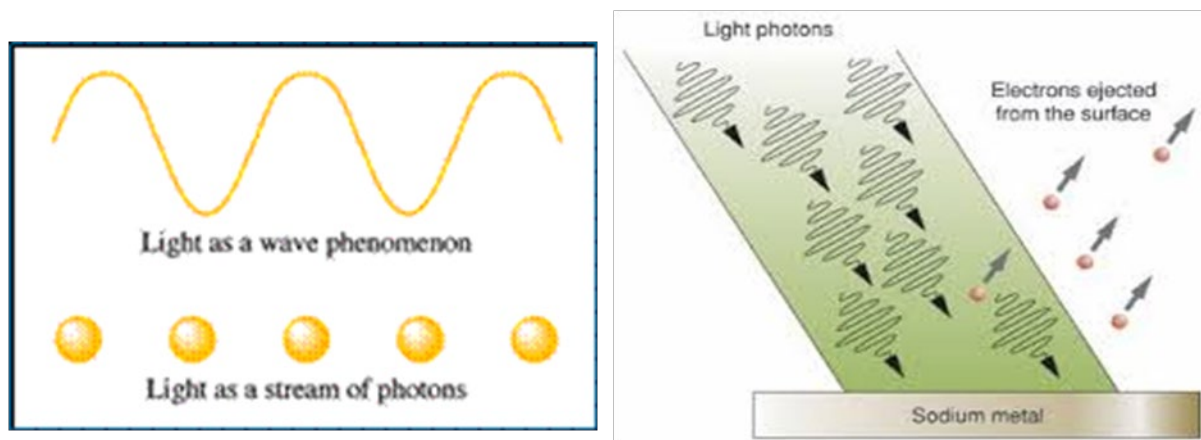


Figure 4.15 The dual nature of light

This was the last lesson and I was extremely stressed. The previous day I had been called to the acting principal's office because a parent, who is also a teacher in the school, had complained that I had not completed the syllabus because I was busy doing my 'little experiments' in class. I was asked to stop doing my research with the kids. I was very discouraged, and I even forgot to record the lesson. This made the reflective process difficult as I was not able to listen to what was happening in the lesson as an aid to remembering whether learners asked questions. Did I ask questions? Were learners engaging? I only had my memory to rely on and jotted down points to work with.

By the end of the lesson I had not marked the class activity, I requested that the learners come back at break time to do this, but some did not come. This was the last teaching time we were having before the learners wrote their examinations, and there were a few learners in the class. At that school, learners tend to absent themselves in the days preceding examinations.

In this lesson, I used a PowerPoint. I explained the energies of different types of radiations. I asked learners to discuss the uses that they already knew about for the different types of radiation.

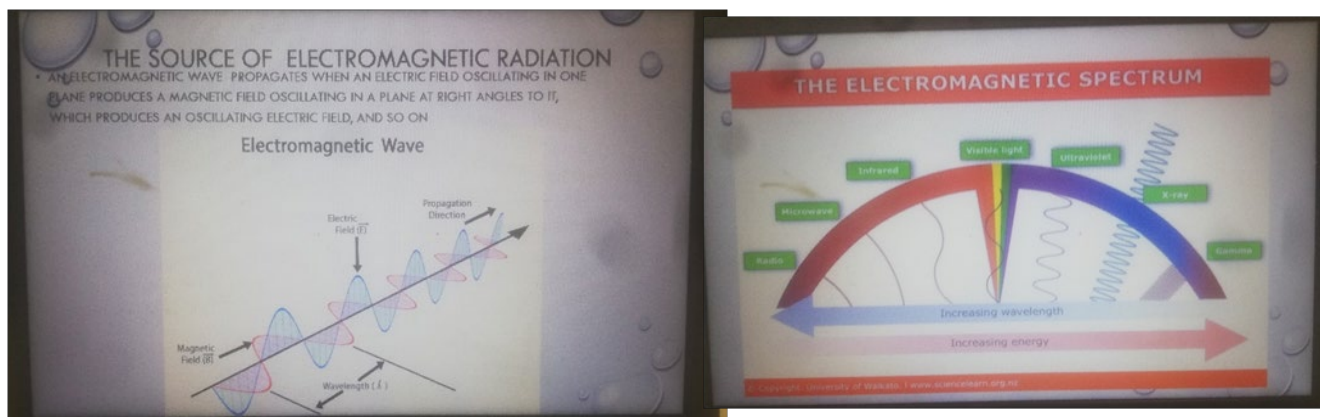


Figure 4.16 The source of accelerating charge and the electromagnetic spectrum

My previous Grade 10 learners had had a hard time understanding the dual nature of the electromagnetic spectrum and how the electromagnetic spectrum is created. The wave nature, they understand because they have dealt with waves, but the particle nature of light is more difficult. This photograph on Figure 4.16 on the left helped learners understand the particle nature of light by illustrating the photons as packets of energy found in light. It would have been much better have had an animation of accelerating charge creating the spectrum. In such a way, learners could have seen the magnetic and electric fields at right angles to each other. They would then also understand what a charge is and what acceleration means. All these terms are only taught fully later in the curriculum. To be specific, it is only in Grade 11 that learners are taught about electromagnetism, the idea of charge comes in term 3 under the topic electrostatics and in term 4 they explore the concept of acceleration when they are taught motion in one dimension. But Grade 10 learners are expected to explain the source of an electromagnetic wave in terms of accelerating charges when they do not understand the words they are using, and so it becomes difficult for them to remember. I realised this when I first started teaching, so I did not dwell on getting learners to understand these words and concepts. They would struggle later to define the terms in an examination, because they had merely memorized them.

I did examples of calculations involving $E = hf$, $E = h\frac{c}{\lambda}$ and $v = f\lambda$ on the board and also wrote down the class activity on the board. The learners could now work with equations and perform substitutions, although I also realised that many struggled with identifying the correct values to substitute in a problem.

I then showed learners the picture on the right of Figure 4.16, because we do not perceive the electromagnetic spectrum (visible light for example) as separated balls of energy but a continuous ray. I had to use this representation of light as a ray with the photons inside. This figure did help the learners greatly in understanding light photons. Calculations based on the electromagnetic spectrum were worked out on the board.

4.4 CONCLUSION

In this chapter there is reasoning behind the teaching methods and structure of my lessons on waves, sound and light. I also shared how I learnt how to use the wave on a string simulation and to download and use videos in teaching. The aim was to show my learning about practice, that is the different ICTs and what took place in each of the lessons.

As I wrote this chapter my reflection back on my experiences in preparing and presenting the lessons and made me realise the importance of time management for a teacher. Learners need the time allocated for each topic as in the CAPS document. Learning is a process and this teaching time gives learners an opportunity to process the concepts, engage in activities and to be given feedback. I think the biggest weakness in teaching this topic was having to condense so many new concepts into such a short time. As mentioned earlier in Section 4.3.1, I did not know the examination start date until a week before the date. I had not been aware of the small amount of teaching time we had left. So with only a week of teaching time, I had to finish this topic of waves, sound and light. In other schools the school management gives out a school planner with important dates, including examination periods. These are vital for a teacher to plan properly. An annual teaching plan (ATP) allows teachers to see if they are on track and not falling behind with their topics. Even though the topics completion dates are on the ATP, I found that I was always behind because of teaching time lost by the school. Even though the school did lose time, nevertheless, I believe that it is up to the teacher and school management to plan strategies to make up for the lost time.

In the next chapter I will share what took place in the lessons and give feedback from my critical friends and learners. This will address Research Question 2: *What are learners' responses to my teaching with information and communication technology (ICT) in Grade 10 Physical Sciences?*

CHAPTER 5 ACCLIMATIZATION CLIMB TWO: LEARNING IN PRACTICE

5.1 INTRODUCTION

In this chapter research question two of the study will be addressed, present all data findings, discussions, reflections on the learner views and conclusions. I have also share feedback from critical friends. The second research question is: *What are learners' responses to my teaching with the use of information and communication technology (ICT) in Grade 10 Physical Sciences?*

Recalling the metaphor of learning being a climb up Mount Everest, as you increase in altitude the atmospheric pressure and air density drops and therefore the amount of oxygen available decreases. Before climbers climb Mount Everest, they do acclimatization climbs in order to force their body to adapt to reduced oxygen supply. The body adapts by increasing breathing depth and heart rate so that it captures the same amount of oxygen it did at lower altitude. Once the body has adapted to these conditions, climbers are ready for the big ascent. Starting to use ICT in class and getting learner views on this was the first step to opening up myself, my body and my mind, to change. In order to transform my teaching, I had to welcome criticism and use it to acclimatize myself in order to improve my teaching. It all starts by opening yourself up to a different altitude than the one you are used to.

5.2 MY LEARNERS' FEEDBACK FROM THEIR QUESTIONNAIRES AND

Learners were given a questionnaire (Appendix J) to answer on each of the five lessons described above. The questionnaires for each lesson remained the same. The main questions asked were based on learners' interest and involvement, their conceptual understanding and my use of ICT. I read the learners' responses and found emerging themes from each lesson which are presented below (underlined). Some of the learners simply gave yes or no answers without any explanation. Some learners also left some questions unanswered.

I grouped the emerging themes from each of the lessons and collated the themes that were common across all lessons. These were the emerging themes that I later discuss in Section 5.5 as 'the views of the learners. The frequency table below shows the number of learners that were

interested by the use of ICT, that said the use of ICT made them understand, those that asked questions and the number of those who felt involved in the lessons.

Table 5.1: Learner responses to my teaching with ICT

	LESSONS	1	2	3	4	5
FREQUENCY OF EMERGING THEMES	Learner interest	7	6	6	6	2
	Learner understanding	7	6	6	6	3
	Learner questions	6	2	4	4	4
	Learner involvement	7	5	3	3	3

5.2.1 Lesson 1

Learners' Interest

All seven learners said the use of ICT evoked their interest because they understood what was being taught. They could see what was being taught. They enjoyed the jerking of the slinky and found it easy to understand how waves are formed. What made learners interested was the visualization aspect of the simulations. They could see the slinky forming a wave and, on the simulation, they could see an animation of what I was teaching.

Learner 5: ...today I was able to see what I was learning; I saw it physically. Usually it only gets explained verbally.

Learner 6: I enjoyed the lesson because it is understandable. By seeing the diagrams, it made it so easy to explain and understand.

All day learners are active and walk between classes and each lesson requires their utmost concentration. The simulations gave visual stimulation and caught and sustained the learners' attention and concentration. I had previously always explained to them the theory verbally, with notes on the board, and they enjoyed this change of theoretical presentations accompanied by

visuals.

Better understanding

Because learners were interested and paying attention, they understood the content better. All the learners reported that they understood the concepts taught. The diagrams helped them to learn better. They could do the class activity with little support.

Learner 2: Yes, I got a better understanding so I could do more.

Learner 6: ... by seeing the diagrams, it made it so easy to explain and understand.

Learner: The projection of how a wave is really formed helped me understand the topic fully.

These quotations indicate that learners could do more than usual in the class; the ICT and its visuals encouraged them to think.

Learners' questions

Six of the learners all indicated that the opportunity to ask questions was there. Only learner went on to elaborate, thus:

Learner 5: There were no questions to be asked because the exercise or the lesson was fully explained and specifically taught.

Learners could answer the questions asked and could do the classwork, but they evidently did not feel the need to ask questions of their own

5.2.2 Lesson 2

Better understanding - interest and visuals

Six of the learners reported a better than usual understanding because of the ICT, and that it was interesting because of the visuals. However, two of them preferred the simulation because it was exciting, and not the video because it was boring and too fast.

Learner 2: No! It was boring. Simulation was much better.

Learner 1: The video and simulation made it more interesting and understandable.

This learner says that the video did not create an interest in learning about waves. two of them reported the video as being boring. Another learner though reported that both the video and the simulation were interesting.

Video was too fast

Two learners reported that the video was too fast to follow and preferred the simulation where there was some control over the pacing.

Learner 7: But the video was playing too fast. The simulation was good.

The other learners were able to keep up with the videos and they said they enjoyed it.

Learner involvement

Two learners reported not being actively involved in class. To them the lesson with ICT was the same as previous lessons without the use of ICT.

Learner 4: No, we are not active in class.

Learner 3: No, it was quite the same for me.

The use of ICT did not change these particular learners' involvement. Three of the learners however reported that they were more involved because of the visuals.

Learner questions

Two learners asked questions. Two learners said they did not have questions because they were shy and the one was scared to ask questions. Two indicated that because everything was clear as in lesson one, they did not need to ask questions.

Other topics for ICT

Learners indicated that they would like other topics to be taught using ICT. Two indicated that they would like chemical bonding to be taught in this way, and one mentioned balancing chemical equations for a suitable ICT topic. I speculate that the learners would like the use of ICT in these topics because from my experience these are the topics the learners are battling with and would like clarity about.

5.2.3 Lesson 3

As explained earlier in Sections 4.3.4 and 5.3.3, because it was in effect two lessons in one, this lesson was content heavy. The lesson covered the relationship between frequency and wavelength, and frequency and period, with calculations involving the relationships.

Better understanding- interest and visuals

All seven learners reported that they had enjoyed the lesson because they understood the

concepts. Only one learner said he does not like the use of ICT.

Learner 1: I enjoyed the simulation because it was clear and understandable.

Learner 7: I enjoyed the lesson because I understood everything except the video explaining frequency of the wave.

Learner 3: I understood the relationship between frequency and wavelength because of the video and simulation.

Most of the learners indicated that they understood the lesson because of the ICT, except for one. There also seems to be a preference for the simulation over the video, as in lesson 2.

Learner involvement

Four learners felt that the lesson was the same as previous ICT lessons and before I started using ICT. They had not been actively involved. This was indicated by responses below.

Learner 3: It was like the last one.

Learner 4: I am always inactive in class.

In class the learners had sat and watched me teach with ICT but they did not do anything. They were quite inactive. Two of the learners however felt involved because they were following and understanding what was going on.

Learner questions

Three learners indicated that they did not ask any questions because the lesson was well taught, and they did not have any questions. One learner said they did not ask questions because they were not interested in learning about it anymore. The other two did ask questions.

Other topics and ICT

Learner 4 indicated that he or she did not want other topics being taught using ICT, while all the others would like more use of ICT, especially in chemistry. They indicated that computers, wifi, and tablets are tools they would like to have in their learning.

5.2.4 Lesson 4

Better understanding - interest, visuals

The learners indicated that they enjoyed the lesson because they understood what was being

taught.

Learner 5: Yes, I was able to do calculations.

Not all learners felt like this. One of the learners did not find it interesting.

Learner 1: I did not get interested because I was unaware of what was going on.

This made me realise that learners enjoy or stay interested if they understand and can follow what is going on in the lesson.

I got similar responses about involvement and questions as was reported for the third lessons.

5.2.5 Lesson 5

In this lesson I used only PowerPoint and relied on the power of colourful images to get through to the learners in teaching them about the electromagnetic wave and the calculations related to it.

Understanding - interest and visuals

Four of the learners did not enjoy this lesson. They lost interest because evidently, they did not understand the content. One learner said I was too fast. This is true. In only one lesson I had to cover so much. Two learners enjoyed the lesson because the pictures on the PowerPoint helped them understand the concept of electromagnetic waves. I got the same responses about learner involvements and learner questions as before.

5.3 THEMATIC DISCUSSION ON LEARNER'S VIEWS

The emerging themes from each of the five lessons were collated and are discussed in the following sub-sections.

5.3.1 *ICT for conceptual understanding*

In the study, the learners reported to have had conceptual understanding of some concepts and lacked it in others. The majority of the learners lacked understanding of the content covered in lesson five. That is unsurprising the majority of the class was absent for this lesson, as has been explained in Section 4.3.1 I also ran out of time before I could give them feedback on their class

work, and although I asked them to come back, only a few did.

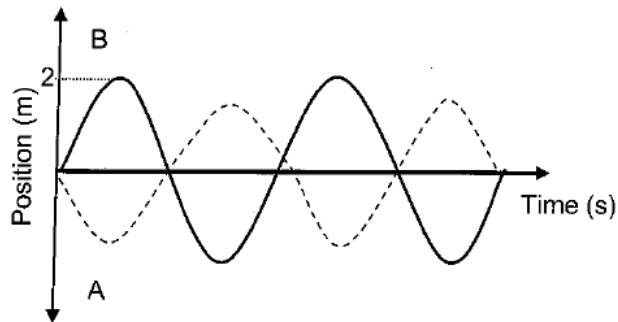
I have had difficulties previously on helping learners understand that ‘the particles in a medium move up and down only in a transverse wave moving horizontally’. So even though they could define a transverse wave they still did not understand the movement of particles. However, this year after explaining this concept through a simulation learners were able to correctly predict the movement of a particle in the class activity. The use of the PhET simulation made it easier for learners to understand because they could see the particle moving up and down only while the wave was generated horizontally.

Among four important benefits of using ICT in teaching identified by (Webb, 2005), the most important one is conceptual understanding, which he called “promoting cognitive acceleration” (p. 728). He adds that, “Simulations provide new affordances for learning, particularly where they are based on phenomena that cannot easily be observed and explored in the real world” (p. 728). For example, in this study learners were able to observe a model of a sound wave which is invisible in reality, and learners repeatedly reported understanding the concepts because of the animations, colour and visuals afforded by ICT. Similarly, Bester and Brand (2013) showed results indicating “There was a significant difference between the average achievements of the group of learners exposed to technology during a lesson compared to the group who were not exposed to technology and only received normal verbal instruction” (Bester & Brand, 2013, p. 10).

Bloom’s taxonomy can be used to help develop a range of questions to help discern whether learners are regurgitating information or whether they have conceptual understanding of the ideas taught. Questions that allow learners to regurgitate information they have memorized represent the lowest three levels of Bloom’s taxonomy. They require learners to simply remember the typed notes or what was on slides (Forehand, 2010) as shown in figure 5.2.

QUESTION 6

The diagram below shows two waves A and B, of the same wavelength but different amplitudes intersecting.



- 6.1 Define *amplitude*. (2)
- 6.2 Determine the amplitude of A if it's amplitude is two thirds that of B. (2)

Figure 5.1 Lower and Higher order questions from a Grade 10 Physical Sciences paper

In Figure 5.1 above, I have shown two examples of questions from the KwaZulu-Natal Grade 10 Physical Sciences paper 1 of 2018. The first (question 6.1) is a lower order question that asks learners to define amplitude. Learners merely need to remember the definition as stated for them in the examination guidelines. A higher order question is given in question 6.2, where learners are supposed to infer the magnitude of amplitude B from the diagram and calculate that of A. Using ICT is supposed to extend learners into higher levels of thinking via cognitive acceleration (Ndlovu & Lawrence, 2012). I was not able to do all the assessment I had planned to do with the learners because of time. However I did some of the assessments. After using ICT in the classroom in lesson one learners initially had to draw and label a pulse, this was easy a low order question. In lesson 2 when learners had to draw the resultant pulse when given two pulses interfering with each other. In order to answer the question they had to understand pulses that are in phase and out of phase and the video showed these well. In lesson 4 and 5 we did calculations which are higher order. I used the white board for calculations. A white board is not a modern ICT tool but it was used for higher order. I do believe however that learners had to understand the concepts taught in the previous lessons using ICT in order to comprehend the mathematical problem given and solve it. But even though ICT may be used in the classroom it does not

guarantee conceptual understanding, as Ndlovu and Lawrence (2012) explain, “The fundamental key in effective use of ICT in the classroom depends on the teacher’s capacity to effectively teach with or without technology. The tool that is used, no matter what it is or no matter how many we have in the classroom cannot enhance learning on its own” (p. 20).

I am learning that the presence of ICT does not guarantee conceptual understanding. The content must still be scaffolded in a thoughtful manner and the ICT tools must support this careful scaffolding. The lesson planning process in this study was carefully thought but there is still room for improvement. In the first two lessons the lessons were at their pace and learners could keep up. From lesson three onwards it became difficult for them to keep up. I need to present and unpack the content slowly in order for learners to understand. Even though I worked well in my technological knowledge and pedagogical knowledge I still need to work on my technological pedagogical knowledge.

This research is a self-study about my learning of ICT in teaching and while I value an increased performance of learners due to ICT use, there are many other factors that can contribute to learner performance. In this regard, Mji and Makgato (2006) identified factors that directly influence the performance of high school learners in South Africa. These include effective teaching strategies and deep content knowledge of the teacher, motivation of the learner, laboratory use in class and completion of the syllabus. All these factors could have played a role in the performance of the learners in class, which cannot be attributed to the use of ICT alone.

5.3.2 *ICT improves learner attitude*

In the first lesson of the study I was anxious about how learners would react but us working together to try make the slinky work proved to me that they too wanted to make the lesson a success. They assisted those that were doing the demonstration by giving verbal instructions, they suggested other ways we could make a pulse. Normally I found that in the school learners will make effort not to make the lesson work or use anything as an excuse for the lesson not to proceed. So initially when the slinky did not work as expected, I anticipated them to complain and say that they do not understand because the slinky was too short. This was special to me because it was the first day and I was anxious, it showed me that it was not I and them but us. In Hamzah, Embi, and Ismail (2010), learners showed positive attitudes towards ICT, their interest and attention

increased. This finding could be attributed to learners not having any negative ideas about the use of ICT because it is new to them, as found by (Eyyam & Yaratan, 2014) in their study to investigate the use of technology in mathematics lessons and its impact on learner achievement and attitudes. They found that learner achievement improved using ICT and furthermore found that learners have positive attitudes towards the use of ICT in the classroom. Learners would rather be in a classroom with technology than in a classroom without, even if they are uncertain whether or not technology would enhance their performance (Eyyam & Yaratan, 2014).

5.3.3 *ICT captures the learner's attention*

Attention is referred to as the mental faculty of considering or taking notice of someone or explicitly focusing on something. Styles (2006) defines it as “taking possession of the mind in clear and vivid form”, as cited in Bester and Brand (2013, p. 2). As soon as the learners in this study walked into the classroom and the data projector was showing something on the wall, they set quietly, in anticipation to what they would see. This interest was also evident among learners who were simply walking past the classroom. They stopped to look at what was going on, and some of them asked me if my class would be watching a movie. Some of them asked their peers what was exciting in their class as they peeped into the class and wished they were part of the lesson. One might say that if they experienced being taught with the projector every day in each classroom it would not fascinate them; it might not get their attention as much. The novelty of the ICT technology also draws their attention for a little while, but an ICT pedagogy is required to sustain their interest and to get them cognitively involved. The learner showed the highest amount of interest in the first two lessons and I noticed that it gradually decreased over the lessons. this could also be lack of interest due to the nearing of the closing of term.

There are plenty of technological tools around us and the methods of teaching with ICT are diverse and currently being explored. For example, I was using a data projector and there are a variety of teaching resources one can use with a data projector, such as video clips, PowerPoint presentations, and simulations. By integrating each one into different lessons, learners can always look forward to challenging and exciting experiences in ICT. However, I express some caution as Maharaj-Sharma and Sharma (2017) warn us about the overuse of the same type of ICT, as it will

lose its effectiveness and learners can become bored again.

One of the well-known benefits of using ICT in the classroom is to capture learners' attention (Mdlongwa, 2012). As confirmed in the study conducted by Bester and Brand (2013), learners in lessons with technology were much more attentive than those receiving conventional verbally orientated teaching.

5.3.4 *ICT for learner engagement*

One advantage of using ICT in the classroom is that it can facilitate a learner-centred classroom, where learners are not passive receptors of knowledge but active creators (Hargreaves et al., 2003). Nevertheless, Ndlovu and Lawrence (2012) caution that ICT does not guarantee any benefit on its own; it is the teacher that holds the key to effective teaching and learning. Along the same lines, Hargreaves et al. (2003) indicate that it is the teacher that determines the level of learner engagement. They give nine different ways in which a teacher can get learners involved in lessons, which the authors have divided into two categories, a surface form and a deep form. They state that the "first five types were regarded as 'surface' forms of interactive teaching, associated by some teachers with 'gimmicky' techniques such as the use of phoneme fans, various games or whiteboards" (Hargreaves et al., 2003, p. 224). Regarding deep forms, they state: "The last four types, however, represent a deeper level of engagement with the purposes of interactive teaching, to probe pupils' understanding, to try to ensure reciprocal interaction and the co-construction of meaning, or to enable children to consider or articulate their own thinking strategies" (Hargreaves et al., 2003, p. 225). In my teaching using ICT one of the areas that I say needs the most improvement is learner involvement. As a novice I concentrated too much on the ICT use rather than teaching with ICT. In my planning I neglected how the ICT can involve the learners. I thought by using ICT it instantly makes the learners involved. Learners want to be involved and active in the class, this is a critical part of pedagogy. In lesson one two learners used a slinky to show a pulse while the others observed. Learners would have been more active if I put them into groups of two, let them propagate a pulse and answer an activity together. When I used the videos I could have given them questions to answer after watching the video to encourage that they follow. I could have also created an Edpuzzle. Which is a video which pauses and asks learners a question about what they have learnt. My PowerPoint slides could have included interactive games,

questions or quizzes to include the learners. all of these could have greatly increased learner activity and made the lesson enjoyable for them.

5.4 DISCUSSION OF LEARNER RESPONSES

In this chapter I intend to answer my second question of the study, which is: *What are learners’ responses to my teaching after the use of information and communication technology (ICT) Grade 10 Physical Sciences?* The analysis of learners’ responses shows that they fall into four dimensions: learning styles, and psychological, cognitive, and social dimensions. These are illustrated in the model shown in Figure 5.2 and are discussed individually next.

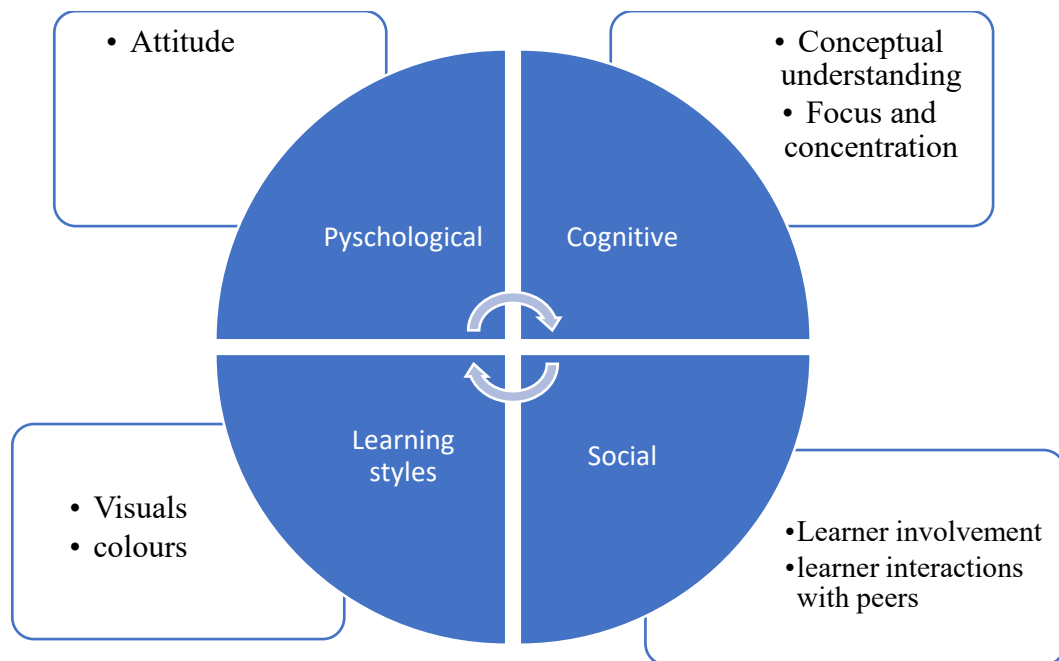


Figure 5.2 A Model showing the dimensions of learner responses to my use of ICT.

5.4.1 Learning styles

A learning style is a preferred way of using one’s ability; it is not an ability but rather a preference (Bergsteiner, Avery, & Neumann, 2010; Sternberg, 1994). Individuals have different learning styles; that is differing ways in which they take in, process and keep new information and skills (Reid, 1995). As (Bergsteiner et al., 2010, p. 30) “Kolb’s theory posits that learning is a cognitive process involving constant adaptation to, and engagement with, one’s environment. Individuals create knowledge from experience rather than just from received instruction. Conflicts,

disagreements and differences drive the learning process as learners move between modes of action, reflection, feeling and thinking” (p. 30). Learning styles therefore reflect learning preferences of individuals and they can change according to the situation (Bergsteiner et al., 2010).

The use of ICT in my lessons allowed learners to explore different learning styles that might have been new to them, as they had not previously been taught Physical Sciences with ICT. For instance, ICT allowed for visuals accompanied with animation and colour. Learners responded that they found the use of ICT in the classroom interesting mainly because of the visuals from the ICT.

5.4.2 **Psychological dimension**

The psychological dimension in this study focuses on the behaviour, emotions and attitude towards the use of ICT. The learners showed positive attitude towards the use of ICT (R. C. Gardner, 1985).

On day one learners were extremely excited and interested when they saw the laptop and data projector in their classroom. Below is a quote from one of the learners from day one. They enjoyed the lesson and they give the reason to visuals that the ICT afforded.

Learner 5: ...today I was able to see what I was learning; I saw it physically. Usually it only gets explained verbally.

Learner attitudes remained with the learners through the lessons, so it was not excitement from seeing ICT hardware for the first time in their class.

5.4.3 **Cognitive dimension**

For the cognitive dimension, the focus is on mental processes expressed by the learners. The learners in this study reported having gained conceptual understanding of the work because of the use of ICT. The visuals encouraged them to focus, to concentrate on what was taught, and therefore to understand the work better. This is similar to the findings from Hadjerrouit (2008). When learners understand they enjoy the lesson, when they do not, they become frustrated and uninterested. This is what one learner said.

Learner: I enjoyed the lesson because it is understandable. By seeing the diagrams, it made it so

easy to explain and understand.

In this study ICT played a huge role in scaffolding learner knowledge.

5.4.4 Social dimension

Maximizing interaction among learners in the classroom is an important aspect of inclusion in education. The learners reported minimal physical involvement in the classroom as they were not working on the ICT, but rather they were watching me teach with the ICT. They interacted with me during classroom discussions, but they had no interaction amongst themselves, as recommended by Shulman (1986, p. 10).

As a novice I think the biggest regret I have in planning the lessons is minimal learner involvement. I did not know how to make the learner involved when teaching using ICT. Learners said that ICT did not make them involved.

Learner 4: No, we are not active in class.

Learner 3: No, it was quite the same for us.

However, this was not a consensus the five other learners felt involved, especially mentally as they followed. Even though learners were not actively working with the simulation they were following. When videos were playing, I stopped to explain and ask questions. From this I can conclude that learners prefer engagement that is hands on.

5.5 CRITICAL FRIEND FEEDBACK ABOUT MY USE OF ICT

5.5.1 Introduction

When an athlete from the coast is to compete inland at higher altitude, he or she needs to practise inland so that the body adapts to the reduced oxygen levels. The same thing happens to a Mount Everest climber, they must do several climbs to allow their bodies to acclimatize. My first climb was the learning of ICT and development of lessons shown in Chapter 4. My second climb was the implementation of the lessons as reported in the first part of this chapter. My third climb is my learning through feedback from learners and critical friends and my reflections. What follows is still part of my third climb as I share the data obtained from critical friends as they

observed me implement the lessons.

5.5.2 Data Collection and Analysis Procedures – critical friend responses to my use of ICT

Three of my critical friends came to observe my teaching with ICT, each observing only one lesson. The data from critical friends could have been strengthened by each critical friend observing the whole series of lessons as I used ICT so that they could track my progress. Unfortunately, this was not possible; it was already a challenge just to ask critical friends to use ‘free periods’ to observe my lessons, and the ones that agreed could only observe one lesson each. This is the harsh reality of a schoolteacher as not only is everyone busy focusing on completing the syllabus, but ‘free periods’ are scarce and precious. This meant I had to reflect thoroughly on my own progress and get as much from the critique of the lessons that the critical friends observed. For anonymity, I refer to my critical friends as A, B and C. Each of the critical friends sat at the back of the class for the lesson they observed, and was given a questionnaire (Appendix I) to fill in. The data from each critical friend are presented after the profiles of the three critical friends.

5.5.2.1 Critical friend A

Critical friend A is a social-psychological worker in the school. She oversees the emotional well-being of all the learners in the school. She is 24 years old and studied social work at the University of KwaZulu-Natal. She joined the school in 2018. One of the challenges the school was facing was pregnancy and substance abuse among learners and she was working hard to give support to the learners identified as facing these problems. We soon became good friends as she is a person who is good in giving emotional support. As soon as she heard of my struggle getting critical friends, she offered to help to be a critical friend. I trusted her knowledge of qualitative research from her own studies that she had shared with me.

5.5.2.2 Critical friend B

I call critical friend B my “go-to person” at work. She taught in the classroom next to mine,

and as a new teacher whenever I was uncertain about something, I would approach her for advice. Whether it was help with documents that needed completing or administrative work needed at the office, or discipline issues in my classroom, she was always so helpful. We often had conversations as we stood outside each other's classrooms as the learners entered. In my first year of teaching she was the Grade 9 Mathematics Grade controller, which meant she oversaw preparing all Grade 9 assessments. I was teaching Mathematics in Grade 9 but was a new teacher and not being formally qualified to teach Mathematics, so she played a big role in assisting me with Mathematics teaching. I also noticed that she had a neat handwriting, so whenever I needed to fill in an official document or form, I would ask her to write it for me. She has been teaching at the school for the past 15 years and is qualified to teach both Mathematics and Physical Sciences. She last taught Physical Sciences in 2008 and has been teaching Mathematics ever since. I was happy to have someone with knowledge of both the subjects and experience in teaching them as a critical friend.

5.5.2.3 Critical friend C

Critical friend C is a 27-year-old teacher at the school who has been teaching at the school since 2017. She obtained her Bachelor of Education degree from UNISA, specialising in teaching isiZulu, Natural Sciences and Creative Arts. At the time of my study, she was studying towards her Master's degree, in environmental education. Our relationship grew as we shared our progress and challenges in doing research. Even though she had a busy schedule she agreed to be and was a valuable critical friend in the study because she understood the process of collecting meaningful data for post-graduate studies.

5.6 QUESTIONNAIRE FEEDBACK FROM MY CRITICAL FRIENDS

5.6.1 Introduction

This chapter presents what critical friends said about learners, my choice of ICT, my ability to use the chosen ICTs effectively and my confidence in their use. The key themes that I have reflected on are underlined.

5.6.2 Feedback: lesson by lesson

5.6.2.1 *Critical friend A- Lesson one observation*

Learners

Critical friend A observed that the learners enjoyed the ICT, which was the PhET simulation. The learners were engaged, and they understood the concepts I was explaining.

Connection between topic and focus of ICT

Critical friend A commented on the important connection between the focus or objectives of the lesson and my use of ICT. What I was teaching was clear for everyone to see. She also suggested that this connection could be improved by audio effects or something learners can listen to instead of just watching the simulation. It might have been more useful if they could have also listened to the sounds. However, the PhET simulation of wave on a string does not have sound, it only shows the movement of the wave. So, as I was showing the learners the horizontal movement of a transverse wave, there was only movement and no audio from the simulation to accompany the animation. Having no sound as the wave moved was convenient for me as I could explain what was happening to the learners.

Improvement of ICT resources

I used a projector to project images in front on the wall of the classroom. The walls were originally painted white, but the paint has become old and dirty and there were crayon writings on the wall. To make what is being projected clearer, my friend suggested that I get a white display board because the background writing was a distraction preventing the learners from having a clear view of the display.

Choice of ICT

My critical friend felt that the ICT chosen made it simple for the learners to understand the lesson content. She also felt that the ICT I had chosen did not deviate from the focus of the lesson, which was to introduce learners to the pulse. In the lesson, learners observed a pulse in the slinky, saw it on the simulation of a pulse in a string.

Ability to use ICT

The critical friend was happy that I understood how to use the ICT and that I was explaining

to the learners as I was working with the ICT, so the learners could follow easily.

5.6.2.2 Critical friend B – lesson 2 observation

Learners

In this lesson learners were taught about the principle of superposition. Through video then a PhET simulation and a picture. Learner were shown constructive and destructive interference. Critical friend B observed learners being actively involved as they were answering the questions. She saw that they could also confidently answer questions posed by other learners. There was an environment of trust created in the class, so learners were comfortable to questions. The critical friend stated that the learners were interested and that they followed the lesson closely. She commented:

“During the lesson, the teacher demonstrated great knowledge of the content and the tool used to deliver the lesson clearly served its purpose and learners were able to engage very well. I could follow what you were doing throughout the entire lesson. There was a logical form of events and the teacher was able to explain the frequency to learners and learners were able to follow without any hindrances of being not sure what was said before.”

The logical sequencing of concepts helped the learners to understand. I feel this is very important to any lesson, with or without ICT. The way the ICT was used was also logical. The delivery of the content should be carefully planned and well thought of in terms of learners’ context, language ability and prior knowledge.

Content knowledge

Critical friend B commented that I showed sound content knowledge because when the learners asked questions, I was able to answer them clearly. She added that while I was teaching, I seemed confident and was able to engage the learners easily.

Choice of ICT

The critical friend stated that the tool(s) used to deliver the content clearly served the chosen purpose. Through the video I could show superposition of pulses, both in and out of phase.

Constructive and destructive interference were demonstrated through the PhET simulation and we measured amplitudes of pulses. The ICT tools I used served their purpose as it showed the learners exactly what I wanted them to observe and experience.

Confidence in my use of ICT

The critical friend observed that I was confident because I was using the ICT tools effectively and explaining to learners what I was doing. I was able to use the ICT to explain to the learners in a logical sequence and help them understand the key concepts in waves, sound and light.

Ability to use ICT to teach (technological pedagogical knowledge)

Being able to use ICT and being able to use it to teach are different ideas. When using ICT to teach, it must assist you to reach your lesson objectives. The critical friend said that the use of ICT was in line with the lesson objectives and that the learners understood with little or no hindrances. Every time there was a new event, for example, using a different ICT tool, I would introduce it to the learners before starting with it. In this way learners also understood the technological tool I was using.

5.6.2.3 Critical friend C – lesson 3 observation

Learners

Critical friend C commented on the strong connection between the topic and the ICT used in class. She added that my learners were very interested. It seemed as if the learners were watching a movie and not learning. They were very focused and attentive.

The critical friend also observed that although learners were paying attention, they were not engaged physically, as they were not given a chance to do things during the lesson in the learning process. They did the class activity that was given to them after I have taught the new material.

Choice of ICT

The critical friend described the use of the data projector in projecting the videos as

amazing. It made the lesson colourful; it was innovative and interesting. It also sustained interest in the learners.

Improvement of resources

She suggested that learners could be more involved in the lesson instead of observing. She suggested that the school could provide tablets for the learners that would make them more involved in terms of output and input responses. The teacher could have online questionnaires to assess learners thereafter.

Confidence in the use of ICT

The critical friend teacher was of the view that I was confident in my use of ICT because I was able to go backwards to look back on what we have already done and relate it to what was currently being taught, while consolidating the concepts, so that the learners could reflect on what was already learnt, and relate it to the new concepts.

ICT for calculations

The teacher thinks even though the use of ICT is amazing, there are some aspects that cannot be taught effectively using ICT, such as calculations. She says ICT helps with theory but not so much application, especially in problem solving exercises where mathematics is required.

5.7 DISCUSSION ON CRITICAL FRIEND QUESTIONNAIRES AND INTERVIEW

5.7.1 Critical friends' questionnaires

The classroom in which the study was conducted is the same classroom I taught in when I first started teaching in 2017. I had never observed or been in another classroom during a lesson. It was the only classroom teaching environment that I had created for myself as a teacher. I had become accustomed to everything in the environment, including the graffiti writing and the marks on the wall and I had assumed that I had no authority to remove them. My critical friend A pointed out the need for improved ICT resources and that I should rather use a white display board instead of the dirty wall. The wall in which I was using as the screen had marks, and this hindered learners

from seeing everything clearly (see Figure 5.3 below).



Figure 5.3 The marks on the wall where the projector image was displayed

But I had not actually noticed this before as these defects were part of our everyday life in township schools. The role of critical friends is vital because they are able to bring things to your attention that you were completely oblivious too (Samaras et al., 2009). This improves professional development (Taylor & Settlemaier, 2003) as one can improve on the identified areas of weakness.

During the week I moved from this classroom into the Physical Sciences laboratory. I taught the last lesson on waves, sound and light in the laboratory. The laboratory was a different environment for me, as only the Grade 11 and 12 classes, whom I did not teach, used this laboratory. It was thus also new for the learners since they had not been taught in the laboratory before. They now had to leave their bags outside, and I had to find an appropriate place for the projector. I was glad that the laboratory wall did not have marks or writing on it so.

My critical friend C also suggested that there should be improvement of ICT resources and that the school can provide the learners with tablets, computer, laptop or chrome books. The use of these would make learners individually involved in the lesson as they would be the ones working on the simulation and it would make them more involved. However, when I am teaching it is beneficial to have learners all looking and concentrating on the same thing without distractions. They would become be useful for individual work as they would allow learners to interrogate their own understanding and also examine if learners had reached the lesson objectives. However, Improvement of ICT in a poorly resourced school is a pipe dream as basic needs must be met first

from the limited funds available. Installing ICTs in a school is expensive and unlikely to be invested in.

5.7.2 Critical friends interviews

Recorded interviews were conducted with critical friends after they had completed the questionnaires. The interviews served as tool to ensure the data is reliable. I wanted to make sure that I had interpreted what they had written correctly in order to get a true meaning.

When critical friend A was asked if she saw a connection between my teaching and the use of ICT, she understood the word connection as being related to the physical ICT hardware, the laptop and the projector which were connected to each other. I had assumed that she referred to the pedagogical connection as the computer was already physically connected to the data projector. She clarified this misunderstanding in the interview and gave me her response. Critical friend B had written that the learners looked as if they were watching a movie and not learning. I was concerned about this feedback and wanted to find out more about it. The critical friend explained that the learners were paying so much attention that they did not act as if they were learning. I understood critical friend C questionnaires answers as she meant them, so there was no need to clarify anything in the interview. She was elaborative in her answers.

During our interview with critical friend B she said that I reminded her of topics she had not thought about in many years. I made her feel nostalgic. Critical friend B taught Physical sciences shortly when she was a novice teacher, more than two decades ago. I realised that none of my critical friends had the subject knowledge and experience in teaching Physical Sciences. I think feedback from a person in this field would have had more weight because they are familiar with the different ways of teaching the content, know other pedagogic tools and can judge my content knowledge.

It was hard to find critical friends, people are busy and overloaded, and they do not want to add to their workload. Each critical friend agreed to sit in one lesson. They could not commit to observe me teach for the entire topic. The critical friends were not able to track my progress or see

how I have done in the other lessons. This was a setback in the study in terms of their feedback.

5.8 CONCLUSION

The aim of this chapter was to learn through practice by getting feedback about my teaching through the views of learners and critical friends.

The views of the learners can be summarised into four dimensions of social, cognitive, psychological and learning styles (Figure 5.9). This then made me reflect that when I teach using ICT, I must ensure that all the above aspects are taken into consideration, I must strive for learners to respond positively across all of the dimensions. One learner reported to having no interest in the use of ICT as it did not make a difference to their learning. I wish I would have had the chance to interview this learner to find out the reasons behind his or her view.

The learners' views of learning via ICT helped me understand that when I am teaching Physical Sciences using ICT, the social component is vital. I learnt that learners were not always actively involved. I found that in my lesson plans, the physical participation of learners was minimal, which may be due to the limited resources we had. It was reinforced for me during my university training that learner participation is vital, with or without the use of ICT.

In the future I will pay careful attention to ask questions that do not require a yes or a no answer in the questionnaires in order to guide learners to support their answers by referring to a particular event that happened during that lesson. I will also explain the terminology used in the questions used what is expected from the questions. This will allow me to get maximum feedback from the participants.

Critical friends are vital in the methodology of self-study. They allowed me to see aspects about my teaching and the classroom I was not aware of. In the future I would improve on the view of critical friends by having all critical friends in all the lesson in order for them to see my progress or lack of progress.

Critical friends were valuable in highlighting aspects I had not been aware of before. For instance, critical friend A had noticed how the writing on the walls was a distraction that hindered teaching and learning. I also noticed how my behaviour changed in the presence of an observer in the classroom. I had to evaluate whether I was myself or had changed my behaviour appropriately.

I found that having someone observing impelled me to behaving differently.

Critical friend A misinterpreted the wording of a question in the questionnaires. She understood the word 'connection' as being related to the ICT hardware. When collecting data in questionnaire I learnt the importance of using the appropriate word that a person being asked would understand or discussing the questions with the interviewee before they answer the questions. The interview played a crucial part in clarifying this.

Chapter 6, answers my third research question where I reflect on my journey of this self-study.

CHAPTER 6 ACCLIMATIZATION CLIMB THREE: LEARNING FROM PRACTICE

6.1 INTRODUCTION

In this chapter I answer my third research question: *How can I learn information communication technology (ICT) pedagogical tools and use them to better teach Grade 10 Physical Sciences?* I have reflected on the feedback from critical friends and my journey through the learning of ICT tools, the planning of the lessons and how I taught using ICT. I also reflect on my journey as a novice teacher. My being a novice teacher is an important aspect in the study because this is the time when I am learning how to be a teacher and developing professionally.

6.2 MY REFLECTIONS OF THE PATHWAYS OF ICT TEACHING AND LEARNING – M A NARRATIVE OF A NOVICE SCIENCE TEACHER SEEKING PROFESSIONAL DEVELOPMENT

6.2.1 Reflections on education views and general perspectives

Umzinto, where I first began to teach, is 125 km from my home. When I got a job there as a teacher, I knew immediately I would have to move because travelling to work and back home every day would be impossible. I had to find a place to rent, which seemed daunting as I did not even know where to start. When the principal and I were talking, I happened to express my concern about this hoping he would refer to me to someone who can help me. He replied, “Ask the learners, they know, they will be able to help you”. I was shocked. I had expected him to refer me to someone older not to a child, because age is associated with being wise and knowledgeable, I wondered if the learners would view that as a weakness that their new teacher is struggling with something. Is a teacher supposed to know everything? I wondered whether or not I would be dragging my private life into the classroom.

I swallowed my pride and within two weeks I had moved into my place, fully furnished, all through the help of the learners. I was astonished at their knowledge about the area and the connections that they had and most importantly their willingness to help me. They knew which place was safe, and which one was dangerous, and they had contacts for transport for me, DSTV

installations, and furniture. It was delightful and it made my moving so much easier. They did not see me as weak at all, in fact I built a close relationship with the learners.

In the classroom I knew that learners are not empty vessels and that they possess prior knowledge, but I think I underestimated the amount of knowledge learners have. After my initial lessons I would be so exhausted because I had done too much, and the learners would have done little. This changed when one day in class we were doing a practical on the motion of an object using a trolley. All the trolleys in the laboratory were not working because there was too much friction. The learners started coming up with ideas of what we could use instead and within minutes they had come up with an alternative way of doing the practical. They suggested we oil the trolleys with oil that was available in the lab, that we lift the plank at an angle for increased acceleration and that we use a smoother plank as a ramp. I was amazed. I had always felt that everything in the classroom was up to me and gave them no sense of responsibility except that of bringing their exercise books to class. This was the only opportunity where the learners had done something for themselves or helped in the classroom. Ever since then when planning my lessons, I always ask, “Will I be doing something that the learners can do for themselves?”

In the first few days of teaching, I was however concerned that the learners were so far behind with the syllabus because they had been without a teacher for some time. I then asked them to read particular pages, make a summary on it and we would talk about it tomorrow. I was surprised the next day to see that no one had done the summary. I had never before been in a school environment where homework was not done, and for no valid reason. After explaining the importance of homework, the next day it was still not done. For the next two years I was scared to even check for homework because I was sure I would just upset myself when it had not been done. I later learnt that it was not just me, it was a school thing, and the learners just did not do their homework or even their classwork. It was a shocking practice. I realised that this is because they will not get any form of punishment for not doing it. The school did not have a detention system, and there were regulations precluding corporal punishment. Parents would be contacted only if really necessary as many were working and could not take time off. So, learners knew that there would be no immediate repercussions for not doing work. Unfortunately, the learners do not appreciate the long-term negative impact this would have on their learning.

After two and a half years at the school, I left to teach in a school where all the learners do their homework, and regularly too. It is hard to compare the schools because they are very

different. But looking at the learner's motivation to do homework at the new school, it is based on the fear of the personal consequences if it is not done. They know that if it is not done, they will get a Demerit, and 3 Demerits will lead to 2 hours in detention. This made me realise that as a teacher, in order to ensure a good teaching and learning environment there must be consequences if rules are not followed. I will have to be consistent and always check learners' homework and in applying the consequences.

In my second year of teaching in 2018 my classes changed. I taught Physical Sciences from Grade 10 to 12, two Grade 8 Mathematics classes and one Grade 8 Natural Sciences class. Being the only teacher teaching Physical Sciences in the school, I felt like everything was on my shoulders. Before staff briefings in the morning and in the passageways during the day, I would interact with colleagues; but usually only in complaining about common problems we faced, like the lack of learner interest. I had no academic support and I was doing everything by myself from developing assessments, choosing appropriate teaching strategies, and designing activities. This consumed all my energy and I felt like I had none left to give in the classroom. I was not able to interact with other teachers who were teaching the same subject as me. I could not be involved in co-teaching, or collaborate with other teachers in planning lessons, and felt very isolated.

In the school I had my HOD who had been teaching Physical Sciences for many years to supervise me (the one who taught Grade 11 and 12 in 2017). I wish I had utilised his expertise more as my job would have been a lot easier. I have met other teachers at workshops, and we planned to assist each other and co-teach but nothing ever came out of it because life gets busy once you get back to school. I had the privilege of being in a school with both senior Physical Sciences and Life Sciences teachers who are mentoring me and are teaching the same grades and subjects as me. There is another new teacher who is the same age group as me, and I like going to her for sharing my problems and ideas. She is very approachable. I am teaching Life Sciences for the first time, and the senior Life Sciences teacher, who is also my HOD, shared her PowerPoint presentations, videos and activities with me. She goes through each slide and she explains how she will teach it. I am exposed to her years of teaching experience in just a few hours. It saves me time; I have less anxiety and I found that I can focus my energy on teaching and interacting with learners in the classroom.

I was planning a lesson on mechanics, specifically ticker tape analysis. Even though it is my third year teaching this topic in this planning I felt like there was a link missing, I went for

advice from the senior Physical Sciences teacher. In less than ten minutes my worry, anxiety and stress about this lesson was resolved. She shared her pedagogy, her worksheet and the sequence in which I should teach it. In previous years I would struggle on my own and was constantly stressed. I wish someone had told me when I had started teaching that I am not alone.

With the exception of my teaching practice experiences during my PGCE, in the first two and a half years of teaching I have never had someone observe my lessons to give me feedback, until this study. This study opened a door for vulnerability but also an opportunity for me to learn about myself as a teacher. The critical friends' feedback for this study was focused on my teaching with ICT and I got a different perspective about myself in front of the class and even about the learners I was teaching that I have never noticed or observed before. Even looking at the pictures of me in front of the classroom was astonishing because that is not the way I had imagined myself. I had to listen to voice recordings of me teaching and it was uncomfortable. I realised that my voice lacks energy and is quite boring to listen to. All these are gaps for me to grow.

I had an opportunity to have my HOD, and principal of the school that I am currently teaching at come observe my teaching in general. One thing that struck me about the feedback was how I am a different person in front of the learners; my posture changed, and I speak in a certain way. I become another person. This was surprising because I had not been aware of it and now it can be something to which I pay attention. Who am I? Am I truly the person I am when I am teaching or am I the person I am outside of the classroom? She also pointed out that my lesson objectives had high expectations from learners, they were only appropriate for highfliers. After hearing that I am always careful that I cater for all learners' needs, and had she not pointed this out I might never have realised and continued to teach in a way that disadvantaged the less able learners.

One of the most valuable lessons I have learnt about being a teacher is not being scared to tell learners that I do not know. When learners asked questions, I used to feel enormous pressure to give the correct precise answer. I am the teacher and I felt that if I could not give them the answers, who will? I attended a Physical Sciences content workshop during my second year of teaching and when one of the supervisors was presenting, they mentioned how we as teachers should not be scared to tell the learners that we do not know the answer when we do not know, because we may end up giving learners the wrong answers. This spoke to me and I thought information is easily accessible, and the internet is at our fingertips to give us answers, we may

not know all the answers, but we must know how to access that information. I have accepted that I am not an encyclopaedia and I am learning continually as I teach.

My first principal in Umzinto sometimes used to tell us to keep pushing the rock even when the rock did not move. He meant that we should continue to teach in the best way we could even if we felt like the learners were not responding positively to our teaching. Learners did not want to learn but we should continue to teach. I taught every lesson without fail, and had lessons after school, yet the learners still did not do their best and were discouraged. I felt like learners needed to be offered something further to engage them in their learning. That something, I believed, was ICT. I used ICT to teach Grade 10 Physical Sciences, and even though the response from learners was positive, I was not fully satisfied with the outcomes.

It was a privilege to be co-supervised in my research by a Physical Sciences teacher educator now with considerable experience on how I could teach Physical Sciences better. I got to learn about different tools I could use to teach Physical Sciences but also learned the attitude that one should develop as a Physical Sciences teacher; that is to continuously motivate and encourage. I took that advice with me because I felt that the learners I taught were discouraged and demotivated. Learners need to believe that what you are teaching will benefit them in the future. Before they can fully absorb what is being taught, they need to believe in their future and dreams; of being that engineer or doctor or anything that they want to be. This taught me that in addition to the use of ICT, learners need to be constantly motivated and encouraged.

6.2.2 Reflections on science person-knowledge and skills

In 2016, when I was studying for my PGCE, my Life Sciences lecturer at UKZN said to us that the first year of her teaching was the hardest. She had had many sleepless nights, doing preparation. She said it would be the same with us, but she promised us that if we do it right the first year then by the third year of teaching it would be a breeze. That is exactly how my first year was. I was busy with preparations, mostly filling in knowledge gaps that I felt I had and learning skills that are necessary to do practical work. It is now my third year of teaching Grade 10 Physical Sciences and I must confirm that what my lecturer said three years ago is true. It does get better, but this is because I had pushed to do everything the first time with maximum effort and aimed to

acquire as much knowledge as I could.

There are things in the curriculum that I did not know, and was not aware of before, that I do know now. I remember when I was teaching the topic waves, sound and light for the first time in my first year, I loved the topic. I had planned my lessons well. But I later realised that in the departmental examination papers that the learners write, in assessing the principle of superposition, they require learners to draw the resultant pulse on a Cartesian plane. I had not let learners practise this. There are things only experience can teach you, like the way questions are asked for certain topics, which would be an advantage for learners. So even though you have taught the topic, you can focus on these specific assessments and allow learners to practise such questions. I was also advised by a subject supervisor that assessment can inform teaching. This has encouraged me to go through and familiarise myself with the different ways in which the different topics can be assessed.

To give an example, chemistry is my love, because I feel I understand it better. Stoichiometry is a broad topic of chemistry calculations, that learners learn initially in Grade 10, but they use it all the way up to matric. It is vital that learners understand it clearly in Grade 10. Learners got confused because they did not know the right time to use the different formulas. I knew there was a link missing somewhere.

Figure 6.1 is evidence of what we as teachers can calculate about a mole. This was shared by a subject advisor at a content workshop at the end of my second year of teaching. This helped improve my knowledge of stoichiometry.

From this diagram I got to learn that using the mole (n) concept, you must know how to define it and calculate the following: mass, concentration, molar mass, molar volume, and use it at standard temperature and pressure (STP). These are done in grade 10, in grade 11 more complex calculations of the following are done, stoichiometry, empirical formula and the use of the molar ratio. I can relate each of the above to a formula and it made me as a teacher see the bigger picture about stoichiometry. After this I could break it down and make it understandable for them learners.

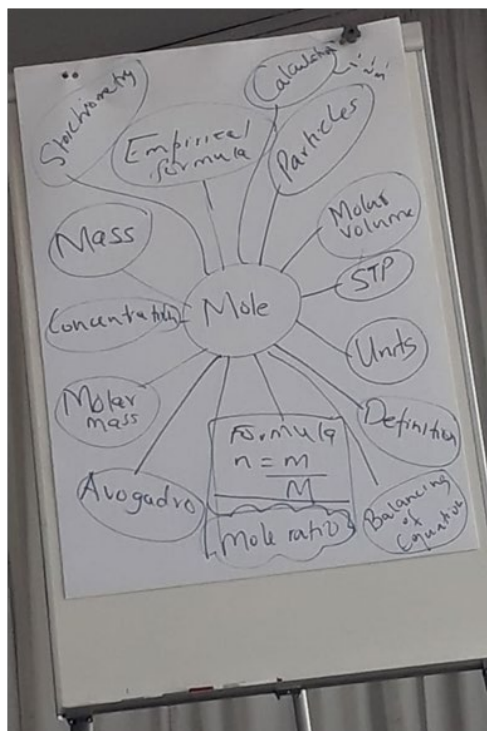


Figure 6.1 Stoichiometric calculations taken from Physical Sciences content workshop in 2018

In my first year, most of my time and energy went to developing my content knowledge, making sure I understood the knowledge requirements for the subjects and trying to read about learners' understanding. After my first year, I could take my time thinking more and planning about how to deliver the content rather than making sure I knew it well, because I had made sure that I understood it in my first year of teaching. In my third year I felt very confident in teaching the subject because each time I would remember myself previously teaching it. I had also encountered more examination style of questions and revised these with learners; in that way my content knowledge was again expanded.

The most stressful times for me occurred when I started teaching and was doing the

formal practicals; particularly in physics. Although I was confident in chemistry practical work, I did not understand the physics practicals. Because the learners always wrote external departmental examination papers, teachers had to ensure that we covered all the prescribed topics prior to these assessments. So, completing the syllabus was always the first priority. But we also had to allow time to do practicals. There was never enough time, there was always a rush. To be honest because of this rush I felt like I never had the freedom to do all the things I would have wanted to do for the learners, the freedom to be the teacher that I wanted to be. The limiting factor was always the pressure of time, exacerbated by the lack of resources and poor learner motivation.

The picture in Figure 6.2 below illustrates me teaching, but I am behind bars and the learners are on the other side. This shows me as not having the freedom to teach the way I want to teach because of insufficient resources and assessment times being restricted.

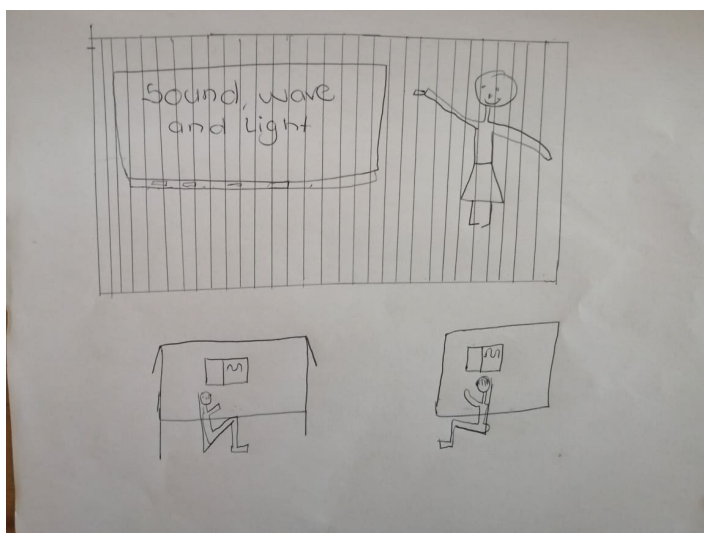


Figure 6.2 A drawing of me behind bars while teaching

The formal prescribed practical's for grade 10 to 12 took us approximately three lessons. The first lesson is for a pre-practical lesson and collection of data. The second is for writing a report and the last lesson is for writing a practical test. The total mark of the practical includes all three aspects, how the learners do the hands-on work, the report and the test. So frequently, I did not do the practical when I was teaching a topic because I would already be behind on my ATP so I was always rushing to get to the next topic. I would delay the practical for when I had time, but the time never came. Before I knew it, the term was almost over. It would be one week before the

examinations and I had not done the practical work. The stresses around formal practical work was primarily because, when I first started teaching, I did not know how to do the practicals and I did not know where to find the equipment in the laboratory. It was even worse when the apparatus did not work as it was supposed to. Practical work for me is represented by the steep slope of the mountain I was climbing. But, encouragingly, with the help of my head of department, who has 34 years' experience of teaching Physical Sciences, formal practical work has become so much easier.

Part of my lesson planning involves choosing activities and examples for learners to do in that lesson. These activities are in line with the lesson objectives and formative assessments. I used to work out the teaching examples before going to the classroom but not the solutions for the learner activities or the questions to ask. When marking it would become difficult because I did not know the correct answer and would depend on the answer that the majority of the learners got on their calculators. This was frustrating when learners presented a variety of different answers. I have learnt to plan and do the activities prior to the lesson, resulting in less confusion for me and the learners.

When I started teaching, I did not think about the questions I would ask the learners as the lesson unfolded. The questions I asked verbally were made up on the spot, based on what we were doing at that time. Then, in my third year of teaching I attended a workshop on critical questions, which focused specifically on how to ask questions. I found that even though the lessons I was teaching were relevant, thinking in advance about what questions to ask can lead to a richer lesson that learners can get more out of.

With more experience, I am now more aware on focusing on the nature of the subject. The nature of science refers to the epistemology of science, the values and beliefs inherent to developing science knowledge (Abd-El-Khalick, Bell, & Lederman, 1998).

6.2.3 Reflections on growth as a science teacher using ICT

When I started teaching, I always wanted to use ICT in my teaching, but I did not because my time was constrained as I was ensuring that I gained maximum content knowledge. Preparing to teach with ICT requires careful preparation. I have moved from not using ICT at all, to using it occasionally, to using it for a whole topic and then to using ICT for all my lessons. In starting to use ICT, I was developing my TPACK. In reflecting on my use of ICT I feel exhilarated, as if I

am close to the peak of the mountain climb. But I know too well it is an ongoing struggle and learning curve! I narrate my ICT use of multimedia reflections in the next subsections.

6.2.3.1 PhET simulations

I first encountered PhET simulations, as mentioned earlier, through a conversation with a teacher during a Physical Sciences workshop during my second year as a teacher. He showed me a version he had downloaded on his cell phone. I was intrigued by it and wanted to learn more. I too downloaded it on my cell phone but found that I had no idea how to operate it. It was only in my third year that I learnt what one can do usefully with the simulations for the topic of waves, sound and light. I learnt more about PhET from my supervisors for this study. After that I felt the need to use it more in my teaching. I self-taught myself how to use PhET simulations for electricity in Grade 9 Natural Sciences and the moving ‘man’ simulations for graphs of motion in Grade 10 Physical Sciences. There is still potential to explore PhET simulations further in my teaching as they offer simulations on a wide variety of physics and chemistry topics.

Physics Education Technology (PhET) is a project founded in 2002 by Nobel Laureate Carl Wieman. The birth of this project arose from Wieman’s vision to improve science education worldwide. For example, when used as a lecture demonstration, the “wave on a string” simulation resulted in greater conceptual learning than did the standard demonstration (Wieman et al., 2008). Most of the learning takes place when the student is actively interacting with the simulation. This leads to the learner asking herself or himself questions that guide him or her to explore the simulation and lead to the discovery of answers (Wieman et al., 2008). The use of simulations however is not automatically successful, it is just a tool that can enhance a well-planned lesson presented by a good teacher (Wieman, Adams, Loeblein, & Perkins, 2010). Wieman et al. (2008) identified characteristics of simulation that make it engaging. Firstly, the dynamic visual environments are controlled by the user. Secondly the challenges presented are neither too hard nor too easy. Thirdly the complexity of the visuals is enough to create curiosity without overwhelming the user. Holec and Spodniakova (2006) suggested phases for learners to follow while guided by a teacher in order to successfully engage in a PhET investigation. However, in my research these are not relevant, as due to previously noted time constraints the learners experienced a lecture type of demonstration of PhET. I think the PhET simulation assisted me in helping learners understand the concepts and I enjoyed using. However, I feel like I could have

improved in this regard by going at the learner's pace and not overwhelm them. I had to ease them in slowly towards the use of the simulation. For instance, the learners had to see me press the button to generate a pulse or a wave and not just see it pop up in the screen. They had to follow which commands I was pressing before that appear for them to understand better

6.2.3.2 *Learning how to download videos*

For months I had been questioning other teachers and friends about how I could download videos from YouTube. I had a router at home for my laptop and the school had internet connection near the office area but there was no internet in the school classroom buildings. So, I would watch videos online on the school computer or at home on my laptop and feel the need to show them to the learners, but I could not download them and bring them into the classroom. In my second year of teaching, one of the subject supervisors sent an email to all the teachers in the district on how videos could be downloaded on save.net. I downloaded so many videos that the school WiFi cost went above the normal quota! But I was excited to have the videos I needed for upcoming topics.

One of the learners said that the video was too fast. I learnt to be careful when choosing a video and it should be appropriate for their level. Following a video may be difficult. During an online course that I did during the national lockdown due to covid I learn about edpuzzle which is a tool that let a teacher embed questions in the video. This makes learners pay attention and follow what is shown so that they can answer the questions. They do not passively consume the knowledge but are active and involved.

6.2.3.3 *PowerPoint*

I was familiar with preparing PowerPoint slides and presenting with PowerPoint. It is the one form of ICT I had used occasionally even before conducting this study. This is because I knew how to work with it, but even though I knew how to use it I found that preparing slides was time consuming. There are also guidelines for using PowerPoint, some of which I already knew. These include ensuring that the words are visible, that there are minimal words on the slides, and that animations are not overused so they become distracting. The school that I am currently at has professional development sessions after school on different aspects of teaching and learning. In one of the sessions our skills in preparing PowerPoint presentations were being developed. A few things I had not been aware of stood out for me. I learnt that below the slide, notes could be added,

which that only the presenter could see. I also learnt that you could set up the computer so that the presenter can see the current slide as well as the incoming slide. At my current school, the principal also emails a weekly newsletter to us about the coming week. A feature on that newsletter is tips on using ICT in the classroom. My favourite one so far was on the use of PowerPoint in figure 6.3. It reiterates the importance of critical friends in your work, people who would look at your work and advise you. These sessions and weekly tips have improved my PowerPoint skills and have inspired me to have a colleague browse through my slides for feedback.

5. TECH BUZZ: Presentations 1

When making a presentation in PowerPoint or Google slides, try to remember these tips:

Presentation Tips

- Avoid bullet points if possible.
- Max. 5 points, 5 words/point.

1. If possible, **do not use bullet points** - a compelling (relevant) picture or chart might be much more effective in capturing and holding your audience's attention. Consider using www.visme.co to create a more "infographic" style.
2. If you do use bullets, try to limit each slide to a **maximum of 5 points, 5 words** per point. Use keywords rather than sentences or paragraphs.
3. Remember the basic point: you are making the speech/talk, **the slide backs up the point** you are making.
4. Make the **font large and readable**.
5. Use **high contrast colours** for font/background. Avoid placing text on pictures.

Max

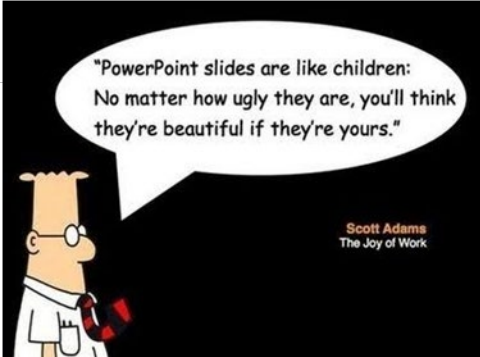
5

Bullets

&

Words

Per bullet



Scott Adams
The Joy of Work

Figure 6.3. A page from the ICT development in the weekly newsletter

Even though I have learnt how to use PhET simulations, downloaded videos and prepared PowerPoint slides, I have learnt that I still have to expand my knowledge on teaching with them. Teaching with these ICTs goes beyond showing learners a video or teaching with PowerPoint and using PhET simulations. It involves deep thought on the sequence in which they should be used in

the lessons and the reasoning behind their use.

The learners did not mentally fully experience the use of Powerpoint in the last lesson, it was the last day of the term and I had asked them to come back during their break time. They were restless and tired. As a teacher I should plan my time better to ensure that the topics are taught within the required time frame and the learners are given sufficient time for the topics. However, I am currently teaching using PowerPoint and I have found it to be a good communicative tool between me and the learners. I do not have to spend time writing on the board, I can add diagrams for illustrations. However the learners did not feel involved. When I plan my lesson I should make them involved using this tool by using putting up a quiz, a game and questions on the slides.

6.2.3.4 Google Classroom

The use of Google Classroom requires that every student has access to a computer or laptop. The school where I conducted this study did not have these resources and therefore did not use this facility. Google Classroom is, however, widely used in the school where I am currently teaching, and so I have had to learn how to use it; fast. To teach myself about Google Classroom I had assistance from a colleague to help me create a Google Classroom for each of my classes, where I can post resources for them such as my PowerPoints slides for the different subjects. This was a start for me, but I wanted to learn more. I prepared a worksheet for a Grade 9 Natural Sciences class where they would be constructing circuit diagrams using PhET simulations and handing them in. Marking the work online was difficult because I still had not learnt how to prepare a rubric (online or offline) to mark their circuit diagrams. My colleagues and I prepared the Grade 10 Life Sciences project to be done online, handed in online and marked online. Through this project I got to learn how to prepare a rubric, mark online and return marks with comments to the learners. I am looking forward to exploring Google Classroom.

6.2.3.5 Google Drive

When I was doing my honours degree, we had a group task and one of my group mates suggested that we use Google Drive to share our work. That was the first time I had heard of Google Drive; when I tried to explore it, I was so confused that I stopped and did not use it again. In my second year of teaching, the district advisor for Physical Sciences created a Google Drive folder for all the teachers in the district so that we could access the information such as past papers,

study guides, and other resources. This was a hard task for him because some people did not have Google accounts, and some of the older people had no idea what he was talking about. He succeeded and this is how I got to understand Google Drive and benefited from it.

On Google Drive I can have access to resources from all the teachers in the science department, like videos, PowerPoint presentations, lesson plans etc. without physically going to them. I am also not good with loose papers. I used to have papers on my desk and forget where they were there and when I needed documents, I had no idea where I had placed them. I have started using Google Drive to file, which has reduced the amount of papers on my desks and the amount of time I needed for requesting and printing copies.

Using less paper is also advantageous for the environment as it decreases deforestation.

Currently global warming is on the rise due to human activities, such as cutting down of trees; see Number 13 out of the 17 sustainable development goals (SDGs)³, which is to protect the environment.

6.2.3.6 *Developing ICT skills*

One day, I was sharing with a colleague, about the difficulties I was having with learning ICT. I was sharing how I would love to use Google Classroom more but I didn't have the time for it because I need to finish the syllabus. He responded by saying something that has always been at the back of my mind, but which I had not always adhered to. He said that it is not about finishing the syllabus, it is about the learning process. Ever since I started teaching, I had always felt the time pressure to finish the syllabus, which is why we so often had extra classes. I forgot about the learning process. I neglected some activities because they would consume class time or simply require too much time in preparing for that lesson. Through this conversation came the realisation of how much I have neglected the learning process.

Teachers have heard of the benefits of using a diverse range of teaching strategies, in order to involve learners. ICT can offer a learning process that engages learners. However, when I was using ICT, I realised that the lessons did not automatically involve learners. Even with the use of ICT strategies I still needed to plan to engage learners. Using PhET simulation does not guarantee successful teaching and learning; it still need to be accompanied by an instructional design by the

³ <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

teacher (Wieman et al., 2008). Using ICT however expands the learners' knowledge to higher orders of thinking.

6.3 CONCLUSION

One of the reasons stated in Chapter 1 for the poor performance in Physical Sciences by learners are teachers not being able to finish the syllabus. It is a harsh reality happening in our schools. During one of the Physical Sciences content workshops I heard a teacher describe how he had to teach the Grade 12 organic chemistry in two days.

The topic waves, sound and light is supposed to be taught over the period of four weeks, but I had to teach it in less than two weeks, by using out of timetable time to complete the topic. Reflecting on my lesson plans about what other activities I could have done with the learners had I had enough time, made me realise the importance of time management in teaching and the importance of using teaching time effectively.

While planning lessons where I would be teaching using ICT, I realised that the exercise it helped me also to understand the content better. As I was searching for activities, reading, looking for appropriate videos, practicing how to use PhET simulations, I found that I was advancing my content knowledge and gaining confidence in the topic.

While I was reflecting on my learning of ICT and teaching using ICT, I noticed that I learnt things from the study that were beyond the traditional school boundaries. Being involved in self-study helped me know myself as a teacher. It helped me identify habits that were inappropriate and to realise that I had to change. The most difficult realisation was with the internal conflicts of beliefs. I had a hard time accepting that I struggle with restorative discipline. Restorative discipline can be said to be non-punitive methods of discipline and may include programmes in place to deal with misbehaviour. As a way to improve student behaviour, by means of verbal communication to get to the root of the ill-discipline, it is seen as an alternative to thus reduces suspensions and exclusions (Augustine et al., 2018). It is something I had to really work on because. In my first primary school corporal punishment was used but I have never done any transgression good enough to deserve it. Even though I had witnessed it I personally did not experience corporal punishment when I was a school learner. In my first high school we were punished with no verbal communication to find out the root of misbehaviour. I was in detention once in high school when

I was in Grade 9 for my blazer not having buttons. It did not have buttons because my mother bought it second hand. No one asked why I did not have buttons; it did not have buttons and so I got punished.

Overall gaining TPACK is a process. It is through practice, through actually teaching using ICT that it is gained. It is not gained instantly. It is not something that you can learn and then when you are done studying, you forget. It is a long process that needs to be continuously re-evaluated.

CHAPTER 7 REACHING THE SUMMIT

7.1 INTRODUCTION

Chapter 1 states the purpose and focus of the study together with the background information. I also stated the research questions, gave a brief overview of the methodology and theoretical framework that guided this study. In Chapter 2 I detailed the methodology of self-study and the data generation techniques and addressed ethical considerations. In Chapter 3 I shared a narrative account of my learning of ICT skills during my school and university days and how ICT had been used to teach me. In Chapter 4 I shared how I learnt about ICT tools that I used for this study. I explained how I planned my lessons using ICT and the reasoning behind the choice of ICT and sequence of lesson events. In Chapter 5 I shared my learning in practice, this included feedback from critical friends and learners.

In Chapter 6 and 7 I responded to my third research question, “How can I learn ICT pedagogical tools and use them to better teach Grade 10 Physical Sciences”. In chapter 6 I reflected on the lessons and feedback to improve the way I teach using ICT.

In this chapter, Chapter 7, I conclude the study by stating the biggest lessons I learned from the study through my research questions. The end of the chapter states the way forward.

7.2 LESSONS LEARNT AND IMPLICATIONS OF TEACHING WITH ICT GOING FORWARD

7.2.1 How do my past experiences of information and communication technology (ICT) in education influence my teaching pedagogy as a novice teacher?

In considering the first research question, I look at the great influence my past experiences have had on who I am as a teacher and as a person. I have learnt to respect who other people are. Respecting does not mean that the person is right all the time, it is just accepting who they are. When I am dealing with learners, colleagues, friends and family I am now always aware of their past experiences. I found that I am more compassionate, patient and understanding, especially with the learners that I teach. I used to become frustrated when learners did not do their homework, but now I understand that some of them come from homes where the environment makes it difficult for them to do homework for school. Some of them come from environments where education is

a priority, so going to school is just a required formality. Their action of not doing homework is not right, but instead of crucifying them with stern discipline, I have decided to talk to them about the matter.

Writing about my past experiences has made me want to hear other people's stories. I now look at a person and become curious about their story. I now believe that every person has a story to tell, and it is an interesting one.

The uses and types of ICT tools are vast. In chapter 3, I talked about the olden day ICT's like land lines, VCRs. In high school, I talk about presentations, cell phones, cameras, videos. In university and the current work, I was working with more focused tools like reworks, PhET simulation. This shows me that technology is always changing and fast. Currently as an educator when I talk about technology I can include, online learning, YouTube videos, e-learning, remote learning, distance learning. In this study for convenience I have decided to focus on PhET simulations, videos and PowerPoint only.

Being part of the timeline of the development of these technologies and using them at school and at home means that they have been part of my life growing up. My daily activities included or dependent on the use of technology and I did not see why teaching had to be any different. Growing up the technology in my area might seem limited from today's perspective but it was sufficient for those times. Family members, the community were excited about these advancements, witnessing this I became intrigued about technology. Especially because it was something we did not have before so we wanted to learn more about it. I grew up when cellphones were starting to be available and advancing fast. A phone with a new feature became the talk of the town and it was most people's wish to own it. I grew up in that rush of wanting the next best technology and what it could offer. Hence I valued technology because I knew that each tool had its benefits and I always had the willingness to learn about ICT. This helped me gain technological knowledge

Having experienced the joy and excitement of being taught with ICT made me want to teach with ICT. In Primary school we watched bible movies, it was amazing to see what I have heard in church. I remember how excited I was to watch a movie about the Great Gatsby after reading the book. Watching the movie challenged the way I had imagined the scenes and the mental conflict was exciting. It made me question, debate and critically analyse what I have read and what I have seen. I learnt that hearing, reading paired with seeing visuals can stimulate higher

order thinking.

When I was trained to be a teacher by teach SA, it was assumed that we had content knowledge already. The training was about pedagogy, so it was drilled in us. When I did my PGCE again pedagogy was the main theme in our classes. This emphasized the values of knowing how to teach and that knowing content is not enough. We were taught about different ways of delivering content. This taught me pedagogical knowledge.

7.2.2 What are learners' responses to my teaching after the use of information and communication technology (ICT) in Grade 10 Physical Sciences?

For the second research question, through inviting the learners to give feedback on my teaching with ICT I learnt about myself and also about the way learners would like to be taught. About myself I learnt ways in which I could improve the technologies that I use and how best to select them. In one of the lessons I chose a video that I thought was really good to show the learners, but in fact the learners did not like it and they thought it went too fast. From this I learnt that not all videos that have the content are suitable. Instead, I should choose videos through their eyes. Before using it in class, I had not noticed that it was fast because I already knew the content. In one lesson I used different ICTs to show them one concept, because I thought it would help them understand it better. Instead, they thought it was too much and it confused them. I could have made the video through Edpuzzle which is a tool that allows questions to be embedded on the video instead of the learners passively taking in information. This would pace the video.

Planning is an essential part of being a teacher. One has a year plan, a term plan, a weekly forecast, a daily forecast and finally a lesson plan. These are done to ensure that the topics are done within the required time frame and that each topic gets enough time. Due to circumstances mentioned in section 2.9 I was behind in my schedule. I remember the learners saying that they were not done with an activity I had given them in lesson 3 and I asked them to please work faster. Due to time I was rushing the learners. I did not wait for others to finish before marking the work, this was not fair on those learners because they did not get a change to try. This demotivates them and they feel excluded from the lesson. I also rushed them in grasping the concepts because I combined two lessons into one, due to time. As a teacher I should better plan for effective teaching

and learning.

The learners want to have all four dimensions of learning, as mentioned in Chapter 5, met. They want to feel like they understand the work so gradual scaffolding of the content is important. The way in which they are taught should meet their learning style or they might feel bored and not learn. They want to be involved in the lessons by being hands on, so in planning the lesson learner involvement is crucial. In order for them to understand the content they should possess a positive attitude towards the lesson.

7.2.3 How can I learn information and communication technology (ICT) pedagogical tools and use them to better teach Grade 10 Physical Sciences?

The most valuable lesson that I learnt from this study gives answers to the third research question. The most important aspect that I will use in my life is being able to ask (mentorship), and to want to learn (self-directed learning). I spent many nights during my first year of teaching puzzled by many different challenges, whether it was teaching a topic, understanding a concept, or finding tools to do a practical. All I needed to do was ask for help and direction. This would have saved me so much worry and time. As a novice teacher I was around highly experienced teachers and I have found that asking for help saves me from unnecessary stress. I learnt how to use pedagogical tools from people, not from a book. This made me realise the importance of people around me and the vast store of knowledge that they have. Having a senior teacher to mentor me has made my work, easier because I have assurance that I am on the right path.

One of the ways to learn is through research, which is the path I have chosen. A self-study is an initiative undertaken by a person in order to improve an aspect of their professional practice. If I had not undertaken this study, I would have not learnt all the ICT tools that I did. I would have not learnt the ICT tools without having to take action and going to teach using ICT, as scary and challenging as it was. That is why I think that the learning of ICT needs a person who will ask and who wants to know more; it paves a way and turns a mountainous task into an enjoyable journey.

When I first heard of self-study, I thought it would be easy because you work in isolation. As I read about it, I realised that the name of the methodology can be misleading, because it is not only about the self. Firstly, it is not easy. It forces you to do introspection after reflecting and

sometimes it is hard to accept that you are doing something that can be changed. I was listening to an audio recording of myself teaching and I realised how expressionless my voice can be. I could have ignored this but that would bring no change in my teaching. I took up this challenge as something that I should work on. It was difficult because it requires effort to bring about a voice full of expression and expressing emotion does not come that easily to me.

Secondly, you do not work alone in self-study, you work with critical friends. Critical friends bring their opinions about your professional practice and they may concern something you have never noticed before. The worst habit we can have when being criticized is to become defensive instead of taking in what we have been told and reflecting on it. Critical friends have played a huge role in the outcomes of this study and my learning.

Being involved in reflections is a critical component of self-study methodology. I ended up adopting reflective practices in other areas of my life. Because of undertaking this self-study now, I always look back at the way I do things, to see if I could have done them differently or better. It made me aware of professional development opportunities that are available around me. I value teacher summit meeting and professional development workshops. My current principal sends out a newsletter weekly and there is a section called professional buzz where there are tips on how the staff can improve their ICT skills. This has become the first section I read on the newsletter because self-study has made me aware of professional development opportunities out there.

Self-study methodology is a type of research and I through this research, I was also learning how to be a researcher. It was an honour to work with a supervisor who is involved in multi-disciplinary research. He was open-minded and has a growth mind-set towards different fields of research and therefore is knowledgeable about different fields when it comes to doing research. One of the lessons I learnt about research was that in research, things do not always go perfectly as planned and that is okay. For instance, I panicked when I suddenly changed the data collection and generation tools from those outlined in the research proposal. The biggest panic was when the critical friends I had planned to work with were no longer available. It was a big realisation for me to justify the choices in all that you plan to do in your research so that when the initial changes takes a detour, you know what you have lost and what other methods you can adopt.

In our Physical Science district we often had workshops and conferences at least once a term. In these workshops I have gained a great deal of knowledge and resources. I heard about

PhET simulations from a colleague in this workshop. I learnt how to download videos on YouTube, we were given CDs with soft copies of past papers, notes and videos and content. I also remember that after the workshops, I would feel so uplifted and encouraged, and it was motivating to keep going each term to school.

I learnt that in order to learn you must want to learn. Self-directed learning is when a professional takes responsibility for their learning. They identify an area which they would like to develop, set goals and focus on what should be learnt, engage in the learning and then evaluating the learning. I realised that over the years I have been involved in self-directed learning. The process of learning how to make invitation cards in high school, learning how to download videos, presenting using PowerPoint are all good example of self-directed learning.

In 2020 during the first term all schools had to close due to a national lockdown forced by the presence of the corona virus, we were forced to teach online. I had never taught online. Now I did an online course on online teaching and it was helpful. I have done other courses online and it has been a wonderful place to learn. This is a vital skill to learn because even after returning back to face to face contact teaching, some learners remained at home and we continued teaching them online. The world is currently is a transition of the education system where it moving towards online teaching and learning.

7.3 IMPLICATIONS FOR TEACHING

One of the challenges experienced in the study is the lack of ICT resources in the school. In South Africa the goal for e-Education White paper is for every learner in the country to be ICT capable by 2013 and for teachers to use ICT in teaching and learning (Department of Education, 2004). Numerous reasons are given for failing to reach this goal, unreliable connectivity, lack of leadership and vision, limited learner access to ICT and lack of ICT skills from educators. The department of education must try to implement the use of ICT in all schools. The levels of literacy and numeracy in countries that use technology have been found to be high (Baliamoune-Lutz, 2003).

One of the reasons for lack of ICT use in South Africa is lack of ICT skills from educators, technological knowledge. Teachers have been trained but there is still inequality within different school quantiles and provinces in South Africa. The progress is slow and major improvements still need to be done (Meyer & Gent, 2016). In my two and a half years teaching in a South African

public school I have never been formally trained for the use of ICT. Furthermore, teachers need to engage in self-directed learning and take charge of their learning of ICT. Self-directed learning happens when an individual takes the initiative in identifying their learning needs, formulates goals, identifies resources for their learning and implementing the activity. The outcomes are evaluated. This can be done with or without the help of others, that is they take responsibility and control for their own learning (Knowles, 1975). Self-direct learning results in improvement of knowledge, skills and competencies (Sumner, 2018). In this way teachers can develop their TPACK and evaluate themselves.

From the study a teacher that is using ICT for teaching and learning needs to be aware of the learner dimensions mentioned in section 5.4. A teacher needs to cater to the psychological, cognitive, learning style and social needs of a learner. Teachers need to be self-driven and exhaust the tools they have at their disposal. If the availability of ICT resources is limited, they must work with what they have but also be the voice in advocating for the use of ICT in teaching and learning. The use of ICT over time increases learners' achievement in sciences and Mathematics (D. Zhang & Liu, 2016)

7.4 AFTER THE SUMMIT

After the climber has reached the summit, their destination after a long climb, they are filled with many positive emotions. They might be happy, proud, in disbelief, or any other positive feeling depending on their motive behind the climb. Even though they have reached the summit, that person will never be the same again because of their experience of climbing Mount Everest. They will go down, but not as the same person who climbed up.

I compared this study to climbing Mount Everest because initially it seemed impossible, there were too many challenges. It was difficult to get critical friends and learners to participate. It seemed impossible but despite those challenges I was able to answer my research questions. By answering the research questions, I have reached the summit and I will not be the same teacher as

I was because of what I have experienced in this study.

7.5 CONCLUSION

The first research question that guided this study was: How do my past experiences of information and communication technology (ICT) in education influence my teaching pedagogy as a novice teacher? I used memory work, artefact retrieval and pictures to recall my past experiences with ICT. This question helped me look back on my schooling, how I learnt to use ICT tools and how ICT was used in my learning. It made me appreciate learning how to use ICT school because I had not been exposed to it at home or in the community. Telling of these experiences taught me to respect people's stories as everyone has a story to tell and our experiences shape who we are.

My second research question was: What are learners' responses to my teaching after the use of information and communication technology (ICT) in Grade 10 Physical Sciences? To get learner responses I gave questionnaires to Grade 10 Physical Sciences learners after each lesson of teaching waves, sound and light using ICT. I found that learners' responses fall into four dimensions; namely, the social, psychological, cognitive domains and learning styles. From these dimensions I saw that the use of ICT stimulated their interest, improved their conceptual understanding in the Physical Sciences topic but it does not guarantee their total and sustained involvement.

My third question was: How can I learn information communication technology (ICT) pedagogical tools and use them to better teach Grade 10 Physical Sciences? To answer this question, I reflected on the views of critical friends after observing my lessons using ICT. I was the main participant in the study, so I reflected on my lessons with the help of an audio recording. I reflected on my growth as a science teacher using ICT, I reflected on science-person knowledge and skills and I reflected on my educational views and perspectives in general. From this research I learnt that ICT alone does not guarantee learner involvement and participation; lessons with ICT still needs to be carefully planned in order to encourage learner involvement and participation.

From my self-study research I have realised the importance of collaborating with other teachers in professional development. The input of critical friends and learners was valuable in contributing to my learning. As a teacher you need to put yourself in a place of vulnerability, be

teachable, have a progressive mind-set and be open to constructive criticism.

Learning about ICT tools made me realise how much educational ICT resources are available that I did not know about as a teacher. This reinforced the idea that indeed teachers need to be lifelong learners. As a teacher you cannot be comfortable and say I know it all, you should be continuously searching for new developments. Especially because society is moving towards the fourth industrial revolution and new technologies are continuously becoming more advanced and new ones developed.

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REQUEST FOR PERMISSION TO CONDUCT RESEARCH

My name is Nqobile Njoko, and I am a Masters student at the University of Kwazulu-Natal (UKZN) at Edgewood Campus. I am conducting a self-study on the use of Information and Communication Technology (ICT) in teaching grade 10 Physical Sciences under the supervision of Prof Nadaraj Govender and Mrs M-A Good. Permission to conduct this study will also be obtained from the Higher Degrees Committee of the Department of Education at UKZN in order to ensure that this study will be conducted in an ethical manner. The purpose of this study is to study my teaching with the intention of improving how I teach Physical Sciences with the use of ICT. This letter serves as request to conduct this research in the school.

Project title: A Self-Study of a Novice Teacher’s Experiences of Using Information and Communication Technology (ICT) in Teaching Grade 10 Physical Sciences

Aims of the Research

The research aims to:

Use my past experiences of ICT in education to understand my current teaching as a novice teacher

Improve my pedagogy with the use of ICT in teaching Physical Sciences Grade 10 learners

Understand my teaching using ICT through obtaining the views of learners and critical friends (teachers in the school)

Benefits of the Research to the School

Conducting the study at the school will expose learners and teachers to the possibilities available with the use of ICT in teaching and learning.

The use of ICT in general is growing at an exponential rate and exposing learners to ICT will give them a glimpse of the reality of the complex world which they are being prepared for, whether it be university or the work place.

The White Paper on E-Education (2004) in South Africa stresses the importance of ICT integration in teaching and learning. The role of education is no longer just about imparting content, but to

develop critical thinking individuals who are ready for a life outside of school.

Research Plan and Method

I will use one grade 10 Physical Sciences topic to conduct the study called Waves, Sound and Light which will be taught over four weeks. I will use my daily lesson plans and activities, lesson audio recordings, class observations by me and critical friends, questionnaires and interviews to gather information for the study. The critical friends will be a few teachers from the school who will be asked to observe my lessons and give feedback in the form of an interview and informal conversations on my use of ICT. The learners will be asked to give their views in form of an anonymous questionnaires. I will use my memory and reflection journal to recall and understand how my previous experiences have shaped my current teaching pedagogy.

All participants in the study (learners and critical friends) will sign a consent form. Parents or guardians' permission will be requested for their children's or wards' participation in this study and learners to give assent. All information collected will be strictly confidential, the name of participants and school will not be used. They will be informed that the study is voluntary and can withdraw from the study at any time.

School Involvement

Once I have received your consent to approach teachers and learners to participate in the study, I will arrange for informed consent to be obtained from participants

This study is supervised by Prof Nadaraj Govender and Mrs M-A Good at the School of Education, UKZN. Prof Govender can be contacted telephonically at 031-2603469 or emailed at: govendern37@ukzn.ac.za. Mrs Good can be contacted telephonically at 031-2603421 Or emailed at Goodm@ukzn.ac.za.

Further information

Research Ethics Committee whose contact details are as follows:

Premlall Mohun, University of KwaZulu-Natal, Research Office,

Email: mohunp@ukzn.ac.za

Tel: 031 260 4557

Fax: 031 260 4609

Your positive consideration of my request will be highly appreciated. Should you agree, please read and sign the attached consent form. Thank you very much for spending time to consider

this request.

Kind regards

Signed: _____ Date _____

Student Number: 215078170

Cell: 0619849353

email: njokonqobile@gmail.com

GATEKEEPER'S (PRINCIPAL) SIGNED LETTER FOR PERMISSION TO CONDUCT RESEARCH



A SELF-STUDY OF A NOVICE TEACHER'S EXPERIENCES OF USING INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN TEACHING GRADE 10 PHYSICAL SCIENCES IN KWAZULU NATAL

School Principal Consent Form

I give consent for you to do a study on the use of ICT in grade 10 Physical Sciences classroom. I have read the Project Information Statement explaining the purpose of the research project and understand that:

- The role of the school is voluntary
- I may decide to withdraw the school's participation at any time without penalty
- Physical sciences learners will be invited to participate and permission will be sought from their guardian/parent
- Only teachers who consent will participate in the project to be critical friends.
- All information obtained will be treated in strictest confidence.
- The teachers' and learner's names will not be used and individual teachers will not be identifiable in any written reports about the study.
- The school will not be identifiable in any written reports about the study.
- Participants may withdraw from the study at any time without penalty.
- A report of the findings will be made available to the school.
- Further information on the project may be sought from Nqobile Njoko on 062 994 3101.

L R NAIDOO

Principal



Signature

25/07/2018

Date

PROVINCE OF KWAZULU-NATAL DEPARTMENT OF EDUCATION & CULTURE ROSEVILLE SECONDARY SCHOOL 2018 -07- 2 5 PRIVATE BAG X0595, UMZINTO 4200 427 LILY ROAD, ROSEVILLE, UMZINTO TEL: 039 974 1296 / 039 974 3645 FAX: 039 974 1296 / 086 511 3793 EMIS 256521

SCHOOL PERMISSION TO CONDUCT RESEARCH

July 25, 2018

Dear Institutional Review Board:

The purpose of this letter is to inform you that I give Nqobile Njoko permission to conduct the research titled: **A Self-Study of a Novice Teacher's Experiences of Using Information and Communication Technology (ICT) in Teaching Grade 10 Physical Sciences at Roseville Secondary**. This also serves as assurance that this school complies with requirements of the Family Educational Rights and Privacy Act (FERPA) and the Protection of Pupil Rights Amendment (PPRA) (see back for specific requirements) and will ensure that these requirements are followed in the conduct of this research.



Mr. L.R Naidoo

Acting Head of School
PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF EDUCATION & CULTURE
ROSEVILLE SECONDARY SCHOOL
2018 -07- 2 5
PRIVATE BAG X0555 UMZINTO 4200
427 LILY ROAD, ROSEVILLE, UMZINTO
TELL: 039 974 1290 / 039 974 2845
FAX: 039 974 1290 / 036 511 3793 EMIS 256027

Appendix C: Informed consent document to conduct research (principal).

INFORMED CONSENT DOCUMENT TO CONDUCT RESEARCH [PRINCIPAL]

Title of the study: A Self-Study of a Novice Teacher’s Experiences of Using Information and Communication Technology (ICT) in Teaching Grade 10 Physical Sciences

I _____ here-by confirm that I understand the contents of this document and the nature of this study, and therefore consent for it to be conducted in the school. I understand that participants are free to leave/withdraw from the study at any time if they want to, without any negative or undesirable consequences to themselves.

I consent to the following data collection activities (please tick):

	YES	NO
a. Questionnaires	<input type="checkbox"/>	<input type="checkbox"/>
b. Interviews	<input type="checkbox"/>	<input type="checkbox"/>
c. Lesson plans and class activities	<input type="checkbox"/>	<input type="checkbox"/>
d. Audio recordings of lessons	<input type="checkbox"/>	<input type="checkbox"/>
SIGNATURE OF PRINCIPAL	DATE	

Dear Parents/ Guardians



I name is N.A. Njoko. I am a teacher at your child's school and currently a master's student with the University of KwaZulu-Natal (UKZN) Edgewood Campus, School of Education. As part of the requirements for this degree, I am conducting a research project in which I investigate my teaching pedagogy of grade 10 Physical Sciences. The purpose of this study is to study my teaching with the intention of improving how I teach Physical Sciences with the use of ICT. This letter serves as request for your child to take part in the study.

In this study I will obtain information through daily lesson plans and activities, questionnaires from learners (without their names being recorded) and audio recording of the lessons. Your participation is, therefore, of most importance to the study and I would appreciate it if you could give your consent for your child to participate in this study. Participation in this study is voluntary and involves no feasible risks or harm. Your child will have no binding commitment and will be free to withdraw at any time without penalty, without giving any reason and without legal rights being affected.

The information gathered will be confidential. The names of the participants will not be identified in any presentation or publication that might come out of the study. I also assure you that I will use this data in a way that respects your dignity and privacy. All information will be securely stored and disposed of.

This study is supervised by Prof Nadaraj Govender and Mrs M-A Good at the School of Education, UKZN. Prof Govender can be contacted telephonically at 031-2603469 or emailed at: govendern37@ukzn.ac.za. Mrs Good can be contacted telephonically at 031-2603421 Or emailed at Goodm@ukzn.ac.za.

You may also contact the Humanities and Social Sciences Research Ethics Committee whose contact details are as follows:

Premlall Mohun, University of KwaZulu-Natal, Research Office,

Email: mohunp@ukzn.ac.za

Tel: 031 260 4557

Fax: 031 260 4609

Your co-operation will be appreciated. Best regards

NA Njoko (Teacher)



Title of the study: A Self-Study of a Novice Teacher's
Experiences of Using Information and Communication Technology (ICT) in Teaching Grade 10
Physical Sciences

I _____ here-by confirm that I understand the contents of this document and the nature of this study, and do consent for my child/ward to be involved in the research that will be conducted in the school during Physical Science lessons. I understand that participants are free to leave/withdraw from the study at any time if they want to, without any negative or undesirable consequences to themselves. I also understand that I can withdraw my

child/ward if I want to.

I consent to the following data collection activities (please tick):

	YES	NO
a. Questionnaires	<input type="checkbox"/>	<input type="checkbox"/>
b. Interviews	<input type="checkbox"/>	<input type="checkbox"/>
c. Lesson plans and class activities	<input type="checkbox"/>	<input type="checkbox"/>
d. Audio recordings of lessons	<input type="checkbox"/>	<input type="checkbox"/>

Signature of Parent or Guardian

Date



Dear Parents/ Guardians

My name is N.A. Njoko. I am a teacher at your child's school and currently a master's student with the University of KwaZulu-Natal (UKZN) Edgewood Campus, School of Education. As part of the requirements for this degree, I am conducting a research project in which I investigate my teaching pedagogy of Grade 10 Physical Sciences. The purpose of this study is to study my teaching with the intention of improving how I teach Physical Sciences with the use of ICT. This letter serves as a request for your child to take part in the study.

In this study I will obtain information through daily lesson plans and activities, questionnaires from learners and audio recording of the lessons. Your participation is, therefore, of most importance to the study and I would appreciate it if you could give your consent for your child to participate in this study. Participation in this study is voluntary and involves no feasible risks or harm. Your child will have no binding commitment and will be free to withdraw at any time without penalty, without giving any reason and without legal rights being affected.

The information gathered will be confidential. The names of the participants will not be identified in any presentation or publication that might come out of the study. I also assure you that I will use this data in a way that respects your dignity and privacy. All information will be securely stored and disposed of.

This study is supervised by Prof Nadaraj Govender and Mrs M-A Good at the School of Education, UKZN. Prof Govender can be contacted telephonically at 031-2603469 or emailed at: govendern37@ukzn.ac.za. Mrs Good can be contacted telephonically at 031-2603421 or emailed at Goodm@ukzn.ac.za

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whose contact details are as follows:

Premlall Mohun, University of KwaZulu-Natal, Research Office,

Email: mohunp@ukzn.ac.za

Tel: 031 260 4557

Fax: 031 260 4609

Your co-operation will be appreciated. Best regards

NA Njoko (Teacher)

Please complete if you are happy to take part in the study

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without legal rights being affected.

I consent to the following data collection activities (please tick):

	YES	NO
	<input type="checkbox"/> YES	<input type="checkbox"/> NO
a. Questionnaires	<input type="checkbox"/>	<input type="checkbox"/>
b. Interviews	<input type="checkbox"/>	<input type="checkbox"/>
c. Lesson plans and class activities	<input type="checkbox"/>	<input type="checkbox"/>
d. Audio recordings of lessons	<input type="checkbox"/>	<input type="checkbox"/>

PARTICIPANT'S SIGNATURE

DATE



Dear Critical Friend

REQUEST FOR CONSENT TO USE FINDINGS FROM INTERVIEWS

Title of the study: A Self-Study of a Novice Teacher's Experiences of Using Information and Communication Technology (ICT) in Teaching Grade 10 Physical Sciences

My name is N.A. Njoko. I am a teacher at your school and currently a master's student with the University of KwaZulu-Natal (UKZN) Edgewood Campus, School of Education. As part of the requirements for this degree, I am conducting a research project in which I investigate my teaching pedagogy of Grade 10 Physical Sciences. The purpose of this study is to study my teaching with the intention of improving how I teach Physical Sciences with the use of ICT. This letter serves as request for you to take part in the study.

In this study I will obtain information from you through my lesson observations, your feedback in the form of interviews and informal conversations. Your participation is, therefore, of most importance to the study and I would appreciate it if you could give your consent to participate in this study. Participation in this study is voluntary and involves no feasible risks or harm. There will have no binding commitment and you will be free to withdraw at any time without penalty, without giving any reason and without legal rights being affected.

The information gathered will be confidential. The names of the participants will not be identified in any presentation or publication that might come out of the study. I also assure you that I will use this data in a way that respects your dignity and privacy. All information will be securely stored and disposed of.

This study is supervised by Prof Nadaraj Govender and Mrs M-A Good in the School of Education, UKZN. Prof Govender can be contacted telephonically at 031-2603469 or emailed at: govendern37@ukzn.ac.za.

You may also contact the Humanities and Social Sciences Research Ethics Committee whose contact details are as follows: Premlall Mohun, University of KwaZulu-Natal, Research

Office,

Email:

mohunp@ukzn.ac.za

Tel: 031 260 4557

Fax: 031 260 4609

Thank you for your assistance.

Yours faithfully

Nqobile Njoko



INFORMED CONSENT DOCUMENT TO CONDUCT RESEARCH

Title of the study: A Self-Study of a Novice Teacher’s Experiences of Using Information and Communication Technology (ICT) in Teaching Grade 10 Physical Sciences

I _____ here-by confirm that I understand the contents of this document and the nature of this study, and so consent to participate in the study. I understand that I am free to leave/withdraw from the study at any time if I want to, without any negative or undesirable consequences to myself.

I consent to the following data collection activities (please tick):

	YES	NO
Audio recording of critical friends’ interview	<input type="checkbox"/>	<input type="checkbox"/>

Signature of the Participant

Date

Appendix I: Semi-structured interview schedule for critical friends.

SEMI-STRUCTURED INTERVIEW SCHEDULE FOR CRITICAL FRIENDS

Project title: A Self-Study of a Novice Teacher's Experiences of Using Information and Communication Technology (ICT) in Teaching Grade 10 Physical Sciences

Relevance/appropriateness of ICT

Could you see a connection between the topic/focus of the lesson and the ICT that I chose to use?

If so, please elaborate on the connection that you saw in terms of content of the lesson and the outcomes/objectives of the lesson.

How could this connection be improved?

Do you think I made a good choice of ICT?

Please elaborate.

If not, then how did you understand my use of the ICT in this lesson, and how did this deviate from your perception of the focus of this lesson – both in terms of the content, and the outcomes/objectives for the lesson?

Can you suggest an alternative? (Why would you suggest this alternative? What benefits

does it offer that my choice of ICT did not?)

Ability to use the ICT chosen as a pedagogical tool.

When I was using the ICT in the lesson, could you follow what I was doing?

Was there a logical form of events?

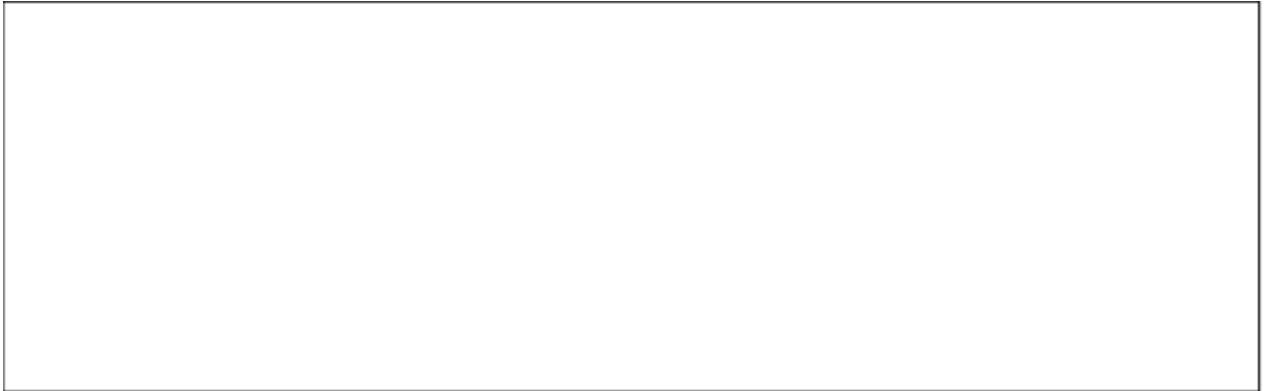
Did I appear to be confident in using the ICT?

What part/aspect of my use did or did not suggest confidence?

Was I explaining what I was doing with the ICT so that you (and my learners) could make

sense of what I was doing?

Please elaborate.

A large, empty rectangular box with a thin black border, intended for the respondent to provide a detailed explanation or elaboration on the question above.

Was I clearly explaining what I was doing with the ICT linked to the concept or skill that

I was teaching in the lesson?

Please elaborate.

Ability to use the ICT as a pedagogical tool

Based on my use of this ICT, could you understand the concept that I was teaching?

Please elaborate.

Based on my learners' responses in the lesson, do you feel that:

The learners enjoyed the lesson?

That they were more engaged/active in the lesson?

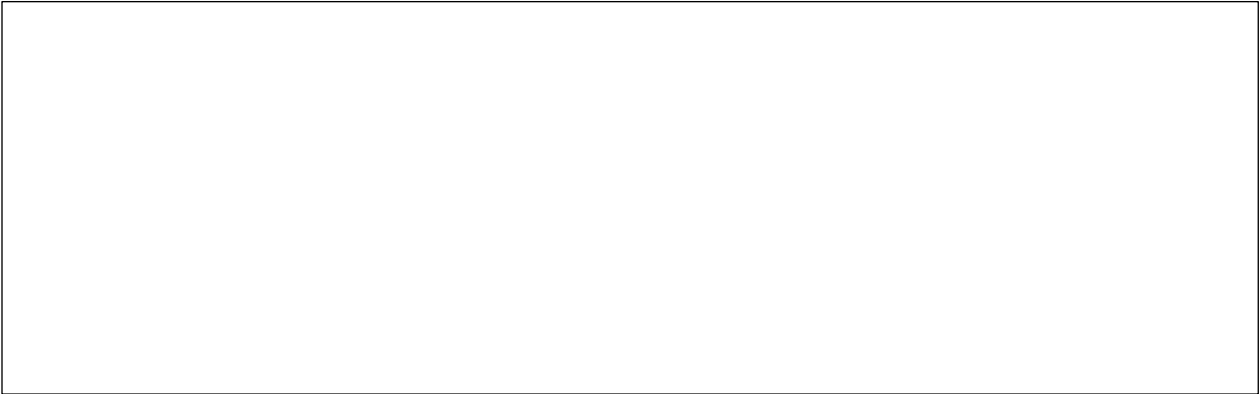
That the lesson was more interactive than a 'traditional' lesson without ICT?

Some/most of my learners understood the concept that I was explaining using this ICT?

Please elaborate as necessary.



Overall, how do you evaluate my use of ICT in today's lesson? What do you think I have done well? Is there anything that I could have done differently to improve my use of this particular ICT?



Questionnaires for learners

Project title: A Self-Study of a Novice Teacher's Experiences of Using Information and Communication Technology (ICT) in Teaching Grade 10 Physical Sciences

Did you enjoy my use of ICT in today's lesson?

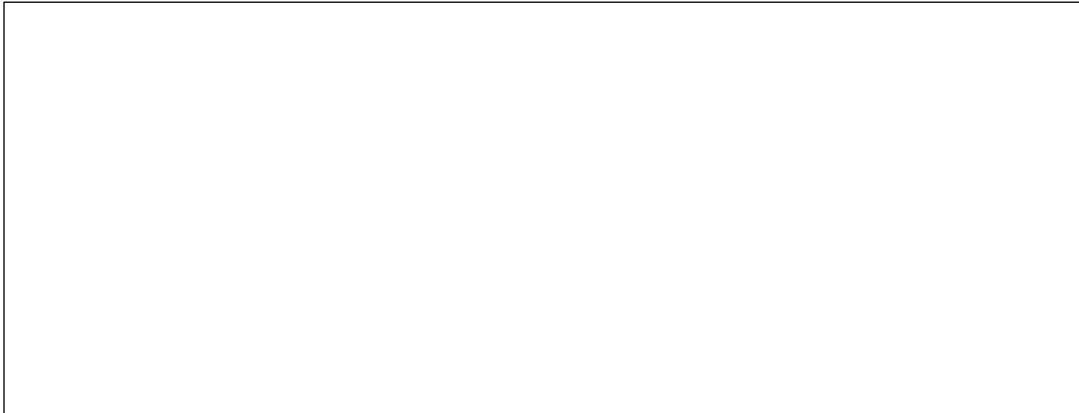
Name the events you enjoyed and why

Did my use of ICT in today's lesson make you more actively involved in the lesson than usual?

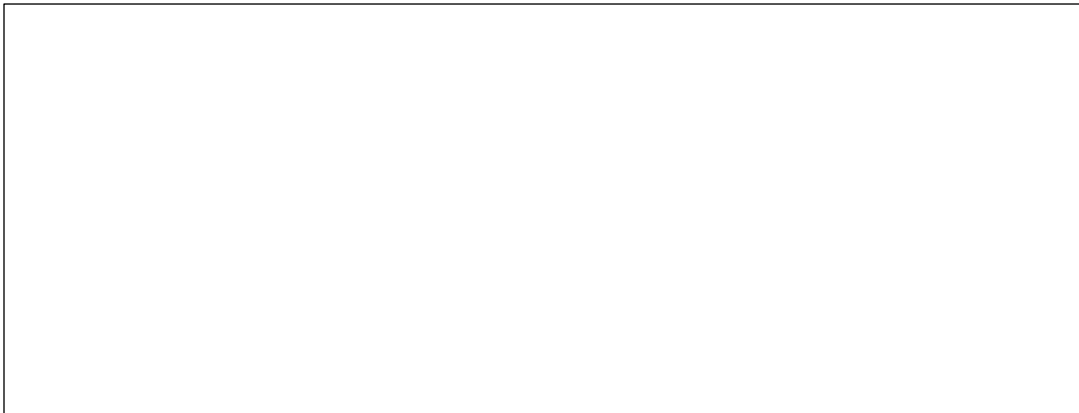
Why?

Did I give you opportunities to ask questions and share your ideas while I was using the

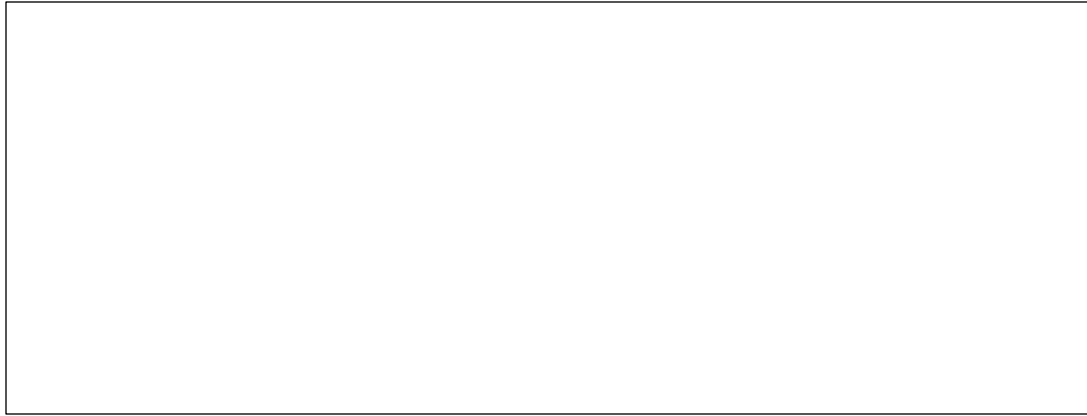
ICT in the lesson?



Did you understand what I was doing with the ICT in this lesson?

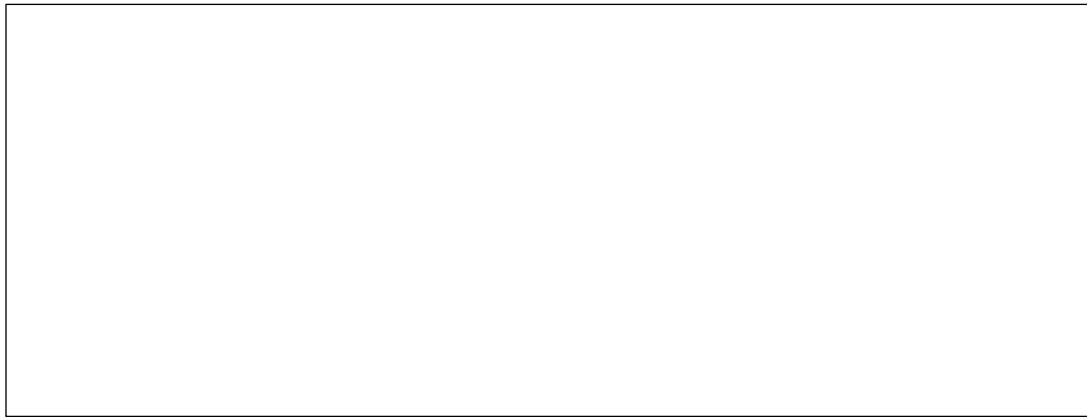


Did my use of ICT in today's lesson make you more interested in learning about waves (or



light/sound)?

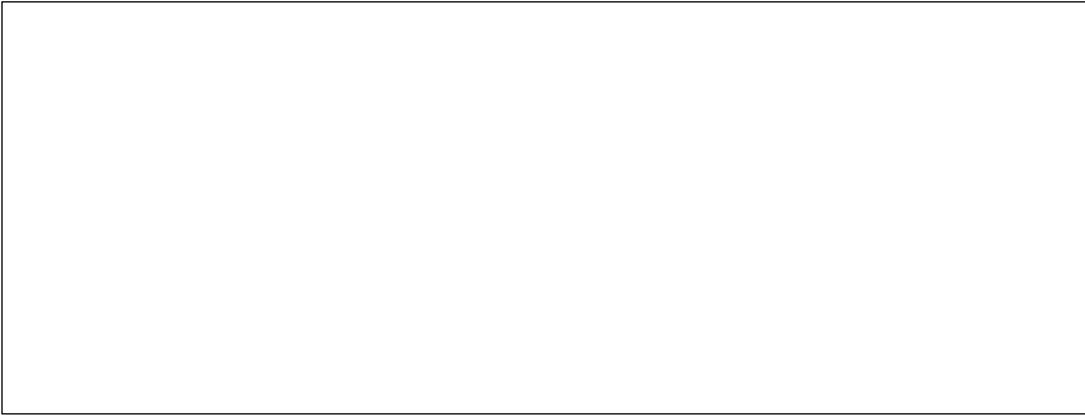
Why?



Would you like me to use similar ICTs in other lessons?

Give examples

What other forms of ICT would you like me to use in my lesson?



Appendix K: lesson plans

LESSON PLAN 1

NAME OF SCHOOL		EDUCATOR		NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK	TOPIC	Pulses	LESSON			1
DATE STARTED:					DATE COMPLETED:			

LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> • Define a disturbance • Define a pulse, amplitude, pulse length • Define a medium • Draw a pulse and label rest position, pulse length, amplitude
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> • Rest position • Application of waves • Cartesian plan • Displacement and speed
RESOURCES NEEDED	<ul style="list-style-type: none"> • textbook, slinky
TEACHING METHODS	<ul style="list-style-type: none"> • observation, question and answer method
TEACHER ACTIVITIES	LEARNER ACTIVITIES
<p>Introduction</p> <ul style="list-style-type: none"> • Facilitate the discussion of the different types of wave's learners. Here it is important to point out to learners that there are also waves that we cannot see like heat, sound waves and waves in the electromagnetic spectrum. Learners further discuss the application of waves. <p>Main Body (lesson presentation)</p>	<ul style="list-style-type: none"> • Discuss different types of waves that learners know of.

<ul style="list-style-type: none"> • Stretch a slinky spring on a bench. In order to see the movement of single turns clearly, tie short pieces of plastic to some of the turns • Have learner one hold the slinky on one end and learner two hold the slinky on the other end. • One learner must move their end of the slinky up and down once. • Learners observe and record what they saw. • Explain to learners that they have just drawn a pulse. A pulse is the simplest part of a wave and it is caused by a single disturbance. • The disturbance gives the particles of the medium energy to move across the medium from the rest position to an amplitude. The rest position was the slinky on the bench and the disturbance was created by moving the one end of the slinky up and down. • Define a medium as the substance or material in which a pulse will move. • Define an amplitude the maximum disturbance of a particle from its rest (equilibrium) position. • Draw a pulse on the board showing the, amplitude, rest position and pulse length. • Show learners a pulse on PhET simulation. • Show them how it is propagated and the properties of a pulse. <p>Main assessment: worksheet</p>	<ul style="list-style-type: none"> • Learners create a pulse using a slinky spring. They must observe and draw what they have seen.
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<p>PhET simulation: show learners a pulse. Vary the tension and help learner reach a conclusion about the speed of the wave as tension changes.</p> <p>Measure the properties if a wave</p> <p>Assessment: Facilitate class work</p> <ol style="list-style-type: none"> 4. Draw a pluse with an amplitude of 4 and a wavelength/wave pulse of 2. 5. Draw a pulse with an amplitude of -6 a wavelength/wave pulse of 2. 6. On the same cartesian plan draw two pulses. One with an amplitude of 2 and -3. 	<ul style="list-style-type: none"> • Draw a graph to show the progression of a transverse pulse in a slinky. Label the axes , pulse length, pulse speed, amplitude, rest position and crest and answer the questions on the worksheet. • Observe • Answer questions. • Conclude relationship about tension and speed <ul style="list-style-type: none"> • Measure amplitude and wavelength. • Draw pulses n a Cartesian plan.
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**SAMPLE LESSON PLAN ACCORDING TO
CAPS**

NAME OF SCHOOL		EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK	TOPIC	Pulses		LESSON	2

DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Draw and label a pulse • Understand the relationship between the energy of the vibration/disturbance to speed and amplitude • Identify direction of movement of the particles of the medium and direction of motion of the pulse 		
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> • Drawing a graph on Cartesian plane • Amplitude, pulse length, rest position 		
RESOURCES NEEDED	<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 		
TEACHING METHODS	<ul style="list-style-type: none"> • Question and answer method, PhET simulation 		

TEACHER ACTIVITIES	LEARNER ACTIVITIES
<p><u>Introduction</u></p> <ul style="list-style-type: none"> • Ask learners what causes the particles of the medium to move or what causes a pulse. Tell learners that today we will be looking at the energy of the vibration in relation to a pulse <p><u>Baseline assessment</u></p> <p>(i) On the same Cartesian plane draw two pulses of different amplitudes. One +3 and one -4. Label both pulses.</p> <p><u>Main Body (lesson presentation)</u></p> <ul style="list-style-type: none"> • Explain that the amplitude of the wave is dependent on the energy of the disturbance. The speed of the wave depends on the properties of the medium. • Using PhET simulations show learners an animation varying the energy of the 	<ul style="list-style-type: none"> • Learners discuss what causes the disturbance that causes a pulse and how the change of energy affect the pulse. • Draw and label pulse with negative and positive amplitudes

<p>vibration. Let learners report what they observe. Vary the energy of the pulse again and let learners report what they observe.</p> <ul style="list-style-type: none"> • Explain that the speed of the wave depends on properties of the medium such as tension, weight. The only way speed of the pulse can be changed is by changing the medium. On PhET simulation vary the tension and let learners observe. • Using a PhET simulation show learners that the propagation of the wave and the movement of particles are perpendicular <p><u>Assessment</u></p> <ol style="list-style-type: none"> 1. Give two ways to change the speed of the pulse in a slinky or rope. Explain briefly. <p>Solution</p> <p>The speed of the pulse is measured by the distance that it travels along the rope (or slinky) per second. The speed of the pulse depends on the tension in the medium, and on its weight.</p> <ul style="list-style-type: none"> • At higher tension, the particles of the medium at exerting greater force on each other. When one moves the other adjacent particles respond to changes in force more quickly – they respond quicker than they would do under lower tension. The speed of the pulse in the medium increases when the tension is increased. • A heavier rope is more difficult to move (disturb) than a lighter rope because it resists changes in its motion more than the lighter rope does. The greater the weight of the medium the slower the pulse is able to move through it. <ol style="list-style-type: none"> 2. Define the amplitude of a pulse. 3. Explain why and how the amplitude of a pulse is related to the energy of the disturbance. 4 What happens to the speed of the pulse when its amplitude is increased? Explain briefly. <p>Solution</p> <ol style="list-style-type: none"> 2. The amplitude is the maximum displacement of the particles from their rest position. 	<ul style="list-style-type: none"> • Make a conclusion on the relationship between the speed of the pulse and the amplitude. • Observe the simulation, discuss and answer questions. • Do assessment questions
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<p>3 The greater the displacement of the particles (amplitude of the pulse) the greater the amount of energy that it transfers through the medium. It takes more energy to displace the particles further from their rest positions, so the greater the energy of disturbing the particles of the medium, the greater the amplitude.</p> <p>4 The speed is not changed. The amplitude does not determine the speed of the pulse in the medium. The tension of the rope (or spring) and its weight determine the speed of the pulse along the rope.</p>	

**SAMPLE LESSON PLAN ACCORDING TO
CAPS**

NAME OF SCHOOL	Roseville Secondary			EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Principle of superposition		LESSON	3	

DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> Define the principle of superposition Identify point in and out of phase Calculate and draw the algebraic sum of the resultant wave after interference 		
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> Draw a pulse on a Cartesian plane 		
RESOURCES NEEDED	<ul style="list-style-type: none"> textbook, overhead projector, worksheet 		
TEACHING METHODS	<ul style="list-style-type: none"> Question and answer method, PowerPoint presentation, video 		

TEACHER ACTIVITIES	LEARNER ACTIVITIES
<p><u>Introduction</u></p> <ul style="list-style-type: none"> Explain to learners that in a medium waves can interact, meet each other. The way they 	

meet is important because it determines one of two phenomena which can take place.

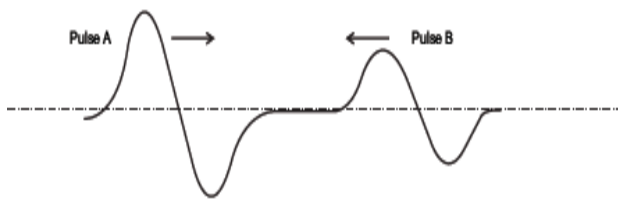
Baseline assessment

- (i) Draw two pulses one with an amplitude of +3 and one with an amplitude of -4. label

Main Body (lesson presentation)

- Explain that pulses can sometimes occupy the same space in time. When they interfere this can be explained by the principle of superposition.
 - Define the principle of superposition as the algebraic sum of the amplitudes of two pulses that occupy the same space at the same time.
 - Use PowerPoints presentation to show learners interference
 - Explain that if the waves meet in phase constructive interference takes place.
 - In phase Two points in phase are separated by a whole number (1; 2; 3; ...) multiple of complete wavelengths.
 - Explain that if pulses or waves meet out of phase destructive interference takes place
- Out of phase Points that are not separated by a whole number multiple of complete wavelengths.
- Use PhET simulation to show learners points that are in and out of phase

Assessment



1. Pulse A travels along the rope towards Pulse B, while Pulse B travels towards Pulse A, as shown in the diagram below.

- Discuss different types of waves that learners know of.

- Answer assessment questions and answer them
- Describe how to produce a transverse pulse using a slinky spring
- Explain how a pulse moves from turn to turn along a slinky
- Draw a graph to show the progression of a transverse pulse in a slinky. Label the axes, pulse length, pulse speed, amplitude, rest position and crest

2 Name the phenomenon which occurs when Pulse A meets Pulse B.

3 State the principle of superposition.

4. The amplitude of Pulse A is 20 cm, and that of pulse B is 10 cm.

a. What is the maximum amplitude of the resultant pulse?

b. What is the minimum amplitude of the resultant pulse?

c. Briefly explain your answers to (a) and (b).

Solution

1 Interference.

2 When two pulses occupy the same space at the same time the displacement of the particles of the medium is found by adding the displacement of the two disturbances.

3 a. 30 cm

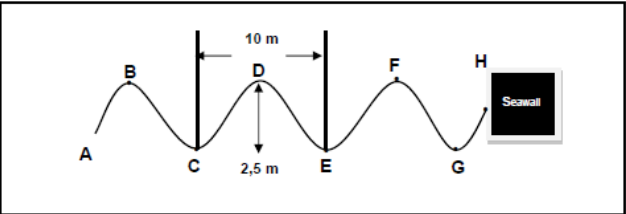
b. 10 cm

c. The principle of superposition states that the amplitude is the sum of the displacements of the two pulses. If the two pulses are both going up at the same time when they meet each other, their amplitudes will add, to give a maximum value of $20 + 10 = 30$ cm. If the pulses are going in the opposite directions when they meet each other, their amplitudes will be either $-20 + 10 = -10$ cm OR they will be $20 + (-10) = 10$ cm. The minimum amplitude is therefore 10 cm.

**SAMPLE LESSON PLAN
ACCORDING TO CAPS**

NAME OF SCHOOL		Roseville Secondary	EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Principle of superposition		LESSON	4

DATE STARTED:			DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to:			
	<ul style="list-style-type: none"> Clearly explain what happens during constructive and destructive interference 			
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> Constructive and destructive interference 			
RESOURCES NEEDED	<ul style="list-style-type: none"> textbook, overhead projector, worksheet 			
TEACHING METHODS	<ul style="list-style-type: none"> Observation, question and answer method, PHET simulation 			

TEACHER ACTIVITIES	LEARNER ACTIVITIES
<p><u>Introduction</u></p> <ul style="list-style-type: none"> Remind learners that the principle of superposition is the algebraic sum of the amplitudes of two pulses that occupy the same space at the same time. In phase: Two points in phase are separated by a whole number (1; 2; 3; ...) multiple of complete wavelengths. Out of phase: Points that are not separated by a whole number multiple of complete wavelengths. <p><u>Baseline assessment</u></p> <p>Two pluses travel toward each other. A with an amplitude of +5 and B with an amplitude of -3. Draw the resultant wave.</p> <p><u>Main Body (lesson presentation)</u></p> <ul style="list-style-type: none"> Using PowerPoint presentation show learners that the wave continue moving in the same direction with the same size after interference. Learners must note that after the interference the pulses continue to move in the same direction with the same amplitude. <p><u>Assessment</u></p> <p>Water waves crash against a seawall around the harbour. Eight waves hit the seawall in 4 s. The distance between points C and E is 10 m. The height of the waveform is 2,5 m.</p>  <p>5.1 Indicate the following by using the letters A to H:</p> <p>5.1.1 Two positions of equilibrium.</p> <p>5.1.2 One crest</p> <p>5.1.3 One wavelength</p> <p>5.1.4 Two points that are in phase with each other.</p>	<ul style="list-style-type: none"> Discuss different types of waves that learners know of. Answer assessment questions and answer them Describe how to produce a transverse pulse using a slinky spring Explain how a pulse moves from turn to turn along a slinky Draw a graph to show the progression of a transverse pulse in a slinky. Label the axes , pulse length, pulse speed, amplitude, rest position and crest

**SAMPLE LESSON PLAN
ACCORDING TO CAPS**

NAME OF SCHOOL	Roseville Secondary	EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Transverse waves	LESSON	5
DATE STARTED:		DATE COMPLETED:					
LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> • Identify movement of particles and direction of waves to be at right angles to each other • Define a transverse wave • Identify one pulse or determine the number of pulses that make a wave • Predict movement of a point or direction 						
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> • The propagation of a pulse and movement of particles 						
RESOURCES NEEDED	<ul style="list-style-type: none"> • PowerPoint presentation, overhead projector, worksheet 						
TEACHING METHODS	<ul style="list-style-type: none"> • Observation, question and answer 						
TEACHER ACTIVITIES						LEARNER ACTIVITIES	

Introduction

- Remind learners that a pulse is the smallest unit of a wave. A series of pulses make a transverse wave or a succession of transverse pulses make a wave.

Baseline assessment

- Draw a single pulse and indicate the direction of motion and movement of particles.

Main Body (lesson presentation)

- Define a transverse wave as a wave in which the particles of the medium vibrate at right angles to the direction of motion of the wave.
- A transverse wave is a succession of transverse pulses. Explain that the movement will be the same.
- Using a PowerPoint presentation show learners all the properties of a wave

Wavelength: The distance between two successive points in phase.

Amplitude: The maximum displacement of a particle from its equilibrium position.

Crest: Highest point (peak) on a wave.

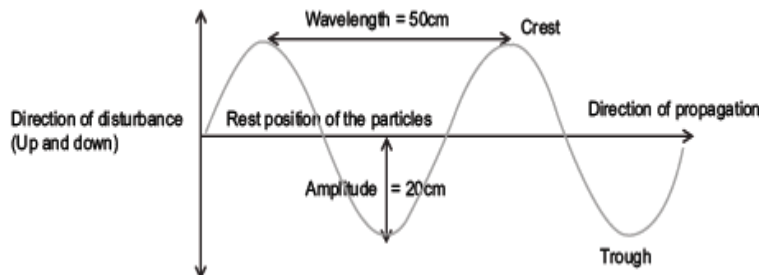
Trough: Lowest point on a wave.

- Also show the learners the length of one pulse.

Assessment

- Draw a wave with two pulses with a wavelength of 50cm, an amplitude of 20cm. also label the trough, crest and the rest position.

solution



- Discuss different types of waves that learners know of.

- Answer assessment questions and answer them
- Describe how to produce a transverse pulse using a slinky spring
- Explain how a pulse moves from turn to turn along a slinky
- Draw a graph to show the progression of a transverse pulse in a slinky. Label the axes , pulse length, pulse speed, amplitude, rest position and crest

**SAMPLE LESSON PLAN
ACCORDING TO CAPS**

NAME OF SCHOOL		EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Transverse waves calculations	LESSON	6
DATE STARTED:			DATE COMPLETED:				
LESSON OBJECTIVES	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Calculate and define period and frequency • Do calculations using $v = f \times \text{wavelength}$ and $s = d/t$ 						
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> • Displacement • speed 						
RESOURCES NEEDED	<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 						
TEACHING METHODS	<ul style="list-style-type: none"> • observation, question and answer method, PHET simulation 						
TEACHER ACTIVITIES				LEARNER ACTIVITIES			

<p>Calculate the answer. Include the SI units. 1.2 $v=f\lambda$ Choose the appropriate equation. $2=0,4 \times \lambda$ Substitute the values. $\lambda= 0,4 \text{ m}$ Calculate the answer. Include the SI units</p> <p>2. The frequency of vibration (oscillation; disturbance) is increased for transverse waves Travelling along a rope. Briefly explain how the following quantitated are affected by an increase in the frequency:</p> <p>2.1 The period of the waves. 2.2 The speed of the waves. 2.3 The wavelength of the waves. 2.4 The amplitude of the waves.</p> <p>Solution</p> <p>2.1 Period = $1/\text{Frequency}$ therefore as the frequency increases, the period decreases.</p> <p>2.2 The speed of the waves depends on the characteristics of the medium (rope). The same rope is used, with the same tension, therefore the speed remains the same (is constant).</p> <p>2.3 Since $v = f\lambda$, then $\lambda = v/f$. The frequency f has increased, but v has remained constant, therefore λ decreases.</p> <p>2.4 The amplitude of the waves depends on the amount of energy used to generate the waves. It remains constant.</p> <p>Add another assessment</p>	

SAMPLE LESSON PLAN ACCORDING TO CAPS

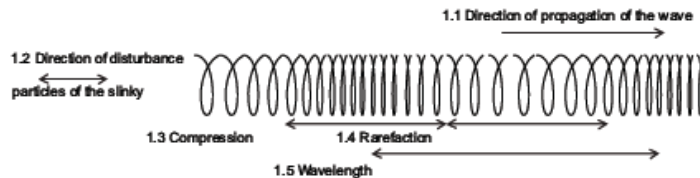
NAME OF SCHOOL		EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK	TOPIC	Longitudinal waves		LESSON	7
DATE STARTED:			DATE COMPLETED:				
LESSON OBJECTIVES	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Define longitudinal wave • Explain the direction of motion and movement of particles in a medium • Identify wavelength, rarefaction, compression on a longitudinal wave 						
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> • Properties of a transverse wave 						
RESOURCES NEEDED	<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 						
TEACHING METHODS	<ul style="list-style-type: none"> • observation, question and answer method, video, PowerPoint 						
TEACHER ACTIVITIES					LEARNER ACTIVITIES		

<p><u>Introduction</u></p> <ul style="list-style-type: none"> • Explain that we will look at a different type of wave called a longitudinal wave. • Explain that this wave also has the same characteristics as the transverse wave. <p><u>Baseline assessment</u></p> <ul style="list-style-type: none"> • Define wavelength, frequency, period, amplitude, trough and crest. <p><u>Main Body (lesson presentation)</u></p> <ul style="list-style-type: none"> • Using an animation show learners how a wave is propagated in a longitudinal wave. • Define a longitudinal wave as a wave in which the particles of the medium vibrate parallel to the direction of motion of the wave. • Using PowerPoint slides show the properties of a wave <ul style="list-style-type: none"> Wavelength: The distance between two successive points in phase. Amplitude: The maximum displacement of a particle from its equilibrium position. • Define a compression as a region of high pressure in a longitudinal wave. • Define a rarefaction as a region of low pressure in a longitudinal wave. • Differentiate between longitudinal and transverse waves. • Show learners a video showing how a longitudinal wave moves <ul style="list-style-type: none"> • Define the period and frequency of a longitudinal wave. <ul style="list-style-type: none"> Frequency: The number of wave pulses per second. Period: The time taken for one complete wave pulse. <p><u>Baseline assessment</u></p> <p>1. A wave is generated in a rope by pushing the free end of the slinky from forwards and backwards along the length of the slinky. The wave travels along the slinky to a fixed end.</p> <p>Draw a diagram of the wave as it travels along the slinky. Label the following:</p> <ol style="list-style-type: none"> 1.1 The direction of propagation of the wave. 1.2 The direction of disturbance of the particles of the 	<ul style="list-style-type: none"> • Define the properties of a transverse wave • Observe animation on the propagation of a longitudinal wave and write down what they observe • Describe how to produce a longitudinal wave
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slinky.

- 1.3 A compression.
- 1.4 A rarefaction.
- 1.5 The wave length.

- **Solution**



2. Distinguish between a transverse and a longitudinal wave, and explain how you can demonstrate their differences using a long spring (slinky).

- **Solution**

A transverse wave is generated (produced) when the movement of the disturbance is at right angles to the direction in which the wave travels. When the spring is jerked at right angles to its length, the wave travels along the rope – the wave moves at right angles to the direction of the vibrations (disturbance). A longitudinal wave is generated when the movement of the disturbance is parallel to the movement of the wave. Push the spring along its length, then pull it backwards to stretch it. The disturbance is forwards and backwards along its length. The wave travels forwards along the spring to the other end of the spring.

3. 3. Define a compression and a rarefaction of a longitudinal wave.

3.2 Explain why the wavelength of a longitudinal wave is measured from the centre of one compression to the next successive compression.

3.3 Explain how you can increase the amplitude of a longitudinal wave in a spring.

- **Solution**

3.1 A compression is a region of a longitudinal wave where the particles are closest together. A rarefaction is a region of a longitudinal wave where the particles are farthest apart from each other.

3.2 It is easier to estimate the middle of a compression than to estimate the beginning and ending of a compression

- Draw a longitudinal wave. Label the axes, wavelength, amplitude and direction of particles to the movement of the medium.
- Answer questions on longitudinal waves.

<p>and rarefaction, so the wavelength is measured from the centre of the compression to the centre of the next compression. This includes the length of one whole compression and one whole rarefaction – that is the length of one complete wave.</p> <p>3.3 The amplitude of a wave depends on the amount of energy it received from the vibrations. To increase the amplitude of a longitudinal wave on a spring push the coils together with more force and stretch the coils apart with more force – giving the vibrations more energy – and the waves a greater amplitude.</p>	

SAMPLE LESSON PLAN ACCORDING TO CAPS

NAME OF SCHOOL				EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Longitudinal waves calculations		LESSON	8	
DATE STARTED:				DATE COMPLETED:					
LESSON OBJECTIVES	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Define period and frequency • Do calculations using $v = f\lambda$ 								
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> • Properties of a longitudinal wave 								
RESOURCES NEEDED	<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 								
TEACHING METHODS	<ul style="list-style-type: none"> • observation, question and answer method, PHET simulation 								
TEACHER ACTIVITIES					LEARNER ACTIVITIES				

<p><u>Introduction</u></p> <ul style="list-style-type: none"> Briefly discuss how a longitudinal wave is propagated and verbally discuss its properties. <p><u>Baseline assessment</u></p> <ul style="list-style-type: none"> Draw a longitudinal wave and label the following: wavelength, frequency, period, amplitude, trough and crest. <p><u>Main Body (lesson presentation)</u></p> <ul style="list-style-type: none"> Explain to learners that a longitudinal wave can be converted to a transverse wave using Define the period and frequency of a longitudinal wave. <ul style="list-style-type: none"> Frequency: The number of wave pulses per second. Period: The time taken for one complete wave pulse. Use the relationship between frequency and period, i.e. $f = \frac{1}{T}$ and $T = \frac{1}{f}$, to solve problems. Use the wave equation $v = f\lambda$ to solve problems involving longitudinal waves Give examples on the board <p><u>Baseline assessment</u></p> <p>A longitudinal wave has a frequency of 20 Hz and a wavelength of 50 cm.</p> <ol style="list-style-type: none"> Calculate its period. Calculate its speed. If the frequency of vibration is doubled, how are the following quantities affected? <ul style="list-style-type: none"> Briefly justify your answers. a. The period b. The speed c. The wavelength <p>Solution</p> <ol style="list-style-type: none"> $T = \frac{1}{f}$ 1/20 	<ul style="list-style-type: none"> Discuss how a longitudinal wave is propagated Draw and label longitudinal waves Answer assessment
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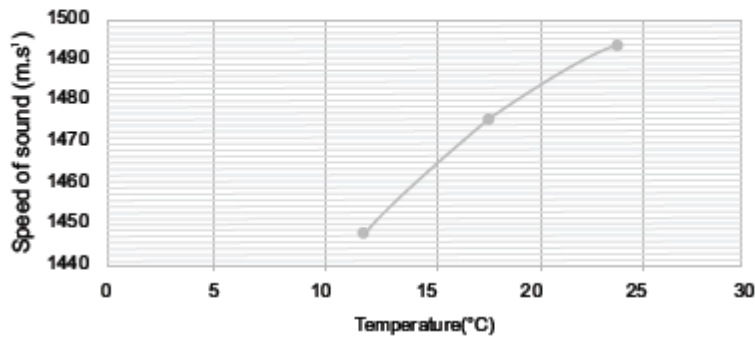
<p>= 0,05 s Unit for answer.</p> <p>4.2 $v=f\lambda$</p> <p>= $20 \times 0,50$ Make sure wavelength has been converted to m.</p> <p>= 10 m·s⁻¹ Unit for answer.</p> <p>4.3 a. The period is halved. $T = f$</p> <p>1 / 40</p> <p>10,025 s</p> <p>b. The speed remains the same (is constant). Speed depends on the characteristics of the medium – and the wave travels through the same medium therefore the speed remains constant.</p> <ul style="list-style-type: none"> c. The wavelength is halved because $v = f\lambda$. When f doubles, λ halves. 	

**SAMPLE LESSON PLAN ACCORDING TO
CAPS**

NAME OF SCHOOL		EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Sound	LESSON	9
DATE STARTED:				DATE COMPLETED:			
LESSON OBJECTIVES		<ul style="list-style-type: none"> • Explain pitch and loudness of sound in terms of frequency and amplitude • Explain the movement of sound in the three states of matter • State the usefulness of ultrasound 					
PRIOR KNOWLEDGE		<ul style="list-style-type: none"> • Longitudinal wave 					
RESOURCES NEEDED		<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 					
TEACHING METHODS		<ul style="list-style-type: none"> • observation, question and answer method, video 					
TEACHER ACTIVITIES				LEARNER ACTIVITIES			

<p><u>Introduction</u></p> <ul style="list-style-type: none"> • Explain to learners that an example of a longitudinal wave is sound • Sound travels through solid, gas and liquid at different speeds <p><u>Baseline assessment</u></p> <p><u>Main Body (lesson presentation)</u></p> <ul style="list-style-type: none"> • Sound waves are created by vibrations in a medium in the direction of propagation. The vibrations cause a regular variation in pressure in the medium. • Explain that sound travels faster in solids as the particles are close to each other, than solids and lastly slower in gases where the particles are far apart. • Show learners an animation of sound travelling through the different medium • Using PowerPoint explain that the loudness of the sound depends on the amplitude and the pitch depends on the frequency • Pitch is the effect produced in the ear due to the sound of a particular frequency. Pitch is directly proportional to frequency. • Loudness is a subjective term describing the strength of the ear's perception of a sound. Loudness is directly proportional to amplitude. • Show learners a video of pitch and sound. <p><u>Assessment</u></p> <p>4. A longitudinal wave with a wavelength of 3 cm travels through air at a speed of 330 m·s⁻¹.</p> <p>4.1 Calculate the frequency of this vibration.</p> <p>4.2 Can a person with a normal range of hearing hear the sound of this wave? Explain briefly.</p> <p>Solution</p> <p>4.1 $v = f\lambda$ Choose the appropriate formula. $330 = f \times 0,03$ Convert and substitute the values. $f = 0.03/330$ Change the subject of the formula. $= 11\ 000\ \text{Hz}$ Calculate the answer. Insert SI units.</p> <p>4.2 Yes. The range of human hearing is from 20 Hz to 20 000 Hz, and this frequency fits within that range.</p> <p>5. The speed of sound depends on temperature. The graph below shows the variation of the speed of sound with temperature for pure distilled water. Study the graph and answer the questions which follow.</p>	<ul style="list-style-type: none"> • Watch a video of the speed of sound in different medium and answer worksheet • Answer assessment
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Graph of the speed of sound in water against temperature



5.1 Determine the speed of sound at

a. 15°C and

b. 20°C.

5.2 Write a general statement describing the relationship between the speed of sound and the temperature of the water.

5.3 Calculate how long it takes for sound to travel 1 000 m in water at 15°C.

5.4 Estimate the speed of sound at 30°C.

Solution

This problem includes analysis and interpretation of data, as well as calculations.

5.1 A. At 15°C the speed of sound is 1 462 m·s⁻¹.

b. At 20°C the speed of sound is 1 482 m·s⁻¹.

5.2 The speed of sound increases when the temperature increases. NB. The graph is not a straight-line graph. It is incorrect to say that the speed of sound is directly proportional to the temperature. Some learners may answer that “as the temperature is increased by 5°C the speed of sound increases, but by a smaller amount every 5°C.” This is actually the best way to describe the relationship – but at this early stage of physics, we can be content to accept the first simple statement as sufficient.

5.3 $v = \text{total distance} / \text{time}$ Choose the appropriate formula.

$1\,462 = 1000 / \text{time}$ Substitute the values.

$\text{Time} = 1000 / \text{time}$ Change the subject of the formula.

$= 0,684 \text{ s}$ Calculate the answer. Insert the SI units.

**SAMPLE LESSON PLAN
ACCORDING TO CAPS**

NAME OF SCHOOL			EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK	TOPIC		Sound calculations	LESSON	10	
DATE STARTED:			DATE COMPLETED:					
LESSON OBJECTIVES		At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Distinguish between noise and sound • Describe echoes and reflections of sound • Do calculations involving sound 						
PRIOR KNOWLEDGE		<ul style="list-style-type: none"> • Pitch and loudness of sound • Speed of sound in different medium • Reflection 						
RESOURCES NEEDED		<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 						
TEACHING METHODS		<ul style="list-style-type: none"> • observation, question and answer method, PowerPoint 						
TEACHER ACTIVITIES					LEARNER ACTIVITIES			

<p><u>Introduction</u></p> <ul style="list-style-type: none"> • Show learners a labelled transverse wave diagram and remind them about the direction of movement and motion of the particles of the medium • Explain to learners that today we will focus on calculations of velocity, period and frequency <p><u>Baseline assessment</u></p> <ul style="list-style-type: none"> • Give learners three waves with different amplitudes and let them determine the order of their loudness. <p><u>Main Body (lesson presentation)</u></p> <ul style="list-style-type: none"> • Relate quality of sound to the waveform as it appears to the listener. Two notes of the same pitch and loudness, played on different instruments do not sound the same because the waveforms are different and therefore differ in quality or tone. • Distinguish between the shape of a pure note and the shape of a noise • Describe echoes as reflections of sound waves. • Use the wave equation $v = f\lambda$ to solve problems involving sound waves that also include echoes, e.g. sonar, bats and dolphins. • Give examples on the board. <p><u>Assessment</u></p> <p>1. When plucked a guitar string emits a sound with a frequency of 256 Hz. The wavelength of the sound is 1,33 m. When the tension of the string is tightened, the guitar string vibrates with a frequency of 300 Hz.</p> <p>1.1 Calculate the speed of sound in air.</p> <p>1.2 When the tension of the string is tightened, how are the following properties of the sound wave affected?</p> <ol style="list-style-type: none"> a. The pitch of the sound b. The speed of the sound c. The wavelength of the sound <p><u>Solution</u></p> <p>1.1 $v = f\lambda$ Choose the appropriate formula $= 256 \times 1,33$ Substitute the values $= 340,48 \text{ m}\cdot\text{s}^{-1}$ Calculate the answer. Insert SI units.</p> <p>1.2</p> <ol style="list-style-type: none"> a. The frequency of the sound increases, therefore its pitch increased. b. The speed of sound remains constant. c. Since $v = f\lambda$ and v remains constant while f increases, the wavelength λ must decrease. 	<ul style="list-style-type: none"> • Determine the order of the loudness of a sound wave by looking at their wavelength <p style="text-align: right;">Do assessment questions</p> <ul style="list-style-type: none"> •
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2. 2.1 State two characteristics of longitudinal wave motion.

2.2 Give evidence from everyday experience or facts that support your answer that

- a. sound travels through solids.
- b. sound travels through water.
- c. sound cannot travel through a vacuum.

2.1 The particles of the medium move parallel (along) the direction of wave travel (propagation). The particles of the medium vibrate about their rest positions; the energy of the wave moves forward. The wave is a periodic motion. (The wave form is repeated again and again at regular repeated intervals).

2.2

a. We can hear sounds through solids e.g. in a table top. In Western movies of the

1950's cowboys or Indians put their ears to the train tracks to hear if the train was coming. Sound travels faster in solids than it does in air. The sound of the train on the tracks would be heard earlier through listening to the sounds in the tracks than it would be heard through the air.

b. Dolphins hear sounds through the water. They have an elaborate system of communication and they rely on the pressure waves carried through water.

c. The classic experiment of an electric bell ringing in a bell jar, from which the air is evacuated, demonstrates that sound cannot travel through a vacuum. Other means of explaining that sound cannot travel through a vacuum are to state that sound waves are mechanical waves – they always require a medium through which to propagate.

3. A ship on the surface of the water sends a signal down to measure the depth of a shoal

of fish which are located beneath it. The signal returns 4 s later. The speed of sound in

water is $1\,450\text{ m}\cdot\text{s}^{-1}$. At what depth below the ship are the fish?

Solution

$t = 4\text{ s}$ Time taken to travel down to the fish and back again.

Distance = speed \times time Use the appropriate formula

= $1\,450 \times 4$ Substitute the values

= $5\,800\text{ m}$ Calculate the answer

Depth = $\frac{1}{2} \times$ distance The question asked for depth (not total distance travelled)

= $\frac{1}{2} \times 5\,800$ Substitute the values

<p>= 2 900 m Calculate the answer. Insert the SI units.</p> <p>4. A longitudinal wave with a wavelength of 3 cm travels through air at a speed of 330 m·s⁻¹.</p> <p>4.1 Calculate the frequency of this vibration.</p> <p>4.2 Can a person with a normal range of hearing hear the sound of this wave? Explain briefly.</p> <p>Solution</p> <p>4.1 $v = f\lambda$ Choose the appropriate formula. $330 = f \times 0,03$ Convert and substitute the values. $f = 0.03$ 330 Change the subject of the formula. = 11 000 Hz Calculate the answer. Insert SI units.</p> <p>4.2 Yes. The range of human hearing is from 20 Hz to 20 000 Hz, and this frequency fits within that range.</p> <p>Add another assessment</p>	

SAMPLE LESSON PLAN ACCORDING TO CAPS

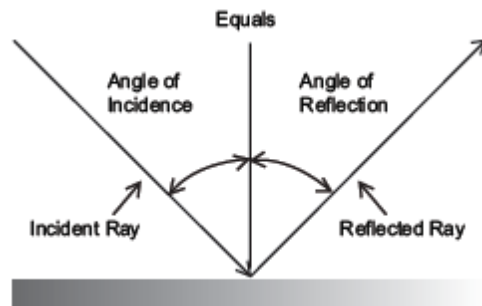
NAME OF SCHOOL				EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Ultrasound			LESSON	11
DATE STARTED:				DATE COMPLETED:					
LESSON OBJECTIVES		At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Define ultrasound • Explain the usefulness of ultrasound 							
PRIOR KNOWLEDGE		<ul style="list-style-type: none"> • Reflection 							
RESOURCES NEEDED		<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 							
TEACHING METHODS		<ul style="list-style-type: none"> • observation, question and answer method, PowerPoint 							
TEACHER ACTIVITIES						LEARNER ACTIVITIES			

Introduction

- Discuss with learners what they think happens when waves/light come across a barrier.
- Lead learns to explain for opaque and transparent objects

Baseline assessment

- .Give learners the flowing diagram and have them label



Main Body (lesson presentation)

- Describe sound with frequencies higher than 20 kHz up to about 100 kHz as ultrasound
- Explain how an image can be created using ultrasound based on the fact that when a wave encounters a boundary between two media, part of the wave is reflected, part is absorbed and part is transmitted.
- Show learners a video on how ultrasound works
 - Describe some of the medical benefits and uses of ultrasound, e.g. safety, diagnosis, treatment and pregnancy using PowerPoint
 - Explain that the property of wave to reflect can be used in SONAR, by bats for navigation, depth sensing
 - Show a video of the different applications of ultrasound

Assessment

1. What type of wave is ultrasound?
 2. During pregnancy, the unborn foetus is monitored using ultrasound.
 - 2.1 Define the term "ultrasound".
 - 2.2 Briefly explain how ultrasound waves can be used to produce an image of a foetus.
 - 2.3 Give two reasons why ultrasound is used instead of x-rays when monitoring the development of the foetus.
 - 2.4 Give another non-medical use of ultrasound technology.

- Discuss reflection, transmission and absorption of waves

- Draw and label a reflection diagram

-

<p>Solution</p> <p>1. It is a sound wave which is a longitudinal wave.</p> <p>2.1 Sound waves with frequencies higher than 20 000 Hz are called ultrasound.</p> <p>2.2 A transducer sends ultrasound waves into the woman's abdomen. These waves reflect off the tissues, and are received by the transducer. A digital image of the tissues is displayed on a computer monitor. This image gives details about the unborn foetus.</p> <p>2.3 a. Ultrasound is safe; it has no ionising radiation (which x-rays have).</p> <p>b. It gives a very clear picture (image) of soft tissue which x-rays are not able to do.</p> <p>2.4 SONAR uses ultrasound for depth sounding, locating shoals of fish etc.</p> <p>Add another assessment</p>	

**SAMPLE LESSON PLAN ACCORDING TO
CAPS**

NAME OF SCHOOL		EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK	TOPIC	Electromagnetic spectrum	LESSON	12	
DATE STARTED:				DATE COMPLETED:			
LESSON OBJECTIVES		At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Define the EM spectrum and its source • Explain the propagation of electromagnetic waves • Explain the penetrating abilities of each and its uses 					
PRIOR KNOWLEDGE		<ul style="list-style-type: none"> • Light as a wave 					
RESOURCES NEEDED		<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 					
TEACHING METHODS		<ul style="list-style-type: none"> • observation, question and answer method, PowerPoint 					
TEACHER ACTIVITIES					LEARNER ACTIVITIES		

Introduction

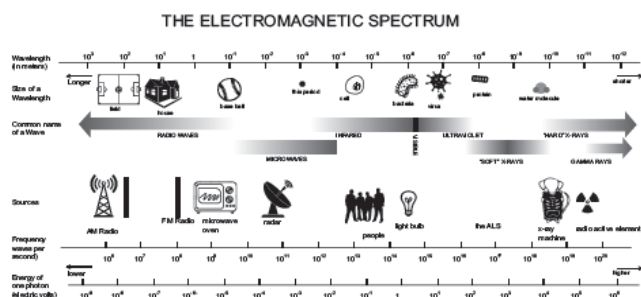
- Ask learners if they think light is a wave? If so what type of wave and in which medium does it travel

Baseline assessment

1. Based on what you have learnt about the properties of waves contrast them with the properties of light as you have observed in daily life.

Main Body (lesson presentation)

- Show learners a PowerPoint of the EM in which light is a part of and explain in terms of frequency and wavelength of each.



- Describe the source of electromagnetic waves as an accelerating charge.
- Describe how an electromagnetic wave propagates when an electric field oscillating in one plane produces a magnetic field oscillating in a plane at right angles to it, which produces an oscillating electric field, and so on.
- State that these mutually regenerating fields travel through space at a constant speed of $3 \times 10^8 \text{ m}\cdot\text{s}^{-1}$, represented by c .
- Show learners a video of accelerating charge
- Using PowerPoint explain that some aspects of the behaviour of electromagnetic radiation can best be explained using a wave model and some aspects can best be explained using a particle model. These happen at the same time.
- Give an example of the use of each type of electromagnetic radiation, i.e. gamma rays, X-rays, ultraviolet light, visible light, infrared, microwave and radio and TV waves.
- Indicate the penetrating ability of the different kinds of electromagnetic radiation and relate it to energy of the radiation.
- Describe the dangers of gamma rays, X-rays and the damaging effect of ultra-violet radiation on the skin.

- Identify light as a type of wave

- Explain how the EM is propagated as seen in the video

Assessment

Which of the following EM radiations has the longest wavelength?

A. radio waves

B. infrared waves

C. visible light

D. x-rays

2. Electromagnetic waves carry

A. positive charge.

B. negative charge.

C. both positive and negative charge.

D. no charge.

3. Electromagnetic waves travel

A. in a medium.

B. without a medium.

C. both in a medium and without a medium.

D. in a distorted path.

4. Sound waves are

A. electromagnetic waves.

B. electromagnetic waves of long wavelength.

C. longitudinal waves.

D. transverse waves.

5. Radio waves differ from sound waves because they

A. travel faster than sound waves.

B. are electromagnetic waves.

C. are transverse waves.

D. have all of the above properties.

Solutions:

1. A

Radio waves have the longest wavelength.

2. D

No charge. EM waves carry energy. In fact, all waves carry energy.

3. C

They consist of interacting electric and magnetic fields which can travel through a vacuum and through a medium.

4. C

Sound waves are pressure waves – longitudinal waves.

5. D

6. Clearly distinguish between “a sound wave” and “a radio wave”.

Solution:

Sound waves are longitudinal waves which are set up by vibrations which cause matter to vibrate in a series of

- Do assessment

<p>compressions and rarefactions. Radio waves are electromagnetic waves which are set up by electric charges accelerating. The transverse wave consists of electric and magnetic fields vibrating at right angles to each other. It can propagate through a vacuum and through materials.</p> <p>Add another assessment</p>	

SAMPLE LESSON PLAN ACCORDING TO CAPS

NAME OF SCHOOL				EDUCATOR	NA Njoko	GRADE	10	TIME	60 MIN
SUBJECT	Physical Sciences	WEEK		TOPIC	Electromagnetic spectrum		LESSON	13	
DATE STARTED:				DATE COMPLETED:					
LESSON OBJECTIVES	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> • Explain the wave and particle and wave nature of the EM • Do calculations for the wave nature and for the particle nature • 								
PRIOR KNOWLEDGE	<ul style="list-style-type: none"> • The different wavelengths and frequencies of the electromagnetic spectrum • The propagation of the EM • $V=f \times \text{frequency}$ 								
RESOURCES NEEDED	<ul style="list-style-type: none"> • textbook, overhead projector, worksheet 								
TEACHING METHODS	<ul style="list-style-type: none"> • observation, question and answer method, PowerPoint 								
TEACHER ACTIVITIES					LEARNER ACTIVITIES				

is the wavelength light in a vacuum and λ is the wavelength.

Assessment

1. Radio waves are reflected from the surface of the moon. The time elapsed between sending the signal and receiving it on earth is 2,5 s.

1.1 How far is the surface of the moon from the earth?

1.2 If radio waves of twice the frequency as those that were originally sent to the moon were reflected from its surface, how long would it take for the signal to return to earth?

Explain briefly.

Solution:

1.1 Distance = speed x time Choose an appropriate formula
 $= 3 \times 10^8 \times \frac{1}{2} \times 2,5$ Insert the speed of light (EM radiation)

1.2 Either half the time here, or after calculating the distance, half the distance.
 $= 3,75 \times 10^8$ m Calculate the answer. Insert the SI units.

2 Calculate the energy of a photon of ultraviolet radiation with a frequency of 6×10^{15} Hz.

Solution

3. $E = hf$ Choose the appropriate formula.

$= 6,63 \times 10^{-34} \times 6 \times 10^{14}$ Insert Planck's constant (h)

Substitute the value for frequency.

$= 3,98 \times 10^{-18}$ J Calculate the answer.

- Insert the SI units.

4. EM radiation produces photons with $4,2 \times 10^{-17}$ J.

4.1 Calculate the frequency of this radiation.

4.2 Calculate the period of the radiation.

4.3 Calculate the wavelength of the

<p>radiation.</p> <p>Solution</p> <p>4.1 $E = hf$ Choose the appropriate formula.</p> <p>$4,2 \times 10^{-17} = 6,63 \times 10^{-34} * f$ Insert Planck's constant (h)</p> <p>Substitute the value for energy.</p> <p>$f = 4.2 \times 10^{-17} / 6,63 \times 10^{-34}$ Change the subject of the formula.</p> <p>$f = 6.33 \times 10^{16} Hz$ Calculate the answer. Insert the SI units.</p> <p>3.2 $T = 1/f$</p> <p>$= 1 / 6,33 \times 10^{16}$</p> <p>$= 1,58 \times 10^{-17} s$</p> <p>3.3 $v = f\lambda$</p> <p>$3 \times 10^8 = 6,33 \times 10^{16} * \lambda$</p> <p>$\lambda = 3 \times 10^8 / 6,33 \times 10^{16}$</p> <p>$= 4,74 \times 10^{-11} m$</p> <p>Add another assessment</p>	



Relevance/appropriateness of ICT

Did I make a connection between the topic/focus of the lesson and the ICT that I chose to use?

If so, what were those connections in terms of content and lesson objectives?

How could I have improved this connection?

Did I make a good choice of ICT for this topic?

If yes, why? What events makes it to be a good choice?

If not, then how could I have used this ICT better? Which other form of ICT could I have used?

Ability to use ICT chosen

When I was using the ICT in the lesson, could the learners and the critical friend follow

what I was doing?

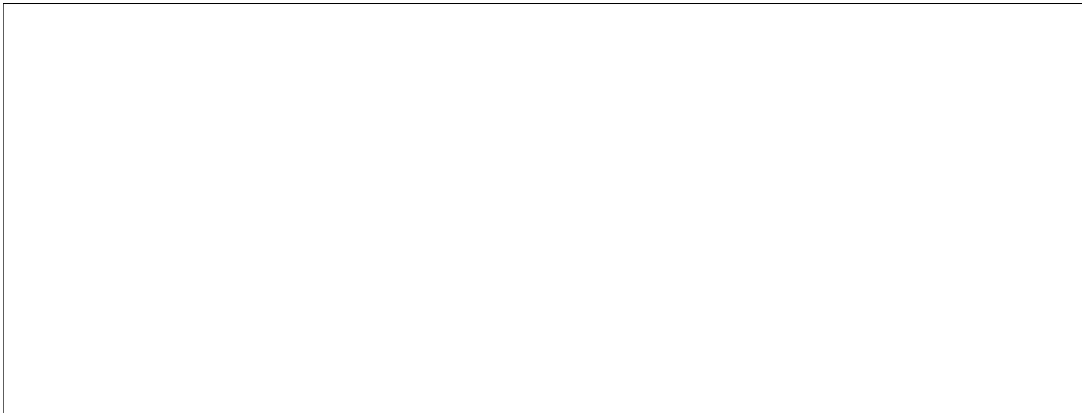
Was there a logical from of events?



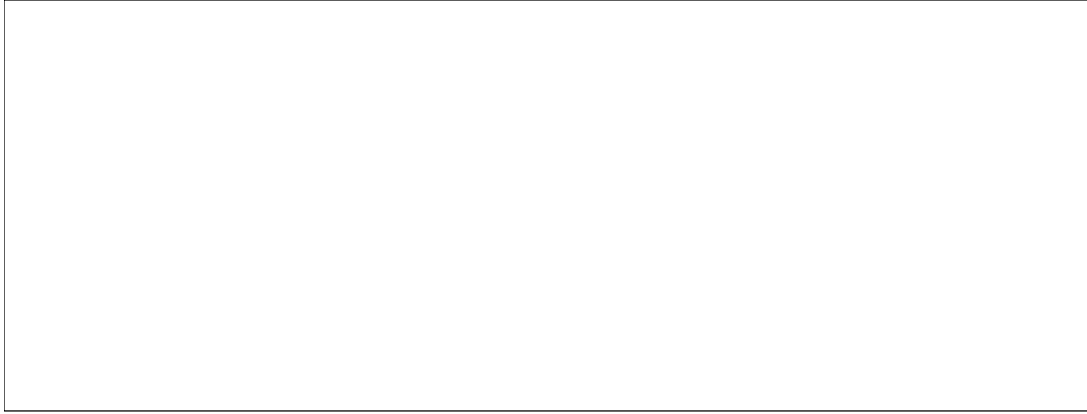
Did I feel confident in my use of ICT?

What did I struggle with and how can I avoid it in the future?

How were the learners and critical friends reacting?



Was I explaining what I was doing with the ICT so that the learners and critical friend could make sense of what I was doing?



Was I clearly explaining what I was doing with the ICT linked to the concept or skill that

I was teaching in the lesson?

Effectiveness of ICT/Ability to use ICT as a pedagogical tool

Based on my use of this ICT, could the learners understand the concept that I was teaching?

Could they do the class activities?

How did the use of this particular ICT help learners reach the lesson objectives/aims?

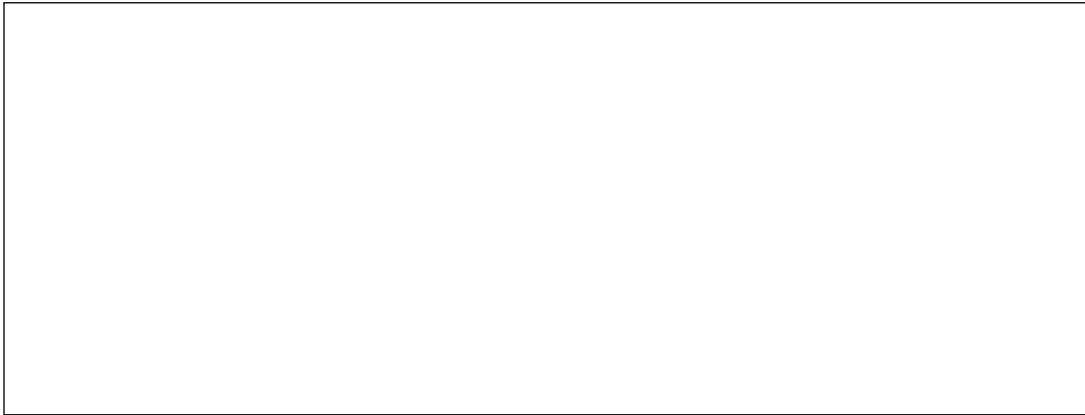
Based on my learners' responses in the lesson, do you feel that:

The learners enjoyed the lesson?

That they were more engaged/active in the lesson?

That the lesson was more interactive than a 'traditional' lesson without ICT?

Some/most of my learners understood the concept that I was explaining using this ICT?

A large empty rectangular box with a thin black border, intended for the user to provide feedback or comments on the use of ICT in the lesson.

Overall, how would I evaluate my use of ICT in today's lesson?

What did I do well?

Is there anything that I could have done differently to improve my use of this particular

ICT?

What were my challenges?

A large, empty rectangular box with a thin black border, intended for the user to write their response to the question above.



23 January 2019

Ms Nqobile Antonia Njoko 215078170
School of Education
Edgewood Campus

Dear Ms Njoko

Protocol reference number: HSS/1941/018M

Project title: A self-study of a Novice teacher's experiences of using Information and Communication Technology (ICT) in teaching Grade 10 Physical Sciences

Full Approval – Expedited Application

In response to your application received 15 October 2018, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully,

.....
Dr Rosemary Sibanda (Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

cc Supervisor: Professor Nadraj Govender & Mrs Mary-Anne Good
cc Academic Leader Research: Dr SB Khoza
cc School Administrator: Ms Ms Sheryl Jeenarain

Humanities & Social Sciences Research Ethics Committee

Dr Rosemary Sibanda (Chair)

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Website: www.ukzn.ac.za



Founding Campuses: ■ Edgewood ■ Howard College ■ Medical School ■ Pietermaritzburg ■ Westville