Name:	**Charlotte Dineo Shirindi**
Student Number:	**585248**
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Supervisor:	**Dr Nokulunga Sithabile Ndlovu**
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DECLARATION

I Charlotte Shirindi, declare that the work portrayed in this thesis is original, excluding citations and acknowledgements. No portion of this work has ever been submitted before for any degree or examination in any other university.

Charlotte Shirindi

Shirindi

October 2024

DEDICATION

This thesis is dedicated to my dearest and beautiful daughter

Rhulani Shirindi

And my loving and supportive husband

Ike Shirindi

Thank you for your understanding and unwavering support throughout my studies. Your tireless support, patience and motivation did not go in vain.

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My sincerest and most heartfelt gratitude to my husband. Your patience and tireless support have not gone in vain. Importantly, to my daughter, I hope the discipline, dedication and determination I displayed throughout this study have inspired you to understand that attitude determines altitude.

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BTDP	Blended Technological Design Process
CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
GBCL	Guided Blended Connectivist Learning
GDE	Gauteng Department of Education
ICT	Information and communication technology
LNSS	Learner Network Society Skill
MEC	Member of Executive Council
OER	Open Education Resources
SAMR	Substitution Augmentation Modification Redefinition

ABSTRACT

The issue of teacher utilization of Information and Communications Technologies (ICTs) confidently and creatively, to help South African learners develop the skills and knowledge they need, has been debated extensively. This is essential for learners to achieve their personal goals and become full participants in the global community. Although the National Curriculum Assessment Policy Statement (CAPS) envisions the utilisation of ICTs for teaching and learning in each subject, it is silent on the pedagogical approaches for learners to acquire the desired ICT skills to participate meaningfully in the global community. Instead, the literature reviewed has revealed that teachers are utilising the available ICT resources deployed in schools mainly for content acquisition. Teachers offering Technology in Gauteng Full ICT schools also fall within this category. The Grade 8 Technology CAPS curriculum is also silent on using ICTs to solve the real-life problems identified.

In an attempt to ensure that South Africa does not fall victim to a 'digital divide', the ICT resources deployed in these schools need to be utilised effectively to develop the necessary knowledge and skills for learners to compete successfully in the global world. Accordingly, teachers in these schools have been capacitated to use ICT resources to enhance the quality of teaching and learning. However, the studies conducted to establish the return on investment in the ICT resources deployed in schools have revealed a mismatch between the desired educational outcomes and what is prevailing on the ground at the implementation level.

This study focused on understanding how Grade 8 Technology teachers from the Full ICT schools in Gauteng utilise the available ICT resources during teaching and learning activities to create opportunities for learners to acquire the ICT skills required to solve the identified real-life problems in Technology and participate meaningfully in the global world. The findings assist in the development of an ICT Teacher Development Framework that guides teachers on how to utilise the available ICT resources to facilitate teaching and learning activities in sync with the South African Education Policy (the CAPS document) aspirations.

The study used a multiple case study design that relied on semi-structured interviews, classroom observations, lesson plans and social media use to understand the development of Learner Network Society Skills (LNSSs) by the Grade 8 Technology teachers in four Full ICT schools in Gauteng. This aimed to customise the findings to facilitate the development of the desired ICT skills, considering the South African context.

The study adopted Connectivism as the main learning theory to understand how teachers could equip learners with network society skills. Since this theory is not wholly suitable for teaching and learning in the South African context, the developed Guided Blended Connectivist Learning Framework became instrumental in achieving this goal. It employs four learning frameworks to merge traditional face-to-face teaching and learning with online learning to help identify teaching and learning activities that facilitate the development of LNSSs in the context of the Full ICT schools in Gauteng. The results reveal the conditions that support the development of the desired ICT skills in these schools.

It is recommended that the current content-heavy Grade 7 - 9 Technology curriculum be reviewed, to incorporate the pedagogy and LNSS to be acquired, as learners engage in the standard technological design process, to address real-life problems.

Key Words: Network Society Skills, Connectivist Learning, Blended Learning, Modelling, Problem-Based Learning.

1 Chapter One: Introduction and Background

1.1 Introduction

Information Communication Technology (ICT) has become an essential part of life in the 21st century, both globally and locally. The appropriate utilisation of ICTs could become an effective means to support teaching and learning that enhances the development of Learner Network Society Skills (LNSS) as they can change pedagogical practices to be more learner-centred and collaborative rather than teacher-centred and dependent on textbooks. However, there is a myth that the mere utilisation of ICTs for teaching and learning will enhance classroom practice – A myth that many people have fallen prey to. This includes policymakers in the education sector. Several studies have revealed that the utilisation of ICTs does not necessarily translate into the desired learning outcomes (Cuban, 2001; Balanskat et al., 2006; Wozney et al., 2006; House, 2010 in Cheema & Zhang, 2013; Cheung & Slavin, 2013; Unser, 2017). This study investigated the development of LNSS in the South African context, with a view to informing a teacher development framework in the utilisation of ICTs to achieve curriculum goals.

Globally, there is an increased trend in the adoption of ICTs for teaching and learning in the education sector. Advancements in technology have led to innovative pedagogical practices aimed at enhancing the quality of education. Calvo and Villarreal (2018, p.26) stated that “the global shift to e-learning was observed through improvement or replacement of traditional learning modes such as classroom experiences, textbook study, Compact Disc Read-Only Memory (CD-ROM), and traditional computer-based training via the online delivery of information, communication, education, and training”. Implicitly, the use of ICTs ushers creative ways of teaching and learning to develop LNSS and achieve curriculum goals at the same time.

In the United States of America, then President Clinton pronounced four goals for the integration of ICTs in schools: to ensure the availability of ICTs in all schools, connectivity in all classrooms and internationally, the installation of relevant software into the ICT devices and the capacity building of teachers to institutionalise ICTs in education (Minty, 2020).

According to Cuban (2001), the assumption that policymakers made was that once ICT devices have been deployed to schools and all teachers and learners have access to connectivity, the realisation of the last two goals would be a given. Yet, many studies conducted have revealed that this is not the case.

In Nigeria, the implementation of ICTs in schools faces several challenges. According to Nwana (2012), these include a lack of appropriate ICT infrastructure, such as computer laboratories, ICT devices and connectivity for online classrooms, especially at the secondary school level. As a result, Nwana (2012) makes recommendations for the effective implementation of ICT in education in Nigerian schools. Firstly, the Nigerian Department of Education should drive a nationwide capacity-building programme for teachers and learners on computer literacy training programmes across all levels. In addition, the necessary arrangements must be made for free access to the Internet so that all classrooms are connected to the Internet to enable online learning. Furthermore, the department must employ ICT experts and technicians to maintain ICT infrastructure, including assisting with technical glitches to ensure teaching and learning are not disrupted.

Other African countries like Kenya have also tried to introduce ICT in education in the schooling sector. Accordingly, the Minister of Education took steps to promote the implementation of their ICT strategy (Mingaine, 2013). However, similarly, the implementation of ICTs in Kenyan schools remained difficult to achieve. Many of the schools had no electricity and had no financial capacity to install it. In addition, teachers and school management lacked the requisite skills to utilise ICTs for teaching and learning, including curriculum management. As a result, learners could benefit from the vast opportunities provided by ICTs (Mingaine, 2013). To address these challenges, many schools seek sponsorships from non-governmental organisations. Notably, training teachers on the utilisation of the available ICT resources is also provided by non-governmental organisations to ensure effective and efficient utilisation of the resources provided.

In South Africa, education policymakers are no different from other countries. They also ascribe to the notion that providing ICTs in schools will positively impact curriculum delivery and management. Consequently, the South African policy on ICT in education has responded to this belief by including in the White Paper on e-Education the statement that by 2023,

> "Every South African manager, teacher and learner in the general and further education and training bands will be ICT capable, that is, use ICTs confidently and creatively to help develop the skills and knowledge they need as lifelong learners, to achieve personal goals and to be full participants in the global community." (Department of Basic Education, 2004, p.17)

Firstly, it defines e-Education as the utilisation of ICT resources to connect learners to expert support services for more information and ideas through facilitating effective combinations of various pedagogy and platforms to enhance learning (Department of Basic Education, 2004). In addition, it emphasises the need for teaching and learning activities to "transcend the mere exchange of information and to transform e-Education into a range of learning activities that meet educational objectives" (Department of Basic Education, 2004, p.14). Furthermore, it outlines indicators which demonstrate that ICTs are utilised effectively to develop the necessary knowledge and skills to compete successfully in the global world (Department of Basic Education, 2004). These include "the ability to apply ICT skills to access, analyse, evaluate, integrate, present and communicate information; the ability to create knowledge and new information by adapting, applying, designing, inventing and authoring information; as well as the ability to function in a knowledge society by using appropriate technology and mastering communication and collaboration skills" (Department of Basic Education, 2004, p.14).

Using the Internet is thus key to connecting teachers and learners to achieving the above as it provides additional information and ideas to promote the acquisition of aforementioned ICT skills and enable meaningful participation in the global community. Importantly, to achieve what the South African education policies aspire for every learner (Department of Basic Education, 2004, 2011, 2017). The details in this regard are provided in the literature review.

1.2 Background

South Africa has nine provinces. Although Gauteng is the smallest in land size of the nine provinces, it is extremely industrialised. Hence, it is considered the country's economic hub (Masango et al., 2022; PeTjé et al., 2002). Following former president Thabo Mbeki's State of the Nation address on 08 February 2002, which highlighted ICT as a critical element in economic development, the then Premier of the province, Mr Mbhazima Shilowa, prioritised ICTs. To that end, he allocated R500 million from the provincial budget to the Gauteng Online Programme to bridge the digital divide and promote economic development (PeTjé et al., 2002).

As a result, the Gauteng Department of Education (GDE) was given the responsibility of managing the Gauteng Online project to its completion. The project equipped each of 2450 public schools with 25 networked computers, including access to the Internet. This resulted in Internet connectivity with email addresses to some 1.5 million learners and 63 000 teachers and administrators, including capacity building on computer literacy (PeTjé et al., 2002; Weideman, 2003). Accordingly, teachers were to capacitate learners with basic computer skills, including communication and collaboration via email and using the Internet to access information, to facilitate curriculum delivery. This was aimed at preparing learners with the requisite ICT skills for higher education institutions and the labour market to contribute positively to the country's economic growth (PeTjé et al., 2002; Mpehle, 2011).

However, according to Chigona and Chigona (2010), Mpehle (2011), Minty and Pather (2014) and the Gauteng Department of Education (2015), there were challenges in the implementation that made it difficult for the GDE to realise this goal. The challenges include theft of computers, vandalism of the Gauteng Online Laboratories, Internet connectivity and inadequate ICT training and support to teachers. In addition, there was slow progress in the implementation of the project, alleged tender irregularities, unreliable connectivity, non-functional Gauteng Online Laboratories, inadequate support to schools on the use of the ICT resources provided, poor management and lack of community involvement, buy-in and commitment to the project. This could be why not all the targeted public schools and teachers benefited from the project.

In 2015, the Education Member of Executive Council (MEC) for the GDE, Panyaza Lesufi, initiated a project named "Paperless Classrooms". A paperless classroom could be described as:

> "…just that…paperless. It is not only the effort but the successful integration of technology in the classroom that eliminates all purposes of paper, ink, clutter…Instead, this classroom will be completely cloud-based. Students will be able to access their lessons, homework, and grades solely through the internet or school network." (Creating a Paperless Classroom, n.d. in Minty, 2020, p.3)

Ideally, the utilisation of the phrase eliminates the traditional teaching, learning and support material, such as chalk, chalkboard, whiteboard, pen, paper and physical textbooks. In other words, these would no longer be used in classrooms. This is exactly what the MEC envisioned for the Gauteng paperless classrooms, as proclaimed in his statement to the press, "Tomorrow morning in this school, we are officially burying the chalkboard, we are officially burying the duster, we are officially burying the chalk. Gone are the days when they have to write in exercise books and hand in the assignment" (Falanga, 2015, paras 4-5). Implicitly, teaching and learning in these classrooms would take place solely through the utilisation of technology, and learners would be equipped with the necessary skills to be creative thinkers and innovators using technology (Matwadia, 2018). This matches the definition of a paperless classroom provided above.

The project was aimed at actualising what the White Paper on e-Education envisages for learners in the South African education system. Similarly, a substantial amount of ICT resources were deployed in public schools. These included Smartboards, laptops and tablets, which were provided to teachers and learners in targeted grades to support teaching and learning that equips learners with the skills to partake in a competitive global economy (Department of Basic Education, 2004; Dlamini, 2018, 2022; Gauteng Department of Education, 2019; Masango et al., 2022). This was an effort by the GDE to ensure learners "learn creatively and build knowledge flexibly, interactively, autonomously, authentically and engage collaboratively in complex problem solving" (Scardamalia & Bereiter, 2014 in Isaacs, 2020, p.13).

In that way, learning would equip learners with the requisite skills to cope with the digital world and contribute positively to reducing poverty and unemployment in the Gauteng province (Gauteng Department of Education, 2019).

Importantly, efficiency in delivering the curriculum would be achieved through using technology in a manner that "challenges learners' higher-order thinking skills instead of a medium through which content knowledge is simply communicated to learners" (Minty, 2020, p.10). In other words, to develop the necessary knowledge and skills for learners to compete successfully in the global world, training teachers should not be confined to the mere acquisition of curriculum and content coverage (Mokate, 2023). Instead, it should include the acquisition of the requisite skills to use the selected technology and software to facilitate the development of higher-order thinking skills through communication and collaboration using the Internet (Department of Basic Education, 2004; Minty, 2020).

Teachers were, therefore, expected to provide quality education and skills that lead to improved quality of life, entrepreneurship and employability and prepare learners to live and thrive in the global economy (Dlamini, 2018, 2022; Gauteng Department of Education, 2019; Mokate, 2023). Ndlovu (2015) and Mlotshwa (2019) support the deployment and utilisation of ICT resources in schools. They reiterate the significant role of ICTs in enhancing the quality of classroom practice.

To realise the return on investment in the ICT resources deployed in schools, many South African scholars (Wilson-Strydom et al., 2005; Moll & Matshana, 2006; Mofokeng & Mji, 2010; Livingstone, 2012; Dlamini & Mbatha, 2018; Dlamini, 2022; Mokate, 2023) support the need to capacitate teachers on the utilisation of ICT resources to enhance the quality of teaching and learning, as well as to prepare learners with the requisite ICT skills to participate in the global economy. The reason advanced is that digital literacy is the key lever of pedagogical innovation and economic growth. In other words, teaching and learning activities designed by ICT literate and innovative teachers to develop digital literate learners who collaborate with others and innovate to address human needs. Leung et al. (2014) corroborate this notion, positing that teaching and learning should prepare learners with the necessary skills to obtain new information and utilise it to address human needs.

However, despite the investments made in these schools, there appears to be a mismatch between the desired educational outcomes and societal expectations (Dlamini & Na-Allah, 2015; Msiza et al., 2020; Dlamini, 2022). According to the Gauteng Department of Education (2019), the education and training policy and programmes have not served the Gauteng Province well economically, as schools are not well suited to produce matriculants with the skills they really need. This offsets the goal of the White Paper on e-Education, which advances the use of ICT resources "…confidently and creatively to help develop the skills and knowledge they need as lifelong learners to achieve personal goals and to be full participants in the global community by 2013" (Department of Basic Education, 2004, p.17). This could be attributed to the self-imposed challenges posed by the quest to complete the syllabus and prepare learners for the final year examinations (Mokate, 2023). To provide a practical example to illustrate this point, the Gauteng Department of Education (2020) concedes that there is not sufficient time in the classroom for teachers to cultivate the acquisition of the desired ICT skills. This is attributed to the extensive subject content to be covered in an academic year to ensure learners pass their grades.

Table 1.1 bears testimony to this assertion. A. Nicolaai, Acting Chief Director: Coordination of Curriculum Implementation in the Gauteng Department of Education presented syllabus coverage during a monitoring and oversight visit by the Department of Basic Education (DBE) from 26 to 28 February 2020 (personal communication, February 26, 2020). The purpose of the visit was to establish the GDE's state of readiness for improving learner performance in 2020.

Table 1.1: Grade 12 2020 Syllabus Coverage and School-Based Assessment Completion Cycle Submission

Monitoring and Support Cycles	Submission Dates	% Syllabus Coverage
Cycle 1: Track	19/02/2020	20%
Cycle 2: Submit	20/03/2020	40%
Cycle 3: Track	14/05/2020	60%
Cycle 4: Submit	12/06/ 2020	80%
Cycle 5: Directors Submit Signed Letters to Deputy Director General	13/08/2020	100%

Source: A. Nicolaai, personal communication, February 26, 2020

This demonstrates that the focus in teaching and learning is on content acquisition and syllabus completion in the South African basic education sector. The pressure exerted on teachers to complete the syllabus is echoed by the research participants in Chapter 6 of this thesis. While teachers are required to ensure all topics within a subject are covered within a year in different grades, the question is: *Is justice done to enable the acquisition of the desired ICT skills, as envisaged by the White Paper on e-Education on ICT in education?*

Duran et al. (2011) caution that chasing syllabus completion during teaching and learning activities could be an impediment to the effective utilisation of ICT resources to promote "learner-centred learning, active, exploratory, inquiry-based learning; collaborative work among learners and teachers; as well as creativity, analytical skills, critical thinking and informed decision-making" (Department of Basic Education, 2004, p.19).

With the pressure created to complete the syllabus, as depicted in Table 1.1, I, as the researcher, wondered if teachers in the GDE are utilising the ICT resources provided in schools to create opportunities for learners to acquire the skills and knowledge they need as lifelong learners to live and thrive in the global economy (Department of Basic Education, 2004; Voogt et al., 2013; Dlamini, 2022).

Or, *could it be that the good intentions of the former MEC in the GDE with paperless classrooms are hamstrung by the curriculum policy and realities on the ground?* Van Dyke and White (2019) in Rwodzi and de Jager (2021) further argue that the levels of poverty in communities could restrict the utilisation of ICT resources outside the traditional face-to-face classroom due to financial constraints and lack of access to resources required to extend the use of ICTs outside the classroom.

To provide context to the study, this chapter offers a brief description of the schools selected for this research study. This includes the ICT resources and the training provided to the schools. Thereafter, the problem statement, aim and research questions are presented. Lastly, a summary of each chapter is provided as an overview of the thesis.

1.3 Context of the Study

From the entire population of 602 Gauteng schools with paperless classrooms in the project cited above, the portion of the schools selected for this research study falls within the category of Full ICT schools. They include new schools built from 2015, schools that obtain a 100% Matric pass rate, Schools of Specialisation and Twinning Schools (Gauteng Department of Education, 2019). These schools enjoy the privilege of being provided with ICT resources end to end. This means that all teachers and learners in all grades have the ICT resources as declared in the ICT Strategy: 2015 – 2020 (Gauteng Department of Education, 2015). These resources include connectivity, digital content in the Smartboards, teacher laptops and learner tablets.

According to Masango et al. (2022) and Dlamini (2022), teachers received basic training on how to utilise the available ICT resources, particularly the Smartboard, including the e-books uploaded. This was aimed at promoting open access to multimedia content and the e-book reader, the development of lesson plans using laptops and presenting these using PowerPoint Presentations predominantly to enhance the quality of teaching and learning activities in the classroom (Gauteng Department of Education, 2019, 2020; Dlamini, 2022). Implicitly, the training focused mainly on operating the ICT resources provided to access information rather than utilising these to enhance pedagogical practices in the classroom.

This means the training did not sufficiently equip teachers with the requisite skills to manage learner utilisation of ICT devices and prepare them to participate meaningfully in the global economy (Minty, 2020; Msiza et al., 2020; Dlamini, 2022; Masango et al., 2022; Mokate, 2023).

Four schools were selected for this study from the entire population of 95 Full ICT schools spread across the five regions in the Gauteng province (Gauteng Department of Education, n.d.). The main selection criteria was school proximity. As a result, the schools selected were from the Johannesburg and Ekurhuleni regions. Teacher confirmation on utilisation of the available ICT resources for teaching and learning, including willingness to participate in the study, narrowed down the number of participating schools to four. Furthermore, the teachers selected in these schools were those offering Technology as a subject. The rationale for this is that the subject was introduced to develop technologically literate learners who would translate into citizens with the requisite ICT skills to communicate and collaborate to address human needs innovatively (Department of Basic Education, 2011). This translated into four secondary schools and four teachers, with a total of approximately 140 learners.

1.4 The Problem Statement

A closer look at the Grade 8 Technology outcomes reveals that the subject is aimed at developing learners' technological literacy, as well as various life skills, such as problem-solving in real-life situations, innovation, communication, collaboration and effective utilisation of resources, as well as prepare learners for the world of work (Ankiewicz, 1995, 2013; Reddy et al., 2003; Department of Basic Education, 2011; Janak, 2019). However, the Grade 8 Technology Curriculum and Assessment Policy Statement (CAPS) is silent on the utilisation of ICTs to investigate, plan, design, create, evaluate and communicate the product made, particularly where the problem-based learning approach is used. Instead, the curriculum stipulates the use of "an approved textbook, a 72-page A4 workbook or exercise book and drawing instruments such as pencils, erasers, a ruler and set squares" (Department of Basic Education, 2011, p.13). This misaligns with the White Paper on e-Education (Department of Basic Education, 2004), as indicated earlier, and the intentions for establishing Full ICT schools. It also goes against Technology, a subject that is aimed at producing,

> "engineers, technicians and artisans needed in modern society and the need to develop a technologically literate population for the modern world. The subject

> stimulates learners to be innovative and develops their creative and critical thinking skills. It teaches them to manage time and material resources effectively, provides opportunities for collaborative learning and nurtures teamwork." (Department of Basic Education, 2011, p.8; Gumbo and Williams, 2014, p.480)

To realise this, teachers are required to create opportunities to identify human needs and solve real-life problems through working collaboratively with others "using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles" (Department of Basic Education, 2011, p.10). Developing the learners' technological literacy for the modern world implies creating opportunities for learners to utilise the available ICT resources to work collaboratively with others throughout the technological process. This entails problem identification and investigation, followed by product design, manufacture, evaluation and communication to solve the problem identified (Ankiewicz, 1995; Reddy et al., 2003; Department of Basic Education, 2011; Ankiewicz, 2013; Janak, 2019; Du Toit, 2020).

However, the Technology CAPS document does not outline the standard ICT skills learners should acquire as they engage in the aforementioned technological process to solve the problem identified. This is an indication of a lack of alignment between the intended curriculum and the content of the curriculum (Ankiewicz, 2013; Du Toit, 2020). Jita (2018) and Janak (2019) corroborate this discrepancy, arguing that the curriculum provides minimal guidance on the ICT skills learners should acquire. South African Technology teachers are, therefore, left to figure out on their own how best to use digital technology to develop the desired network society skills advocated for in the ICT policy. This leads to the compromised implementation of the policy and the failure of learners to acquire the skills they need to network in the information society that the country has been pursuing (Department of Basic Education, 2004). The other unintended consequence could be different interpretations by teachers of the network society skills to be acquired by learners, leaving no room for standardised implementation across the country.

As indicated earlier, teachers in the Gauteng province have undergone numerous ICT professional development aimed at preparing them for effective use of the available ICT resources. However, numerous studies found that training teachers in Full ICT schools has not adequately prepared them to utilise these resources to enhance their teaching and learning activities (Dlamini & Na-Allah, 2015; Minty, 2020; Msiza et al., 2020; Masango et al., 2022; Dlamini, 2022; Mokate, 2023). This leaves Technology teachers and the rest of the schools' teaching staff clueless about how best to adapt their pedagogical practices as they integrate ICTs so they are able to develop LNSSs.

There is, therefore, a need to investigate how teachers in technology-rich schools, such as the designated Full ICT schools, develop LNSSs in the absence of guidance from the policy and the training aimed at preparing them to enhance the delivery and achievement of the curriculum goals.

1.5 Purpose Statement

This study focused on understanding how Grade 8 Technology teachers from Full ICT schools in Gauteng utilise the available ICT resources during teaching and learning activities to create opportunities for learners to acquire LNSSs. The findings of the research will offer insight into the utilisation of the available technological and pedagogical affordances in promoting the acquisition of these skills, as espoused in the preamble of the Grade 7 – 9 Technology CAPS document (Department of Basic Education, 2011). This will inform the development of a Teacher Development Framework to guide Technology teachers on strategies they could employ to develop the LNSSs required to solve real-life problems. Jita (2018) supports this notion, reiterating the need to clearly define the ICT skills to be acquired by teachers to promote the learners' technological literacy. Hence, there is a need for a framework to assist teachers in designing teaching and learning activities that will prepare learners with the desired skills to thrive in the global economy.

1.6 Objectives of the Study

The following objectives of the study enabled the researcher to establish if the Grade 8 Technology teachers from the Full ICT schools in Gauteng utilised the ICT resources provided by the GDE to create opportunities for learners to acquire LNSSs.

1. To explore the Technology teachers' espoused practices in the development of LNSSs to achieve the subject learning outcomes.
2. To determine how teachers purposefully plan for learner utilisation of ICT resources to elicit productive learning activities that promote the development of LNSSs.

3. To investigate how teachers purposefully utilise ICT resources to elicit learning activities in the classroom and online to develop LNSSs.
4. To understand how teachers promote the acquisition of LNSSs in their use of ICT resources during teaching and learning activities.

The study was organised to respond to the following research questions. The main research question is:

How does teaching Grade 8 Technology in Gauteng Full ICT schools create opportunities for learners to utilise the available ICT resources to acquire LNSSs?

The main research question was informed using the following sub-questions:

1. What are the teachers' espoused practices in the development of LNSSs?
2. How do teachers **plan** for learner utilisation of ICT resources to develop LNSSs to solve real-life problems?
3. How do teachers **utilise** ICT resources to develop LNSSs?
4. What **conditions promote** the teachers' enactment of their espoused practices to promote **the acquisition of LNSSs** and realise the goals of education policies?

1.7 Rationale of the Study

The lack of guidance from the Grade 7 – 9 Technology CAPS document in the design of teaching and learning activities that promote the acquisition of LNSS compelled me to extend my search for relevant policies from a few African countries, for example, Rwanda and Kenya (RMOE, 2015a, 2015b; KMOE, 2017, 2018). Seemingly, there is an equal lack of guidance from their education policies with respect to pedagogical approaches that promote the acquisition of LNSSs. Concerningly, the training provided in Gauteng Full ICT schools focuses more on operating the devices to access information and presenting this information in PowerPoint Presentations for curriculum and content coverage rather than preparing learners to participate meaningfully in the global community (Minty, 2020; Msiza et al., 2020; Dlamini, 2022; Masango et al., 2022; Mokate, 2023). Padayachee's (2017) study, which aimed to determine the extent of ICT usage in South African schools, corroborates the impact of the training. The study revealed that teacher utilisation of the available ICT resources to access information for curriculum delivery was 41% while sharing information, the utilisation of the experiential tools and reflective dialogue was 29%, 26% and 18%, respectively.

Although Mhlanga and Moloi (2020) argue that the South African education system generally has some elements of excellence in the utilisation of ICTs, this points specifically to higher education institutions. In the basic education sector, the utilisation of the available ICT resources remains at curriculum and content coverage as a result of the training provided. For example, using DBE and GDE websites and social media, recorded lessons and live TV broadcast lessons on Channel 318 and 317 (local satellite).

Notably, the focus on teacher perceptions and challenges around teaching the subject was conspicuous during my interaction with the limited literature pertaining to teaching Technology in South Africa (Gumbo & Williams, 2014; Mapotse, 2014; Khoza, 2015; Mapotse, 2015, 2017).

The lack of literature on empirical studies on the use of ICT resources in teaching Technology to equip learners with the requisite ICT skills convinced me that my proposed study was necessary to initiate further discourse in this area. This could translate into the development of a framework aimed at equipping teachers with the requisite skills to manage learner utilisation of ICT devices and prepare them to participate meaningfully in the global economy (Minty, 2020; Msiza et al., 2020; Masango et al., 2022; Dlamini, 2022; Mokate, 2023).

1.8 Outline of Chapters

Chapter One: Introduction and Background

This chapter gives an overview of why LNSSs are important in this era where there is an influx of digital technology. It also provides a brief background for the Gauteng Online Laboratories and Paperless Classrooms programmes, which were initiated by the GDE for ICT in Education. The latter involves specific schools, namely, Full ICT schools. The chapter then considers studies carried out on the utilisation of ICT resources since the Paperless Classrooms' inception in 2015 – importantly, studies conducted on the utilisation of these resources in Technology – providing background and facilitating the rationale for undertaking this study. The purpose statement and the research questions are also included.

Chapter Two: The Development of LNSSs in Full ICT Schools

To set the tone, this chapter begins by clarifying LNSSs and the use of ICT resources in the South African context, as well as reviewing education policies that inform teaching and learning activities promoting the use of ICTs to develop the desired ICT skills. This establishes the main education policies in the South African context considered to be the development of LNSSs in the utilisation of ICTs, as depicted in the White Paper on e-Education (Department of Basic Education, 2004), the Grade 7 – 9 Technology CAPS document (Department of Basic Education, 2011) and the Professional Development Framework for Digital Learning (Department of Basic Education, 2017). It then presents literature on the development of LNSSs that form part of the theoretical and conceptual frameworks, which include teaching and learning methodologies promoting the development of these skills. The two were used to develop an analytical tool that assisted in engaging with data in the context of this study to respond to the research questions.

Chapter Three: The Development of the Analytical Framework

This chapter presents the study's analytical framework, which was developed from Siemens's (2011) four levels of interaction in Connectivist Learning, infusing Puentedura's (2009) Substitution Augmentation Modification Redefinition (SAMR) Model and Laurillard's (2012) six learning types. Thereafter, the essential concepts and how they are employed in the framework are explained.

Chapter Four: Research Design and Methodology

This chapter presents and defends the research methodology, which suits the type of study that this investigation adopted. The discussion focuses on the appropriateness of the research design, which is a qualitative approach and an interpretivist paradigm, in understanding the utilisation of available ICT resources during teaching and learning activities in Full ICT schools in Gauteng to develop LNSSs.

Chapter Five: Presentation of Findings

Data from the teachers' espoused and enacted practices on the utilisation of available ICT resources to develop LNSSs are presented. The indicators in the analytical framework developed are used as a lens to interpret their teaching and learning activities.

Chapter Six: Analysis of Teachers' Espoused and Enacted Practices

This chapter employs thematic analysis to interpret the data presented in Chapter Five on the development of LNSSs by the study's four participating teachers to lift the core content or meaning. Thereafter, it analyses and interprets each of the four teachers' espoused and enacted practices against the analytical framework's indicators. This is aimed at making decisions on the consistency between each teacher's espoused and enacted practices in the development of LNSSs, as well as identifying the emerging trends.

Chapter Seven: Emerging Trends

This chapter delves into the identified themes in the development of LNSSs: guided learning, blended learning, using ICTs mainly for content acquisition, using social media mainly for sharing tasks and resources and restricted LNSSs acquisition. The process culminates into a storyline and draws conclusions that respond to the main research question (Gibbs, 2007; Maguire & Delahunt, 2017). The chapter concludes by identifying the conditions that support the development of LNSSs by the four Technology teachers in the participating Gauteng Full ICT schools.

Chapter Eight: Contributions of the Study and Conclusions

In the last chapter, the theory applied to examine the development of LNSSs in the Gauteng Full ICT schools is reviewed against the study's findings to highlight the study's contribution to the field of ICT in the South African education context. The chapter also highlights the study's limitations and concludes by making recommendations for further study.

2 Chapter Two: The Development of Learner Network Society Skills in the Gauteng Full ICT Schools

2.1 Introduction

The desired impact of ICTs on people, especially in the education system, is dependent on the worldwide ability of the human mind to utilise the 'click option', in that the Internet gives access to vast amounts of information and opens lines of communication and collaboration to address human needs and contribute positively to the global community. Hence, Battro (2004) proclaims that without the utilisation of the Internet, it would be difficult to reach the current level of globalisation in our societies. This is made possible by the quality of the information accessed and how it is used to facilitate discussions, decision-making, innovation, creativity and critical thinking skills by providing opportunities for collaborative learning and teamwork to meet people's needs and wants by developing practical solutions to real-problems identified (Department of Basic Education, 2011). For teachers utilising ICTs in their classrooms, the affordances are vast (Battro, 2004). This is made possible by the Internet, which is an integral part of the processes of globalisation and education. Globalisation, which will be expounded on later in this chapter, refers to the emergence of the networked society and worldwide economy associated with the rise of the information society after the 1960s. It has expanded human collaboration locally, nationally and internationally to produce the products or services that contribute positively to the quality of human life (Carnoy & Castells, 2001; Battro, 2004).

According to the Department of Basic Education (2004, p.10), the desired quality of human life could be realised through the utilisation of ICTs as an effective tool for social and economic development, as well as moving away from teacher-centred and content recall-oriented tasks to pedagogical approaches "…where learners work collaboratively, develop shared practices, engage in meaningful contexts and develop creative thinking and problem solving skills" (Department of Basic Education, 2004, p.16). The aim of the current study was to investigate teaching Grade 8 Technology in Gauteng Full ICT schools to establish how the subject's teaching and learning activities create opportunities for learners to utilise the available ICT resources to develop the desired skills and increase their chances of thriving in the global economy.

My preliminary search for literature started with network society skills to help me gain insight into what constitutes these skills. It then examined studies conducted on the utilisation of ICTs for teaching and learning in the South African context to have a sense of the studies conducted and determine the relevance of the current study's focus. I then proceeded to review three South African education policies, namely, the White Paper on e-Education (Department of Basic Education, 2004), the Technology Curriculum and Assessment Policy Statement: Senior Phase (Department of Basic Education, 2011) and the Professional Development Framework for Digital Learning (Department of Basic Education, 2017). These should inform teaching and learning activities promoting the use of ICTs. However, a lack of guidance from these policies in designing teaching and learning activities that promote the acquisition of LNSSs compelled me to extend my search for relevant policies from other African countries: Rwanda and Kenya (RMOE, 2015a; KMOE, 2017, 2018). As indicated in Chapter One, these African countries were also found wanting in this area.

As a result of the lack of relevant literature, particularly in the field of the development of LNSSs in South Africa, the scope of the literature search was expanded to encompass the learning theory of the digital age, namely Connectivist Learning. Although Siemens' (2005) eight principles of Connectivist Learning may not necessarily be suitable for Grade 8 learners in the South African context in that they require independent learning, particularly students at the university level, it is crucial in that it is the learning theory of the digital age. As a result, the current study customised it to the South African context by incorporating three pedagogical approaches to facilitate guided learning that promote the acquisition of the desired skills: Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types. Considering these teaching and learning strategies will guide the utilisation of the available ICT resources in the development of LNSSs in the South African context. Hence, in this thesis, I will refer to Guided Blended Connectivist Learning (GBCL) even though I am fully aware of Siemens' (2005) intentions with Connectivist Learning.

Figure 2.1 below summarises the aspects covered in this chapter.

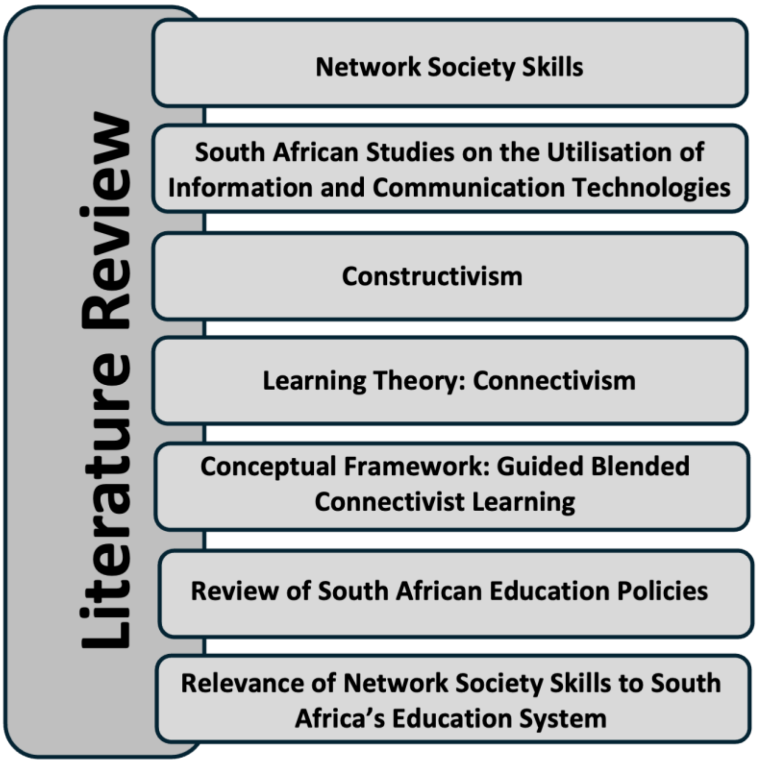


Figure 2.1: Literature Review Focus

Source: Author's construct

2.2 Literature Review and Conceptual Framework

Main Research Question

How does teaching Grade 8 Technology in Gauteng Full ICT schools create opportunities for learners to utilise the available ICT resources to acquire the LNSSs?

Research Sub-Questions

1. What are the teachers' espoused practices in the development of LNSSs?
2. How do teachers **plan** for learner utilisation of ICT resources to develop LNSSs to solve real-life problems?
3. How do teachers **utilise** ICT resources to develop LNSSs?
4. What **conditions promote** the teachers' enactment of their espoused practices to promote **the acquisition of LNSSs** and realise the goals of education policies?

Chapter One highlighted the purpose of introducing Technology as a subject, as depicted in the CAPS document (Department of Basic Education, 2011). Accordingly, there is a need to gain insight into how the subject should be taught to achieve the curriculum goals using ICTs. The next section provides this insight.

2.2.1 Technology as a Subject

Technology is defined as “the use of knowledge, skills, values and resources to meet people’s needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration” (Department of Basic Education, 2011, p.8). The subject is aimed at developing learners’ technological literacy by creating opportunities for learners to develop and apply specific design skills to solve technological problems under four themes, namely: “structures, processing of materials, mechanical systems and control, and electrical systems and control” (Department of Basic Education, 2011, p.10).

To realise this aim, teaching and learning activities should create opportunities for learners “to solve problems in creative ways, use authentic contexts rooted in real situations outside the classroom, combine thinking and doing in a way that links abstract concepts to concrete understanding, evaluate existing products and processes including their own products, use and engage with knowledge in a meaningful way, deal with inclusivity, human rights, social and environmental issues in their tasks, use a variety of life skills in authentic contexts, such as decision-making, critical and creative thinking, cooperation, problem-solving and needs identification. In addition, while creating positive attitudes, perceptions and aspirations towards technology-based careers, opportunities need to be created for learners to work collaboratively with others through practical projects using a variety of technological skills such as investigating, designing, making, evaluating and communicating” (Department of Basic Education, 2011, p.9-10). Importantly, these opportunities should suit different learning styles.

Accordingly, teachers are required to design teaching and learning activities that would enable learners to apply the knowledge and skills acquired to design and create a solution to the identified technological problem. The starting point is exposing learners to a problem or need in a real-life situation. “The Design Process (Investigate, Design, Make, Evaluate, Communicate – IDMEC) forms the backbone of the subject and should be used to structure the delivery of all learning aims” (Department of Basic Education, 2011, p.12). Importantly, although the acquisition of content knowledge is essential in the context of the themes indicated earlier in this section, it should not be the most important part. Instead, opportunities should be created for learners to apply the knowledge and skills acquired to solve real-life problems, rectify design issues and address human needs (Ankiewicz, 1995; Reddy et al., 2003; Department of Basic Education, 2011; Ankiewicz, 2013).

However, Dede (2010) and Waghid et al. (2019) caution against the traditional instructional approach of transferring content knowledge from a teacher to a learner. They argue that such approaches do not optimally draw on the full power of ICT resources to equip learners with the requisite skills. Instead, using ICT resources in schools should promote teaching and learning strategies that advance the development of LNSSs rather than on the learner pass percentage based on content mastery (Ally, 2019; Janak, 2019; Du Toit, 2020). In other words, throughout the design process, learners need to use ICT resources to communicate and collaborate with others to solve real-life problems. In addition, various learning approaches should be employed to accommodate different learning contexts and styles.

The following section expands on the Technology design process in the context of teaching and learning activities that employ collaborative and project-based learning, as envisaged by the Technology curriculum goals (Department of Basic Education, 2011).

2.2.2 Collaborative Problem-Based Learning

Laurillard's (2012) Conversational Framework capitalises on problem-based learning and collaborative learning as essential in the acquisition of content knowledge and LNSSs, as well as the development of problem-solving skills. This would facilitate the attainment of the policy outcomes (Department of Basic Education, 2011), which include working collaboratively with others through practical projects using various technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles. In addition, the Department of Basic Education (2017) also advances learning strategies that address real-life issues through collaboration among learners locally and globally. The how part is expounded in the following sections.

Collaborative Learning

Salim et al. (2019) describe collaborative learning as a learner-centred approach, wherein a small group of learners work together under specific conditions laid down by the teacher to accomplish a task and enhance their and each other's learning. In other words, collaborative learning is a learning environment designed to enable learners to purposefully work together to maximise one another's performance. The prerequisites for bringing out the best in learners include designing activities and setting standards that promote constructive interdependence and interaction to achieve the desired results (Opdecam & Everaert, 2018; Hussien, 2020).

Problem-Based Learning

Problem-based learning is described as a teaching strategy that uses an existing problem as a starting point of the learning process wherein the problem presented to the learners affords them the opportunity to take the lead in the process of finding the solution to the problem while acquiring knowledge and learning at the same time (Da Silva et al., 2017; Bruna et al., 2019). In other words, for learners to decide on a solution to the problem identified, they need to understand the problem and identify the information they require to solve the problem, as well as the approaches to solve it. In that way, they learn by solving the problem (Purnamasari et al., 2018).

From these descriptions, it is evident that the learner is placed at the centre of learning through exploration, analysis and assimilation of information (Bruna et al., 2019). Accordingly, teaching Technology should create opportunities for learners to identify the problem, use the Internet to discover the relevant information, communicate and collaborate to share ideas and use these to plan, design, create and evaluate the solution to the identified problem in the real-life situation (Ankiewicz, 1995; Reddy et al., 2003; Department of Basic Education, 2011; Ankiewicz, 2013; Janak, 2019; Du Toit, 2020). As a result, teachers should design teaching and learning activities that expose learners to the Blended Technological Design Process (BTDP), illustrated in Figure 2.2.

Figure 2.2: The Blended Technological Design Process

Source: Author's construct

Problem Identification

Problem identification requires teachers to expose learners to a real problem that is related to any of the four themes in Technology. Bruna et al. (2019) suggest various ways the problem could be presented discursively in the classroom to establish interest in the acquisition of the knowledge required to solve the problem. These include the utilisation of technological affordances, such as a video and pictures depicting the site where the problem is experienced. This requires the teacher to thoroughly prepare authentic material for problem identification rather than artificial material obtained from textbooks (Da Silva et al., 2017; Purnamasari et al., 2018; Bruna et al., 2019).

Research

According to Anderson and Krathwohl (2001), this step requires teachers to provide step-by-step guidance for learners to use the Internet to find relevant information to promote their understanding of concepts. This means teachers have to design teaching and learning activities that enable learners to conduct web searches to find, choose, show and communicate the information gathered to solve the problem identified (Anderson & Krathwohl, 2001; Laurillard, 2012; Laurillard & Kennedy, 2017). As they do, they communicate and collaborate to find solutions to solve the real-life problem identified.

Communication and Collaboration

To make sense of the information gathered, the teacher should facilitate communication and collaboration among learners using social media (Neo et al., 2013). This should be a platform for learners to deepen the knowledge and skills acquired discursively in the classroom by building ideas and concepts together experientially outside the classroom to reinforce their knowledge construction process and promote deep learning (Neo et al., 2013; Opdecam & Everaert, 2018; Hussien, 2020). The prerequisites for bringing out the best in learners include designing activities and setting standards that promote positive interdependence, individual accountability, promotive interaction, social skills and group processing (Opdecam & Everaert, 2018; Hussien, 2020).

Throughout the collaborative process, the teacher is required to motivate learners by providing feedback in class and asynchronously through online engagements. Furthermore, the learning process should be monitored on the blogs created through ongoing assessment and evaluation of the learners' progress throughout the different stages of the technological process (Neo et al., 2013). This will facilitate reflective learner engagements, which promote teamwork and the acquisition of higher-order thinking skills such as critiquing, comparing, judging, negotiating, inferring, decision-making and problem-solving (Churches, 2008; Opdecam & Everaert, 2018; Salim et al., 2019; Hussien, 2020).

Importantly, **collaboration** requires teachers to establish Open Education Resources (OERs) that contain teaching, learning and research material presented in any form and medium to promote sharing digital outputs at no cost (Anderson, 2009; Downes, 2012; Belshaw, 2013). They are, therefore, able to identify artefacts they can use to create desired artefacts.

Learning Artefact Creation

Learning artefact creation leverages the digital material in OERs for the creation and presentation of new ideas, solutions, theories, products and models (Downes, 2012; Wang et al., 2014). According to Neo et al. (2013), using OERs enables learners to transfer their innovative ideas from paper to online platforms. As a result, learners are afforded the opportunity to present the knowledge and skills acquired during project development in a visually appealing manner and keep a record of the learning artefacts.

The artefacts created could be in the form of drawings, objects, models or anything that is built by learners through remixing, modification and repurposing within the network to produce something new or adjust it to address the problem identified (Anderson, 2009; Downes, 2012; Laurillard, 2012; Belshaw, 2013; Laurillard & Kennedy, 2017). To facilitate this, the teacher is required to use multimedia content, digital design and production tools available on the Internet to design a learning environment that will promote the acquisition of the desired skills and the eventual attainment of the Technology learning outcomes (Neo et al., 2013).

Evaluation

To determine if the learning artefacts created provide a solution to the problem identified, learners should present their reports and defend their proposed solutions (Ankiewicz, 2013; Da Silva et al., 2017; Bruno et al., 2019; Euefueno, 2019). In the context of GBCL, the teacher should provide a reporting template to guide learners in the process of demonstrating what they have learnt during project-based learning. According to Ankiewicz (2013), Da Silva et al. (2017), Bruno et al. (2019) and Euefueno (2019), the reporting template could include main headings: description of the problem, project brief, research conducted and findings, description of the plans and designs to solve the problem, development of the product and evaluation of the product.

Guided reporting at the end of the project affords learners an opportunity to integrate theory, practice, reflection and decision-making. At the same time, defending proposed solutions to the peers in the classroom, as well as online to the problem initiator sponsoring the project, equips learners with the necessary communication and persuasive skills required in the world of work (Neo et al., 2013; Da Silva et al., 2017; Euefueno, 2019).

Although Da Silva et al. (2017) and Bruna et al. (2019) emphasise exposing learners to solutions that could be applied in the real world, it is worth highlighting at this point that the GBCL Framework's emphasis is not to solve the problem in the real world per se but to learn from it. Euefueno (2019) argues that teaching Technology focuses on the development of prototypes and not the real product that could be applied in the real-life situation.

Considering these learning strategies that underpin the attainment of LNSSs and the learning outcomes in teaching Technology, this study delved into literature to gain insight into how teachers utilise available ICT resources when teaching the subject. The literature reviewed revealed that teachers understand the desired outcome of offering technology as a subject, namely, producing engineers, technicians and artisans required in modern society and contributing positively to the development of the country and the global economy (Gumbo & Williams, 2014). However, the findings highlighted several red flags that hamper the development of LNSSs, as depicted in the following section.

2.2.3 Challenges in Teaching Technology

One of the main findings is that there is a discrepancy between the main purpose of introducing Technology Education into the South African curriculum and implementation at the school level. For example, the curriculum stipulates using an approved textbook, a 72-page A4 workbook or exercise book and drawing instruments, such as pencils, erasers, a ruler and set squares (Department of Basic Education, 2011). As a result, the teachers' main resource for teaching and learning is the textbook (Gumbo & Williams, 2014; Mapotse, 2015). This indicates a lack of alignment between the intended curriculum and the curriculum's content (Du Toit, 2020).

The studies conducted by Khoza (2015) and Mapotse (2015, 2017) on Technology Education corroborate the above. They reveal that some teachers in Limpopo, Gauteng and KwaZulu-Natal have not embraced the utilisation of ICTs in teaching this subject. These teachers confined their teaching and learning to the traditional face-to-face model and were complaining about the absence of physical laboratories and workshops to conduct practical tasks. Furthermore, the studies revealed that many Technology teachers preferred to be provided with scripted lesson plans and obtain the content to be taught in class from textbooks. Basically, teaching Technology Education meant following instructions from the CAPS document (Department of Basic Education, 2011) and slavishly adhering to the content in the textbooks. Such classroom practices do not create opportunities for learners to acquire LNSSs (Mapotse, 2015, 2017; Khoza, 2015).

Rwodzi and de Jager (2021, p.62) corroborate, positing that "For the most part, some teachers are not pedagogically capacitated to teach their respective subjects using technology in South Africa." Of great concern, many learners do not have direct access to the required ICT resources in their classrooms. In cases where these resources are available, it is mainly for the teacher (Gumbo & Williams, 2014; Ndlovu, 2015).

The assumption made by Mapotse (2015, 2017), Khoza (2015) and Mbatha (2020) is that the use of technology is the only means of providing teaching and learning activities to achieve educational outcomes. Bates (2019) refutes this, arguing that as teachers strive to utilise the available ICT resources, the contextual factors associated with the teachers' and the learners' backgrounds and practices, and the infrastructure need to be taken into consideration (Fawns, 2019). This means pedagogy should not only be informed by existing methods and technology. Instead, it should be influenced by the aims, background and values of learners, teachers and other relevant stakeholders (Fawns, 2022).

In addition, when teaching Technology Education to solve the problem identified, Mapotse (2014, 2017) asserts that the teacher's main goal is the finished product. The design process is not considered that important in teaching the subject as teachers do not monitor and support the how part in the creation of the product outside the classroom. In other words, the acquisition of skills in the process of investigating, planning, communicating, collaborating, designing, making and evaluating the product is not important (Mapotse, 2014, 2017). As a matter of concern, learners use the material readily available from their surroundings to create the products.

Furthermore, due to time constraints and the requirement to complete the syllabus, as per the CAPS document (Department of Basic Education, 2011), the focus during teaching and learning activities is on content acquisition to prepare learners for the final year-end examinations (Gumbo & Williams, 2014; Mapotse, 2014). Lastly, the Technology curriculum does not provide the standard ICT skills learners should acquire as they engage in the aforementioned technological process to solve the problem identified. Gumbo and Williams (2014) and Janak (2019) corroborate this finding, arguing that the Technology curriculum provides minimal guidance and creates room for different interpretations by teachers, leaving no room for standardised implementation across the country.

These challenges could be attributed to the lack of guidance in the Technology CAPS document (Department of Basic Education, 2011) on the ICT skills learners should acquire in teaching the subject. As a result, there is a need to first understand what constitutes these skills (LNSSs). This will serve as a lens to establish the link between the concepts used in the conceptual framework and the development of these skills. The following section defines these skills by explaining their components: the network society and the skills required to operate in this society.

2.2.4 Network Society Skills

Network Society

Firstly, a network society is a community (of individuals and or organisations) whose structure is made of interconnected nodes powered by the Internet to share information anytime and anywhere to serve different purposes (Castells, 2004). These interconnected nodes are described by Monge and Contractor (2003, p.39) as "…the patterns of contact that are created by flows of messages among communicators through time and space". In other words, a network society expands communication and collaboration among people in the global world. Steger (2003) supports this notion, acknowledging the role ICTs have played in expanding the forms of human contact and collaboration among governments, businesses and people worldwide.

According to Castells (1999), such widespread collaborative networks facilitate the establishment of economic, social and political relationships worldwide. The vital tool of the network society is the Internet. In other words, to operate successfully in a network society and achieve network goals, one needs to acquire internet skills. These are expounded in the next section.

Internet Skills

Van Deursen (2010) argues that having internet skills should not be confined to the ability to read and write using ICT devices. Instead, such skills should also include engagement with programmes and communication and collaboration with people, as well as making informed decisions to achieve a specific goal.

This means internet skills call for more interaction than merely using the available multimedia content to enhance the understanding of concepts. In other words, over and above the ability to operate ICT devices to access information, other skills are also required to use the information provided to realise the network society's goals (Castells, 2004). Table 2.1 summarises the skills required to engage with ICTs, communicate and collaborate with people and make informed decisions to achieve a specific goal.

Table 2.1: Internet Skills

Internet Skills	Description
Tool Literacy	The ability to recall and operate Information and Communication Technologies (ICTs) to collect, organise, analyse, store, retrieve, process, transmit, present, communicate and collaborate.
Resource and Research Literacy	The ability to understand the procedure to access online learning platforms that connect learners to social networks, as well as use ICT tools (e.g., multimedia content, Google, etc.) to promote the understanding of concepts.
Social Structural Literacy	The ability to understand how to locate, communicate and collaborate in social networks to produce the desired information.
Publishing	The ability to arrange and produce ideas electronically in multimedia forms to achieve the desired goal.
Emerging Technology Literacy	The ability to try out and adopt new innovations in information technology through informed decision
Critical Literacy	The ability to evaluate human, social and intellectual strengths and weaknesses, as well as the advantages and disadvantages of the available ICT resources.

Source: Adapted from Shapiro and Hughes, 1996 in Van Deursen, 2010

These skills (Table 2.1) would be pertinent if learners use the Internet purposefully to interact with knowledge, peers and experts as they tackle their tasks in the classroom and online. The environment would thus promote a social space where all learners can draw from multiple sources and be able to construct new knowledge while acquiring the desired internet skills in the process. Accordingly, internet skills, henceforth referred to as LNSSs, are not confined to utilising the available ICT resources for content acquisition. Instead, such skills also include communication and collaboration, as well as making informed decisions, to realise the intended purpose of participating in networked societies.

In the main, they include the ability to identify potential sources of information from the Internet, develop search strategies, access and process relevant information, evaluate information, manage information, organise and reorganise information for practical applications, select optimal tools for the task, generate knowledge and utilise it to produce the products or services that would contribute positively to the economy and the quality of human life (Steger, 2003; Castells, 2004; Van Deursen, 2010; Wilson & Scalise, 2015; Muller et al., 2016). Such skills are essential to deliver quality education that promotes the use of ICTs for social development and economic growth (Department of Basic Education, 2004). This means network society skills call for more interaction than merely using the available multimedia content to enhance the understanding of concepts.

Importantly, the noun 'learner' prefaces network society skills to accentuate the need for pedagogical practices that promote active learner participation to develop these skills.

Before delving deeper into the literature reviewed on the development of LNSSs, it is prudent to provide an overview of the studies conducted in South Africa that focus on using ICTs for teaching and learning to achieve curriculum goals. This assisted in determining the study's relevance, as well as the appropriate learning strategies required to develop LNSSs in the South African schooling context.

2.2.5 South African Studies on the Utilisation of Information and Communication Technologies for Teaching and Learning

Teacher Utilisation of Information and Communication Technologies

In South Africa, multiple studies explore the utilisation of ICTs to enhance the quality of teaching and learning in the classroom (Ndlovu, 2015; Mukhari, 2016; Dlamini & Mbatha, 2018; Mlotshwa, 2019; Ndlovu & Meyer, 2019; Mbatha, 2020). Although this is the case, each study has a unique pivotal point that contributes to understanding how and why teachers use ICTs in the classroom.

Ndlovu (2015) focused on understanding the pedagogical value of using ICTs in South African classrooms. Mukhari (2016) proceeded to investigate the teachers' experiences in utilising ICTs for teaching and learning in the classroom. While Mlotshwa (2019) investigated the actual utilisation of ICTs in improving teacher practices to enhance teaching and learning, Ndlovu and Meyer (2019) established teacher readiness to utilise ICTs in the delivery of subject content. Examining these studies revealed that they revolve around exploring the effective utilisation of ICTs during teaching and learning activities to promote content acquisition.

Notably, Mhlongo et al. (2023) highlight four themes that extend active learner participation in using ICTs in the traditional classroom to online activities synchronously and asynchronously. Although there is an indication that the Internet is used during teaching and learning activities, similarly, their study does not contribute to understanding how Technology teachers could utilise the available ICT resources to promote the acquisition of the LNSSs.

On the other hand, Kizito (2016) focused on the learning activity design that supports technologically enhanced collaboration and network formation to stimulate meaningful dialogue learning in connectivist environments. Although her study focuses on Siemens' (2005) connectivism, the learning of the digital age, it is not wholly suitable for teaching and learning in the South African context, particularly Grade 8 learners in Gauteng Full ICT schools. Laurillard and Kennedy (2017, p.12) argue that "…children need the social and emotional interaction with teacher and peers that physical schools provide".

It is worth highlighting at this point the experiences of teachers in Gauteng during and post the COVID-19 pandemic. Rwodzi and de Jager (2021) conducted a study to understand the utilisation of ICT resources and the pedagogies employed in teaching English outside the traditional face-to-face classroom setting. The study targeted secondary township schools with limited ICT resources. The findings revealed that teachers embarked on an initiative to use technology due to COVID-19 lockdown restrictions. This translated into teachers creating opportunities for communication and collaboration using the available ICT resources to assist learners in attaining the learning outcomes in English. As a result, teachers in these schools created social media groups with their learners. They designed teaching and learning activities that facilitated discussions and debates on various topics. This involved teamwork, which was facilitated through online platforms such as WhatsApp, Twitter, Facebook and Instagram. In addition, the activities on these platforms included sharing past examination question papers, written texts from different social media platforms and emojis, as well as the use of other multimedia content, such as pictures, audio and video, to promote the understanding of concepts. Importantly, the platforms were used to discuss homework, respond to questions, share experiences and provide guidelines on completing tasks.

The reviewed studies provide evidence that there are pockets of excellence in Gauteng schools promoting the development of LNSSs. However, the major challenge with this model of learning is the lack of consideration for learners from previously disadvantaged communities. These learners may not have access to ICT resources for participation in online teaching and learning activities outside the classroom. This heightens the relevance of blended learning as a teaching and learning strategy to accommodate resource-constrained environments to help learners achieve learning outcomes (Bates, 2019; Fawns, 2019, 2022).

Blended learning, to accommodate the utilisation of ICT resources in the South African context, will be expounded later in this chapter. In their conclusion, Rwodzi and de Jager (2021) recommend the development of a teacher development framework that provides clear guidelines on the utilisation of ICT resources that promote learning through communication, collaboration, networking, texting and group chats to institutionalise the e-Education mandates and attain the desired learning outcomes.

Although there are pockets of excellence in Gauteng schools in using ICTs for teaching and learning, many studies highlight challenges constraining the appropriate utilisation of the available ICT resources. The next section delves into these challenges to determine the root causes of the impediments to realising curriculum goals by using ICTs.

Challenges Constraining Teacher Utilisation of ICTs

Several studies focused on internal and external factors in the schooling system that have an impact on the utilisation of ICTs, including inadequate teacher training, lack of skills, lack of control over learner devices, lack of data and connectivity, general state of the infrastructure, teacher characteristics, educational practices, technical support, limited access to ICT infrastructure and the digital divide in Quintile 1 schools (Dlamini & Mbatha, 2018; Makwela, 2019; Mbatha, 2020; Minty, 2020; Mhlanga & Moloi, 2020; Msiza et al., 2020; Chisango & Marongwe, 2021; Masango et al., 2022; Dlamini, 2022; Mhlongo et al., 2023; Mokate, 2023).

In the main, these challenges revolve around teacher training, ICT infrastructure and post training support.

Teacher Training

Studies found training provided in Gauteng Full ICT schools is inadequate. The reasons advanced are that it was a one-week generic training and focused more on operating the devices to access information and presenting this in PowerPoint Presentations for curriculum and content coverage rather than preparing learners to participate meaningfully in the global community (Minty, 2020; Msiza et al., 2020; Dlamini, 2022; Masango et al., 2022; Mokate, 2023). Padayachee's (2017) study, which aimed to determine the extent of ICT usage in South African schools, corroborates the impact of the training provided. The study revealed that teacher utilisation of the available ICT resources to access information for curriculum delivery was 41%, while sharing information and using experiential tools and reflective dialogue was 29%, 26% and 18%, respectively.

Although Mhlanga and Moloi (2020) argue that the South African education system generally has some elements of excellence in the utilisation of ICTs, this points specifically to higher education institutions. In the basic education sector, the utilisation of available ICT resources remains at curriculum and content coverage due to the training provided, for example, using the DBE and GDE websites, social media recorded lessons and live TV broadcast lessons on Channel 318 and 317 (local satellite television).

Accordingly, Dlamini (2022, p.35) recommends teacher training to include:

> "Using ICT for learning, selection of ICT resources for teaching, use of ICT for assessment, knowledge and understanding of using ICTs in specific contexts, technological pedagogical knowledge, use of ICT for administrative purposes, use of ICT for teaching, use of ICT for repository tools, ICT integration in the classroom and the development of ICT skills in a particular context."

However, these recommendations for teacher training do not guarantee the efficient utilisation of ICT skills essential in developing LNSSs and delivering quality education that promotes social development and economic growth. For example, the study conducted by Mbatha (2020) reveals a discrepancy between the ICT skills acquired during training and what teachers implement in the classroom. As a result, the study concludes that ICT training does not necessarily translate into ICT integration in the classroom.

Instead, to promote the application of the knowledge and skills acquired during training in the classroom and online, there is a need to identify dependencies in the return on investment in the training provided. The next section identifies these dependencies.

ICT Infrastructure

Padayachee (2017), Mhlanga and Moloi (2020) and Mokate (2023) identified poor ICT infrastructure as the main reason for lower utilisation. This includes lack of learner access to the Internet and poor connectivity. In addition, the general state of infrastructure, which could be attributed to lack of maintenance, theft and vandalism, is a major impediment to the development of LNSSs (Chigona & Chigona, 2010; Mpehle, 2011; Minty & Pather, 2014; Gauteng Department of Education, 2015).

Post-Training Support

According to Msiza et al. (2020), school management teams and teachers cited inadequate onsite support to promote the institutionalisation of the knowledge and skills acquired during the training. The ICT experts allocated to schools are overloaded in that each is responsible for five or more schools for technical support. This means teaching and learning are compromised due to the lack due to the lack of immediate assistance with technical glitches.

If left unattended, teachers will likely resort to traditional pedagogical practices. Thus, curriculum goals would not be achieved through ICTs as envisaged by the basic education sector (Department of Basic Education, 2011).

Considering these challenges, the next section focuses on the learning theories that could facilitate the development of LNSSs and, in the process, promote the attainment of the curriculum goals. The starting point is constructivism. This is an overarching learning theory that could leverage the development of the desired skills since it advances active learner participation in the learning situation. Thereafter, the Constructivist Learning theories that promote the acquisition of the desired ICT skills in the South African context are considered. The point of departure is connectivism, the learning theory of the digital age, followed by the learning theories accommodating guided learning in the schooling sector.

2.2.6 Learning Theories

Constructivism

The crux of constructivism is that knowledge is constructed as individual learners are actively involved in their environment and participate in social activities. Piaget (1976) corroborates this, arguing that learning is neither characterised by observable behaviour nor inborn thinking processes; instead, it is influenced by an individual's ongoing interaction with societal structures. From this theory, von Glasersfeld (1984), Jaworski (1994) and Yilmaz (2011) conclude that learners are not passive in a learning environment.

Instead, they are actively involved in the process of knowledge acquisition through exploration, assimilation and adaptation of their world to understand it. Although they all support the notion that learners construct their own knowledge, Jaworski (1994) and Yilmaz (2011) highlight the difference between von Glasersfeld's Radical Constructivism (1984) and Vygotsky's Social Constructivism (1987) as contexts of knowledge acquisition. The former proclaims that knowledge is constructed entirely in the individual's thoughts through interaction with his/her external world. While the latter posits that all learning occurs socially through interaction with knowledgeable others. This is facilitated by the utilisation of cultural tools like objects, language and social institutions, which construct thinking. Hence, Vygotsky (1987) argued that an individual first learns in the social context and subsequently utilises the knowledge to further understand the concepts on an individual level (Jaworski, 1994; Moll, 2021).

In the context of teaching and learning, when children learn, they first receive guidance from a knowledgeable other. This could be a teacher or a peer. From there, they internalise the understandings of the knowledgeable other and make them their own. To facilitate learning in the social context, the focus areas in Vygotsky's (1987) theories of learning include scaffolding and the zone of proximal development.

Scaffolding

Scaffolding is the process of controlling activities that are beyond the learners' capabilities to enable them to focus on and grasp those elements of the activities that they could master quickly (Bruna et al., 2004 in Schunk, 2012). According to Bandura (1986 in Schunk, 2012), the scaffolding technique requires the teacher to initially model the skill to be acquired, provide support and slowly reduce it as learners steadily acquire the skill. In other words, scaffolding promotes the understanding of concepts, as well as the acquisition of skills, through guided learning by the knowledgeable other. This could include using ICT resources, templates and manageable step-by-step instructions. As the learners demonstrate an understanding of concepts and competence to utilise ICT resources, the teacher gradually withdraws the support so that learners perform tasks independently (Campione et al., 1984 in Schunk, 2012; Moll, 2021). This can easily be achieved by using social networks facilitated by the Internet. Furthermore, there needs to be evidence of the acquisition of skills, and the zone of proximal development assists in that regard.

Zone of Proximal Development

Vygotsky (1987, p.187) describes the zone of proximal development as “the discrepancy between a child’s actual mental age and the level he reaches in solving problems with assistance...”. In other words, it is the distance between the child’s ability to complete a task with guidance and support from the knowledgeable other and the capacity to complete the task without any assistance. Put differently, it is the space during which new understandings can be constructed for the learner, and the teacher must locate himself/herself in that space (Bod, 2018; Moll, 2021).

Both Jaworski (1994) and Yilmaz (2011) further expand the understanding of the zone of proximal development by asserting that concepts are not readily understood by learners, as it takes time for a child to fully operate at an abstract level. As a result, concepts go through noteworthy stages of development, depending on the children’s ability to comprehend the adult’s language. They both proclaim that the more competent must guide the less competent to reach levels from which to think more abstractly about the nature of things. In other words, the zone of proximal development propagates for a learning environment that matches the learner’s level of development.

Based on this, the constructivists argue that in the learning situation, learners should not be passive recipients of knowledge. Instead, they should be active participants in the construction of their own knowledge. As a result, teaching and learning activities should be designed accordingly (Moll, 2021), creating learning environments where it is easy for the teacher to detect the acquisition of LNSSs in Technology, the subject under study.

Connectivism

Over the last two decades, the way people learn, live and communicate has been influenced by technology. Therefore, there is a need for learning theories to be aligned to the digital age as the principles and methodologies of learning should be contextualised to the prevailing social setting (Siemens, 2005). Connectivism is acknowledged by many scholars as a new way of actualising learning in the digital world (Siemens, 2005; Downes, 2007; Boitshwarelo, 2011; Wang et al., 2014, 2017; Kizito, 2016). As a result, the current study adopted connectivism as the main learning theory to understand how teachers could equip learners with LNSSs.

Connectivism is defined as the learning theory of the digital age, wherein knowledge flows through connections between information sources such as individuals, groups, communities and non-human resources (Siemens, 2005; Kizito, 2016; Shrivastava, 2018). One of the theory's fundamental assumptions is that knowledge is scattered and can be located externally from individuals. In other words, Connectivist Learning advances teaching and learning through the Internet and social media. It is associated with the utilisation of ICT devices and the networked society. Learners are required to be able to use various technologies and learn in complex, information-loaded environments through self-regulation, orientation and pattern recognition (Moll, 2012; Littlejohn, 2013; Wang et al., 2014). That means Connectivist Learning calls for building and maintaining networks that connect individuals to other humans and non-human appliances (Siemens, 2005; Bell, 2011). According to Moll (2012), the digital age in which we live, characterised by computers, mobile telephones, television, satellite technology, etc., has serious implications for teaching and learning. The way in which these technologies are connected to each other creates opportunities for innovative ways to present and communicate information.

Furthermore, since modern-age computers are connected to each other in a network, they easily encourage collaborative ways of learning. Implicitly, learners are required to independently build their personal learning environment using different media, particularly social media. Siemens (2011, p.157) supports this notion, pointing out that "social interactions are vital to how participants made sense of course content and how they orient themselves spatially". Hence, network society skills as knowledge reside in networks of social and technological devices (Dowdy, 2010; Moll, 2012).

Kizito (2016) argues that knowledge acquisition in connectivism differs from Piaget's (1976) constructivism, which propagates that knowledge is constructed by the learner. However, the information gathered by the learner through human and non-human resources still needs to be internalised by the learner for one to say learning has taken place. Without the learner actively getting involved, one may not say the desired outcome for teaching and learning has taken place. Siemens (2005) supports this notion, defining learning in connectivism as actionable knowledge by a learner by connecting with specialised databases and people to learn and know more.

On the other hand, what sets connectivism apart from the preceding learning theories is that it moves from the premise that,

> "Decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognise when new information alters the landscape based on decisions made yesterday is also critical." (Siemens, 2005, p.5)

Based on this, "knowledge is therefore not a set of facts, but rather a learner's ability to learn, unlearn, and relearn information quickly and be able to apply that new knowledge in an ever-changing information landscape" (Utecht & Kellar, 2019, p.108). Shrivastava (2018) supports this notion, arguing that decisions made at some point should not be static because of rapidly changing foundations informing decisions.

To entrench Connectivist Learning, Siemens (2005) advances eight principles that promote the ability to construct knowledge by moving across different networks: learning and knowledge rests in the diversity of options; learning is a process of connecting specialised nodes or information sources; learning may reside in non-human appliances; capacity to know more is more critical than what is currently known; nurturing and maintaining connections is needed to facilitate continual learning; ability to see connections between fields, ideas, and concepts is a core skill; currency (accurate, up-to-date knowledge) is the intent of all Connectivist Learning activities; and decision-making is itself a learning process. The question is: How do teachers in a classroom ensure learners coming from diverse backgrounds (some with no exposure to technology and the Internet) are able to behave as above? Otherwise, intentional planning and implementation of learning environments that develop these capabilities with and through the use of technology would be critical.

Planning for Connectivist Learner Utilisation of ICT Resources

According to Kizito (2016), these connectivist principles suggest new roles for the teacher, including assisting each learner in building and making connections in their learning networks, directing learners to appropriate resources and other experts and creating experiences that promote continual learning. Table 2.2 depicts the implications for teachers when designing learning activities that would promote Connectivist Learning and the eventual attainment of the LNSSs.

Intentional inclusion of the ideas in the second column (Table 2.2) can help create opportunities where LNSSs can be developed. In such a case, the teacher's plan for using technology for teaching and learning is driven by the desire to achieve a particular learning outcome. Thus, the principal assists in making decisions on the technology and activities for learners. The next section expands on Siemens' (2011) four levels of interaction to promote the application of these principles.

Table 2.2: Principles of Connectivism

Principles of Connectivism	Implications for Learning Activities
1. Learning and knowledge rests in a diversity of opinions 2. Learning is a process of connecting specialised nodes or information sources	Provide multiple nodes of connection and points for learners. This should translate into learning activities that: ● Facilitate various connection points for learners to enable them to explore the area of study from different angles
3. Learning may reside in non-human appliances 4. Capacity to know more is more critical than what is currently known 5. Ability to see connections between fields, ideas and concepts is a core skill	Support the interactive acquisition of knowledge; this would be evident when: ● Activities allow learners to use multiple sources of information to come up with a solution to the identified problem ● There is no restriction on information gathering; the information sources could be people, journals, books, articles, databases, social networks, etc.
6. Nurturing and maintaining connections is needed to facilitate continual learning 7. Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities	Involve current topics and clearly indicate pathways for deepening the knowledge in future. This would be evident when: ● Activities given to learners focus on the outputs rather than knowledge acquisition ● Topics given to learners are relevant to the present situation ● Activities provided to learners are aimed at developing competencies that could be applied to the identified problem
8. Decision-making itself is a learning process; choosing what to learn and the meaning of incoming information…. affecting the decision	Allow learners to make their own decisions and choose their learning path; this would be evident when: ● Learners choose what to learn and understand that the knowledge gained is dynamic. As a result, it could change due to the rapid changes in the information climate ● Learning is learner-centred; the teacher plays the role of a moderator

Source: Adapted from Siemens, 2005, p.5-6; Shrivastava, 2018

2.2.7 Four Levels of Interaction in Connectivist Learning

Operation Interaction

Operation interaction is a process whereby learners connect with different technologies by practising and recalling how to operate different media to facilitate their learning. The purpose of interaction at this level is to enable learners to build their personal learning environment to establish links with different information and opportunities (Wang et al., 2014). Learners learn how to follow the prompts or step-by-step instructions to obtain the information and combine and filter content from different digital social networks (Downes, 2011). This means learners have vast social and networking capabilities at their disposal, and they determine their knowledge construction through these network connections. These networks could include blogs, emails, WhatsApp groups, Facebook, Twitter, YouTube, Instagram, Micro-Blogging, etc. Such interactions would enable learners to work collaboratively with others, utilising various online tools. Wang et al. (2014) argue that although there is concept interaction at this level, it is at a very low level. In other words, learners merely follow instructions, practice and recall how to operate various media to build their learning spaces.

As indicated earlier, at this point, interaction is aimed at building the learner’s personal learning space with different technologies, enabling them to gain access to various information, opportunities and people. The ability to engage widely in social networks entrenches the diversity principle of connectivism (Siemens, 2005; Wang et al., 2014; Kizito, 2016). This interaction facilitates collaborative problem-based learning and forms the fertile ground for this diversity principle. However, in the case of the act or process of solving problems, more is required to ensure all know where and how to find their way in this collaborative space.

Wayfinding Interaction

Wayfinding is defined by Siemens (2011) as a process wherein learners make ways to navigate through complex and information-loaded environments by using landmarks, symbols and environmental cues. This is aimed at finding the relevant information and people directly to reach higher levels of understanding, application and evaluation during the next level of interaction (Siemens, 2005, Wang et al., 2014). Put differently, wayfinding is about the connection of information and people interacting in networks (Dron & Anderson, 2014). To maintain information exchanges, teaching and learning activities need to provide step-by-step guidance for learners to find their way in complex, information-loaded digital environments using symbols, landmarks and environment cues. At this level, learners could display memory of previously learnt information by recalling facts, basic concepts, responses and instructions. Hence, at this level, learners would also be required to find, choose, show and communicate the information gathered for sensemaking (Anderson & Krathwohl, 2001). This could be achieved through Laurillard’s (2008) learner-teacher, learner-content and learner-learner interactions (Siemens, 2011; Wang et al., 2014).

Siemens (2013) and Wang et al. (2014, 2017) point out that the Connectivist Learning environment is more open, interactive and controlled by individual learners and has widespread social and networking connection capabilities. At the inception level, interactions are mainly found on the course web page. However, as learning progresses, interactions occur in many spaces, including blogs, Wikis, Twitter, Facebook, Google Group, YouTube, etc. This requires learners to judge which information is important and valuable to find their way in the digital space. Such multi-spaced and distributed interactions are not common in traditional online courses, where interaction is confined to specific classrooms, discussion forums, blog sites or other established online spaces for learners (Wang et al., 2017). Understanding this distinction is essential in promoting the acquisition of the LNSSs and yet, making sense of the accessed information is required so that learners can manipulate it for the benefit of resolving the problem.

Sensemaking Interaction

Siemens (2011) defines sensemaking interaction as activities wherein individuals make sense of complex information-loaded environments by filtering, extracting and integrating relevant information to enhance their understanding of information. Put differently, it is a pattern recognition process to promote a coherent understanding of information, which is a prerequisite to the application of the information in a new situation, analysis, evaluation and making informed decisions (Siemens, 2009 in Wang et al., 2014).

To realise this, information from different human and non-human resources must be connected through a collaborative process. The process could include aggregation, sharing, discussion, negotiation, reflection and decision-making through Laurillard's (2008) learner-teacher, learner-learner and learner-content interactions (Wang et al., 2014). As a result, the participants in the learning situation bring together concepts from different domains to gain a clear understanding of information, though at a lower level of Bloom's Taxonomy (Siemens, 2009 in Wang et al. 2014).

Accordingly, learners make sense of concepts by describing, explaining, demonstrating, illustrating, paraphrasing, summarising, interpreting, etc. (Anderson & Krathwohl, 2001; Churches, 2008). Such abilities facilitate engagement that has the potential to resolve problems in innovative ways.

Innovation Interaction

According to Downes (2012), innovation interaction is the most abstract process of knowledge creation and growth. It feeds from the sensemaking outputs by building and presenting new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion. Wang et al. (2014) refer to these as learning artefacts. They could be in the form of drawings, objects, models or anything created by learners when communicating, collaborating and sharing artefacts on the OERs. In other words, the OERs are teaching, learning and research resources available in the public domain. Importantly, these resources facilitate the attainment of LNSSs at no cost.

Supporters of OERs in Connectivist Learning argue that the platform creates self-directed active learner participation opportunities for remixing, wherein learners could build something new or adjust it to address the human need or problem identified (Anderson, 2009; Downes, 2012; Belshaw, 2013). To attain this desired learning outcome, learners are required to utilise the knowledge acquired during the sensemaking interaction to apply, analyse, evaluate and create artefacts in the digital space (Puentedura, 2009; Laurillard, 2012).

Based on this, interaction at this level is the most critical. It is at this level of interaction where artefacts could be created, remixed, shared and commented on to achieve the desired outcomes of the teaching and learning activities in Technology Education (Downes, 2012; Wang et al., 2014, 2017). This calls for learning activities that require learners to organise, plan, examine, compare, discover, criticise, judge, agree, disagree, justify, decide, build, adapt, improve, solve, etc. (Anderson & Krathwohl, 2001; Churches, 2008; Wang et al., 2017; Shouman & Momdjian, 2019; Aldosemani, 2019; Rehman & Aurangzeb, 2021).

Although interaction is claimed to be a cornerstone in Connectivist Learning, it is under-conceptualised, and its role in learning is not clearly pronounced from a theoretical point of view (Clarà & Barberà, 2014; Wang et al., 2014). In addition, it is worth highlighting at this point that although acclaimed by some, Connectivist Learning has its defects, particularly in the schooling sector. The learning theory is more suitable for university students who are engaged in distance learning (Kizito, 2016). That means participants should have a good level of technological literacy. However, many of the learners in the schooling sector, particularly in the lower grades, lack these skills, such that interactions across the four levels of Connectivist Learning to promote deeper learning and the acquisition of LNSSs could be challenging for them.

To attain these desired learning outcomes, guided learning needs to be provided to facilitate the utilisation of the knowledge acquired during the sensemaking interaction to apply, analyse, evaluate and create artefacts in the digital space (Puentedura, 2009; Laurillard, 2012). This calls for the incorporation of guided learning into the four levels of Connectivist Learning, considering that Technology as a subject was introduced in South African schools to develop the learners' technological literacy (Janak, 2019).

In pursuit of just outcomes, the next section examines learning strategies that facilitate the understanding of content knowledge and the acquisition of LNSSs in the South African schooling sector. The following section outlines how the Web-Based Conversational Framework could be a lever that propels the development of the LNSSs across the four levels of Connectivist Learning in teaching Grade 8 Technology in the study's four Full ICT schools.

2.2.8 Web-Based Conversational Framework

The Web-Based Conversational Framework introduces the utilisation of the Internet in the classroom and expands it to online learning outside the classroom to include web-blogging, social networking and collaborative activities (Neo et al., 2013). The Web-Based Conversational Framework has been adapted from Laurillard's (2008) Conversational Framework. The framework captures a repetitive learning process that promotes the understanding of content knowledge. The process entails communication, reflection, adaptation and other activities geared towards the attainment of learning outcomes. Throughout the learning process, feedback from the teacher is essential (Neo et al., 2013). In other words, the Conversational Framework captures learning experiences for learners and foregrounds dialogue as an essential component to effectively engage learners in deep learning throughout their learning journey, as depicted in Figure 2.3.

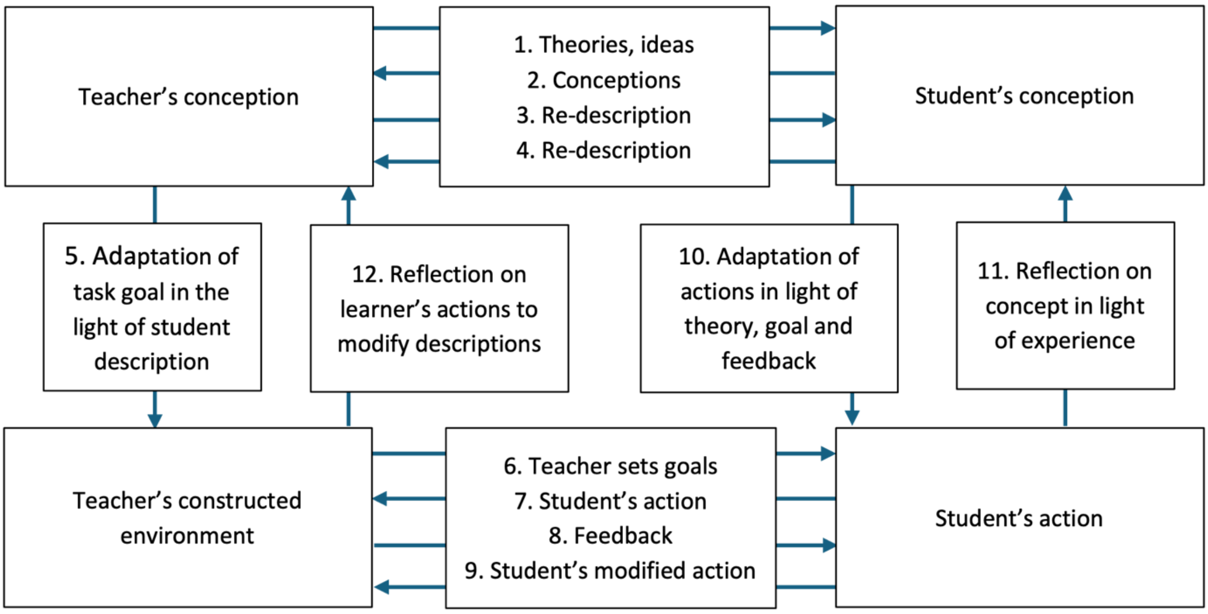


Figure 2.3: Laurillard's Conversational Framework

Source: Adapted from Neo et al., 2013

The Conversational Framework in Figure 2.3 categorises the learning process into the discursive and experiential levels. The former takes place in the classroom. The teacher explains concepts and then engages learners in discussions. Feedback is provided through the question-and-answer method to promote understanding of the concepts. Learners are also given an opportunity to question and express their own ideas to demonstrate their understanding of the concepts.

Interaction and feedback are repetitive until the teacher is happy that learners have grasped the theories, concepts and principles and better understand the objectives of the project (Laurillard, 2003). The teacher then proceeds to give learners tasks to create opportunities for them to engage in the next level of the learning process, namely experiential learning. At this level, learners work asynchronously to transform their understanding of concepts into practical adaptation and reflection of what was discussed and reflected in class (Neo et al., 2013). In other words, learners practice, action and apply the ideas, theories and concepts acquired through classroom discussions in the real-life situation to solve the problem identified. This creates a fertile ground for learners to communicate and collaborate with their peers, knowledgeable others and, particularly, with their teacher anytime and anywhere.

Many scholars support this notion. They assert that a teacher in blended learning is vital to learners as it makes use of online activities to enhance teacher-initiated classroom work. The non-progression of classroom practice into the online space diminishes the supportive and emotional value attached to the teacher's presence in the learning process (Laurillard, 2012; Neo et al., 2013; Kizito, 2016; Laurillard & Kennedy, 2017).

This learning process serves as the basis for the GBCL Framework to support the development of LNSSs in teaching Grade 8 Technology. Neo et al. (2013) have mapped out the twelve areas of focus in Laurillard's Conversational Framework to demonstrate how the understanding of concepts at the discursive level and the application of the knowledge and skills acquired at the experiential level could translate into the development of LNSSs and the desired learning outcomes, as depicted in Figure 2.4.

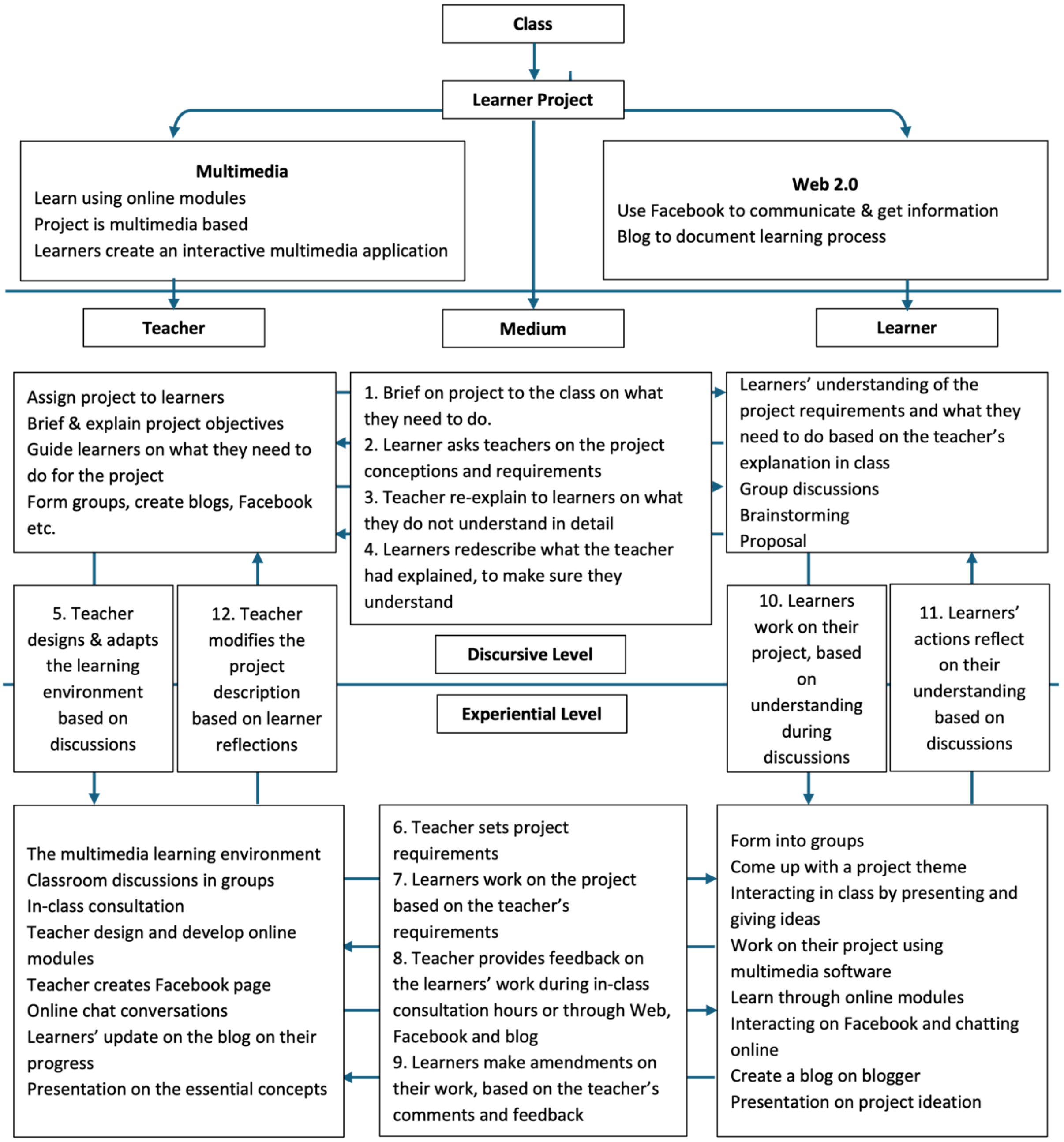


Figure 2.4: Mapping Laurillard's Conversational Framework into Class Design

Source: Adapted from Neo et al., 2013

The contents of this learning process could be adapted into teaching and learning activities in the Grade 8 Technology classroom as the process promotes the understanding of concepts, ideas, theories and principles. This would translate into the eventual application of the knowledge and skills acquired to gather relevant information online, communicate, collaborate, develop and share the learning artefacts created on the open network (Downes, 2012; Wang et al., 2014). Throughout the process, learners would acquire the network society skills across the four levels of Connectivist Learning. Laurillard and Kennedy

(2017, p.11) support this notion, asserting that “Teacher presence is important to learners, and so ‘blended learning’ is significant because it uses digital activities to supplement teacher-supported classroom work.” In other words, for Connectivist Learning to achieve the desired learning outcomes in teaching Grade 8 Technology, teachers need to design teaching and learning activities that assist learners in building and making connections in their learning networks, directing them to appropriate experts and non-human resources (Laurillard, 2012; Neo et al., 2013; Kizito, 2016; Laurillard & Kennedy, 2017). Importantly, Laurillard’s Conversational Framework capitalises on problem-based learning and collaborative learning as essential learning strategies in the acquisition of content knowledge and LNSSs, as well as the development of problem-solving skills.

Considering the previously cited challenges by Padayachee (2017), Mhlanga and Moloi (2020) and Mokate (2023) around the utilisation of ICTs in the South African context, the next section examines blended learning to mitigate the risk of the lack of access to ICT infrastructure. As a result, there is a need to modify Connectivist Learning to incorporate pedagogical approaches that will mitigate the risk of limited resources to support and enhance the acquisition of content knowledge and the desired LNSSs. Agherdien (2023) and Gachago et al. (2023) support this notion, propagating shying away from a mechanistic application of models as the practice disregards contextual factors.

Blended Learning

Blended learning is defined as an approach to learning that combines face-to-face teaching and learning activities with online instruction, which could also include technology-mediated learning (Ferdig et al., 2012; Senturk, 2021). Put differently, the model integrates pedagogy in various environments to merge face-to-face teaching with virtual or online learning (Doering, 2006; Garrison & Vaughan, 2008). Briefly, the rationale behind this model is to provide a broad range of sources to mitigate the weaknesses of various learning methods and capitalise on their strengths to create the most conducive learning environment (Graham, 2006; Williams et al., 2008; Brown, 2016). In that way, the opportunities for attaining learning outcomes are maximised (Bersin, 2004; Garrison & Kanuka, 2004; Stein & Graham, 2014). This approach takes into consideration that the ICT resources provided in schools are required to “…support teaching and enhance learning in different subjects in a wide range of socio-economic contexts that teachers encounter in South Africa" (Department of Basic Education, 2017, p.10). As a result, Connectivist Learning must be modified to incorporate pedagogical approaches that will mitigate the risk of limited resources to support and enhance the acquisition of content knowledge and the desired LNSSs.

Before delving into how Connectivist Learning could promote the development of LNSSs in the South African schooling context, it is important to examine Constructivist Learning strategies that promote active learner participation and thus accentuate guided blended learning that facilitates the acquisition of LNSSs.

Constructivist Learning Strategies

To promote the acquisition of the desired skills, Hurley and Chater's (2005) Modelling Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types, which ascribe to constructivism, could be woven across the four levels of Siemens' (2011) Connectivist Learning. Considering that the current study's theoretical framework is developed from connectivism as a learning theory, this section resumes with it to illustrate how learning occurs in this context.

Accordingly, guided learning through teacher-learner interaction needs to be carefully planned. To achieve this, Hurley and Chater (2005) introduce the '**I do**', '**We do**' and '**You do**' Modelling Instructional Strategy. This approach is augmented by Puentedura's (2009) SAMR Model, which helps make explicit what learning gain is there in the process of this guided learning experience. These two frameworks can be used to modify Siemens' (2011) four levels of Connectivist Learning into guided learning.

Modelling Instructional Strategy

Modelling is an instructional strategy wherein the teacher demonstrates a new concept or skill to be learnt. Learners learn through observation and practice (Eggen & Kauchak, 2001). In that way, the teacher's expertise is passed to learners in sequential, scaffolded steps.

In the context of the current study, modelling demonstrates how ICTs could be purposefully engaged at the discursive level in a traditional classroom through guided learning to promote the understanding of concepts and the acquisition of LNSSs. Once the desired skills have been achieved, the knowledge and skills acquired could be applied by learners experientially online (Laurillard, 2002; Kop, 2011; Mackness & Bell, 2015; Goldie, 2016; Downes, 2019). This blended approach would translate into the development of LNSSs in Full ICT schools in Gauteng. Hurley and Chater's (2005) modelling phases are:

> **I do:** This entails demonstrating to learners how to perform a task or procedure. In the current study's context, how to utilise ICT resources to enhance or acquire the desired ICT skill. The acquired knowledge or skill could be scaffolded with planned, written tasks with clear step-by-step instructions (Hermin, 2002).
>
> **We do:** During this phase, a second task, similar to the first task but with different features, creates an opportunity for a collaborative exercise to promote the internalisation of concepts and skills. This is usually done through probing questions, dialogue and demonstration of learning through practice.
>
> **You do:** At this stage, the third task, similar but slightly different to the first and second tasks, is provided. This time, learners work independently. Another strategy to ensure the task provided is successfully completed could entail ensuring the second task done jointly remains visible to promote recalling the steps to be carried out to perform the task. To assist the learning process, the teacher could quietly provide the necessary guidance and support to individual learners as and when the need arises. In other words, this stage is about gradual withdrawal of support rather than complete withdrawal by the teacher (Laurillard, 2002; Kop, 2011; Mackness & Bell, 2015; Goldie, 2016; Downes, 2019).

Table 2.3 provides a succinct description of the rules of engagement during teaching and learning activities in the traditional classroom to promote the acquisition of LNSSs. Levy (2007) improved the aforementioned phases by adding the '**You do it together**' phase. This is an expansion of Hurley and Chater's (2005) '**We do**' phase to guide teachers on how to provide fading support to ensure that learners gradually develop the competence and confidence to work independently.

Table 2.3: Rules of Engagement to Promote the Acquisition of Learner Network Society Skills in a Traditional Classroom

	Teacher	Learner
'I do' Direct Instruction	● Provides direct instruction ● Establishes goals and purpose ● Models ● Thinking aloud	● Actively listening ● Taking notes ● Asking for clarification
'We do' Guided Instruction	● Interactive instruction ● Working with students ● Checking, prompting, providing clues ● Providing additional modelling ● Meeting with needs-based groups	● Asking and responding to questions ● Working with teacher and classmates ● Completing process alongside others
'You do it Independently' Independent Practice	● Providing feedback ● Evaluating ● Determining the level of understanding	● Working alone ● Relying on notes, activities and classroom learning to complete an assignment ● Taking full responsibility for the outcome
'You do it Together' Collaborative Learning	● Moving among groups ● Clarifying confusion ● Providing support	● Working with classmates and sharing the outcome ● Collaborating on the authentic task ● Consolidating learning ● Completing the process in a small group ● Looking to peers for clarification

Source: Adapted from Levy, 2007

Although this modelling strategy is important for learning, it is confined to the four walls of the classroom. As a result, it does not sufficiently explore all the available ICT software and tools to create a learning experience that equips learners with the actual skills required to participate in the global economy. In other words, when using ICTs, it is important that pedagogy not only enhances learning through drills and practice. Instead, it should create opportunities for the application of the knowledge and skills acquired in the classroom in the real-life situation to equip learners with the desired skills to thrive in a highly networked global economy (Steger, 2003; Battro, 2004; Ogunsola, 2005; Zembylas & Vrasidas, 2005; Schwab, 2018; World Economic Forum, 2020). Hence, guided learning must be extended outside the classroom by the SAMR Model, particularly through modification and redefinition at the transformation level (Shouman & Momdjian, 2019).

SAMR Model

Puentedura coined the SAMR Model to approach ICT integration from four different hierarchical tasks, categorised into two stages: enhancement and transformation. The model is aimed at facilitating transformative practice using a variety of Web 2.0 applications to promote the effective integration of ICTs into teaching and learning that not only enhances the understanding of concepts but also includes the acquisition of higher-order thinking skills to apply the knowledge acquired through collaborative learning to solve real-life problems (Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021), as depicted in Figure 2.5.

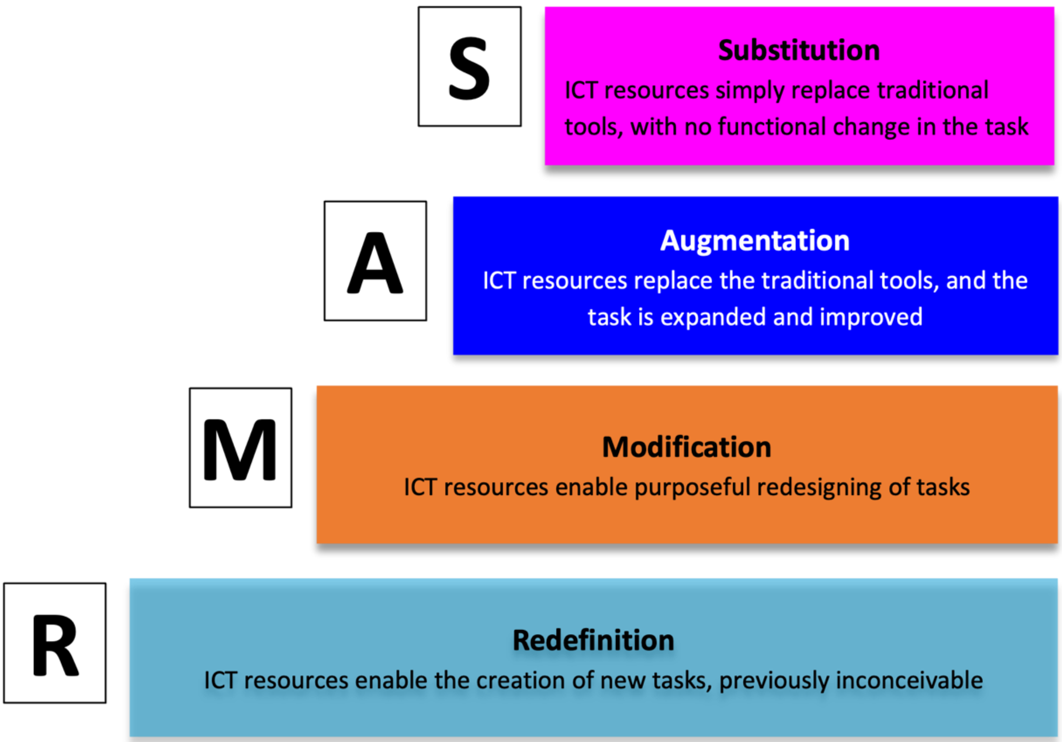


Figure 2.5 The Substitution Augmentation Modification Redefinition (SAMR) Model

Adapted from Shouman and Momdjian, 2019; Aldosemani, 2019; Rehman and Aurangzeb, 2021; ICT: Information and Communication Technology

1. Substitution: At this level, the ICT resources simply substitute older methods and tools. There isn't much that has changed in the scope of the task performed. In other words, learners use ICT resources to perform a learning task; however, the task could still be completed without these resources. This could include using different applications on ICT devices to take notes, complete classwork activities and do quizzes, as well as glancing through a set of information on the Internet to substitute physical textbooks.

2. Augmentation: Opportunities are created for learners at this level to explore additional new features the Internet offers that can **enhance** the teaching and learning activities that could still be accomplished without ICTs. For example, learners communicate and collaborate in the learning process to share opinions and ideas and post real-time comments using their mobile devices. In that way, they could correct each other to enhance their understanding of the concepts. The teacher, on the other hand, could assess the learner's understanding of the concepts and provide instant feedback. This means using the Internet makes learning interactive. However, such interaction could also be achieved without using ICT resources.

3. Modification This step supports making changes to the task to present new ways and opportunities for learning that would not be easily accomplished without the use of ICT resources. Not only is learning enhanced, as was also the case in the previous stage, but it is also transformed to add depth to the task. This could include creating opportunities for learners to use Google or YouTube for learning purposes without using a textbook. For example, through Google Classroom, learners could be given a task provided with a link to access simulations, videos or audio material to further enhance their understanding of concepts and respond to a set of questions online. They could also be provided with a link to enable the use of various information to demonstrate deeper learning.

4. Redefinition: At this level, the learners' potential to create and innovate new tasks is unleashed through learning artefact creation. This would have been mission impossible without the use of the ICT resources. To realise this, opportunities are created for learners to apply the knowledge gained from the previous levels to real-life learning experiences. For example, learners could video record the design process to solve the technological problem identified step-by-step and share the recording of each step with their peers and the teacher for comments and refinement before submitting the final product. In addition, they could use existing ideas, solutions, theories and products in the form of drawings, objects, models or anything created locally, nationally and globally on the OERs and apply these creatively in the new context to solve the technological problem identified (Anderson, 2009;

Downes, 2012; Laurillard, 2012; Belshaw, 2013; Wang et al., 2014; Laurillard & Kennedy, 2017).

It is worth highlighting at this point that this model demonstrates that using ICT resources has not assisted in transforming the task before it reaches the levels of modification or redefinition, wherein learners could apply the knowledge gained to an authentic learning experience in the real-life situation. Hence, when using ICT resources, it is important that teaching and learning activities not only enhance the acquisition of content knowledge through substitution and or augmentation but ICTs should also truly transform learning by modifying and or redefining a task to enable the application of knowledge and skills in new contexts or innovatively. This is what constitutes deep learning (Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021).

However, Puentedura (2012) warns that arriving at the level of redefining tasks with the technology being used is not an instantaneous process; it may take more time than expected. To do justice to the capacity building programme, it may take longer (up to three years) to capacitate teachers to the point of institutionalising the use of ICT resources from substitution to redefinition. This means the capacity building for teachers in the development of the LNSSs should not be a once-off short programme. The implementation plan of the training programme should be aligned to the four levels.

Accordingly, the incorporation of the modelling approach and the SAMR Model into the four levels of Siemens' (2011) Connectivist Learning adapts it to suit teaching and learning in the South African context. In addition, the adaptation accommodates learners from previously disadvantaged communities who were never exposed to ICT resources at the primary school level (Fawns, 2022). In that way, teaching and learning activities would be inclusive and address the diverse needs of all learners, taking into consideration the learners' home, educational and cultural backgrounds (Department of Basic Education, 2017; Korica & Nicolini, 2019; Fawns, 2022). In that way, customised Connectivist Learning becomes an enabler for all learners in Full ICT schools to acquire the requisite LNSSs. Such could benefit them in their future careers, including collaborating in the global community to address human needs (Shouman & Momdjian, 2019).

The next section depicts the six learning types that could be incorporated across the four levels of Connectivist Learning, as well as the SAMR Model, to guide the teachers' lesson planning so that their teaching and learning activities could promote the development of LNSSs.

Six Learning Types

According to Laurillard (2012), the starting point in promoting the acquisition of LNSSs is categorising the teaching and learning activities into six learning types that are unique to web-based learning: learning through acquisition, inquiry, practice, discussion, collaboration and production. This will facilitate the design of teaching and learning activities that cater for "…the newer objectives, processes and actions presented by the integration of Information and Communication Technologies (ICTs) into the classroom and their impact on the lives of our students" (Churches, 2008, p.5). As a result, the teaching and learning activities in Technology would be more inclusive of digital technologies, digital cognitive activities and objectives (Laurillard, 2012; Neo et al., 2013; Kizito, 2016; Laurillard & Kennedy, 2017).

Hence, these six learning types should be woven across the four levels of Siemens' (2011) Connectivist Learning to promote the acquisition of LNSSs. As explained earlier, these skills include learning how to access the relevant information from both human and non-human resources, process it, evaluate information, manage information, organise and reorganise information, select optimal tools for the task, generate knowledge and utilise it to produce the products or services that would contribute positively to the economy and the quality of human life (Steger, 2003; Castells, 2004; Wilson & Scalise, 2015; Muller et al., 2016).

Table 2.4 depicts the features of these six learning types and indicates what LNSSs can be developed by each attribute.

Table 2.4: Laurillard's Six Learning Types

Features	Learner Network Society Skills
1. Acquisition ● Video ● Multimedia ● Animation ● Augmented Reality ● Virtual Reality	Describing, naming, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising
2. Inquiry ● Web Searching	Recognising, googling, searching, identifying, highlighting, bookmarking, favouriting, naming, locating, finding, retrieving
3. Practice ● Design Tools ● Digital Simulation ● Games ● Assessment Tools ● Analytical Tool ● Learning Analytics	Implementing, carrying out, using, loading, uploading, sharing, editing, operating, running, executing, playing
4. Discussion ● Synchronous and Asynchronous Online Groups ● Forums	Commenting, inferring, critiquing, judging, blog journaling, tagging
5. Collaboration ● Online Discussion Forums with Digital Design and Production Tools (Open Education Resources)	Critiquing, checking, blog commenting, posting, networking, judging, moderating, monitoring, reviewing
6. Production/ Digital Authoring ● Learning Artefact Creation ● Sharing Artefacts	Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making

Sources: Adapted from Churches, 2008; Laurillard, 2012; Laurillard & Kennedy, 2017

This matrix can assist teachers in designing teaching and learning activities to be incorporated into their lesson plans and guarantee the acquisition of specific LNSSs.

In a nutshell, **acquisition** entails the utilisation of technological affordances such as video, multimedia, amination, augmented reality and virtual reality to enhance the learners' understanding of concepts. **Inquiry** (web searching) requires learners to practice and recall how to operate different media to conduct web searches to find information, as well as search for relevant, high-quality sources and tools to promote learning. As learners master this basic skill, teaching and learning activities could progress to advanced web searching wherein opportunities are created for learners to navigate through complex information-loaded environments by using landmarks, symbols and environmental cues to find relevant information and people directly.

To promote deeper learning, teaching and learning activities are designed to create opportunities for learners to **practice** using design tools, digital simulation, games, assessment tools, analytical tools and learning analytics. In addition, **discussions** could be facilitated by extending teaching and learning through online asynchronous or synchronous groups. This will promote the negotiation of ideas, reflection and adaptation. Importantly, **collaboration** promotes sharing teaching, learning and researched material to promote deep learning (Anderson, 2009; Downes, 2012; Belshaw, 2013).

Lastly, **production/digital authoring** promotes learning artefact creation. This includes building and presenting new ideas, solutions, theories, products and models on the OERs. They could be in the form of drawings, objects, models or anything created by learners during communication, collaboration and sharing artefacts on the OERs (Anderson, 2009; Downes, 2012; Laurillard, 2012; Belshaw, 2013; Wang et al., 2014; Laurillard & Kennedy, 2017).

The acquisition of LNSSs calls for both teachers and learners to understand their roles and responsibilities in online learning. The teacher must create the environment for learning, guide learners in the process of selecting and finding relevant content and facilitate learning. Learners, on the other hand, must be selectors of the content, collaborators and creators of learning artefacts (Neo et al., 2013; Laurillard & Kennedy, 2017). In other words, each undertaking their roles and responsibilities would consequently help show how the utilisation of the available ICT resources could translate into the acquisition of LNSSs across the four levels of Connectivist Learning.

In the context of teaching Technology, the six learning types are more inclusive of digital technologies, digital cognitive activities and objectives. Accordingly, these learning types make explicit the network society skills learners could acquire across the four levels of Connectivist Learning. In addition, they create widespread collaborative networks that could facilitate the acquisition of the necessary knowledge and LNSSs to address human needs or solve the problem identified (Castell, 1999; Churches, 2008; Laurillard, 2012; Neo et al., 2013; Laurillard & Kennedy, 2017).

Accordingly, the next section employs a conceptual framework that integrates the key concepts in the learning theories and frameworks and makes explicit how LNSSs in the South African schooling context can be developed to achieve curriculum goals.

2.3 Conceptual Framework

The focal point of the current study is the development of LNSSs in the use of ICT resources by Technology teachers in Full ICT schools in Gauteng. The findings will be used to inform a Teacher Development Framework that can help in capacitating Technology teachers in schools with ICT resources to design teaching and learning activities that translate into the acquisition of the desired ICT skills, including the eventual attainment of the curriculum goals (Department of Basic Education, 2011).

To realise this goal, the conceptual framework developed combines the pedagogical approaches that influence the development of LNSSs in the South African education system. It is shaped by the constructivism theory using the lens of the four levels of interaction in the Connectivist Learning model, as depicted earlier in this chapter. This is aimed at contextualising the study to Full ICT schools in the Gauteng province through GBCL. To realise this, the framework integrates Siemens' (2011) four levels of interaction in Connectivist Learning, Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types as contributors to the aspects relevant to this study. Importantly, the SAMR Model is the primary contributor as it engages guided Connectivist Learning in a traditional classroom set-up and extends it beyond the classroom to facilitate collaborative internet-based online learning.

Figure 2.6 depicts the conceptual framework, bringing together the pedagogical practices that promote the development of LNSSs and the eventual attainment of the curriculum goals.

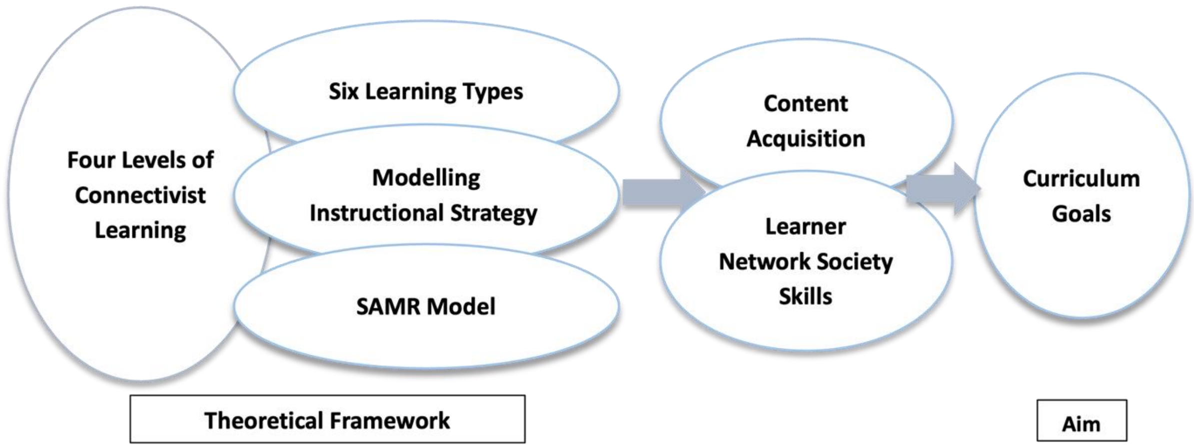


Figure 2.6: The Study's Conceptual Framework

2.3.1 Language Description

Within the framework, the development of LNSSs is spread across Siemens' four levels of interaction in Connectivist Learning to facilitate the acquisition of technical and cognitive skills across all the cognitive levels through GBCL. In addition, Hurley and Chater's Modelling Instructional Strategy demonstrates how ICTs could be purposefully engaged at the discursive level in a traditional classroom through guided learning to facilitate the understanding of concepts and the acquisition of LNSSs. In addition, Puentedura's SAMR Model integrates face-to-face classroom learning and internet-based online learning to promote the effective integration of ICTs into teaching and learning that not only enhances the understanding of concepts but also includes the acquisition of higher-order thinking skills through collaborative learning to solve real-life problems. Furthermore, Laurillard's six learning types suggest various teaching and learning activities that could be employed to promote the understanding of the subject content, as well as the acquisition of LNSSs across all levels of Connectivist Learning.

Jointly, these learning strategies demonstrate the role that the teacher could play in developing LNSSs as envisaged in the preamble of the Technology CAPS document (Department of Basic Education, 2011). Accordingly, the conceptual framework would be useful in the development of an analytical tool that could be used to analyse the current study's data to respond to the research questions.

Using the available ICT resources, including the DBE and GDE zero-rated websites and social media mentioned in Chapter One, engaging the Constructivist Learning theories within the developed GBCL conceptual framework would create opportunities for learners to acquire LNSSs. Importantly, as the learning types within the framework integrate Anderson and Krathwohl's (2001) Revised Bloom's Taxonomy and Churches' (2008) Bloom's Digital Taxonomy, learners would acquire cognitive and technical skills across all the cognitive levels, as depicted in Table 2.5.

Table 2.5: Cognitive and Technical Skills

	Higher-Order Thinking Skills	**Revised Bloom's Taxonomy Verbs**	**Bloom's Digital Taxonomy Verbs**
Innovation Interaction	Creating	Designing, constructing, planning, producing, inventing, devising, making	Designing, constructing, planning, producing, inventing, devising, making, mixing, remixing,
Sensemaking Interaction	Evaluating	Checking, hypothesising, critiquing, experimenting, judging, testing, detecting, monitoring	Checking, hypothesising, critiquing, experimenting, judging, testing, detecting, monitoring, blog commenting, posting, moderating
	Analysing	Comparing, organising, deconstructing, attributing, outlining, finding, structuring, integrating	Comparing, organising, deconstructing, attributing, outlining, finding, structuring, integrating
	Applying	Implementing, carrying out, using, executing	Implementing, carrying out, using, executing, running, loading, playing, operating, uploading, sharing
Operation and Wayfinding Interaction	Understanding	Interpreting, summarising, inferring, paraphrasing, classifying, comparing, explaining, exemplifying	Interpreting, summarising, inferring, paraphrasing, classifying, comparing, explaining, exemplifying, blog journaling, commenting, twittering
	Remembering	Recognising, listing, describing, identifying, naming	Recognising, locating, finding, retrieving, searching, googling, bookmarking
	Lower Order Thinking Skills	**Revised Bloom's Taxonomy Verbs**	**Bloom's Digital Taxonomy Verbs**

Source: Adapted from Churches, 2008

Revised Bloom's Taxonomy

To demonstrate content acquisition, **remembering** at **Level 1** focuses on creating opportunities for learners to recall previously learnt facts or concepts. **Understanding** at **Level 2** requires teaching and learning activities that make learners demonstrate their understanding of the concepts learnt by describing, paraphrasing, organising, making comparisons and interpreting pieces of information to make inferences. **Applying** at **Level 3** requires learning activities enabling learners to carry out instructions to demonstrate the application of the knowledge and skills acquired at Levels 1 and 2. **Level 4** activities (**analysing**) necessitate interrogating information through deconstructing, comparing, organising and integrating information to arrive at conclusions. This includes finding evidence to support the conclusions made. **Evaluating** at **Level 5** involves making judgements based on criteria and set standards by checking adherence to the set standards, critiquing and formulating opinions. Lastly, **creating** at **Level 6** involves reorganising acquired knowledge to create new ideas or solutions (Anderson & Krathwohl, 2001; Churches, 2008).

Bloom's Digital Taxonomy

To acquire LNSSs in the process of content acquisition, the design of teaching and learning activities must employ the utilisation of the available ICT resources to elicit Bloom's Digital Taxonomy verbs across the four levels of Connectivist Learning. Ideally, at **Level 1 (remembering)**, learners should recall specific information, operations or symbols and recognise, locate and navigate through networks to find, access, retrieve and upload information. **Level 2 (understanding)** requires teachers to create opportunities for learners to engage in reflective practice in classroom activities to demonstrate the understanding of content through paraphrasing, describing, explaining, summarising and authoring through blog journaling or commenting on the OERs. In this case, the DBE or GDE websites and social media. **Level 3 (applying)** requires the teacher to create opportunities for learners to practice the LNSSs acquired through modelling. This could be achieved by executing the acquired skills in a different, familiar setting. For **Level 4 activities (analysing)** need to be created for learners to enter raw data obtained through social networks and process it by entering it into spreadsheets (data processing) using features like sort, filter, formulas and equations to break it into smaller parts (data manipulation), to explore and construct meaning, as well as establish relationships and trends, and ultimately draw accurate conclusions from the data. In the end, the trends and conclusions made should be presented using suitable methods for the type of data, purpose of the presentation and the audience. **Level 5 (evaluating)** requires the teacher to create opportunities for learners to critique, judge and test the value of the ideas, concepts and materials on the OERs by applying the set standards and criteria and replying by commenting, moderating, reviewing, reflecting and posting. Finally, **creating (Level 6)** entails combining (mixing and remixing) ideas and concepts posted on the OERs to generate new ideas or products (Churches, 2008).

Given that the findings from the aforementioned studies on ICT in education and Technology do not elicit clear teaching and learning activities that promote the acquisition of LNSSs, the next section explores the education policies in the South African context to establish if they provide a framework in the utilisation of ICT resources to facilitate content acquisition and the development of LNSSs. Importantly, the implications for teachers in the development of the desired skills are considered.

2.4 South African Education Policies on ICTs

To understand ICT in education in the South African context, it is essential to delve into the relevant policies. These include South Africa's White Paper on e-Education (Department of Basic Education, 2004) and the Professional Development Framework for Digital Learning (Department of Basic Education, 2017). These documents drive the agenda on ICT in education in the GDE to promote the utilisation of ICTs in schools in the quest to enhance the quality of teaching and learning and prepare learners accordingly to optimally utilise ICTs and contribute positively "to address South Africa's development challenges and enhance South Africa's global competitiveness" (Department of Basic Education, 2004, p.10).

This section reviews elements within these policies that inform teaching and learning activities promoting the use of ICTs to develop LNSSs. This is aimed at establishing what the main education policies in the South African context consider to be the development of LNSSs in the utilisation of ICTs. Thereafter, the consistency of the relationship between these policies and what literature says about the development of LNSSs is examined to establish if the policy framework is suitable as a practical guideline for teachers in the development of the desired ICT skills.

It is worth highlighting at this point that this section will not delve into the Technology CAPS document (Department of Basic Education,2011) as the gap in its silence on the utilisation of ICTs has already been highlighted. Hence, the next section reviews the two policies on ICTs to determine their relevance in promoting the development of the requisite skills. However, the policy review process includes this policy document to heighten the gap identified. The following section delves into what the policies advocate in the use of ICTs to ascertain their suitability as a practical guideline for teachers in the development of LNSS.

2.4.1 Policy Review – the use of ICTs and the development of Learner Network Society Skills

The context in which the study's participating Full ICT school teachers work has been made explicit in the introductory section in Chapter One. This section, therefore, highlights areas where the three policies are aligned with the developed conceptual framework. In addition, it shows (with an asterisk) areas where its description clearly does not match the teaching and learning activities facilitating the development of LNSSs. Where the policy description does not clearly state whether the statement refers to the utilisation of ICT resources, this will be indicated. However, this will not be described as implying the use of ICT resources as there is no indication of such in the documents.

To determine the suitability of the three policies as a practical guideline in the development of LNSSs, this section examines the consistency of the relationship between these policies and the conceptual framework. For ease of reference, the White Paper on e-Education, the Grade 7 – 9 Technology CAPS document and Professional Development Framework for Digital Learning would be referred to as Documents 1, 2 and 3, respectively.

Four tables have been employed in the review process. Each table considers one of the four levels of interaction in Connectivist Learning. Each column in each table cites relevant sections from the documents that align with Laurillard's (2012) six learning types, categorised within four levels of Siemens' (2011) Connectivist Learning and Puentedura's (2009) SAMR Model. The numbers denote the policy document and the relevant page, for example, 1:17 for Document 1, page 17. Since it is anticipated that the documents suggest desired teaching and learning activities that promote the development of LNSSs, 'content analysis' has been employed rather than 'evidence' to highlight sections from each policy document that relate to the types of learning promoting the desired ICT skills. The tables' second columns provide the overview of the insights gained. Thereafter, shortcomings identified in the policy framework are indicated to highlight the implications that could negatively impact the development of LNSSs in teaching Technology.

Operation Interaction

Table 2.6: Policy Review – The Development of Learner Network Society Skills at Operation Interaction

Learning Type	Policy Framework Overview
Web Searching (Accessing information from the Internet) 1:17 – *Operational dimension refers to the skills that are necessary for [the] use of new information and communication technologies.* 2:10 – *Through practical projects, using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles.* *3:41 – Digital tools allow the learner to investigate a concept in ways otherwise not feasible.*	Document 1 acknowledges the importance of first learning how to operate digital tools before using these to investigate and obtain information from the Internet, as well as different social networks, as depicted in Document 3. In the context of this study, this requires learners to practice and recall independently what the teacher demonstrated (Hurley & Chater, 2005).

The indicator provided in Document 1 on the use of ICTs does not say how to conduct web searches. Document 3 seems to provide direct guidance on a learning activity requiring the use of ICT resources. However, there is no indication of how guided learning could be provided so that the desired LNSSs are acquired as learners investigate concepts. The description is ambiguous in that it is up to the teacher to figure out the instructions to guide focused web searches geared towards the attainment of learning outcomes. Ideally, the subordinate documents (Documents 2 and 3) need to further explain how teachers can use ICTs to achieve the aims of teaching Technology as a subject through web searching. However, this is not the case (Table 2.6).

Wayfinding Interaction

As for operation interaction, the indicators provided in Documents 1, 2 and 3 on the use of ICTs do not provide guidance on how teachers could create opportunities for learners to conduct advanced web searches to find relevant information and acquire LNSSs as they navigate complex and information-loaded environments (Table 2.7). This ambiguity could result in time-consuming exercises and information overload, with some information gathered irrelevant to the attainment of the desired learning outcomes.

Table 2.7: Policy Review – The Development of Learner Network Society Skills (LNSSs) at Wayfinding Interaction

Learning Type	Policy Framework Overview
Advanced Web Searching 1:16 – *Accessing information that increases knowledge, inquiry and depth of investigation* 2:10 – *Through practical projects, using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles* *3:41 – Digital tools allow the learner to investigate a concept in ways otherwise not feasible*	To promote the development of LNSSs, Document 1 and 3 reiterates the need for teachers to create opportunities for learners to use digital tools to find wide ranging information from various sources. Wang et al. (2014) describe this as finding information in complex and information-loaded environments using landmarks, symbols and information cues. In the context of the current study, this calls for guided learning, which could include a demonstration by the teacher in class or step-by-step instructions (Campione et al., 1984 in Schunk, 2012; Bod, 2018; Moll, 2021).

Sensemaking Interaction

The policies seem to be cognizant of ICT affordances facilitating sensemaking interaction and that it should encompass acquisition, practice, collaboration and discussion as per the adopted analytic framework. However, Document 2 simply states that through practical projects, teachers should create opportunities for learners to investigate, design, make, evaluate and communicate, but it is silent on how ICTs should be employed throughout the design process. Notably, Documents 1 and 3 do not give guidance on how to utilise ICTs to create opportunities for learners to engage in various sensemaking interactions in the classroom and online.

Table 2.8: Policy Review – The Development of Learner Network Society Skills at Sensemaking Interaction

Learning Type	Policy Framework Overview
Acquisition	The use of multimedia content during teaching and learning activities in the classroom is essential in promoting the understanding of concepts. This serves as a stepping stone to meaningful collaboration and discussions among teachers and learners, as well as local and global communities. Ideally, collaboration and discussions should promote the sharing of teaching, learning and researched material to promote deep learning, which translates into the evaluation of the information at hand and making informed decisions to solve the problem identified (Anderson, 2009; Downes, 2012; Belshaw, 2013). To realise this, guided learning should afford learners the opportunity to practice operating different media to demonstrate the acquisition of the desired skills to engage in constructive social networks (Campione et al., 1984 in Schunk, 2012; Bod, 2018; Moll, 2021).
1:20 – The quest for active contextual learning to promote understanding will be supplemented by multimedia applications 3:41 – I have found digital content to reinforce and enhance the teaching that I do in the class 3:41 – Content is available in a variety [of] modes (e.g., graphics, sound, text, video) and media (e.g., books, films, photos, apps)	
Practice	
1:20 – Once ICTs are embedded in learning and teaching reform processes, [they] can be effectively used in conjunction with other methods of assessment 2:10 – Through practical projects, using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles 3:41 – I have found digital content that will enable the learner to work more independently, alone or in small groups, during lesson time 3:39 – Create digital format assessments with self-marking and/or diagnostic abilities	
Collaboration	
1:15 – * …inclusive and integrated practice where learners work collaboratively, develop shared practices, engage in meaningful contexts and develop creative thinking and problem solving skills 2:8 – *Technology Education…provides opportunities for collaborative learning and nurtures teamwork 2:10 – Through practical projects, using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles 3:17 – *Afford learners an opportunity to share knowledge and skills using digital platforms 3:17 – *Designing learning activities that require interaction or collaboration between your learners and a local or global community	
Discussion	
1:17 – *Approaches that employ an elaborate human network of support among teachers and learners and adopt a collective approach to knowledge and problem-solving are rich and powerful for the processes of learning and knowledge of ICTs in education 1:9 – *To use a variety of life skills in authentic contexts (such as decision-making, critical and creative thinking, cooperation, problem-solving and needs identification) 2:5 – *Use science and technology effectively and critically, showing responsibility towards the environment and the health of others 2:10 – Through practical projects, using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles 3:40 – *I have created opportunities for the learner to think deeply and discuss issues 3:40 – *I have identified ways in which my learners will actively participate and communicate with each other or the community (sharing ideas, asking questions, clarifying facts, etc.)	

Although Document 3 provides examples of activities that promote collaboration and discussions, the detail on how to utilise the available ICT resources to design the activities remains at the performance indicator level (Table 2.8). As a result, it takes an innovative teacher who is willing to go beyond classroom borders to design teaching and learning activities that promote the acquisition of LNSSs at the sensemaking level. Furthermore, although Documents 1 and 3 share the same understandings with those in the developed conceptual framework on the competencies required to develop LNSSs, they do not provide guidance on how teachers should plan and implement teaching and learning activities to develop these skills at the sensemaking level. As a result, in the context of the current study, this declares them inadequate. As indicated earlier, Jita (2018) and Janak (2019) support this assertion, cautioning that the unintended consequence could be different interpretations by teachers on the LNSSs to be acquired, leaving no room for standardised implementation across the country.

These gaps in these documents confirm that the study's participating teachers have not been given clear guidelines on how they should develop LNSSs as propagated by the National Development Plan (National Planning Commission, 2011, p.23) that institutions "…need to be better structured, to ensure that South Africa does not fall victim to a digital divide".

This responsibility is left to the teachers, who, in this case, are supposed to have been capacitated on how to utilise the available ICT resources to promote the understanding of content knowledge (Department of Basic Education, 2017). Yet, it is at the school level that the how part in the design of teaching and learning activities should be clear so that teachers can easily implement, based on the guidelines from the DBE.

Innovation Interaction

Table 2.9: Policy Review – The Acquisition of Learner Network Society Skills at Innovation Interaction

Learning Type	Policy Framework Overview
Production/ Digital Authoring 1:14 – **e-Education….is the ability to create knowledge and new information by adapting, applying, designing, inventing and authoring information* 2:9 – *Technology will teach learners the opportunity to learn to solve problems in creative ways* 2:10 – *Through practical projects, using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles* *3:26 – *Independent digital learning, collaboration and content creation. Effective use of digital tools and resources*	Documents 1 and 3 consider creating opportunities for learners to create new information and products through designing, adapting, applying, inventing and utilising the available ICT resources as digital authoring. This could include demonstrations or step-by-step instructions facilitating the building and presentation of new ideas, solutions, theories, products and models on the Open Education Resources (OERs). The product made could be in the form of drawings, objects, models or anything created by learners during communication, collaboration and sharing of artefacts on the OER (Anderson, 2009; Downes, 2012; Laurillard, 2012; Belshaw, 2013; Wang et al., 2014; Laurillard & Kennedy, 2017). In Technology Education, the creation of new information and products should be in the context of the design process: investigating, designing, making, evaluating and communicating the product made to solve the problem identified.

* The policy's description clearly does not match the teaching and learning activities facilitating the development of Learner Network Society Skills

It appears Documents 1 and 3 acknowledge the ability of ICTs to create and present new information through the use of ICT resources. Contrary to Document 1, in the case of Document 3, the use of ICTs may be at the level of artefact creation and not at the level of creating knowledge and new information (Department of Basic Education, 2017, p.43). However, both documents do not provide explicit guidance on how to create knowledge and new information with ICTs. The lack of guidance in this regard could result in lower to zero levels of utilisation of the available ICT resource due to ignorance.

Document 2 clarifies the opportunities that should be created for learners to engage in the Technology design process, as well as the desired outcome to be achieved. However, all the documents are not explicit about how this could be done with ICTs. Although the creation of knowledge and new information does not necessarily require the use of ICTs, engaging the available ICT resources may facilitate the acquisition of the network society skills required for learners to create knowledge and new information through communication and collaboration.

Review Findings

The three reviewed documents highlight the importance of the acquisition of LNSSs in their preambles. However, the 'what' and the 'how' components related to creating opportunities that facilitate the acquisition of these skills and the eventual attainment of the desired learning outcomes are either missing or vague. Notably, the teaching methodology in Document 2 is silent on the 'what' component of the four levels of interaction in Siemens' (2011) Connectivist Learning, Puentedura's (2009) hierarchical levels of learning and Laurillard's (2012) six learning types. Its preamble does allude to the use of "technology effectively and critically" (Department of Basic Education, 2011, p.5) in the "Design Process: Investigate, Design, Make, Evaluate and Communicate" (Department of Basic Education, 2011, p.12). However, its description of the teaching and learning methodology is silent on the use of ICTs. Instead, it focuses on teaching and learning activities that do not relate directly to the use of ICTs and the eventual development of LNSSs. Ideally, Document 2 should advance the aspirations of Document 1. In other words, it should provide explicit guidance to Technology teachers about 'how' to utilise ICTs to develop LNSSs and achieve the Technology learning outcomes.

Although Documents 1 and 3 seem to cover the 'what' component of the levels of interaction in Connectivist Learning and the six learning types, this is at varied levels and vague. Table 2.10 depicts how these education policies relate to the development of LNSSs.

Table 2.10: Summary of Policy Relevance to the Development of Learner Network Society Skills

Levels of Interaction	Document 1	Document 2	Document 3
Operation Interaction	X	0	X
Wayfinding Interaction	X	0	X
Sensemaking Interaction	X	0	X
Innovation Interaction	X	0	X

x: Existent: 0:Non-existent

White Paper on e-Education

The main goal of this policy (Document 1, Table 2.10) is that by 2013, all learners in the basic education sector (primary and secondary schools) should be ICT capable. Obviously, ten years later, this goal has not been attained. To realise this, these institutions are to be transformed into e-schools. Such schools are described as having “learners who utilise ICTs to enhance learning, qualified and competent leaders who use ICTs for planning, management, and administration, qualified and competent teachers who use ICTs to enhance teaching and learning and access to ICT resources that support curriculum delivery, as well as connections to ICT infrastructure” (Department of Basic Education, 2004, p.18).

Importantly, the policy proclaims that e-Education is more than developing skills necessary to operate various types of ICTs. As a result, the policy outlines the following specific indicators, which demonstrate that ICTs are utilised effectively to develop the necessary knowledge and skills to compete successfully in the global world (Department of Basic Education, 2004).

a. Apply ICT skills to access, analyse, evaluate, integrate, present and communicate information; The implication here is that ICTs may not only be utilised to gather information. In the process of transferring knowledge, it could be manipulated to expand the contexts where it can be applied. This means ICTs should not only be used merely to gather information but to create opportunities for learners to generate new forms of knowledge, which could be applied in the real-life situation (Wilson-Strydom et al., 2005). Although Siemens’ (2011) four levels of Connectivist Learning, which will be expounded later in this chapter, do not distinctly demonstrate this problem-solving cycle, the incorporation of Laurillard’s (2012) six learning types across the four levels translates into the attainment of the desired outcomes.

b. Create knowledge and new information by adapting, applying, designing, inventing and authoring information; Learners are required to create knowledge and solve the problem identified by using the available ICT resources. The teacher, through guided teaching and learning activities in the classroom and online, should create opportunities for learners to engage in learning that promotes the acquisition of knowledge and skills across Bloom’s different cognitive levels (Churches, 2008): remembering, understanding, applying, analysing, evaluating and creating.

Pachler (2003, p.25) supports this view, arguing that learners should be equipped with “problem-solving skills and not on computer skills per se”. As a problem in the real-life situation is presented, learners should utilise the available ICT resources to acquire these skills through guided learning, face-to-face in the classroom and online outside the classroom. In that way, learners maximise the potential of ICTs as they engage “high quality, relevant and diverse resources” (Department of Basic Education, 2004, p.23). This translates into the use of higher-order thinking skills and taking learners beyond recall, recognition and reproduction of information to evaluation, analysis, synthesis and production of arguments, ideas and performance (Department of Basic Education, 2004, p.20).

c. Enhance teaching and learning through communication and collaboration by using ICT; In the context of GBCL, for communication and collaboration to promote the understanding of content knowledge and the acquisition of LNSSs, both the teacher and learners work together in this process. Therefore, teacher-learner and learner-learner communication and collaboration must be carefully planned and not incidental. For online communication and collaboration to yield the desired outcomes during teaching and learning activities, adherence to social networking principles informed by educational theories is key. For example, teachers need to remember that learners need social and emotional interaction with the teacher and peers that the face-to-face classroom provides (Laurillard & Kennedy, 2017). Not all learners are able to direct their own learning and acquire the necessary knowledge and skills on their own. Many tend to be disconnected from their online learning experience without guidance from a knowledgeable other (Kop, 2011; Mackness & Bell, 2015; Goldie, 2016; Downes, 2019).

In other words, to promote the acquisition of LNSSs, guided teaching and learning activities and learner-learner interaction should progress into the online space. Laurillard (2002) supports this notion, arguing that for Connectivist Learning to be effective, teachers must design the utilisation of the Internet in the context of the Conversational Framework.

d. Function in a knowledge society by using appropriate technology and mastering communication and collaboration skills; Operation at this level is advanced. It is achieved through frequent exposure to and utilisation of ICT resources in the classroom and online over time. Learners who are only exposed to guided learning in the classroom would be excluded from acquiring these skills, which are critical for participating meaningfully in the global economy.

The Department of Basic Education (2004, p.20) reiterates that its "quest for active contextual learning to promote understanding will be supplemented by multimedia applications that require learners to create realistic contexts for problem-solving, data analysis and the creation of knowledge in the learning process". The applicability of this approach in the context of the Full ICT schools in Gauteng is attainable on condition both teachers and learners have access to ICT resources.

While this policy provides indicators for using ICTs that promote the development of LNSSs, the 'how' component and the requisite skills to effectively utilise the available ICT resources to develop LNSSs appear to be missing in the policy. As indicated in Chapter One, this gap could be complemented through the development of a framework to guide Technology teachers on strategies they could employ to develop LNSSs, sustaining the relevance of the policy in teaching Technology. The next document is reviewed to determine the appropriateness of the guidance it provides to teachers in the development of the desired ICT skills.

The Professional Development Framework for Digital Learning

The gap identified from the Technology CAPS document and the White Paper on e-Education is that they do not overtly disclose how ICT resources should be used in the teaching and learning experience to achieve the desired learning outcomes. For this reason, the Professional Development Framework for Digital Learning was developed. It supplements the CAPS document and White Paper to promote the utilisation of ICTs to enhance the quality of teaching and learning (Department of Basic Education, 2017). To realise this, the framework adopts the TPACK Model, which employs a three-pronged approach to promote a better understanding of subject content. The model incorporates 1) a pedagogical content knowledge dimension, which is about finding multiple ways to present content knowledge to enhance learning; 2) the technological content knowledge dimension, which promotes a deeper understanding of which specific technologies are best suited to promote the understanding of concepts and 3) technological pedagogical knowledge, which facilitates an understanding of how teaching and learning can change when particular technological affordances are used in particular ways (Koehler et al., 2013).

In addition, to facilitate a better understanding of subject content, ten digital learning competencies (knowledge, skills, attitudes and indicators) that teachers should have are identified on pages 15 to 18 of the Professional Development Framework for Digital Learning (Department of Basic Education, 2017). Of the ten competencies, five relate to the development of LNSSs, such as sharing knowledge and skills using digital platforms, communication between the teacher and learners, communication and collaboration among learners and local and global communities, and the innovative use of digital tools and resources to create new knowledge or products. Importantly, it propagates that the identified competencies should translate into teaching and learning activities that promote the development of learners' information acquisition and digital and media literacy skills. Implicitly, the framework envisages that these competencies will enable teachers to create opportunities for learners to use available ICT resources to facilitate the development of LNSSs, as advanced by the White Paper on e-Education (Department of Basic Education, 2004). Furthermore, critical engagement with the framework depicts teaching and learning activities that could be incorporated into lesson plans to facilitate the development of LNSSs in teaching Technology and the eventual attainment of the desired Technology learning outcomes (Department of Basic Education, 2017).

Based on this, the framework requires teachers to facilitate learning activities that promote learner-teacher dialogue, communication and collaboration among learners, including people with expertise locally and in the global community, to share and create content using the Internet. Importantly, it propagates the creation of opportunities for learners to apply the acquired content knowledge in the real-life situation through project-based learning. Although this is the case, the framework is also silent on the network society skills learners should acquire to participate meaningfully in the global economy, as outlined in the goals and definition of e-Education (Department of Basic Education, 2004). The unintended consequence could be different interpretations by teachers of the network society skills to be acquired by learners, leaving no room for standardised implementation across the country.

It is worth reiterating at this point that the ultimate aim of the TPACK Model adopted by the framework is to "…better understanding of the subject content" (Department of Basic Education, 2017, p.40) while "Technology skills are a by-product of this, unless the subject taught is CAT [Computer Applications Technology] or IT [Information Technology]" (Department of Basic Education, 2017, p.40). However, the framework does mention Puentedura's (2009) SAMR Model, which provides guidance on how ICT resources could be used to promote the development of LNSSs through collaboration in the network society. However, the framework is silent on the 'how' part. Instead, it suggests the SAMR Model could be used to "gauge the impact that the technology has on the task and on learner engagement" and not on ICT skill acquisition per se (Department of Basic Education, 2017, p.26). Notably, an elaborate description of the TPACK Model spans over four pages of the framework, while a scanty description of the SAMR Model is confined to one page. This is a strong indicator that the DBE propagates for pedagogy that focuses on content acquisition rather than acquiring LNSSs.

In short, while the White Paper on e-Education (Department of Basic Education, 2004) and Technology CAPS document (Department of Basic Education, 2011) envision the utilisation of ICTs during teaching and learning, the policies are silent on the pedagogical approaches to be employed for learners to acquire the desired LNSSs (Ankiewicz, 2013; Khoza, 2016; Jita, 2018; Janak, 2019; Du Toit, 2020). In other words, they do not clearly outline the teacher's role in using resources, yet teachers are the tools through which this mandate can be realised. Although the Professional Development Framework for Digital Learning (Department of Basic Education, 2017) attempts to address this gap, the 'how' part of the utilisation of ICTs to equip learners with network society skills and prepare them for participation in the global economy is missing. Such could be labelled as restricting the development of the type of learner envisaged, thus perpetuating inequality.

Implicitly, the challenges highlighted earlier in this chapter related to the utilisation of ICTs in education and the development of LNSSs could be attributed to the identified gaps in the three education policies.

Accordingly, the next section elevates the importance and relevance of facilitating the development of LNSSs in South Africa's basic education sector. It employs a conceptual framework to make explicit how to go about developing these skills in the South African context, which could close the identified gap in the education policies. This will go a long way to ensure learners achieve their personal goals and participate meaningfully in the global economy (Department of Basic Education, 2004).

2.4.2 The Relevance of the Learner Network Society Skills to the South African Education System

The White Paper on e-Education (Department of Basic Education, 2004, p.17), which is the policy on ICT in education in the South African context, envisaged that by 2013,

> "Every South African manager, teacher and learner in the general and further education and training bands will be ICT capable, that is, use ICTs confidently and creatively to help develop the skills and knowledge they need as lifelong learners, to achieve personal goals and to be full participants in the global community."

In contemporary society, participation in the global community implies globalisation. According to Castells (1999), globalisation is the process of collaboration among governments, businesses and people throughout the world, which has its origins in the 19th century as a result of improvements in transportation and ICT. In addition, it is a multifaceted human interaction that establishes and expands communication and collaboration across the globe, leading to greater interdependence in the exchange of goods, services and capital to promote economic growth and the quality of human life (Steger, 2003; Battro, 2004).

To realise the aspirations of the White Paper on e-Education, Carnoy and Castells (2001, p.3) highlight the significance of ICT infrastructure, which "includes networked computer systems, advanced telecommunications, information-based technology, fast transportation systems for people, goods and services, with a planetary reach, and the information processing capacity, to manage the complexity of the whole system". Battro (2014) supports this notion, elevating the Internet as one of the essential drivers of globalisation. He argues that the Internet ushers in a new era in which human interaction across many borders shapes a new human environment educationally, politically, scientifically, artistically, religiously, socially and economically. Hence, without the acquisition of the aforementioned network society skills, it would be difficult for learners to reach the required level of globalisation for social development and economic growth (Battro, 2004; Department of Basic Education, 2004).

Although Castell (1999), Steger (2003) and Battro (2004) praise globalisation for promoting free trade, its contribution to economic growth, increasing the global wealth and people's standards of living, sharing of technologies and more extensive cultural exchange, they also acknowledge its downside. Their arguments against globalisation include the growing individualised labour, which has lowered the global labour standards, undermining wages in rich countries and the exploitation of workers in poor countries, giving multinational enterprises mobile phones too much power and severe forms of ecological degradation, as well as the growing indebtedness of the Global South to the North. In addition, Schwab (2016) and Moll (2021) highlight the following as implications of globalisation: individualised labour processes and the global spread of work demanding high levels of expertise, growing service sector activities and diminishing middle-skills jobs, the permeable local community boundaries, as well as the widening gap between the rich and the poor.

Despite the aforementioned cons of globalisation, it may not be disputed that some national economies have increased their productivity due to free trade, competition, specialisation and ICT (Steger, 2003). In addition, it may not be disputed that ICTs are offering developing countries like South Africa an opportunity to compete favourably with developed countries economically. Hence, it is important for the South African education system to be aware of these advantages of globalisation and prepare learners accordingly to " …transform their economies into high value-added information economies that can compete with the advanced economics on the global market" (Faye, 2000 in Ogunsola, 2005, p.2).

The understanding of globalisation seems to be the conceptual space within which we need to understand the importance of LNSSs in contemporary education and society. However, it is worth highlighting at this point that the current study is not aimed at developing a theory on globalisation, but rather it is geared towards understanding the implications of globalisation for the development of requisite skills in the education context. For this reason, this chapter has provided a broad background on globalisation, its implications for the world of work and its specific claims about teaching and learning.

There is evidence that new technologies, production systems and the organisation of international trade continue to change the traditional way of work. As indicated earlier, an education system must create conditions for learners to learn using the Internet, enabling them to change and adapt to the new dictates of the work environment (Castells, 1999; Steger, 2003; Battro, 2004; Drennan & Moll, 2018).

Accordingly, in promoting more use of the Internet and the acquisition of LNSSs to succeed in the global economy, the National Development Plan states:

> "South Africans should be able to acquire and use knowledge effectively. To this end, the institutional arrangements to manage the information, communications, and technology (ICT) environment need to be better structured, to ensure that South Africa does not fall victim to a 'digital divide'." (National Planning Commission, 2011, p.23)

Without these skills, learners would be deprived of opportunities to participate and compete in the global world economically, socially and politically (Steger, 2003; Battro, 2004; Ogunsola, 2005; Zembylas & Vrasidas, 2005). Hence, in the current study's context, these skills are referred to as LNSSs, highlighted earlier in this chapter to prepare the reader for the relevance of these skills in advancing South Africa's aspirations in the utilisation of ICTs.

2.4.3 Policy Implications on the Development of Learner Network Society Skills

It is worth highlighting at this point that the current study's emphasis is not on content acquisition per se but on the deliberate design and delivery of guided learning aimed at the development of LNSSs. It is concerning that the reviewed policies do not provide guidance for 'how' teachers should go about creating opportunities for the development of LNSSs. In other words, the level of descriptions within these documents does not seem to explain clearly 'how' teachers could facilitate guided learning and the development of the desired skills.

Having highlighted the distinguishing characteristics of each policy document, especially in the context of the current study, this review finds the Technology CAPS document weak in articulating the teaching methodology to facilitate the development of LNSSs. Its inability to provide guidance to Technology teachers compromises the White Paper on e-Education's goal of developing the knowledge and ICT skills learners require to participate meaningfully in the global economy. This means guidance is not provided to teachers on 'how' to create opportunities for learners to utilise the available ICT resources to "access, analyse, evaluate, integrate, present and communicate information; create knowledge and new information by adapting, applying, designing, inventing and authoring information" (Department of Basic Education, 2004, p.14).

Based on this, it is up to the teacher to figure out their teaching methodology to guide the development of LNSSs and the eventual attainment of the learning outcomes. Yet, the attainment of these outcomes by using ICTs needs to be explicit, as the ambiguity could lead to non-standardised implementation. Accordingly, the current study concentrated on the 'how' part that is missing in teaching Technology that facilitates the development of LNSSs and the eventual attainment of the learning outcomes.

Interestingly, juxtaposing the basic education policies and competency-based curriculum frameworks from other developing countries like Kenya and Rwanda revealed similar patterns. In both countries, the curriculum is aimed at equipping learners with skills to thrive in a competitive and highly networked globalised world. As a result, both countries also propagate the use of ICTs to promote knowledge and skill acquisition through research, communication, collaboration, critical thinking, creativity and problem-solving (KMOE, 2017, 2018; RMOE, 2015a, 2015b). However, similar to Documents 1, 2 and 3, their policies and frameworks are silent on the network society skills learners should acquire to compete in the global economy. In addition, there is no guidance provided on teaching and learning methodologies to acquire these skills. This could justify the inequalities in the distribution of globalisation benefits between the developed and less developed countries, including the widening of the gap between the rich and the poor (Ogunsola, 2005; Schwab, 2016; Moll, 2021).

Significantly, the studies on ICT in education and the teaching of Technology do not elicit clear teaching and learning activities that promote the acquisition of LNSSs. In the main, the information gathered from these studies provides little that can be used to develop a framework that would guide teachers to use available ICT resources to promote the acquisition of the desired ICT skills, as well as the attainment of the learning outcomes in teaching Technology.

2.5 Chapter Conclusion

It has been argued that it is impossible to foster effective use of ICT resources with the traditional education approach. In this respect, education systems, schools and education programmes should be designed in a way that provides rich opportunities to develop LNSSs. Furthermore, teaching and learning approaches must be aligned accordingly, positively influencing learners' academic achievement to realise their personal goals and, importantly, the acquisition of LNSSs to be full participants in the global economy (Department of Basic Education, 2004; Huang et al. 2008; Atef & Medhat, 2015). The next chapter reveals the analytical framework developed for this study.

3 Chapter Three: The Development of an Analytical Framework

3.1 Introduction

This study focuses on understanding the development of LNSSs, as envisaged by the South African Education Policy documents and enacted by teachers in Full ICT schools. The insights gained will be used to inform the Teacher Professional Development Framework, which equips Technology teachers with the knowledge and skills to incorporate the development of LNSSs in their pedagogy. Accordingly, there is a need to have performance indicators that could be recorded as evidence of teaching and learning activities that facilitate the utilisation of ICT resources to enhance learners' understanding of the concepts, as well as the eventual attainment of LNSSs. These would inform an analytical tool that can be used to identify teaching and learning activities associated with GBCL from the data gathered in this study. The data sources were interviews, lesson observations, lesson plans and social media. The tool had to be brief and yet comprehensive to demonstrate how GBCL combines face-to-face learning in the classroom and online learning outside the classroom, contributing to self-directed learning, deep learning and reflective and critical thinking to solve real-life problems in teaching Technology.

The study's theoretical framework incorporates Siemens' (2011) four levels of Connectivist Learning, infusing Puentedura's (2009) SAMR Model, Hurley and Chater's (2005) Modelling Instructional Strategy and Laurillard's (2012) six learning types to facilitate guided learning in the acquisition of the LNSSs. This is aimed at improving the development of LNSSs as learners follow the BTDP to solve the problem identified. In this context, the teachers design teaching and learning activities to facilitate the development of LNSSs during face-to-face teaching and learning activities in the classroom and online. Learners become active participants during teaching and learning activities, aiming to promote the understanding of concepts and the eventual development of the LNSSs.

This analytic framework was developed from Siemens' (2011) four levels of interaction in Connectivist Learning: operation, wayfinding, sensemaking and innovation. Puentedura's four levels of learning in the use of ICT resources have been woven into these levels to accommodate blended learning in Gauteng Full ICT schools. These levels are elaborated by the six learning types, advanced by Laurillard (2012), namely inquiry, acquisition, practice, collaboration, discussion and production or digital authoring. The learning types make explicit the form of teaching and learning activities that will facilitate the development of LNSSs across the four levels of interaction in the developed GBCL Framework.

The infusion makes it possible to improve the LNSSs acquired during teaching and learning activities, while The Modelling Instructional Strategy enables the identification of teaching and learning activities that guide the development of these skills in the traditional classroom. Importantly, considering the South African context, the study infuses Anderson and Krathwohl's (2001) and Churches' (2008) cognitive levels to accommodate guided learning, facilitating the understanding of concepts and the eventual acquisition of LNSSs during face-to-face teaching and learning activities and online.

Based on the above, the development of the analytical framework resumes with the four levels of interaction, as presented by Siemens (2011). Table 3.1 depicts the analytical tool that was used in this study.

3.2 Analytical Tool Developed From Siemens' Four levels of Connectivist Learning and Laurillard's Six Learning Types

As indicated earlier, there is a need to have performance indicators that could be recorded as evidence of teaching and learning activities that promote the utilisation of ICT resources to enhance the learners' understanding of concepts in Technology, as well as the eventual attainment of LNSSs. Importantly, it is possible that the utilisation of ICT resources to acquire the desired skills could be located on any of Siemens' (2011) four levels of interaction depending on the learners' context and level of development. The last column in Table 3.1 was used to record teaching and learning activities observed across the six learning types during the three areas of data collection (see Appendices J, K and L for the Classroom Observation Analysis Instrument, Lesson Plan Analysis Instrument and Social Media Analysis Instrument, respectively).

In addition, the teaching and learning activities designed to promote the attainment of the aforementioned Technology outcomes should be in authentic contexts rooted in real situations outside the classroom using various "life skills in authentic contexts, such as decision-making, critical and creative thinking, cooperation, problem-solving and needs identification" (Siemens, 2011, p.9). In that way, learners would achieve the DBE's

Technology learning outcomes 6 and 8 as the designed learning activities will enable them to deal with inclusivity, human rights, social and environmental issues in their tasks while creating positive attitudes, perceptions and aspirations towards technology-based careers. The information used in column 2 (Table 3.1) is adopted from Laurillard's (2012) description of learning activities, the use of the available ICT resources and the eventual acquisition of the desired LNSSs, while the action verbs used in column 3 (Table 3.1) depict the LNSSs acquired at different cognitive levels in GBCL (Anderson & Krathwohl, 2001; Churches, 2008; Drennan & Moll, 2018). The arrows in Table 3.1 indicate how the content in each column links to the other.

Table 3.1: The Study's Analytical Tool

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Based on Data
4. Innovation Interaction ● Redefinition ● Modification	**6. Production/Digital Authoring** Create and share learning artefacts, present new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion	**Online Creation** Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making, creating and editing a video, transforming written tasks to visual form, developing material, creating content, using multimodal media to create sophisticated products, decision-making, teamwork/collaboration, compiling presentations, producing and representing knowledge, reference appropriately, inserting text, pictures, audio material and videos into assignments/presentations	
3.4. Sensemaking Interaction ● Augmentation	**5. Discussion** Through synchronous and asynchronous groups/ forums, bring together ideas from knowledgeable others to gain a clear understanding of information	**Online Evaluation** Posting, critiquing, checking, blog commenting and reflecting, tagging, inferring, networking, judging, moderating, monitoring, reviewing, receiving written and verbal comments digitally, decision-making, teamwork, collaboration	
3.3. Sensemaking ● Augmentation	**4. Collaboration** Collaborate with others synchronously or asynchronous in online discussion groups with digital and production tools (i.e., Open Education Resources) to facilitate learning	**Online Collaboration** Blog journaling, Twittering, commenting, annotating, subscribing, sharing work digitally through a blog, sending and receiving work through any app to and from the teacher and peers, receiving written and verbal comments digitally, teamwork/collaboration	
3.2. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification	**3. Practice** Operate different media (design tools, digital simulation, games, assessment tools, analytical tools, learning analytics) to demonstrate learning	**Online Practice** Implementing, carrying out, using, executing, downloading, uploading and sharing, editing, playing, hacking, inserting text, pictures, audio material and videos into assignments/presentations, completing tasks through an appropriate app, submitting completed digital work, sending and receiving work through any app to and from the teacher and peers, sharing work digitally through a blog	
3.1. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification	**2. Acquisition** Use of multimedia content (text, images, audio, video, multimedia, amination, augmented reality and virtual reality) to enhance the understanding of concepts	**Online Acquisition** Describing, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising	

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Based on Data
2. Wayfinding Interaction ● ‘**I do**’, ‘**We do**’, ‘**You do**’ Modelling Instructional Strategy ● Substitution	**Inquiry 2: Advanced Web Searching** Navigate through complex and information-loaded environments through the use of landmarks, symbols and environmental cues to find relevant information and people directly	**Advanced Searches** Refining searches to suit needs, using features of the advanced search: domain, country, language, file type, location on a page; entering appropriate keywords or phrases **Boolean Searching** Entering multiple appropriate keywords with Boolean refinements ‘and’ or ‘not’, modifying keywords to refine the searches, categorising and tagging	
1. Operation Interaction ● ‘**I do**’, ‘**You do**’, ‘**We do**’ Modelling Instructional Strategy ● Substitution	**Inquiry 1: Web Searching** Practice and recall how to operate different media to obtain information, combine and filter content from different digital social networks	**Remembering** Searching, googling, recognising, identifying, finding, retrieving, locating, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favouriting/local bookmarking, saving resources, accessing and using multimedia content, receiving tasks electronically, submitting completed digital work, recording and replaying spoken words, receiving written and verbal comments digitally, receiving tasks electronically, working independently	

Sources: Adapted from Anderson & Krathwohl, 2001; Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021

The section below illustrates how the elements in each row (Table 3.1) can be understood in the context of data analysis.

3.2.1 Interpretation of the Analytical Tool

To promote coherence and consistency in the utilisation of the framework, the interpretation of Table 3.1 must be clarified. In general, the four levels of interaction in Connectivist Learning in the first column, described with Anderson and Krathwohl's (2001) Bloom's cognitive skills and Churches' (2008) Bloom's digital taxonomy, are used to group the possible teaching and learning activities in the utilisation of ICT resources during the anticipated GBCL. To accommodate GBCL, the activities under each level are aligned with Puentedura's and Hurley and Chater's learning strategies. The levels are further elaborated by the six learning types in the second column (Table 3.1), advanced by Laurillard (2012). The learning types make explicit the teaching and learning activities that will facilitate the development of LNSSs across the different levels of interaction in the first column. These must be identified and used in the analysis of the teacher's lesson plans and the teaching and learning activities during classroom observation, including online activities outside the classroom. The third column (Table 3.1) depicts the LNSSs to be acquired at different cognitive levels, described through Anderson and Krathwohl's (2001) and Churches' (2008) Bloom's action verbs, to accommodate GBCL.

Lastly, the specific guided teaching and learning activities observed are recorded in the last column (Table 3.1). These are used as performance indicators that the use of ICT resources is contributing positively to the development of specific LNSSs. It is worth highlighting at this point that the acquired LNSSs may differ depending on the description of the learning activities. The evidence would be the study's observed teaching and learning activities.

Each row will now be expounded, starting with operation interaction and ending with innovation interaction. At this stage, the direct link between each level of interaction in Connectivist Learning and the six learning types mentioned in the literature review is insignificant. Instead, the focus is on the teaching and learning activities that have aided the development of the analytical framework.

Operation and Wayfinding Interaction

Table 3.2: Operation and Wayfinding Interaction

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Observed
Operation and Wayfinding Interaction	**Inquiry**	**Web searching** Searching, googling, recognising, identifying, finding, retrieving, locating, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favouriting/ local bookmarking, saving resources, accessing and using multimedia content, receiving tasks electronically, submitting completed digital work, recording and replaying spoken words, receiving written and verbal comments digitally, receiving tasks electronically, working independently	

The **operation and wayfinding interaction levels** (Table 3.2) create opportunities for learners to connect with different technologies through practice and recalling how to operate different media to facilitate their own learning. The purpose of interaction at this level is to enable learners to build their own personal learning environment to establish links with different information and opportunities (Wang et al., 2014). Learners learn how to follow the prompts or step-by-step instructions, obtain the information and combine and filter content from different digital social networks (Downes, 2011).

This could be achieved through Hurley and Chater's (2005) phases of modelling, wherein the teacher demonstrates a new concept, skill or approach to learning and learners learn by observing and practising (Eggen & Kauchak, 2001). For learners to recall and practice how to utilise the ICT resources available, this involves the **'I do'** phase, wherein the teacher demonstrates to the learners how to perform a task. In that way, the teacher passes their expertise to the learners in a series of staged, scaffolded steps.

As indicated earlier, at this point, interaction is aimed at building the learners' personal learning space with different technologies. This would enable learners to gradually conduct web searches independently to access multimedia content, promoting learning. Throughout Laurillard's (2012) inquiry process, the LNSSs acquired could include those indicated in the third column (Table 3.2). The last column was used to record teaching and learning activities through inquiry during data collection.

Sensemaking Interaction

Sensemaking interaction is a pattern recognition process to promote a coherent understanding of information. This is a prerequisite to the application of information in a new situation, analysis, evaluation and making informed decisions (Siemens, 2009 in Wang et al., 2014). To realise this, information from different human and non-human resources must be connected through a collaborative process. The process employs the GBCL Framework adapted from Laurillard's (2008) Conversational Framework. The framework captures a repetitive learning process that promotes the understanding of concepts and the acquisition of LNSSs in the context of the South African basic education system.

It categorises the learning process into the discursive and experiential levels during face-to-face teaching in the classroom and online to promote sharing information, aggregation, discussion, negotiation, reflection and decision-making through Laurillard's (2008) learner-teacher interaction, learner-learner interaction and learner-content interaction (Wang et al., 2014). Accordingly, opportunities are created for learners to engage in other learning types, such as acquisition, practice, discussions and collaboration (Laurillard, 2012). In other words, upon understanding concepts and acquiring the desired ICT skills through face-to-face guided blended learning in the classroom, learners practice and apply the concepts and ideas acquired online. Mainly, the learning in Technology entails communication and collaboration, reflection, decision-making and adaptation to solve the problem identified in the real-life situation.

The next section explains how sensemaking could be realised through Laurillard's (2012) acquisition, practice, discussions and collaboration.

Table 3.3: Acquisition in Sensemaking Interaction

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Observed
Sensemaking Interaction	**2. Acquisition**	**Understanding** Describing, naming, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising	

Acquisition entails using multimedia content, such as text, pictures, videos, illustrations, diagrams, amination, augmented reality and virtual reality, to enhance the learners' understanding of concepts (Laurillard, 2012). The teacher explains concepts using multimedia content and then engages learners in Hurley and Charter's (2005) **'We do'** modelling level, which could involve Laurillard's (2008) teacher-learner, learner-learner and learner-content interaction in demonstrating the understanding of concepts through questioning and dialogue. In addition, the understanding of concepts and the mastery of LNSSs could be scaffolded by providing prepared learner tasks that have the same structure as the first task in the **'I do'** level but with different features. However, guidance could be provided through the question-and-answer method or step-by-step instructions (Hermin, 2002). The interaction and feedback are repetitive until the teacher is happy that learners have grasped the concepts and the desired LNSSs and learners engage in online learning activities independently (Laurillard, 2003). This would enable learners to gradually conduct web searches independently to access multimedia content, promoting learning. Throughout the process, the LNSSs acquired could include those indicated in the third column (Table 3.3). The last column was used to record teaching and learning activities through acquisition during data collection.

Table 3.4: Practice in Sensemaking Interaction

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Observed
Sensemaking	**3. Practice**	**Applying** Implementing, carrying out, using, executing, downloading, uploading and sharing, editing, playing, hacking, inserting text, pictures, audio material and videos into assignments/ presentations, completing tasks through an appropriate app, submitting completed digital work, sending and receiving work through any app to and from the teacher and peers, sharing work digitally through a blog	

The prerequisite for **practice** is creating opportunities for learners to engage with digital tools. This could include using design tools, digital simulation, games, assessment tools, analytical tools and learning analytics to promote deep learning. At this level, learners work asynchronously to transform their understanding of concepts into practical adaptation and reflection of what was discussed and reflected in class (Neo et al., 2013).

This is Hurley and Chater's (2005) **'You do'** level, which requires learners to work independently. This means that the learner works alone on a third, similar problem. This might be a partially completed problem or task. To facilitate guided learning, the original model or worked example remains visible to remind learners of the steps to be followed to complete the task at hand. At this stage, the learners work alone. To accommodate the adopted GBCL Framework, the teacher determines the learners' level of mastery of the desired ICT skills and provides feedback. This could include providing further demonstration to learners who require additional support. Learners could rely on textbooks, workbooks, and handwritten notes taken in the classroom to complete their online tasks asynchronously at home (Levy, 2007 in Mbatha, 2020; Bath & Bourke, 2010).

As this study focuses on the development of LNSSs, this level should not be confused with exam conditions. Instead, it is about the teacher gradually withdrawing support to promote the mastery of the desired LNSSs (Mbatha, 2020). As learners practice, the LNSS skills acquired could include those indicated in the third column (Table 3.4). The last column was used to record teaching and learning activities through practice.

Table 3.5: Collaboration in Sensemaking Interaction

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Observed
Sensemaking Interaction	**4. Collaboration**	**Analysing** Blog journaling, Twittering, commenting, annotating, subscribing, sharing work digitally through a blog, sending and receiving work through any app to and from the teacher and peers, receiving written and verbal comments digitally, teamwork/collaboration	

Collaboration should be aimed at bringing together concepts from different domains in a novel way to obtain a coherent understanding of information to make informed decisions (Siemens, 2009 in Wang et al., 2014). This could include sharing teaching, learning and researched material to promote deep learning (Anderson, 2009; Downes, 2012; Belshaw, 2013). It is similar to Hurley and Chater's (2005) **'We do'** stage, which involves joint learning. In GBCL, face-to-face collaboration could entail small group discussions, interviews, role-playing and project work (Bath & Bourke, 2010).

The teacher provides a different task to enhance the understanding of the same concept covered in the **'I-do'** stage. Usually, this is done through the question-and-answer method (Hurley & Chater, 2005). Learners work on the tasks provided and share outputs to consolidate learning. They depend on each other for clarification. The teacher moves among the groups and provides the necessary guidance and support for further clarity (Levy, 2007 in Mbatha, 2020). To establish if learning has taken place, assessment and evaluation could entail demonstrations, written tasks, verbal responses, performance tasks or a portfolio of evidence (Bath & Bourke, 2010).

Progression into **online collaboration** could entail interviews, discussions, group work, chat rooms and digital learning shares in the virtual classroom. Teacher-learner interaction could be facilitated through emails, social media, online chats, online announcements and discussion forums. Opportunities should also be created for guided online learner-learner interaction. These could include digital learning shares, interviews and discussions, as well as group work in the virtual classroom and chat rooms (Bath & Bourke, 2010). The skills acquired could include those indicated in the third column (Table 3.5). The last column was used to record teaching and learning activities facilitating online collaboration during data collection.

Table 3.6: Discussion in Sensemaking Interaction

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Observed
Sensemaking Interaction	**5. Discussion**	**Evaluating** Posting, critiquing, checking, blog commenting and reflecting, tagging, inferring, networking, judging, moderating, monitoring, reviewing, receiving written and verbal comments digitally, decision-making, teamwork, collaboration	

The teacher should facilitate **discussions** by extending teaching and learning activities to online asynchronous or synchronous groups (Neo et al., 2013). This guidance is essential to promote sharing and negotiating ideas with others, reflection and adaptation. In other words, collaboration and discussions should be geared towards practice and application of the knowledge and skills acquired during face-to-face learning to solve the problem identified (Laurillard, 2012; Neo et al., 2013; Kizito, 2016; Laurillard & Kennedy, 2017). It is, therefore, important for both teachers and learners to understand their roles and responsibilities in online learning. The teacher should create the environment for learning, guide learners in the process of selecting and finding relevant content and facilitate learning (Neo et al., 2013).

It is worth highlighting at this point that the availability of learner ICT resources is a prerequisite to online discussions. These could include the Internet, web connection, digital content and digital learning software (Bath & Bourke, 2010).

The skills acquired throughout online discussions could include those indicated in the third column (Table 3.6). The last column was used to record teaching and learning activities facilitating online discussions during data collection.

Innovation Interaction

Table 3.7: Production/Digital Authoring in Innovation Interaction

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Observed
4. Innovation Interaction	**6. Production/ Digital Authoring**	**Creating** Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making, creating and editing a video, transforming written tasks to visual form, developing material, creating content, using multimodal media to create sophisticated products, decision-making, teamwork/collaboration, compiling presentations, producing and representing knowledge, referencing appropriately, inserting text, pictures, audio material and videos into assignments/ presentations	

Production/digital authoring calls for the creation of opportunities for learners to build and present new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion (Downes, 2012). In addition, existing ideas and products on OERs could also be adjusted to solve the problem identified (Anderson, 2009; Downes, 2012; Belshaw, 2013). In other words, innovation in the adopted framework requires learners to construct learning artefacts and share these on OERs (Wang et al., 2013).

These could be in the form of drawings, objects, models, e-portfolios, virtual learner performance or anything created by learners during communication, collaboration and sharing of artefacts on OERs (Anderson, 2009; Bath & Bourke, 2010; Downes, 2012; Laurillard, 2012; Belshaw, 2013; Wang et al., 2014; Laurillard & Kennedy, 2017). This means opportunities are created for learners to network, present and showcase the products made on online platforms. To realise this, learners should select the content, collaborators and creators of content (Neo et al., 2013). According to Levy (2007), at this point **(‘You do it**

together' phase), the teacher provides fading support to promote learner navigation of the web space independently, as well as demonstration of the learnt skills. The skills acquired through digital authoring could include those indicated in the third column (Table 3.7). The last column was used to record teaching and learning activities facilitating digital authoring.

3.2.2 How the Analytical Tool is Used

It is expected that the analysis of the data collected may not perfectly match all the indicators in the analytical tool because three months is allocated for the Technology design process (Department of Basic Education, 2011). As a result, it may not be possible to witness all the teaching and learning activities within the allocated 45 minutes for classroom observation. However, as the researcher, I intended to match the content of the analytical framework using data collected through interviews, lesson plans and social media. This accommodates a consolidated learning experience to determine the acquisition of LNSSs across the design process. What matters is the acquisition of these skills and the attainment of the learning outcomes. In a case where the learning types are not engaged at all, which is stated as 'no evidence', it was imperative for the researcher to establish the root cause and make the necessary recommendations, supporting the development of the desired skills. The teachers' espoused practices in terms of what they said were recorded as 'implied' and 'depicted' in the aforementioned indicators. Incongruities with the framework were highlighted and described.

As the development of LNSSs is described in each occurrence, Laurillard's (2012) six learning types were used to locate the desired skills to be acquired across the four levels of Connectivist Learning throughout the entire BTDP (investigate, plan, design, make, evaluate and communicate), outlined in the literature review. This assisted in determining a set of indicators likely to be improved when engaging the study's data. For example, if the teacher demonstrates to learners how to find multimedia content on the Internet and affords learners the opportunity to do the same, inquiry is at play. In that way, learners acquire LNSSs, such as searching, googling, recognising, identifying, finding, retrieving and locating. The links within the different levels can be determined through the design process. In that way, the framework promotes consistency in describing and understanding the development of LNSSs as portrayed in the teachers' practices.

It is worth highlighting at this point that the duration of the design process in problem-based learning in Grade 8 Technology is three months (Quarter One). As a result, the entire design process could not be observed in the classroom, as the duration for classroom observation was only 45 minutes. However, the teachers' three-month lesson plans do reflect the teaching and learning activities covering the entire design process. Accordingly, the lesson plans and the utilisation of social media were included in the analysis to accommodate teaching and learning activities beyond the study's classroom observation.

Importantly, in GBCL, the development of LNSSs in teaching Technology should happen as learners utilise ICTs throughout the design process to acquire content knowledge and communicate and collaborate with others on social networks to create learning artefacts to solve technological problems identified in the real-life situation. A balance needs to be created between the two to promote the acquisition of these skills, as per the White Paper on e-Education (Department of Basic Education, 2004).

3.3 Chapter Conclusion

While Siemens' (2011) four levels of interaction and Laurillard's (2012) six learning types were initially developed to help explain how learning takes place in Connectivist Learning, the discussions for each type attempted to illustrate how teachers can use them in blended learning to achieve the same effects. The emphasis of the discussion was on demonstrating how using ICT resources through GBCL could translate into the development of LNSSs. Variables in the development of these skills differ per teacher. Thus, using the analytical framework assisted in determining themes that could be used to inform a teacher framework on the development of LNSSs in the South African context.

The described analytical tool was used to analyse the components of the four theoretical frameworks infused into the conceptual framework. Thereafter, the experiences depicted in Chapter Five were organised to facilitate the emergence of major findings and discussions in Chapters Six and Seven that should inform the development of a teacher training framework that will cater for teaching different subjects in all South African schools, particularly previously disadvantaged schools with limited ICT resources. The next chapter explains the research design and methodology.

4 Chapter Four: Research Design and Methodology

4.1 Introduction

This chapter describes the methods and research design utilised in this study to generate a response to the main research question: *How does teaching Grade 8 Technology in the Gauteng Full ICT schools create opportunities for learners to utilise the available ICT resources to solve the technological problem identified from the real-life situation and acquire the network society skills in the process?* Figure 4.1 shows the data sources that were analysed in isolation and thereafter connected to respond to the research question.

Figure 4.1: Data Sources

Source: Author's construct

This study developed the GBCL Framework to understand how the four Grade 8 Technology teachers in the participating Gauteng Full ICT schools create opportunities for learners to utilise the available ICT resources to solve the technological problem identified and acquire the LNSSs in the process. Methodically, the framework reveals how teaching and learning activities in the classroom and online could translate into the acquisition of content knowledge and, in particular, the desired LNSSs (Siemens, 2011; Hurley & Chater, 2005; Puentedura, 2009; Laurillard, 2012).

4.2 Research Design

Understanding how teachers in the four Full ICT schools utilise ICT resources to equip learners with LNSSs is important in this study. As a result, the research design was chosen taking into consideration that which would assist in providing a response to the research questions for the portrayal of the phenomenon under study. For this reason, the qualitative research design was utilised as it studies "things in their natural settings, attempting to make sense of, or to interpret, [a] phenomenon in terms of the meanings people bring to them" (Denzin & Lincoln, 2000, p.3). In addition, this type of research enables the researcher to make observations and utilise various sources of information to develop a full understanding of the topic under study and draw conclusions (De Vos et al., 2011; Punch, 2011; Linneberg & Korsgaard, 2019). Furthermore, to draw conclusions, this design requires the description and analysis of the participants' individual and collective beliefs, insights and actions (McMillan & Schumacher, 2006). The next section describes the path this study followed in its examination of teacher practices.

4.3 Research Paradigm

A paradigm could be described as a lens through which people see the world around them, as informed by their belief systems, ideas and values. The worldview adopted provides researchers with an understanding of how to approach their research studies (Creswell, 2014). In the education context, the study of social phenomena comprises four main research paradigms: positivism, interpretivism, critical and pragmatic (Hermin, 2002; Kivunja & Kuyini, 2017; Davis & Fisher, 2018).

Broadly, positivism utilises methods of natural sciences to investigate social truths and sets aside the researchers' values and subjectivity to demonstrate its scientific and objective nature (Hermin, 2002; Kivunja & Kuyini, 2017). In other words, positivism argues that authentic knowledge comes from what is directly experienced through our senses. This means the best way to learn is through observation and hands-on experience rather than relying on abstract theories generated without any form of evidence.

In contrast, the interpretive paradigm views reality as being subjective and that it differs from person to person. It moves from the premise that it is through dialogue and interaction between the research participants and the researcher that the empathetic understanding of human activities and experiences could be captured (Hussain, 2015; Kivunja & Kuyini, 2017; Flick, 2018). The critical paradigm, on the other hand, is mainly aimed at investigating inequalities and injustices and emancipating people through raising awareness and promoting social, political and cultural change leading to equality and social justice (Hussain, 2015; Kivunja & Kuyini, 2017). Meanwhile, the pragmatic paradigm shuns the debates between the positivists and the interpretivists, addressing the weaknesses of other approaches and paying attention to doing what works to solve the 'real world' problems (Denzin, 2016 in Davis & Fisher 2018; Kivunja & Kuyini, 2017).

Based on these research paradigm descriptions, the interpretivist paradigm was identified as the most appropriate for the current study. Before delving into the research paradigm employed in this study, it is important to outline its philosophical approach. The section that follows attempts to do this.

The Ontological Assumptions

In philosophy, ontology is defined as the study of being or existence, which describes a particular field of knowledge (Tashakkori & Teddlie, 2008). In other words, it is the study of the groupings of things that exist in a particular field. Crotty (2003, p.10) defines ontology as "the study of being", focussing on "what kind of world we are investigating, with the nature of existence, with the structure of reality as such". This means, ontology is primarily concerned with the nature of existence of a particular phenomenon (Hudson & Ozanne, 1988). Hence Guba and Lincolin (1989, p.83) argue that ontological assumptions are those that respond to the question 'what is there that can be known?' or 'what is the nature of reality?' In other words, ontology seeks an answer to a research question through pointing to existing knowledge.

From the afore-mentioned definitions of ontology, it is worth indicating the ontology of this study. It uses an ontology which is fundamentally dependant on meanings derived in a social world. Accordingly, there is a need to bear in mind that people have their own thoughts, different interpretations and meanings. Importantly, investigations need to be characterised by the use of different research methods and techniques suitable for the interpretive design, in order to interpret the participants' inner thoughts and moods. Hence, the use of a case study as a methodology in this study focussed on the teachers' experiences, opinions, inner thoughts and moods.

The Epistemological Assumptions

Epistemology can be defined as 'a way of understanding and explaining how we know what we know' (Crotty,2003, p.3). In other words, it is concerned with how a researcher perceives the world and plans to uncover knowledge, to confirm its existence (Carson, Gilmore, Perry & Gronhaug, 2001).

The epistemological stance in this study is connectivism. Connectivism is the learning theory of the digital age (Siemens, 2005). The researcher accepts that the incorporation of guided learning into connectivist learning facilitates deep learning that translates into the acquisition of LNSSs (Siemens, 2011; Laurillard, 2012; Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021).

The reasons why connectivism is the epistemological stance of this study are as follow. First, the researcher is trying to find an answer to the question, "How does teaching Grade 8 Technology in Gauteng Full ICT schools create opportunities for learners to utilise the available ICT resources to acquire LNSSs?" by presenting the case studies of four Grade 8 Technology subject teachers. Second, meaning is established within a social context through interviews, classroom observations, lesson plans and social media. Finally, the researcher's view is that teachers are utilising the available ICT resources, to develop LNSS. However, at varied levels. This is represented in the conclusion as the researcher suggests the development of an ICT Teacher Development Framework, to promote standardised pedagogy in the development of LNSS by the Grade 7 – 9 Technology subject teachers.

The Axiological Assumptions

Axiology is defined as the "the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of the methods to the desired outcomes" (Crotty, 2003, p.3). It is aimed at describing, evaluating and justifying the use of particular methods (Wellington, 2000). In other words, it is a method employed to establish how valid knowledge can be attained. Therefore, axiology is the study of different research methods and analyses used in research (Stenbacka, 2001). This means the key question in axiology is how the researcher could go about finding out whatever she or he believes can be known.

The axiology of this study is a case study. A case study is briefly defined by Pring (2004, p.40) as 'the study of the unique case or the particular instant'. Cohen (2000, p.181) points out that case studies present research participants in their real-life situations. This enables the researcher to understand ideas better than simply obtaining these in abstract theories.

The next section zooms into the paradigm chosen for this study, to describe, explore and understand the context of developing LNSS by the Grade 8 Technology subject teachers in the four Gauteng Full ICT schools (Davis & Fisher, 2018).

Interpretivist paradigm

The interpretivist paradigm recognises that a researcher may not be divorced from the people involved in the study. It places emphasis on understanding the participants and their interpretation of the world around them to generate theory (Davis & Fisher, 2018). In addition, the paradigm is characterised by the utilisation of small sample sizes to gather detailed information that describes the individual experiences of those being studied. Information is gathered predominantly through observation, interviews, document analysis and focus groups. Unlike the deductive reasoning which begins with a theory, developing a hypothesis from that theory, collecting and analysing data to test the hypothesis and eventually arrive at a confirmation ; this study employed inductive reasoning, wherein theories are informed by onsite observations and experiences as opposed to testing theories in positivism. The emphasis is on the interpretation and understanding of the information gathered (Hermin, 2002; Davis & Fisher, 2018).

The utilisation of the interpretivist lens enabled the researcher to assess the teachers' understanding of the network society skills learners must acquire, as espoused in the preamble of the Grade 7 – 9 Technology CAPS document which states,

> "Technology education was introduced into the South African population in recognition of the need to produce engineers, technicians and artisans needed in the modern society and the need to develop a technologically literate population for the modern world. The subject stimulates learners to be innovative and develops their creative and critical skills." (Department of Basic Education, 2011, p.8)

Furthermore, the researcher was able to observe in practice the utilisation of ICT resources in the classroom and online, as well as determine if that translated into the development of LNSSs. At the same time, the researcher was able to interrogate the teachers' lesson plans to establish how teachers purposefully plan for learner utilisation of the available ICT resources to elicit productive learning activities (Merriam, 2002; Hussain, 2015).

4.4 Research Approach

An inductive approach was employed in the current study as the study aimed to observe teachers in practice to understand how they utilise the available ICT resources to develop LNSSs. Linneberg and Korsgaard (2019) support this notion, positing that the approach is relevant in an investigative study to assist the researcher in making observations, understanding the area under study and generating a theory through inductive reasoning. Thus, this study developed the GBCL Framework to guide the development of LNSSs in the South African context (Hermin, 2002; Davis & Fisher, 2018).

4.5 Research Strategy

This is a multi-case study since four teachers were involved because the utilisation of ICTs by each teacher becomes a case on its own. Furthermore, it contributes to the establishment of a common understanding in the study, namely the development of LNSSs (Stake, 1995). Accordingly, the study involves “a number of sites or participants” (McMillan & Schumacher, 2006, p.316). In this thesis, four schools and four teachers were selected. Their schools have ICT infrastructure and they admitted that they are utilising ICTs in teaching Grade 8 Technology. Miles and Huberman (1994) support this notion, arguing that multi-case studies leverage the development of a generic theory. This was the current study’s intention.

A case study is defined as an investigation of a confined system over a specific timeframe and place, which utilises various sources of information to collect data in a natural setting to develop a full understanding of the topic under study (De Vos et al., 2011; Punch, 2011). Data in a case study was gathered through various methods, such as observations, interviews and document analysis (Punch, 2011; Creswell, 2014). The main disadvantage of a case study is that its findings cannot be generalised to the entire population (Mouton, 2008). Davis and Fisher (2018) support this view, asserting that based on its limited transferability to the general population, policymakers may be reluctant to fund interpretive research. Furthermore, they argue that data collection and analysis exercises can be laborious and time-consuming.

Despite the aforementioned disadvantages, the current study adopted this methodology as it enabled the researcher to engage the Grade 8 Technology teachers from the four Gauteng Full ICT schools, interrogate their lesson plans, observe teaching and learning in natural settings, share the teachers' meanings and develop insights on how teachers in these schools utilise ICTs for teaching and learning (Hussain, 2015). Importantly, it helped analyse the teachers' espoused and enacted practices under study to identify the development of LNSSs. It is envisaged that the findings not only contribute to the body of knowledge but also assist in developing a framework for teaching Technology that would guide teachers in developing the learners' technological literacy, as well as various life skills, such as problem-solving in the real-life situation, innovation, communication, collaboration and effective utilisation of resources, as well as prepare learners for the business world (Ankiewicz, 1995; Reddy et al., 2003; Department of Basic Education, 2011).

4.5.1 Sampling

Since this was a multi-case study, Miles and Huberman (1994) point out that each sample is unique as each situation has some characteristics it shares with others while some characteristics it does not share with others. As a result, the findings become comprehensive. The similarity among the study's participating teachers is that they all used ICTs to teach Technology. However, their methodology differs. These similarities and differences in their teaching practices were revealed by using an analytical tool developed from Siemens' (2011), Hurley and Chater's (2005), Puentedura's (2009) and Laurillard's (2012) concepts (Chapter Three).

In a qualitative research study, sampling is defined as a process the researcher uses to select participants based on their relevance to the field of study to gain insight into the key issues of the research topic (Flick, 1998; Denzin & Lincoln, 2000; Nieuwenhuis, 2007). In other words, sampling was used to identify people who would assist in providing information to respond to the research questions. Generally, for a qualitative case study, purposive sampling is used to choose participants in a deliberate way based on the type of information the research participants have (Merriam, 2009; Neuman, 2011; Punch, 2011). Based on the current study's main research question, the development of LNSSs was the investigated phenomenon. As a result, the sample had to demonstrate how teaching Grade 8 Technology creates opportunities for learners to utilise the available ICT resources to acquire LNSSs.

In a multi-case study, the selection criteria are generally informed by the research questions (Miles & Huberman, 1994). Accordingly, the schools selected for this study had to be those who believe their utilisation of ICTs in their teaching practice develops LNSSs. As already indicated, the analytical framework enabled the description of teaching and learning activities geared towards the development of LNSSs and the attainment of the learning outcomes in the CAPS document.

Selection of Sites

According to Miles and Huberman (1994, p.27), the selection of a case study should “set boundaries: define aspects of your case(s) that you can study within limits of your time and means, that connect directly to your research questions, and that probably will include examples of what you want to study”. Hence, the starting point was to identify the Gauteng Full ICT schools as sites.

As indicated in Chapter One, this study responds to other studies that revealed a perceived mismatch between the desired educational outcomes and societal expectations despite the investments made in ICT infrastructure in Gauteng schools (Dlamini & Na-Allah, 2015; Msiza et al., 2020; Dlamini, 2022). Logically, the yardstick for the sites dictated that the selected schools were Full ICT schools as teachers in these schools utilise ICTs for teaching and learning.

The ICT schools sampled had to be reduced to a manageable size. Thus, the contextual factors were considered. Rauscher (2011) and Ankiewicz (2013) attest that Technology is a fairly new subject that lacks well-established teaching and learning methodologies to equip learners with the requisite skills to thrive in the global economy. To be part of the solution in the South African Basic Education Sector, Grade 8 Technology teachers were included in the selection criteria. Grade 8 is the lowest grade at the secondary school level. The idea was to establish how teachers ‘catch them young’ and equip them with the requisite ICT skills to thrive in the global economy. Importantly, the teachers selected had to confirm that they utilise ICT resources in their teaching and learning methodologies. Miles and Huberman (1994) support this notion of political importance in sample selection as it increases the chances of implementing the study’s recommendations.

Purposeful sampling was employed in choosing the schools (Neuman, 2011; Punch, 2011). The Gauteng province has a representation of a Full ICT school population, with teachers utilising ICTs for teaching and learning purposes. Although Full ICT schools are spread across the province, the schools selected fall within the Johannesburg and the Ekurhuleni regions for convenience and easy access (Scott & Morrison, 2005). Thereafter, schools within the two regions with Grade 8 teachers who utilise ICTs to teach Technology had to be identified. Officials from the Reorganisation of Schools and E-learning Department at the provincial level assisted in this regard (Marshall, 1996). In addition, the researcher obtained the names of all the Full ICT schools and the principals' contact details. This was aimed at accessing the Grade 8 teachers who believe their utilisation of the ICT resources provided in their schools translates into the development of LNSSs. This formed the basis for the selection of the research participants (Miles & Huberman, 1994). Thirteen schools in the two regions with teachers purportedly utilising the ICTs to equip learners with the network society skills were convenient and accessible to the researcher (Scott & Morrison, 2005). However, the researcher was only able to find four schools and four teachers who satisfied the criteria and were willing to participate in the study (Appendix E and Annexure F). This was done through emails, telephone calls and onsite visits in some instances. Although the sample size may seem small, as the researcher, I was assured by Patton (2002), who argues that qualitative research has no stipulations on the sample size. What is important is "the purpose of the inquiry, what's at stake, what is useful, what will have credibility, and what can be done with available time and resources" (Marshall et al., 2013, p.12). A description of these schools is provided in Chapter One.

Selection of Participants

The research questions (Appendix I) guided the selection of participants to ensure the required information on the phenomenon to be studied was obtained (Creswell, 2007; Merriam, 2009). Thus, the participants were identified based on their assertion that their utilisation of ICTs promotes the acquisition of LNSSs. The teachers had to be using the available ICT resources in the classroom and outside the classroom regularly. It is from such practice that the phenomenon under study could be demonstrated strongly (Scott & Morrison, 2005). Furthermore, they had to be offering Technology in Grade 8, as already indicated. To ensure their anonymity, pseudonyms are used (Mr Bozwana, Mr Cele, Ms Sithole and Mr Banda). Their schools are also referred to as School 1, 2, 3 and 4.

Except for Ms Sithole, the participants were male. Ideally, gender equity during participant selection would have been preferred. However, the selection criteria derailed this. In other words, the selection process had to be informed by the phenomenon under study to promote the provision of suitable information in the area of interest. Maykut and Morehouse (1994, p.56) support this notion, arguing that the "approach for selection depends on which will give the clearest understanding of the phenomena".

This study anticipates utilising the results from the four different school contexts to help inform an ICT teacher training framework on the development of LNSSs in South Africa for teaching Grade 7 – 9 Technology. Miles and Huberman (1994, p.29) support this methodology of a multi-case study, asserting that,

> "By looking at a range of similar and contrasting cases, we can understand a single-case finding, grounding it by specifying how and where and, if possible, why it carries on as it does…If a finding holds in one setting and, given its profile, also holds in a comparable setting but does not in a contrasting case, the finding is more robust."

In addition, although the participants in a multi-case study might perform the same activity, in this case, the frequent utilisation of ICT resources in their teaching and learning activities. However, their practices differ (McMillan & Schumacher, 2006). Arguably, it is the distinctiveness of each context and how it strengthens the understanding of the same phenomenon that contributes to the richness of the current study.

Description of the Participants and Sites

Chapter One describes the Full ICT schools. This section goes further to profile the teachers participating in this study.

Table 4.1: Description of Participating Teachers and Sites

School	Teacher[1]	Qualifications	Years of Experience Offering Technology	Available Teacher ICT Resources	Available Learner ICT Resources
School 1	Mr Bozwana	Masters in ICT	13	Laptop, Smartboard, Smart Cell Phones	Tablets, Smart Cell Phones, Smartboard
School 2	Mr Cele	BED (Hons) Technology	1	Laptop, Smartboard, HDMI Cable, USB	Tablets, Smart Cell Phones, USB
School 3	Ms Sithole	BED Technology	7	Laptop, Smartboard, Smart Cell Phones, Smart Pen	Tablets, Cell Phones,
School 4	Mr Banda	BED Technology	8	Smartboard, Laptop	Tablets, Laptops

[1]Pseudonyms

School 1 is in a township largely occupied by a coloured community, while Schools 2 and 4 are in a black township. School 3 is in a suburb previously occupied by whites only. School 4 is one of the schools that enjoyed the privilege of being provided with ICT resources across all the grades when the GDE piloted Paperless Classrooms.

In all four schools, the chalkboards have been removed in all the classrooms. Teachers have access to ICT resources and utilise these for teaching and learning.

Although it may be argued that the findings from smaller samples may not be generalizable to the broader population, Patton, 2002 in Marshall, Cardon, Poddah and Fontenot (2013) posits that there are no rules for sample size in qualitative research. The size of the sample largely depends the expected reasonable coverage of the phenomena, based on the purpose of the study. This includes the right amount of data through the interviews to achieve the research objectives. Corroboration this notion is Islam and Aldaihani (2022) who argue that when the last interview transcripts reveal the same findings, this means the researcher has reached a saturation point. As a result, the data collection process can stop. Accordingly, the size of the sample is justifiable, as the data collected from the four teachers enabled the researcher to accomplish the purpose of the study.

4.6 Research Instruments

As indicated earlier, this study aimed to facilitate the development of a teacher training framework on the development of LNSSs in teaching Technology that is customised to the South African context. As a result, the triangulation of what the teachers said and what they actualised in practice, as well as how this matches the South African national curriculum policy aspirations, is appropriate to this study. According to Ertmer (2005), what teachers say (espoused) and what they do (enacted) are likely to impact each other. It is this connection that enabled the full understanding that this study sought.

To capture the essence of teacher practices in the development of LNSSs, Neuman (2011) identifies two types of data to be collected: primary and secondary. Primary data is the original information, evidence or items that are gathered from those who lived in the past and have survived to the present. On the other hand, secondary data is readily available data that has already been collected by other researchers who have spent a lot of time studying primary data.

According to Creswell (2003) and Punch (2011), the basic types of data in qualitative research include interviews, focus groups, observation, documents and multimedia (audio and visual material). The current study utilised all of these, except for the audio material and focus groups.

Interviews and observations were used as the primary data collection tools. The interviews enabled the researcher to obtain the views, opinions and experiences on the phenomenon under study directly from the research participants (Kvale, 1996; Monette et al., 2005; Lunenburg & Irby, 2008). Field notes were taken during the interviews. These were read after the interviews to establish meaning and an understanding of the phenomenon under study. The observations, on the other hand, enabled the researcher to witness and record teacher practices in action rather than relying on their espoused practices in response to the questions posed during the interviews (McMillan & Schumacher, 1993; King & Stahl, 2020).

4.6.1 Primary Data

Semi-Structured Interviews

Once the schools were identified, a telephonic discussion with the school principals led to an informal synchronous virtual meeting with the recommended teachers. As per Opdenakker's (2006) recommendation, formal interviews and classroom observations were then scheduled with the teachers via email and WhatsApp who had confirmed frequent utilisation of ICT resources in their teaching and learning activities. One component of data collection was face-to-face interviews. According to Rosnow and Rosenthal (1996), such interviews create an opportunity to establish rapport with the participants and stimulate trust and cooperation, as well as probe sensitive areas.

Importantly, using semi-structured interviews enabled the teachers to reveal their beliefs about the utilisation of ICTs in developing LNSSs. This also created an opportunity for the researcher to assist teachers with the interpretation of questions. Where possible, as much information as possible was extracted from them (Merriam, 1998). To achieve the intended purpose, the interview questions were divided into three sets (Appendix I). Section A was aimed at profiling the teachers and establishing their understanding of teaching Technology, as outlined in the CAPS document. Section B sought to elicit web-based activities designed for learners to enable them to obtain information, enhance the understanding of concepts and promote communication and collaboration to solve the problem identified to guide the development of LNSSs.

Lastly, Section C focused on the lesson plan to determine if teachers purposefully plan for the teaching and learning activities to enable learners to utilise the available ICT resources throughout the design process, as well as showcase the learning artefacts created. During the interviews, some responses provided sufficient information, while others did not. In such instances, the researcher followed up with probing questions. This enabled teachers to provide more clarity on the issue at hand. The additional information was useful during the coding process and the employment of the analytical framework informed by Siemens' (2011) Four Levels of Interaction in Connectivist Learning, Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types. Consequently, the researcher could determine the extent to which each teacher's utilisation of the available ICT resources discursively in the classroom and experientially outside the classroom promoted the development of the desired LNSSs across the four levels of Connectivist Learning.

Mouton (2012) cites several factors that could influence biases during interviews. However, in this case, this was averted by assuring the teachers that the researcher had limited experience in the phenomenon under study and was privileged to learn from their best practices. This created confidence among the teachers. As a result, they freely expressed their beliefs. By doing so, the researcher could identify some mismatch between their espoused and enacted practices. These discrepancies are revealed in Chapter Five.

To elicit adequate data, the researcher implemented Kemmis and McTarggart's (1988) recommendation of one-on-one interviews. In other words, teachers were interviewed individually to promote elaborate responses, which assisted the coding process, as indicated earlier. Furthermore, pen and paper were used to record each interview because the researcher was more comfortable with this method as it is easier and quicker to scan through a written record, unlike listening to or watching the entire interview (Denzin & Lincoln, 2013).

In instances where further clarification was required on the utilisation of ICT resources, particularly outside the classroom, to gain more insight into guided online teaching and learning activities that promoted the acquisition of LNSSs, field notes were also employed to record the responses. These were used later on to reflect on teaching and learning activities that promoted communication and collaboration.

I, as the researcher, have intimate experience with teaching and learning methodologies in the classroom and the lesson plans, as well as the social media utilised (Creswell, 2003). This enabled me to establish if there were consistencies between the individual teacher's espoused and enacted practices, verifying the trustworthiness of their beliefs in the development of the desired skills. As a result, the similarities and inconsistencies could be highlighted and justified. This translated into a comprehensive description of each case.

Observations

At this point, the researcher observed and recorded the teaching and learning activities in the classroom and online rather than only relying on the teachers' responses to questions during the interviews (McMillan & Schumacher, 1993; King & Stahl, 2020). Accordingly, observations in GBCL include teacher and learner interactions, reflective contributions, peer evaluation data through social media, visual data in the form of images and videos, digitally created artefacts, recordings of learner activities, email correspondence, etc. (Miles et al., 2014; Kizito, 2016; Linneberg & Korsgaard, 2019).

In this case, the researcher observed how teachers purposefully utilised the available ICT resources to elicit productive learning activities and the acquisition of LNSSs. To realise this, the developed GBCL Framework was used as a lens to observe the creation of LNSSs that stimulate meaningful dialogue and promote a collaborative learning community. In other words, throughout the observation process, the researcher looked for evidence of network society skills acquired by learners as they utilised ICT resources through GBCL teaching and learning activities aligned to the four levels of Connectivist Learning (Siemens, 2011; Hurley and Chater, 2005; Puentedura, 2009; Laurillard, 2012).

Figure 4.2 depicts indicators of teaching and learning activities that facilitate the development of LNSSs in GBCL.

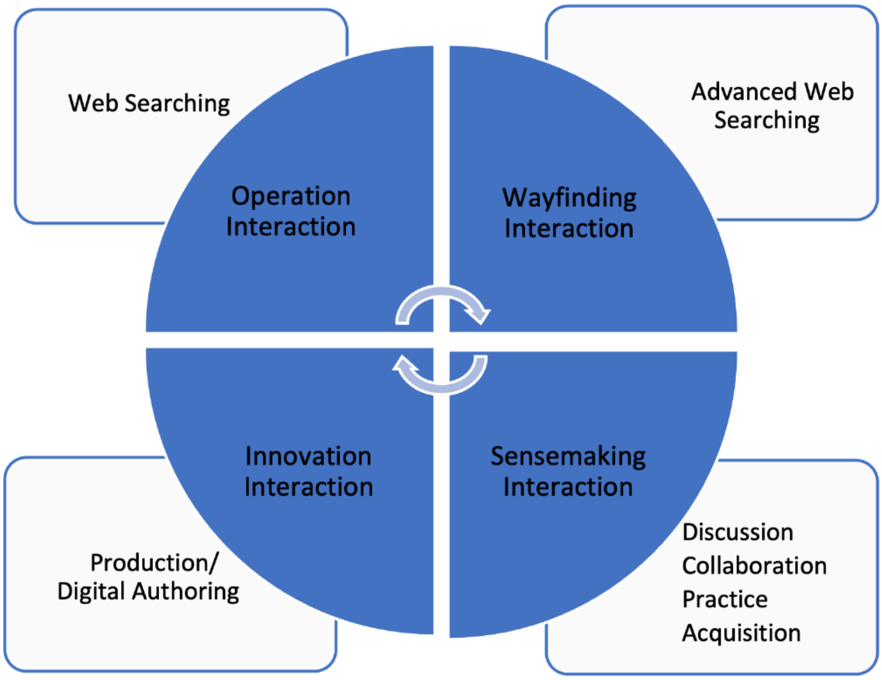


Figure 4.2: Teaching and Learning Activities Facilitating the Development of Learner Network Society Skills

Source: Author's construct

The researcher looked out for these indicators, expounded in Chapter Three, throughout the data collection process. The observed lessons were video-recorded to capture the intricacies of integrating ICTs into teaching and learning activities (Appendix G). Throughout the process, the researcher positioned the recording equipment unobtrusively at the back of the classroom to ensure the classroom's flow of activities was not disrupted (Marshall & Rossman, 2016). In addition, the researcher used the indicators (Figure 4.2) to note any teaching and learning activities aligned to Laurillard's (2012) six learning types and the associated LNSSs. Furthermore, the researcher noted events that transpired in the classroom that stood out and were likely to bring things into perspective at a later stage. All these enabled the collection of the data required to facilitate a thorough description of the pedagogical practices, not only based on what the researcher saw and heard but also on reflections (McMillan & Schumacher, 2010).

4.6.2 Data Analysis

After capturing the empirical data, the researcher proceeded to thematic analysis and document analysis. The former was employed to identify patterns of meanings across the data sets that responded to the research question: *How does teaching Grade 8 Technology in the Gauteng Full ICT schools create opportunities for learners to utilise the available ICT* *resources to acquire network society skills?* The latter refers to the analysis and interpretation of documents that contain information about the phenomenon under study to find meaning, gain understanding and produce empirical knowledge (Rapley, 2007; Corbin & Strauss, 2008; De Vos et al., 2011).

Thematic Analysis

Coding was used to analyse the data. To promote a systematic and credible research process, the researcher used the six interconnected stages illustrated in Figure 4.3 to guide data analysis from the initial transcripts to the development of a storyline, leading to the conclusions.

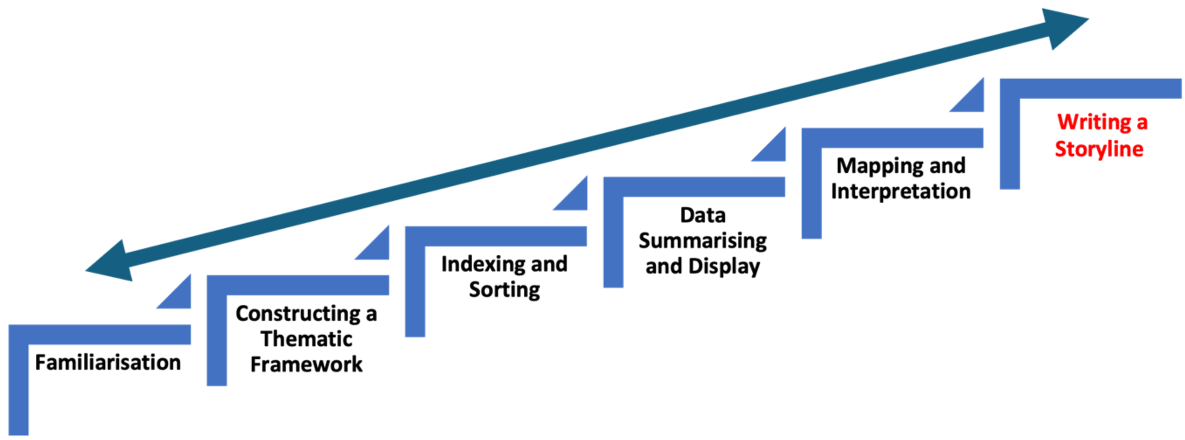


Figure 4.3: Stages of Thematic Analysis

Sources: Adapted from Gibbs, 2007; Maguire & Delahunt, 2017; Hackette & Strictland, 2018

Figure 4.3 depicts the sequential stages of data analysis, with each stage building on the previous one. However, thematic analysis is a repetitive process with forward and backward movement across the different stages (Strauss & Cobin, 1990). During this process, the researcher engaged in the following steps:

1. **Familiarisation:** read the entire body of data several times, made rough notes, briefly highlighted ideas that came to mind and jotted down early impressions regarding the highlighted sections (Maguire & Delahunt, 2017; Hackette & Strictland, 2018).
2. **Constructing a thematic framework:** built a collection of codes from both the conceptual-driven and data-driven codes. The former was drawn from the literature (previous research),

while the latter was drawn from interview transcripts, field notes from classroom observation, lesson plans and social media (Ritchie & Lewis, 2003; Gibbs, 2007).

3. **Indexing and sorting:** read through the text line by line, reflected on the data at hand by focusing in detail on its characteristics and lifted the main content or meaning (Strauss & Cobin, 1990). Once the core content or meaning had been established, the researcher labelled these accordingly using the conceptual or data-driven codes.
4. **Data summarising and display:** recorded information for each research participant using thematic charts. This entailed having one verbatim quote from each participant and using the next column to highlight an initial interpretation of the data and other relevant information to formulate the initial themes, for example, tone of voice, facial expression, hand gestures, etc., during the interviews and classroom observation.
5. **Mapping and interpretation:** developed the main themes and sub-themes from the initial themes identified from the preceding stage (Gibbs, 2007; Maguire & Delahunt, 2017; Hackette & Strictland, 2018).
6. **Writing a storyline**: moved up and down, backward and forward between the different stages to lift the main theme that brought together all the other themes into a storyline. The process culminated in drawing conclusions and eventually responding to the main research question (Gibbs, 2007; Maguire & Delahunt, 2017).

Document Analysis

Punch (2011) points out that any source of both past and current information that points the researcher to the indicators to respond to the research question could be employed in document analysis. As a result, the documents that the researcher identified to aid analysis were the teachers' lesson plans against Siemens' (2011) four levels of Connectivist Learning and Laurillard's (2012) six learning types, which informed the analytical framework. The analytical framework was employed throughout the analysis. The results enabled the researcher to determine if teaching and learning activities were aligned with the aforementioned indicators facilitating the development of LNSSs. Hodder (1994, p.704) points out that "document analysis can say many different things in different contexts". The data in the current study was analysed and interpreted in the context of the analytical framework expounded in Chapter Three. It is worth highlighting at this point that the data could be interpreted differently should another tool be used.

Identification of Documents

Bowen (2009) highlights the importance of determining the most relevant documents for the analysis and understanding the purpose of each. Arguably, purposeful sampling was also utilised in the identification of documents. Since the study is aimed at developing a framework to guide teachers in the development of LNSSs, it was essential for the researcher to consider the teachers' lesson plans, as these documents were envisaged to outline teaching and learning activities that facilitate the development of LNSSs.

The next section explains the evaluation and relationship phases employed to analyse the documents.

Evaluation Phase

Using the analytical tool's indicators, this phase aimed to determine the appropriateness of the planned teaching and learning activities in promoting the development of LNSSs by responding to the question: *What is the value added in this study?* To assist the process, Laurillard's (2012) six learning types, outlined in Chapter Three, were used as indicators of the teaching and learning activities that contribute to the acquisition of the desired ICT skills. Table 4.2 was used for this purpose.

Table 4.2: Lesson Plan Analysis Tool

Laurillard's (2012) Six Learning Types		**Lesson Plan Overview**
Innovation Interaction	**Production/Digital Authoring**	An integrative description of teaching and learning activities in the lesson plan to highlight LNSSs to be acquired upon utilisation of each learning type
	Relevant extract of teaching and learning activities from the lesson plan	
Sensemaking Interaction	**Discussion**	
	Relevant extract of teaching and learning activities from the lesson plan	
	Collaboration	
	Relevant extract of teaching and learning activities from the lesson plan	
	Practice	
	Relevant extract of teaching and learning activities from the lesson plan	
	Acquisition	
	Relevant extract of teaching and learning activities from the lesson plan	
Wayfinding Interaction	**Advanced Web Search**	
	Relevant extract of teaching and learning activities from the lesson plan	
Operation Interaction	**Web Searching**	
	Relevant extract of teaching and learning activities from the lesson plan	

Relationship Phase

In this phase, the data collected during the interviews, classroom observations, lesson plans and social media were used to establish coherence between teacher practices and the developed analytical framework. This required a response to the question: *What is the relationship between the aforementioned indicators and the teachers' espoused and enacted practices?*

The lesson plan analysis tool in Table 4.2 helped to determine the planned teaching and learning activities that facilitate the development of LNSSs. This is used in Chapter Six to compare with teacher practices. Crotty (1998) and Bowen (2009) argue that the research methods used to collect and analyse data should be linked to the research hypothesis, including other data sources, such as interviews, observation, document analysis, etc. As proposed by Bowen (2009), the same analytical tool was employed for the analysis of other datasets to address the current study's research questions. This study appreciates the teachers' context; hence, the four theoretical frameworks lifted from the conceptual framework in Chapter Two were incorporated into the analytical tool.

During data analysis, every input contributed to a deeper understanding and interpretation of the development of LNSSs by the participating teachers. Later, this is matched with the analytical framework developed in Chapter Three to establish compliance. As indicated earlier, the field notes assisted with the preliminary analysis as the researcher attempted to understand the teachers' practices. The notes were used to capture distinct features that seemed to be pertinent to the description of each teacher's enacted practices.

In addition, this study used its conceptual framework to develop an analytical framework that could be used to facilitate the development of LNSSs in the context of Full ICT schools in Gauteng using the available ICT resources. The process covered all the participants in their different contexts and mainly focused on understanding the area under study (Merriam, 1998). The analysis had to establish the development of LNSSs in terms of the four learning strategies: the four levels of interaction in Connectivist Learning, the SAMR Model, the Modelling Instructional Strategy and the six learning types, as expounded in Chapter Two.

Upon developing the analytical framework, the next step entailed the identification of words and phrases from the transcripts that relate to the description of teaching and learning activities associated with the development of LNSSs, as depicted in the analytical tool. Labelling emanating from the contents in the analytical tool was used to summarise teacher practices (Strauss & Cobin, 1990). Using the analytical framework, the relationship between the teachers' espoused and enacted practices generated insights into the nature of teaching and learning activities that seem to assist in providing a deeper understanding of the development of LNSSs.

Table 4.3 juxtaposes the four teachers' espoused and enacted practices to highlight the conditions that support the optimum development of the desired skills across the four levels of the GBCL Framework and implicitly Laurillard's (2012) six learning types.

Table 4.3: The Study's Participating Teachers' Espoused and Enacted Practices

Teacher	O		W		S		I		Learner Network Society Skills		Supporting Conditions
Mr Bozwana	En	Es	En	Es	En	Es	En	Es	Enacted Practices	Espoused Practices	
Mr Cele											
Ms Sithole											
Mr Banda											

O: Operation Interaction; W: Wayfinding Interaction; S: Sensemaking Interaction; I: Innovation Interaction; En: Enacted Practices; Es: Espoused Practices

The coherence between the teachers' enacted and espoused practices is provided in Chapter Seven.

Thereafter, tables were populated to capture the four teachers' practices against the analytical framework's requisites to identify emerging trends among the four teachers, improving the impact of the Technology CAPS document's silence on how teachers should utilise ICTs in the design process to solve the problem identified. The impact could be generalised to other Full ICT schools in Gauteng. This is inductive inference, a notion supported by Mouton (2012, p.81), who asserts that qualitative research can be used as "a form of inductive inference called analytic induction, to generalise from a small number of examined cases to a larger population of similar cases".

Themes emerged when using the analytical tool, which were used to identify elements of consistencies and inconsistencies that were vital in responding to the last research sub-question*: What **conditions promote** the teachers' enactment of their espoused practices to promote the acquisition of LNSSs and realise the goals of education policies?* The themes facilitated the development of concepts that seemed to be crucial in the extent to which teachers created opportunities for learners to acquire network society skills. Conclusions on teacher practice were made based on the findings.

The process continued to Chapters Seven and Eight as greater insight into the value that the four teachers portrayed in their utilisation of the available ICT resources to develop LNSSs. This point facilitates the response to the main research question: *How does teaching Grade 8 Technology in Gauteng Full ICT schools create opportunities for learners to utilise the available ICT resources to solve the technological problem identified from the real-life situation and acquire LNSSs in the process?* By using Siemens'(2011) and Laurillard's (2012) concepts, teacher practices in the utilisation of ICTs to develop LNSSs were revealed, described and examined. From the process, the researcher identified key areas that would inform the South African Teacher Development Framework on teaching and learning activities that promote the acquisition of LNSSs.

4.7 Validity and Reliability

According to Hammersley (1990, in Silverman, 2010), validity is the extent to which a description matches the reality of social phenomena to which it refers. Neuman (2011) concurs and describes validity as a truthful presentation of social reality in line with the viewpoint of the participants who have hands-on experience of the situation. Thus, validity demonstrates that the information presented is credible and represents a true reflection of the participants' experiences and views about the research problem to enhance the researcher's credibility (Janesick, 1998). The current study's credibility is demonstrated by the full descriptions and the evidence shown in Chapters Five and Six. The researcher also recorded the teachers' responses word for word. This is evident in the presentation of data in Chapter Five. In addition, the details given in describing what was observed improves the study's credibility.

The utilisation of the analytical framework, crafted from Siemens' (2011) four levels of Connectivist Learning, infusing Puentedura's (2009) SAMR Model, Hurley and Chater's (2005) Modelling Instructional Strategy and Laurillard's (2012) six learning types, is customised to suit the context of Full ICT schools in Gauteng. Thus, the analysis is verifiable as it is based on data (Lincoln & Guba, 1985). To promote trustworthiness, as the researcher, I presented parts of this thesis during PhD workshops and received feedback from critical peers during writing retreats. The feedback assisted in identifying areas of improvement in the presentation of the study's analysis and findings.

On the other hand, an element of reliability and validity must be included in the research study to promote the consistency of the data presented (Neuman, 2011). Reliability is the extent to which a researcher would find the same results should the study be repeated (Merriam, 2002). To promote reliability, the researcher collected data alone. As a result, the participants were never affected emotionally to the point of negatively impacting their performance. In addition, validity and reliability tests were conducted, as described in the next section.

4.7.1 Instrument Validity and Reliability Test

Validity

The detailed process used to validate the data analytical tool is discussed in this section, as well as the reliability assessment. Validity is understood to be an assessment that tests and measures if a tool has been designed to measure what it was designed to measure (Field, 2005). On the other hand, Ghauri and Grønhaug (2005) explain validity as a process that measures how well the collected data covers the area of investigation. The data analytical tool developed was authenticated using the three dimensions of face validity, namely: accuracy, agreeability and relevance, to establish if it measured what it was supposed to measure (Thomas et al., 1992). For this research thesis, face validity was utilised using three experts in educational technology who all have a minimum qualification of master's degrees in ICT and Educational Technology coupled with a minimum of five years of industry experience as practitioners in the development of learning frameworks and monitoring tools for teacher professional development.

One expert works for the GDE, while the other two are contracted with the Matthew Goniwe School of Leadership and Governance. These experts were engaged to solicit opinions on the categorisation and adaptation of frameworks used to develop the study's data analytical tool. The study adopted three validated frameworks: (i) Laurillard's (2012) six learning types, (ii) Puentedura's (2009) SAMR Model and (iii) Hurley and Chater's (2005) Modelling Instructional Strategy. The developed analytical tool has five domains of skills acquisition and categorisation of knowledge and skills progression, which underwent face validity and content validity using the content validity index.

During a workshop, the analytical tool was presented to the experts, who then engaged with the researcher (the tool's developer). The experts went on to develop a questionnaire that they utilised to rate the degree of accuracy, acceptance and relevance using the dichotomy of favourable and unfavourable about the alignment of the domains against the adapted skills and knowledge progression (Table 4.4). According to Taherdoost (2016), face validity is a subjective judgement on the operationalisation of a construct; thus, evaluation tools were developed to mitigate against bias.

Rating Scale

Table 4.4: Rating Scale Validation of the Study's Data Analytical Tool

No.	Domain	Response a) Favourable b) Unfavourable	Ratio of rating by experts
1.	**Domain 1:** ● Innovation Interaction	Favourable	2/3
2.	**Domain 2:** ● Sensemaking Interaction ● Augmentation	Favourable	1/3
3.	**Domain 3:** ● Sensemaking '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy	Favourable	3/3
4.	**Domain 4:** ● Wayfinding Interaction ● Substitution	Favourable	3/3
5.	**Domain 5:** ● Operational Interaction	Favourable	3/3

Descriptive statistics were used to understand the data obtained from the expert's questionnaire responses. The degree of acceptance and relevance had a mean score of 60%.

Frequency distribution was utilised to record how often a category was selected with a similar response item (Table 4.5).

Table 4.5: Content-Related Validity Index

Item Number on the Instrument	**Domain**	**Number of Descriptors Learner Network Society Skills**	**Number of Learner Network Society Skills Excluded**	**Rater 1**	**Rater 2**	**Rater 3**
4	Innovation Interaction (Redefinition)	37	3	-	-	x
3.4	Sensemaking Interaction (Augmentation)	18	2	-	x	-
3.3	Sensemaking (Augmentation)	15	0	-	-	-
3.2	Sensemaking (‘**I do**’, ‘**We do**’, ‘**You do’** Modelling Instructional Strategy) Modification-**Practice**	21	1	x	-	-
3.1	Sensemaking (‘**I do**’, ‘**We do**’, ‘**You do**’ Modelling Instructional Strategy) Modification-**Acquisition**	11	0	-	-	-
2	Wayfinding Interaction (‘**I do**’, ‘**We do**’, ‘**You do**’) Modelling Instructional Strategy Substitution	9	0	-	-	-
1	Operation Interaction (‘**I do**’, ‘**We do**’, ‘**You do**’) Modelling Instructional Strategy Substitution	32	4	x	x	-
		143	10	5/7 or 0.71	5/7 or 0.71	6/7 or 0.86

Based on the expert review panel, ten items in Table 4.5 were deleted from the 143 LNSS items on the instrument. These did not meet the content validity index, nor were they related to the seven domains. In terms of universal agreement, two experts agreed that 133 out of 143 items had content validity. The average agreement rate on the content validity tool was 0.76. Other descriptors were rephrased based on the expert's suggestions.

Reliability

According to Taherdoost (2016), reliability concerns the extent to which a measurement of a phenomenon provides stable and consistent results. Two of the three experts who validated the analytical tool each observed a different Technology class to determine if the instrument was adaptable and produced similar results. The validity instruments utilised by the experts are presented in Appendix M. The experts agreed that the tool had a high level of consistency.

Above all, my supervisor's input on the writing contributed positively to the study's validity and reliability as areas of improvement were pointed out and addressed during consultation sessions.

4.7.2 Ensuring Trustworthiness of the Study

In a qualitative study, it is essential to authenticate the research findings. "Authenticity means giving a fair, honest and balanced account of social life from the viewpoint of someone who lives it every day" (Neuman, 2000, p.171). According to Patton (2002) this assists the researcher to establish the trustworthiness, credibility, dependability, transferability and confirmability of a study. The degree to which the researcher is able to establish confidence in the trustworthiness of the findings is regarded as credibility. Accordingly, in terms of the research participants, including the research context, the findings must be true. In this study, the findings emanated from detailed transcriptions of interviews with the Grade 8 Technology subject teachers, classroom observations of Technology subject lessons, lesson plans and the use of social media.

Transferability and dependability suggest that should the same study be conducted under similar conditions, the findings of both studies would be commensurate (Neuman, 2014; McNeill & Chapman, 2005). As a result, the transferability of this study may only be confirmed by future researchers.

The confirmability of a study indicates the degree to which the results of a study could be verified by researchers. It is "… concerned with establishing that data and interpretations of the findings are not figments of the inquirer's imagination, but are clearly derived from the data" (Tobin & Begley, 2004 in Anney, 2014, p.279). Therefore, a reflexive journal, triangulation and an audit trail promote the confirmability of a qualitative study (Lincoln & Guba, 1985). The records kept of how this study was conducted include, interview transcripts, video recorded classroom observations of Technology subject lessons, lesson plans and pictures depicting the use of social media. These were transcribed for data analysis. Throughout the data collection process, a reflexive journal was kept wherein from time to time, the researcher reflected upon the interviews and the classroom observations that were conducted.

To increase the credibility of the results, it is essential for the researcher to use varied methods, to promote triangulation (Flick, 2014; Patton, 2014). Triangulation is a method in which three or more sources are used to assess and cross-check the authenticity of data (Denzin, 1978). For this study, the requirements for triangulation were realised by using different sources of data. The researcher employed classroom observations, lesson plans, social media and the literature review, to cross-check the trustworthiness of the information provided by the teachers during the interviews (Patton, 2014).

4.8 Ethical Considerations

To strike a balance between advancing knowledge and protecting the rights of those being studied, the researcher complied with the research ethics (McMillan & Schumacher, 2006). As a starting point, the research proposal was submitted to the University of the Witwatersrand's ethics committee (non-medical) to obtain ethics approval to conduct the study. The committee confirmed the study's ethical trustworthiness; thereafter, the researcher was granted approval to proceed with data collection (Appendix A).

Once the proposal was approved, the researcher completed the GDE's Research Request Form seeking permission to obtain data from the identified four Full ICT schools. The GDE granted permission, providing a signed letter stating the purpose of the research, prospective participants, the methods to be used and the stipulated timeframes to collect data (Appendix B).

The researcher used the letter to access the schools. She introduced herself to each school's principal and the Grade 8 Technology teachers. After that, advocacy sessions were convened with the research participants to promote understanding of the rationale behind the study, what was expected of them, and how the study would benefit both the researcher, the participants and the training of Technology teachers in the long term. In addition, permission was sought from the learners to venture into their space as the researcher also intended to observe learner participation in the online space (Annexure C). The participants were guaranteed anonymity and confidentiality of the information gathered (Appendix H) (Scott & Morrison, 2005; McMillan & Schumacher, 2006; Neuman, 2011).

At the end of the advocacy sessions, the principals and the four teachers read and signed the consent forms as evidence that the researcher was given permission to collect data. The learners took the parent or guardian information sheet (Appendix D) and consent forms (Appendix H) home for their parents to sign, giving permission for their children to be observed in class. The signed consent forms were collected by the researcher prior to the collection of data. The hard copies of the raw data collected have been stored in a locked safe. Soft copies can only be accessed by the researcher on a password-protected personal computer.

Data collection started once all the ethics protocols were in place. Scott and Morrison (2005, p.88) support this ethics process, asserting that it is imperative that the researcher "abides by the principle of informed consent" and adheres to research ethics (McMillan & Schumacher, 2006).

4.9 Chapter Conclusion

The conceptual framework employed in this study contributed to the choice of the research design, as well as the methods used. The literature and the research methods engaged assisted in steering through the obstacles that the researcher encountered. Throughout the process, the methods used generated responses to the research questions in ways beyond expectation. The next chapter demonstrates this.

5 Chapter Five: Presentation of Findings

5.1 Introduction

In this chapter, the data is presented, interpreted and analysed to respond to the research questions.

Main Research Question

How does teaching Grade 8 Technology in Gauteng Full ICT schools create opportunities for learners to utilise the available ICT resources to acquire LNSSs?

Research Sub-Questions

1. What are the teachers' espoused practices in the development of LNSSs?
2. How do teachers **plan** for learner utilisation of ICT resources to develop LNSSs to solve real-life problems?
3. How do teachers **utilise** ICT resources to develop LNSSs?
4. What **conditions promote** the teachers' enactment of their espoused practices to promote **the acquisition of LNSSs** and realise the goals of education policies?

The analytical framework expounded in Chapter Three is the focal point of analysis in this chapter. This study utilised the developed GBCL Framework to make sense of teaching and learning activities at four Full ICT schools in Gauteng.

Literature has demonstrated how ICTs could be utilised to acquire the requisite skills to thrive in the modern world (Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021). The framework enabled the researcher to determine if the Technology teachers utilise the ICT resources provided by the GDE to create opportunities for learners to acquire LNSSs.

Table 5.1 outlines the teachers who participated in this study. Although this data did not form part of the investigation, it provides a better understanding of the teachers' practices during the data analysis.

Table 5.1: Outline of Participating Teachers

School	Teacher[1]	Qualifications	Years of Experience Offering Technology	Available Teacher ICT Resources	Available Learner ICT Resources
School 1	Mr Bozwana	Masters in ICT	13	Laptop, Smartboard, Smart Cell Phones	Tablets, Smart Cell Phones, Smartboard
School 2	Mr Cele	BED (Hons) Technology	1	Laptop, Smartboard, HDMI Cable, USB	Tablets, Smart Cell Phones, USB
School 3	Ms Sithole	BED Technology	7	Laptop, Smartboard, Smart Cell Phones, Smartpen	Tablets, Smart Cell Phones
School 4	Mr Banda	BED Technology	8	Smartboard, Laptop	Tablets, Laptops

[1]Pseudonym

All teachers who participated in this study are qualified to teach Grade 8 Technology (Table 5.1). In addition, Mr Bozwana has an ICT in Education Masters qualification. Three of the teachers have sufficient experience teaching the subject. Mr Cele only has one year of experience and may be deemed inexperienced in teaching the subject. Importantly, the teachers and learners who participated in the study have ICT devices (Table 5.1).

The study is built on the premise that Connectivism is the learning theory of the digital age (Siemens, 2005). It accepts that the GBCL Framework makes vivid how guided learning environments facilitate deep learning that translates into the acquisition of LNSSs (Siemens, 2011; Laurillard, 2012; Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021).

This chapter, therefore, examines how the GBCL Framework's three learning strategies could translate into the acquisition of LNSSs. As indicated in Chapter Two, these skills include learning how to access relevant information from the Internet, process, evaluate, manage, organise and reorganise the information, select optimal tools for the task, and generate and utilise knowledge innovatively to create products or services that would contribute positively to the economy and the quality of human life (Steger, 2003; Castells, 2004; Wilson & Scalise, 2015; Muller et al., 2017). In other words, this chapter examines how the utilisation of ICTs in teaching and learning equips learners with the necessary ICT skills to thrive in the economic market locally and globally. To make explicit the ICT skills to be acquired by learners, whenever the study refers to LNSSs, it denotes the relevant skills learners could acquire as they engage across the four levels of interaction in Connectivist Learning, as depicted by Siemens (2011).

Using conceptually-driven codes generated insights into the nature of teaching and learning activities that provide a deeper understanding of the development of LNSSs in four Gauteng Full ICT schools. In addition, data-driven codes provided insights into the rationale behind teacher practices. The next section explains how codes were used to present the study's data.

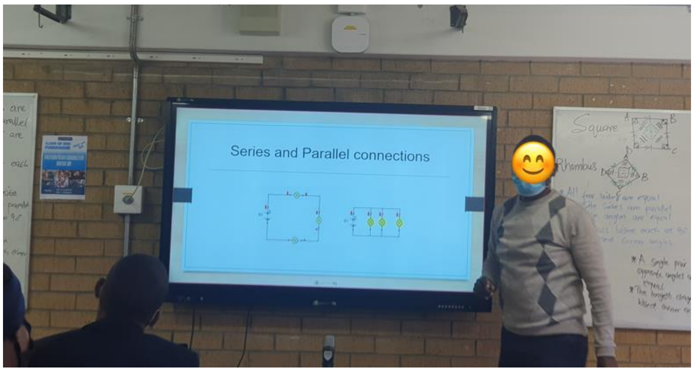
5.2 Data Presentation

This section includes the presentation of the interview, lesson observation, lesson plan and social media data for each of the four participating teachers. Concepts from the analytical framework are highlighted to make it easy to draw similarities and contrasts that should help in making sense of the data discussion in Chapter Six. To gain insight into how the four teachers from the participating Full ICT schools utilise the available ICT resources to develop LNSSs, the following interview questions aligned to the first three sub-questions were used:

1. What, in your understanding, is the main aim of teaching Technology as a subject?
2. What web resources do learners utilise to obtain information, communicate and collaborate with others to solve the problem or address the need identified?
3. What web-based activities have you designed for learners to enable them to utilise the available ICT resources, obtain information and understand the information obtained to solve the problem identified?
4. How do you utilise the teacher ICT resources available in your classroom to guide learning and the acquisition of the desired ICT skills?
5. In your lesson planning, what activities have you designed for learners to enable them to utilise the available web resources to plan, investigate, design, make and evaluate the artefacts/products made digitally?

The following sections present the four teachers' data.

5.3 Teacher 1: Mr Bozwana



Interview

In teaching Technology, Mr Bozwana utilises a variety of ICT resources. Furthermore, he goes beyond the classroom borders in his utilisation of ICT tools. He said,

> "*I use quite a number of ICT resources: laptop, Smartboard, overhead projectors. The chalkboards have since been removed. I also communicate with learners through their smart cell phones.*"

Mr Bozwana uses several digital resources to teach Technology, indicating that his ICT proficiency is high, which gives him leverage to be innovative in exposing his learners to activities that promote LNSSs. In addition, he takes advantage of learners' access to smart cell phones, enabling him to give them instruction beyond the classroom. With access to the Internet both at home and at school, learners can engage with others for longer periods, thus acquiring LNSSs.

In his understanding of teaching Technology, Mr Bozwana considers the acquisition of skills in an evolving world as the main aim of teaching Technology. The following extract from the interview transcript attests to this:

> *Researcher: "What, in your understanding, is the main aim of teaching Technology as a subject?"*
>
> *Mr Bozwana: "Very important. It helps learners acquire skills for the changing world."*

To realise this aim, he gives learners projects aimed at equipping them with the knowledge and skills to address human needs. He also understands that the policy, the CAPS document

(Department of Basic Education, 2011), requires Technology as a subject to be geared towards learners creating solutions to meet people's needs and wants in their real-life situations. As an example, he said,

> *"Learners were given a project to construct a bridge and a tower. They had to learn to join things together and make them strong using the knowledge and skills acquired in Technology. Through teaching Technology, learners acquire the ability to invent and create things, as well as appreciate their environment. Technology is utilised to develop our country. Our country needs good infrastructure, for example, road networks and all the things, for example, electricity generating plants."*

This activity indicates that learners operate at the production level in LNSSs. Constructing models requires engagement of other learning types that equip learners with the knowledge and skills they need to construct objects.

Operation Interaction and Wayfinding Interaction

Mr Bozwana finds ways to use ICT resources in the classroom to mediate content knowledge, share teaching and learning activities, search for information, and promote a better understanding of concepts. His interview response depicts this:

Researcher: "What web resources do learners utilise to obtain information, communicate and collaborate with others to solve the problem or address the need identified?"	Substitution
Mr Bozwana: "The teacher laptops are loaded with textbooks. I use the laptop in class and connect it to the Smartboard. In that way, I am able to share the textbooks on the Smartboard for learners to obtain relevant information. I also use the Internet to find information on a related topic covered in class. Learners also use Google to obtain information. They use social platforms to communicate and collaborate	Blended learning Web searching/Inquiry Collaboration

> *with others. For example, they use WhatsApp and email.*"

His use of the laptop to share content in textbooks can be considered as operating at Puentedura's (2009) substitution level. Digital technology is used instead of books. The teacher and learners use web resources as they search the Internet, and this is at the wayfinding level. The technology used here is at a lower level; it is when they use social platforms that their use of technology moves up to sensemaking interaction in Connectivist Learning.

Mr Bozwana also creates opportunities for learners to navigate through the software to promote the acquisition of LNSSs. For example, his learners access digital content on YouTube. The following dialogue depicts this.

> *Researcher: "What web-based activities have you designed for learners to enable them to utilise the available ICT resources, obtain information and understand information obtained to solve the problem identified?"*
>
> *Mr Bozwana: "We have no choice but to use it. We were found wanting by COVID-19. I make learners find animations on YouTube and attach videos to make them understand certain concepts. I also give them projects Projects are a good way to make learners utilise all ICTs. Project-based learning forces learners to get information*."

Acquisition

Production

As learners look for animations with specific content to extend their knowledge and understanding, the teacher allows them to apply their search skills to participate in projects. By the nature of such tasks, learners draw from lower levels of interaction to create and share the product of their learning artefacts.

Sensemaking Interaction

Mr Bozwana presents digital content in class and guides learners through face-to-face demonstrations in the classroom, as well as gives learners practical tasks to help them grasp new concepts and promote the acquisition of the desired ICT skills. The following extract from the interview transcript depicts this.

Researcher: "How do you utilise the teacher ICT resources available in your classroom to guide learning and the acquisition of the desired ICT skills?"

Mr Bozwana: "The teacher laptops are loaded with textbooks. I use the laptop in class and connect it to the Smartboard. In that way, I am able to share the textbooks on the Smartboard for learners to obtain relevant information. I also use the Internet to find information on a related topic covered in class. I demonstrate to learners in class how to obtain information, as well as access videos on YouTube and Google." Practical Assessment Tasks make learners go onto the web to search for information [and] go on Google and YouTube to find information and see video[s] on what to do. They go to YouTube and watch videos to cement what they were looking for on the web to promote better understanding. For example, how to understand abstract information. Videos provide concrete objects. For example, a simple animation of an engine.

Substitution
Blended learning
Web searching/Inquiry
Modelling
Operation Interaction and Practice
Acquisition

As the teacher demonstrates technical skills, he models and contributes to learner sensemaking that can be established through practice in practical tasks that are assessed, thus forcing learners to apply the skills taught. This could be at the **'You do'** stage in Hurley and Chater's (2005) Modelling Instructional Strategy. The advantage of this exposure to digital content is that it opens opportunities to establish learning concepts.

Furthermore, to make sense of the information obtained during teaching and learning in class and promote a deeper understanding of what is required to solve the problem identified, the learners communicate and collaborate with one another through social media.

Mr Bozwana said,

> *"Learners like sharing. They use WhatsApp groups, for example, to remind each other of what the teacher said in class [and] share videos. Certain learners learn better from their peers. They teach each other through WhatsApp group[s] and share information. For collaboration, learners are given homework. Groups are formed to enable learners to share information in responding to the task provided."*

Collaboration

Social media seems to play an important role in enabling learners to participate in sensemaking in online groups and share information outside the classroom. Mr Bozwana designs learning to foster such interactions through collaborative activity online.

Innovation Interaction

Planning, designing and creating prototypes to solve the problem identified, as well as showcasing the finished product, is done physically in class. Mr Bozwana attributes this to a lack of capacity:

> *Researcher: "In your lesson planning, what activities have you designed for learners to enable them to utilise the available web resources to plan, investigate, design, make and evaluate the artefacts/ products made digitally?"*
>
> *Mr Bozwana: "We are not yet there where we make learners do things digitally. As teachers, we still need to be trained to make learners create things digitally. When we want them to investigate, we make them*

Restricted LNSS acquisition

Web searching/Inquiry

use Google. The ICT skills they would acquire include searching information [on] the web. Searching skills on the web will be important later in life when these learners are at university."

He acknowledges that the work created by learners does not result in the creation of digital content. However, this remains at the sensemaking level. My Bozwana frames this as not benefiting learners in class but in future. His inability to expose learners to tasks where they can create objects digitally is attributed to his lack of skill. What matters is that these experiences prepare learners for the practical tasks he referred to earlier.

The school's strategy to get learners to create content online seems to be a move towards advancing learners to operate at the innovation interaction level. However, the teacher does not indicate that he will guide this experience. He points out that his learners are already using social media to showcase their work, which is not necessarily part of the lesson planned. They do it voluntarily. He said,

"As a school, we are planning to do that. The school has a website. Learners want recognition. We are planning a school competition. The competition will be posted on the school website so that the public can see the work done by learners. Learners also use WhatsApp individually or a WhatsApp group, to showcase their work."

Augmentation

This innovation could be because of the skills they have acquired in class through the teacher's demonstration and outside the classroom as they interact using social media. They can search for information for their formal school learning so they take it beyond that and create digital content that they share out of school.

Conclusion: Interview

During his interview, Mr Bozwana indicated that he utilises the available ICT resources to substitute the chalkboard and traditional textbooks. He employs modelling to facilitate understanding concepts and demonstrate the task to be carried out. He then creates opportunities for learners to conduct web searches to find multimedia content using Google or YouTube to enhance their understanding of concepts (acquisition). In that way, learners practice finding information on their own. There is no indication that he creates opportunities for production or digital authoring. However, he argues that his learners do engage at the augmentation level when showcasing the physical products made on social media. There is a semblance of blended learning where out-of-class activities given by the teacher give learners an experience that augments and establishes what they learnt in class.

The next section analyses the observed lesson, which depicts Mr Bozwana's enacted practices and learning activities.

Lesson Observed

Topic: Revision of Simple Circuits and Components

ICTs used: Smartboard, laptop, tablets and smart cell phones

Overview of the Lesson

This was a revision lesson intended "to [combine] thinking and doing in a way that links abstract concepts to concrete understanding" (Department of Basic Education, 2011, p.9). Mr Bozwana introduced the lesson using a PowerPoint Presentation, reminding learners of electrical components. He used a diagram on the Smartboard to demonstrate the input, output and control devices in a simple circuit. He further pointed to a real-life example of a simple circuit by switching on and off the lights in the classroom.

He used the question-and-answer method to establish the learners' understanding of the following concepts: a simple circuit, input, output, control devices, series and connection, as well as parallel connections. To link what they do in class to a real-life situation, he asked learners to provide practical examples of these concepts in the real-life situation, as well as prompted them to recall what they had learnt in Natural Science.

Throughout the lesson, Mr Bozwana engaged in blended learning. Learners read the definitions displayed on the Smartboard or Google definitions on their own from their tablets. Through guided learning, Mr Bozwana also created opportunities for learners in the classroom to find diagrams and videos on the Google platform to promote a better understanding of the concepts. As a result, learners who initially struggled to obtain information on their own from the Internet were observed googling, recognising, locating, finding and retrieving information from their tablets independently.

The LNSSs depicted in the analytical tool were used to examine the different LNSSs acquired as the teacher engaged them in teaching and learning activities.

Operation Interaction

Learners had their ICT devices in class. Opportunities were created for learners to operate and connect with different technologies (operation interaction) to learn how to follow prompts on the ICT devices to obtain information (web searching) and combine and filter content from different digital social networks (Figure 5.1). The classroom observation revealed elements of personal learning as learners could follow prompts on their devices (operation interaction) and find information, diagrams and videos on their own (practice) without guidance from the teacher, enhancing their understanding of concepts (acquisition). As the teacher used a PowerPoint Presentation to explain a simple circuit and its components (substitution), learners browsed on their tablets (practice) to search for definitions and illustrations of a simple circuit and its components. As a result, learners were observed acquiring LNSSs, such as implementing instructions, loading and playing.

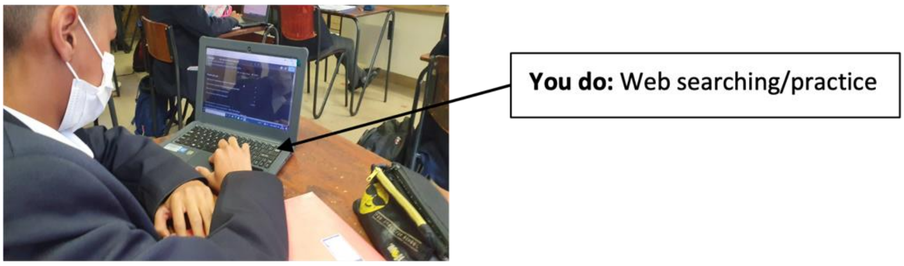


Figure 5.1: Learner Conducted Web Searches

Source: Author's photograph

Wayfinding Interaction

Teaching and learning activities in the classroom create opportunities for learners to find multimedia content in complex, information-loaded digital learning environments using symbols.

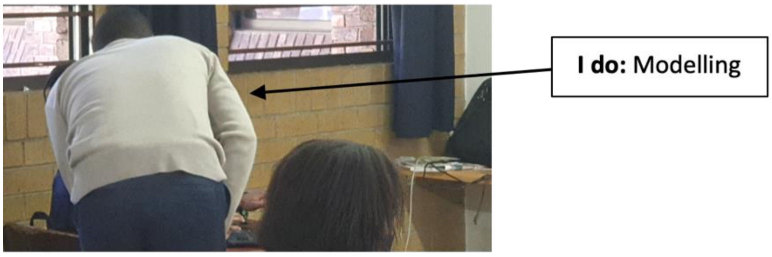


Figure 5.2: Mr Bozwana Demonstrated Navigating Complex Information to a Learner

Source: Author’s photograph

Mr Bozwana employed a modelling strategy to demonstrate to learners how to navigate complex information to access multimedia content, namely, definitions, diagrams and videos showing a simple circuit face-to-face (Figures 5.2 and 5.3). He employed blended learning to help learners engage in wayfinding interaction. He verbally guided learners on how to search and find a definition and a diagram, as well as a video showing a simple circuit. Thereafter, opportunities were created for learners to access multimedia content.

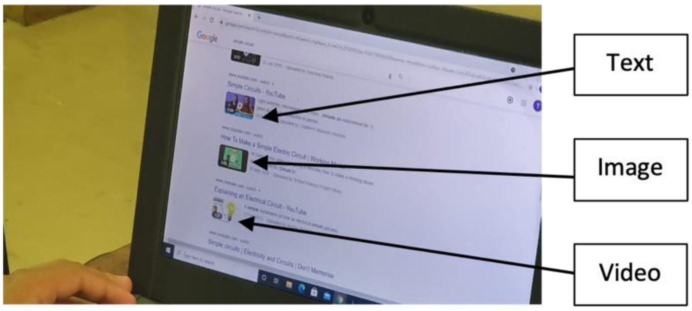


Figure 5.3: An Example of a Complex Information-Loaded Digital Environment

Source: Author’s photograph

Figure 5.3 illustrates the screen as the learner navigated through a complex information-loaded digital environment, locating text providing definitions of a simple circuit, images illustrating a simple circuit and a video demonstrating how to develop a simple circuit.

At the end of the lesson, Mr Bozwana provided learners with a task (practice) and reminded them how to access a video to understand how an electric circuit works:

“Type in ‘simple circuit.’”

“Go to videos.”

“Click videos.”

“Scroll down”

Guided learning

Sensemaking Interaction

At the sensemaking interaction level, Mr Bozwana also employed blended learning to facilitate learner understanding of concepts, as well as the acquisition of LNSSs, as depicted in Figure 5.4.

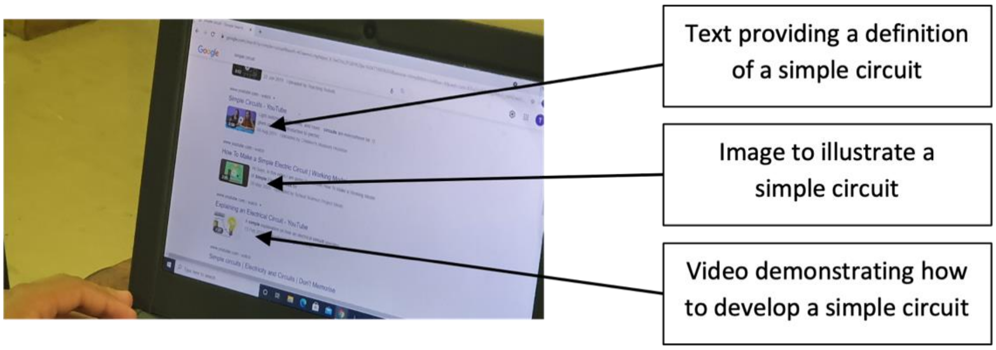


Figure 5.4: An Example of Blended Learning as Employed by a Learner after Demonstration by Mr Bozwana

Source: Author's photograph

The learners interacted with definitions, images and videos of a simple circuit to enhance their understanding of the concept (acquisition).

For **scaffolding**, Mr Bozwana used a PowerPoint Presentation on the Smartboard (substitution) to explain and illustrate the following concepts: a simple circuit diagram, series and connection, as well as series and parallel connections (acquisition) (Figure 5.5).

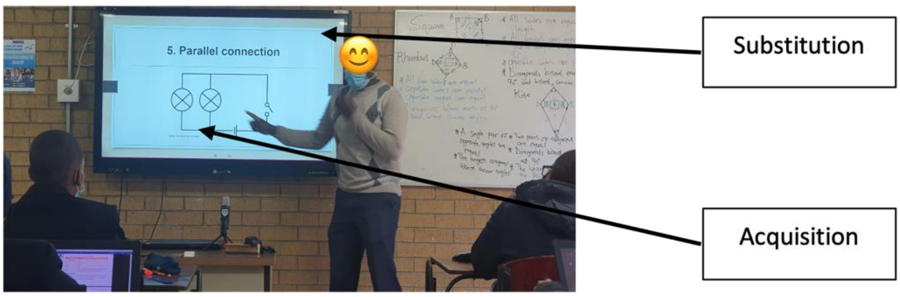


Figure 5.5: Mr Bozwana Used the Smartboard to Explain Concepts

Source: Author's photograph

For further illustration of concepts to be learnt, he employed blended learning (Figure 5.6).

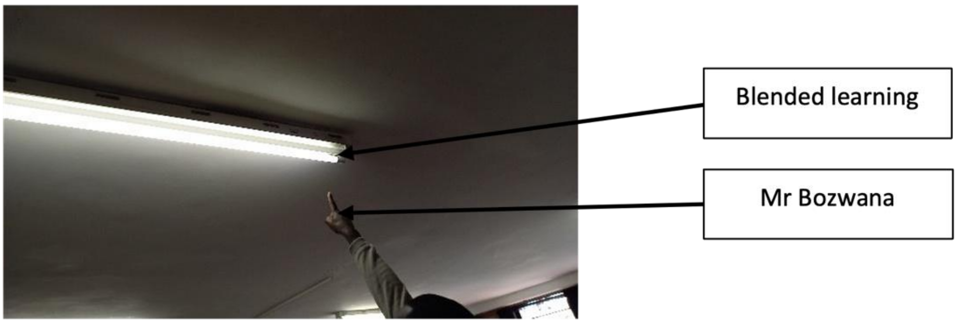


Figure 5.6: Mr Bozwana Used Blended Learning to Illustrate Concepts

Source: Author's photograph

After engaging learners in the utilisation of multimedia content (acquisition) to promote the understanding of concepts, Mr Bozwana illustrated a real-life example of the input, output and control devices in an electric circuit by switching on and off the physical lights in the classroom (Figure 5.6).

To assess the understanding of concepts, he engaged learners in classroom discussions, as depicted in Figure 5.7.

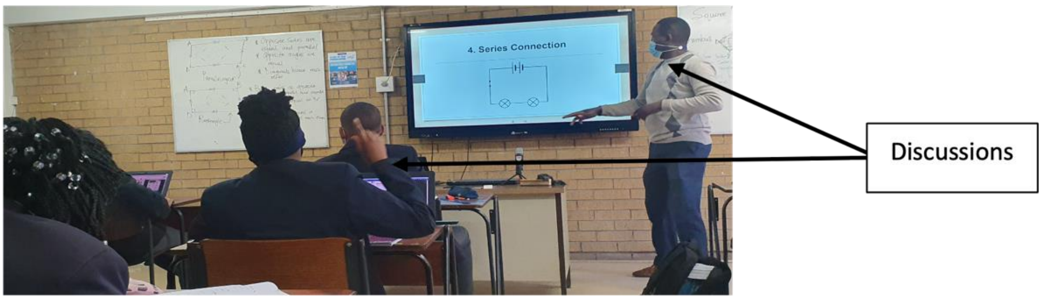


Figure 5.7: Mr Bozwana Engaged Learners in Classroom Discussions

Source: Author's photograph

Discussions were confined to face-to-face learner-teacher interaction. Mr Bozwana used blended learning to facilitate the learners' understanding of concepts by using multimedia content (acquisition), including physical examples in the classroom. Thereafter, learners were afforded the opportunity to demonstrate the acquisition of content knowledge by summarising, paraphrasing, explaining or describing the concepts, including providing examples of concepts learnt from a real-life situation outside the classroom (applying).

Innovation Interaction

From the classroom observation, the researcher could not locate production/digital authoring new ideas, solutions, products or models on the open education resource to solve the problem identified.

The analytical tool in Table 5.2 shows how Mr Bozwana's teaching and learning activities incorporate Siemens' (2011) four levels of interaction in Connectivist Learning, Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types to promote the acquisition of the LNSSs.

Table 5.2: Interpretation of Mr Bozwana's Development of Learner Network Society Skills (LNSSs) During Classroom Observation

Levels of Connectivist Learning	Six Learning Types	Observation in the Classroom	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/Digital Authoring**	Not observed	N/A	N/A
3.4. Sensemaking Interaction	**5. Discussion**	Use of question-and-answer method to engage learners in dialogue to demonstrate the understanding of concepts	Summarising, paraphrasing, explaining, describing, exemplifying	N/A
	4. Collaboration	Not observed	N/A	N/A
	3. Practice	Learners follow prompts on their own and access definitions, diagrams and videos on the Internet	N/A	Implementing, carrying out, using, executing, downloading, uploading
	2. Acquisition	Learners interact with definitions, diagrams and videos on the Internet to enhance their understanding of simple circuits	Summarising, paraphrasing, explaining, describing, exemplifying	N/A
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	The teacher models how to access multimedia content on simple circuits Learners navigate complex digital environments to access multimedia content on simple circuits	N/A	Entering appropriate keywords to refine the searches to find relevant information
1. Operation Interaction	**1.1. Inquiry: Web Searching**	Learners follow prompts to search for information on the Internet related to simple circuits	N/A	Searching, googling, recognising, identifying, finding, retrieving, locating, work independently

Sources: Adapted from Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Shouman & Momdjian, 2019; Aldosemani, 2019; Rehman & Aurangzeb, 2021

Conclusion: Classroom Observation

The classroom observation data reveals that Mr Bozwana's teaching and learning activities focused on both content acquisition and the development of LNSSs. The evidence of content acquisition was observed at the acquisition and discussion levels, while the development of LNSSs was evident at operation interaction.

Lesson plan

Mr Bozwana's lesson plan for 18 – 22 October 2021 was a revision exercise of an electric circuit and its components, as depicted in Table 5.3.

Table 5.3: Extract from Mr Bozwana's Term 4, Week 6 Lesson Plan for Teaching and Learning Activities

Periods	1	2
Content, Concepts and Skills	• **Revise:** simple circuit components; input devices (electrochemical cell; generator; solar panel), output devices (resistor; lamp; heater; buzzer; motor); control device (switches). Note: Some devices can serve as input, output, process or control devices. • Correct connections, short circuits, electrical components and their accepted symbols. Emphasis on series connections of cells, switches and bulbs with the aim of explaining the AND gate.	• Drawing electrical circuits using accepted symbols (as in Grade 12; see Addendum C). • Set up circuits using a range of components. Draw the circuits using symbols. Emphasis on parallel connections of cells, switches and bulbs with the aim of explaining the OR gate.
Teacher's Activities	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources
Learners' Activities	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement
Type of Assessment	Formal / Informal	Formal / Informal
Resources	DBE Workbook 2 Gr. 8, YouTube videos	DBE Workbook 2 Gr. 8
	CAPS	CAPS
	Examples / Samples	Examples / Samples
Classroom Activities	**Teacher Activities**	**Learner Activities:**
	It will be necessary to talk learners through concepts and ideas. Ask relevant questions to help them understand and interpret this information. Teach the specific meaning of all terms and talk learners through the concepts and ideas. Be aware of the different meanings of a specific word may have (e.g., the word 'stage' can mean a period of time, a platform, a performance, a robbery)	Actively participate with questions, where possible, practical examples, etc.

Mr Bozwana's planned activities seem to be more teacher-centred than learner-centred. He planned to facilitate discussions using the question-and-answer method, as well as providing guidance to learners through demonstrations (modelling) during the revision of the concepts learnt on electrical systems and control (Table 5.4). Appendix N (Lesson Plans) provides a complete picture in this regard.

The main resources for researching and obtaining information are a Technology Workbook provided by the DBE, YouTube videos and the Technology CAPS (Table 5.4). This implies blended learning. However, the lesson plan is silent on the teaching and learning activities where YouTube would be employed.

The analytical tool (Table 5.4) was used to determine how Mr Bozwana's lesson plan incorporates Siemens' (2011) four levels of interaction in Connectivist Learning, Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types to promote the acquisition of LNSSs.

Table 5.4: Interpretation of Mr Bozwana's Lesson Plan on the Development of Learner Network Society Skills (LNSSs)

Levels of Connectivist Learning	Six Learning Types	Applicability of Learning Types in the Lesson Plan	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/ Digital Authoring**	None	None	None
3.4. Sensemaking Interaction	**5. Discussion**	None	None	None
	4. Collaboration	None	None	None
	3. Practice	None	None	None
	2. Acquisition	None	None	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	None	None	None
1. Operation Interaction	**1.2. Inquiry: Web Searching**	None	None	None

Sources: Adapted from Siemens, 2011; Laurillard, 2012

Conclusion: Lesson Plan

When analysing the full lesson plan, it is evident that the activities are geared towards the development of skills that learners could utilise in their future careers. For example, using the correct connections of electrical circuits and their accepted symbols is a skill that could be used in electrical engineering (Department of Basic Education, 2011). However, column 3 in Table 5.4 reveals no planned teaching and learning activities on Laurillard's (2012) six learning types to facilitate the development of LNSSs.

The last section of Mr Bozwana's analysis presents the utilisation of social media to develop LNSSs.

Social Media

At the end of the lesson, Mr Bozwana requested learners to show the researcher evidence that they can operate, communicate and collaborate using social media (Figure 5.8).

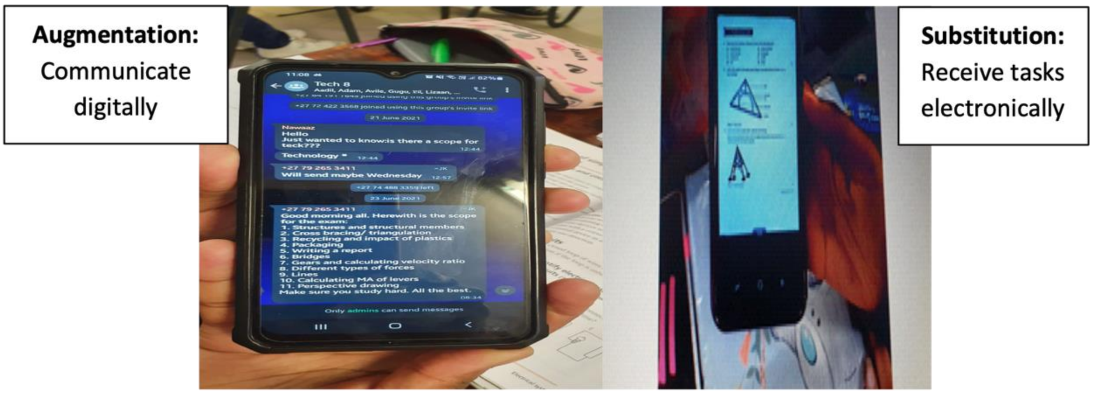


Figure 5.8: Learners Use Social Media to Communicate and Receive Tasks

Source: Author's photographs

Indeed, the learners could follow prompts on their smart cell phones to share and receive information digitally (augmentation). At the same time, learners could receive and retrieve digital content from social media (substitution).

The analytical tool in Table 5.5 depicts how using social media promotes the acquisition of LNSSs.

Table 5.5: Interpretation of Mr Bozwana's Use of Social Media to Develop Learner Network Society Skills (LNSSs)

Levels of Connectivist Learning	Six Learning Types	Applicability of Learning Types in the Use of Social Media	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/ Digital Authoring**	Not applicable	None	None
3.4. Sensemaking Interaction	**5. Discussion**	Not applicable	None	None
	4. Collaboration	Share tasks digitally	None	Sharing work digitally through a blog, sending and receiving work through an app to and from the teacher and peers, receiving written and verbal comments digitally
	3. Practice	Learners operate social media to communicate, send and receive tasks	None	Implementing, carrying out, using, executing, downloading, uploading and sharing, sending and receiving work through an app to and from the teacher and peers, sharing work digitally through a blog
	2. Acquisition	None	None	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	None	None	None
1. Operation Interaction	**1.3. Inquiry: Web Searching**	None	None	None

Sources: Adapted from Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Shouman & Momdjian, 2019; Aldosemani, 2019; Rehman & Aurangzeb, 2021

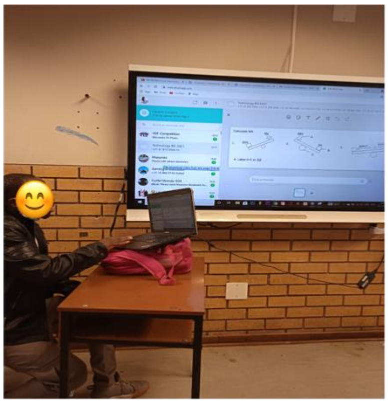
Conclusion: Social Media

It is worth highlighting that learners showed the researcher that they could operate, connect and communicate via social media at the end of the lesson observation. The reason for this is that communication via social media was not part of the lesson plan and, therefore, could not be observed in practice in the classroom. In addition, the researcher did not identify any evidence of discussions and innovation interaction to share ideas on the task to be completed. Instead, collaboration was confined to the sharing of tasks. Furthermore, the researcher did not identify any evidence of discussion and innovation interaction.

Overall Conclusion

Mr Bozwana's practices demonstrated his understanding of the importance of using the available ICT resources to equip learners with LNSSs to participate meaningfully in the changing world. The teaching and learning activities in the classroom, as well as learner utilisation of social media, demonstrated the development of LNSSs. However, the skills acquired spanned across only three levels of Siemens' (2011) Connectivist Learning: operation, wayfinding and sensemaking interaction. In addition, from Laurillard's (2012) six learning types, there is evidence of skills acquired at the inquiry, acquisition, practice and collaboration levels. While within Puentedura's (2009) four levels of interaction, there is evidence of skills acquired at the substitution and augmentation levels. In the interview, Mr Bozwana said innovation is happening outside the classroom.

5.4 Teacher 2: Mr Cele



Interview

When teaching Technology, Mr Cele predominantly utilises the laptop, the Smartboard and the USB to share information and resources. As in the case of Mr Bozwana, his laptop and the Smartboard in the classroom are loaded with Technology content and resources, which he shares with learners. He said,

"I use the USB to take information from my laptop to the Smartboard. I also use visual aids on the Smartboard to make learners understand."	Substitution Acquisition

Visual aids are assumed to have value in ensuring learners understand, and this could thus augment the learning process.

Mr Cele has a sound understanding of the goal of teaching this subject. Like Mr Bozwana, he considers solving the identified human technological problems or needs, as the main aim of teaching Technology as a subject. He said,

"The main aim of teaching Technology is to provide learners with the basics of Technology. For example, learners acquire the skill to investigate, plan, design, make and evaluate products. In summary, Technology teaches learners how to solve the identified technological problems. The learners solve a problem using technological processes."	Technology design process Problem-based learning

As learners follow the technological design process, problem-solving skills are acquired. Mr Cele uses a problem-based teaching approach to inculcate his learners' skills to solve human problems. To realise this aim, he gives learners a case study that depicts a human problem to be solved in a real-life situation. He also understands that the CAPS document requires Technology as a subject to be geared towards learners creating solutions to meet people's needs and wants in their real-life situations. He said,

"Learners developed a mine shaft. The problem identified was that they need[ed] to design a shaft to move minors, as well as goods, in a mine. The miners and goods had to be moved in a vertical tunnel/ open pit mine."	Production/Digital authoring

This project example demonstrates how Mr Cele gives his learners authentic tasks so they can acquire LNSSs through the activities they engage in. They would then apply the skills in the production learning type.

The four levels of Connectivist Learning were used to determine the development of LNSSs throughout the teaching and learning activities.

Operation Interaction and Wayfinding Interaction

Mr Cele confidently shares the opportunities he creates for learners to utilise the available ICT resources to obtain information, understand the information obtained and communicate what they have learnt, as well as collaborate with others to solve the problem identified. The following dialogue depicts this.

Researcher: "What web resources do learners utilise to obtain information, communicate and collaborate with others to solve the problem or address the need identified?" *Mr Cele: "They use WhatsApp and Google Cloud to collaborate with others. Learners are provided with a link and use their cell phones or tablets, if there is connectivity, to respond to practice questions on Google*	Augmentation Practice Web searching/Inquiry

Form[s] to test learning that has taken place. The project given to learners requires them to conduct research using Google, the Internet or YouTube."

Social media is used as a substitute for classroom collaborative activities assigned by the teacher. In addition, practice activities are accessed through links shared in the online forum. Web searching or inquiry is also achieved through digital technology, which contributes to collaboration as they work on the projects.

Mr Cele also creates opportunities for learners to navigate through the non-human appliances to promote the acquisition of LNSSs. For example, his learners access digital content, as well as tasks, through Google and YouTube. The following dialogue portrays this.

Researcher: "What web-based activities have you designed for learners to enable them to utilise the available ICT resources, obtain information and understand information obtained to solve the problem identified?" *Mr Cele: "Learners are given an opportunity to investigate/research using Google/YouTube. Learners also access learning material, for example, notes, classwork and homework from Google Cloud. Opportunities are created for learners to use Auto-Correct from Google Form[s]. This is automatic feedback on learner practice activities from Google Form[s]. It tells the learner whether the response provided is correct or incorrect. Learners also access videos from Google on their own. They also access e-books from their tablets."*	Web searching/Inquiry Substitution Practice Acquisition

Sensemaking Interaction

Mr Cele presents digital content in class and guides learners through face-to-face demonstrations in the classroom, as well as gives learners practical tasks to help them grasp new concepts and promote the acquisition of the desired ICT skills. The following extract from the interview transcript depicts this.

Researcher: "How do you utilise the teacher ICT resources available in your classroom to guide learning and the acquisition of the desired ICT skills?" *Mr Cele: "I use the laptop along with HDMI so that learners can see what I am doing. For example, [I] demonstrate to learners how to draw an object. I also demonstrate to learners how to get information from their Google Drive. Then, learners do it on their own from their tablets. They are also shown how to navigate the platform to obtain videos, notes, classwork/homework and School-Based Assessment Tasks. This they do together with the teacher in class."*	Modelling Practice

To make sense of the information obtained during teaching and learning in class, as well as promote a deeper understanding of what is required to solve the problem identified, the learners communicate and collaborate with one another through social media. According to Mr Cele,

"They use WhatsApp and Google Cloud to collaborate. They discuss their ideas [and] send pictures [and] videos for the compilation of their PowerPoint Presentations. They also create a link on the PowerPoint Presentation to show a picture or a video during their presentation."	Sensemaking interaction/ Collaboration/ Discussion Modification

Innovation Interaction

Planning, designing and creating prototypes to solve the problem identified, as well as showcasing the finished product, is done physically in class. Mr Cele attributes this to the outdated school curriculum:

Researcher: "In your lesson planning, what activities have you designed for learners to enable them to utilise the available web resources to plan, investigate, design, make and evaluate the artefacts/products made digitally?"	Restricted LNSS acquisition Augmentation

Mr Cele: "Because learners do things manually, learners are not given the opportunity to plan, design, make and evaluate products digitally. For example, they can't draw using their tablets because what we teach them is outdated. The learner's tablets do not have the software to allow learners to plan, design and make products digitally."

We follow CAPS and what the Department provides. For example, the Department provides us with School-Based Assessment Tasks in the form of a template. That's why there are no digitally created products/artefacts. The products/artefacts are physically made. They are submitted physically in class, as well as showcased physically. The learners use the Smartboards to present their work using PowerPoint Presentations. This is done physically in the classroom. In the main, learners plan, design and make products physically. If learners can do all these things digitally, I would be so happy. What we are doing is outdated. We are not following the current economic trends."

Although the above is the case, Mr Cele realises the importance of equipping learners with the skills to plan, design and make products digitally. Hence, he creates opportunities for learners to acquire these skills outside of contact time. He said,

"We usually make learners do the above activities during extra time, after school hours. For example, learners do the Scratch Activity to allow learners to create animations/objects. However, these activities that are done by learners after school may not be counted as they are not compulsory."

Restricted LNSS acquisition

Practice

Conclusion: Interview

During his interview, Mr Cele asserted that he employs the available ICT resources to substitute the chalkboard and traditional textbooks, including assessment tasks. He employs modelling to facilitate the understanding of concepts, as well as to demonstrate to learners how to access multimedia content to promote the understanding of concepts (acquisition), as well as how to access homework and school-based assessments from Google Drive. He then creates opportunities for learners to conduct web searches to find multimedia content using Google or YouTube (practice). In addition, learners engage in sensemaking interaction to discuss and collaborate to develop PowerPoint Presentations (modification). Furthermore, learners practice finding information independently. Importantly, he indicated that opportunities are created for his learners to use the available ICT resources to create animations or artefacts (production/digital authoring). From his espoused practices, it is evident that learners could be engaged across all four levels of Connectivist Learning to facilitate the acquisition of LNSSs.

The next section analyses the observed lesson, depicting Mr Cele's enacted practices, including the learning activities.

Lesson Observed

Topic: Revision of Simple Circuits and Components

ICTs used: The Smartboard and laptop

Overview of the lesson

This was a revision lesson on how electricity works, the simple circuit and its components. It aimed to enable learners to combine "thinking and doing in a way that links abstract concepts to concrete understanding" (Department of Basic Education, 2011, p.9). To introduce the lesson, Mr Cele allowed the learners to watch a video to remind them of how atoms work.

Throughout the lesson, Mr Cele employed blended learning. He used the question-and-answer method (sensemaking interaction/discussion), as well as the audio-visual material from his laptop projected onto the Smartboard (substitution), to test the learners' recollection and understanding of concepts, such as a simple circuit, a closed circuit, a short circuit, conductor, insulators, components of electricity, etc. (acquisition).

The researcher used the analytical tool to examine the different teaching and learning activities, including the LNSSs acquired across the four levels of interaction in Connectivist Learning. The following sections depict this.

Operation Interaction

Learners did not have their tablets in class (restricted LNSSs acquisition) (Figure 5.9).

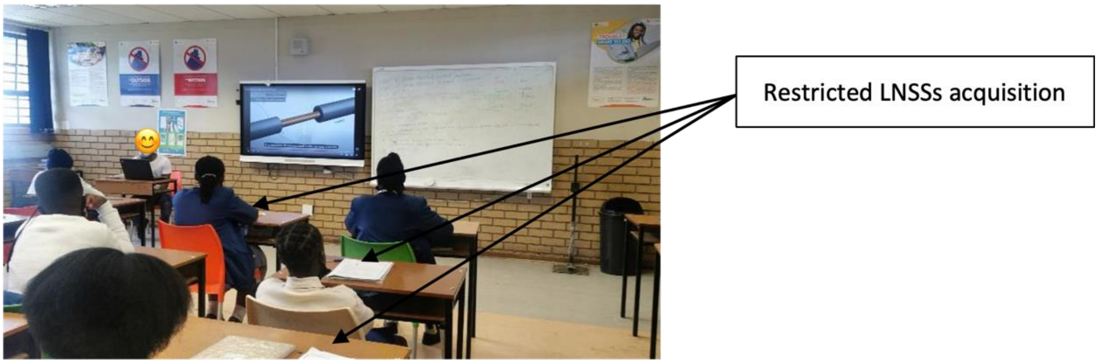


Figure 5.9: Learners Did Not Have Their Tablets in Class

Source: Author's photograph

Mr Cele used modelling to demonstrate to learners how to obtain information from the Internet. Learners were passive in the learning situation.

Mr Cele used blended learning to present multimedia content in the classroom to facilitate the understanding of concepts (acquisition).

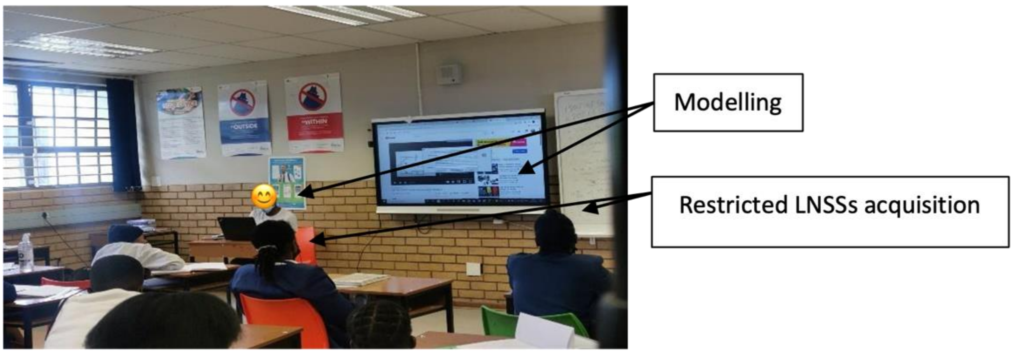


Figure 5.10: Mr Cele Used Websites to Obtain Information, Diagrams and Videos

Source: Author's photograph

Mr Cele first displayed the websites on the Smartboard to access multimedia content (substitution). He then clicked on the websites to obtain information, diagrams and videos on circuits and their components while learners were watching (modelling) (Figure 5.10). He also drew a parallel circuit using taskbars and toolbars (substitution) while learners watched (modelling).

Wayfinding Interaction

Figure 5.11 is a further indication that learners did not have tablets in class (restricted LNSS acquisition).

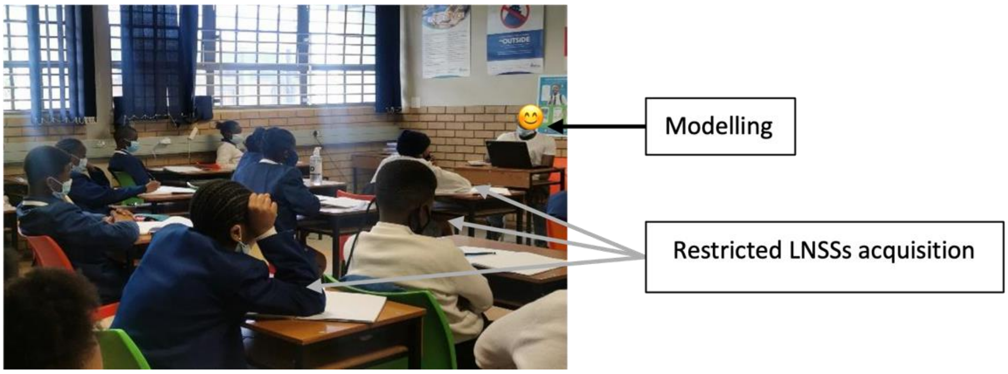


Figure 5.11: Learners Did Not Have Tablets in Class

Source: Author's photograph

Mr Cele first displayed the websites on the Smartboard to access multimedia content (substitution). He then clicked on the websites to obtain information, diagrams and videos on circuits and their components while learners were watching (modelling). Teaching and learning activities in the classroom did not provide opportunities for learners to find their way in complex, information-loaded digital environments to find relevant multimedia content to enhance their understanding of concepts. They were passive participants in the learning situation.

Sensemaking Interaction

Figure 5.12 depicts Mr Cele using the Smartboard to facilitate the understanding of concepts related to electrical systems and control. He presented multimedia content on concepts, such as a simple circuit, a closed circuit, a short circuit, conductors, insulators, components of electricity, etc. (acquisition), which he had aggregated from different websites (substitution). This included written content, diagrams and pictures on the PowerPoint Presentation, as well as videos, to help learners grasp important concepts (acquisition).

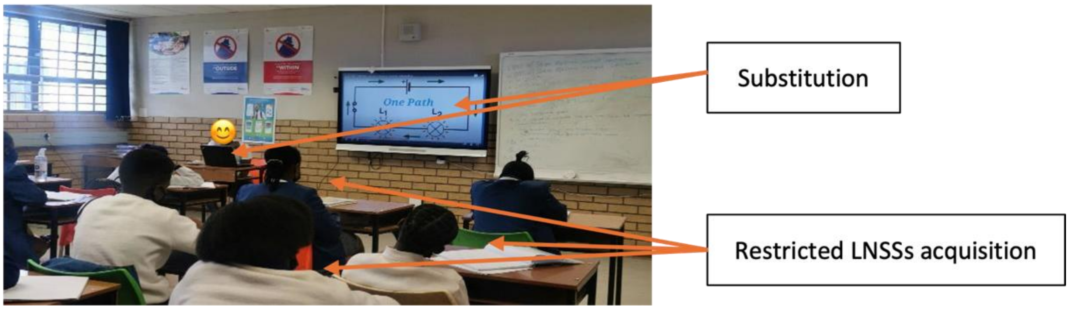


Figure 5.12: Mr Cele Used the Smartboard to Facilitate the Understanding of Concepts
Source: Author's photograph

To establish if learners have grasped concepts, Mr Cele paused at regular intervals and asked questions (sensemaking interaction/discussion). When there was an indication of a misunderstanding of concepts, he provided further clarity on the concepts through diagrams and videos (acquisition). However, he did not maximise opportunities for learners to practice gathering information, aggregating the information, sharing, discussing, reflecting and making informed decisions to solve the problem identified. He confined knowledge acquisition to the information he gathered himself.

In addition, discussions to assess learners' understanding of concepts were confined to classroom-based learner-teacher interaction, including physical demonstrations of the understanding of concepts in different contexts (application) (Figure 5.13).

Figure 5.13: Physical Demonstrations Are an Example of Classroom-Based Learner-Teacher Interaction
Source: Author's photograph

Learner-teacher and learner-learner dialogue occurred voluntarily, through positive or negative reinforcement, depending on the learners' responses to the teacher (learner-teacher interaction). Learners rubbed their hands to demonstrate understanding the concept of friction using a different example (application).

Mr Cele showed learners the physical resources, which were to be used in class the following day to create a Christmas tree (Figure 5.14).

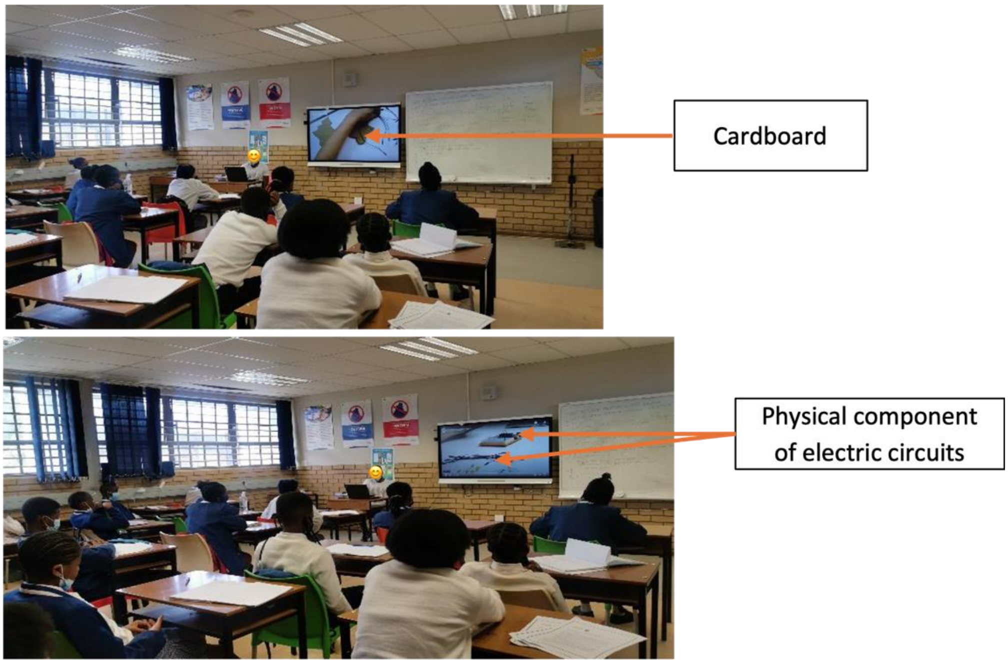


Figure 5.14: Mr Cele Used the Smartboard to Show Physical Resources to be Used to Create a Christmas Tree

Source: Author's photographs

At the end of the lesson, learners touched and felt the physical components of an electric circuit. They also watched a video about the components of an electric circuit that Mr Cele played (acquisition).

Innovation Interaction

Throughout the lesson, there was no evidence of digitally created plans, designs and artefacts. Instead, Mr Cele told learners they would physically build a Christmas tree in class the following day (restricted LNSS acquisition). Learners watched a video on how to use different components of an electric circuit to create a Christmas tree (production) (Figure 5.15).

Figure 5.15: Learners Watched a Video on How to Use Different Components of an Electric Circuit to Create a Christmas Tree

Source: Author’s photograph

The analytical tool (Table 5.6) depicts how Mr Cele’s teaching and learning activities incorporate Siemens’ (2011) four levels of interaction in Connectivist Learning, Hurley and Chater’s (2005) Modelling Instructional Strategy, Puentedura’s (2009) SAMR Model and Laurillard’s (2012) six learning types to promote the acquisition of the LNSS.

Table 5.6: Interpretation of Mr Cele's Development of the Learner Network Society Skills (LNSSs) during Classroom Observation

Levels of Connectivist Learning	Six Learning Types	Observation in the Classroom	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/ Digital Authoring**	Learners are shown physical resources to be used to build a Christmas tree Learners watch a video on how to build a Christmas tree	None	None
3.4. Sensemaking Interaction	**5. Discussion**	Use of question-and-answer method to determine understanding of concepts	Summarising, paraphrasing, explaining, describing	None
	4. Collaboration	Not observed	None	None
	3. Practice	Not observed	None	None
	2. Acquisition	Use of Smartboard to present multimedia content on simple circuits Learners watch a video on the components and functions of an electric circuit	Summarising, paraphrasing, explaining, describing	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	The teacher displays websites on the Smartboard to access multimedia content The teacher models how to access multimedia content	None	None
1. Operation Interaction	**1.4. Inquiry: Web Searching**	The teacher models how to obtain information from the Internet The teacher models how to use a toolbar to draw on the Smartboard No learner devices are allowed in class; learners observe the teacher passively	None	None

Sources: Adapted from Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Shouman & Momdjian, 2019; Aldosemani, 2019; Rehman & Aurangzeb, 2021

Conclusion: Classroom Observation

The data on classroom observation reveals that Mr Cele's teaching and learning activities focused mainly on content acquisition. Evidence of the understanding of concepts was observed at the acquisition and discussion levels. The development of LNSSs was only modelled for learners at the operation and wayfinding interaction level. However, learners could not practice what they had observed in class as they did not have their ICT devices. However, as mentioned in the interview, sensemaking and innovation happened in social media as learners collaborated as they solved authentic problems given by the teacher.

Lesson plan

Mr Cele's lesson plan for 18 – 22 October 2021 was a revision exercise of an electric circuit and its components, as depicted in Table 5.7.

Table 5.7: Extract from Mr Cele's Term 4, Week 1 Lesson Plan on Teaching and Learning Activities and Resources

<table>
<tr><td colspan="3">CLASSROOM ACTIVITIES:</td></tr>
<tr><td rowspan="2">Teachers Activities</td><td>Day 1: Suggested teacher activities</td><td>Day 2: Suggested teacher activities</td></tr>
<tr><td>The teacher revises:
● simple circuit components
● input devices (electrochemical cell; generator; solar panel)
● output devices (resistor; lamp; heater; buzzer; motor)
● control device (switches)</td><td>The teacher continues to discuss the following aspects with learners:
● Correct connections, short circuits
● Electrical components and their accepted symbols</td></tr>
<tr><td rowspan="2">Learners Activities</td><td>Day 1: Suggested learner activities</td><td>Day 2: Suggested learner activities</td></tr>
<tr><td>Enabling task 1
● Learners draw a circuit diagram using component symbols</td><td>Enabling task 2
● Learners should be given a chance to set up circuits using a range of components.</td></tr>
<tr><td>Resource</td><td colspan="2">Textbook</td></tr>
</table>

The planned activities seem more teacher-centred than learner-centred. Appendix N (Lesson Plans) provides a complete picture in this regard. In addition, the main resource for obtaining information was a textbook. The lesson plan was silent on what learners would use to draw a circuit diagram and to build circuits using a range of components.

The analytical tool in Table 5.8 was used to determine how Mr Cele's lesson plan incorporates Siemens' (2011) four levels of interaction in Connectivist Learning, Hurley and

Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types to promote the acquisition of LNSSs.

Table 5.8: Interpretation of Mr Cele's Lesson Plan on the Development of Learner Network Society Skills (LNSSs)

Levels of Connectivist Learning	Six Learning Types	Applicability of Learning Types in the Lesson Plan	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/Digital Authoring**	None	None	None
3.4. Sensemaking Interaction	**5. Discussion**	None	None	None
	4. Collaboration	None	None	None
	3. Practice	None	None	None
	2. Acquisition	None	None	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	None	None	None
1. Operation Interaction	**1.1. Inquiry: Web Searching**	None	None	None

Sources: Adapted from Siemens, 2011; Laurillard, 2012

The planned activities from Mr Cele's lesson plan are geared towards developing skills that learners could utilise in the future; for example, designing electrical circuits and understanding how they work is a skill that could be used in electrical engineering (Department of Basic Education, 2011). However, column 3 (Table 5.8) reveals that there are no planned teaching and learning activities to facilitate the development of LNSSs.

The last section presents how Mr Cele used social media to develop LNSSs.

Social Media

During the interview, Mr Cele indicated that he uses Google Classroom to provide tasks to be completed, as well as to share multiple representations of the content taught in class (Figure 5.16).

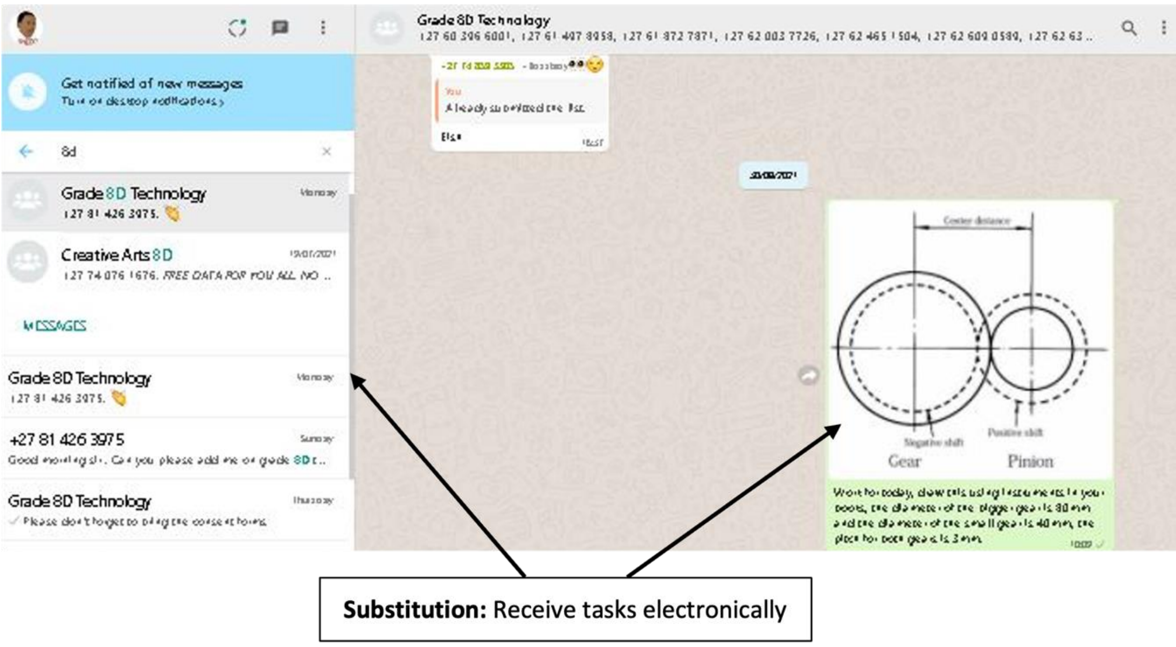


Figure 5.16: Mr Cele uses Google Classroom to Share Tasks with the Learners

Source: Screengrab taken by author with permission

From Figure 5.16, it is evident that learners can operate their tablets and smart cell phones to connect to Google Classroom. In addition, they can follow prompts from their ICT devices to receive the content shared in the classroom electronically. However, there was no evidence of sensemaking and innovation interaction on this platform.

The analytical tool in Table 5.9 depicts how the use of social media promotes the acquisition of LNSSs.

Table 5.9: Interpretation of Mr Cele's Development of Learner Network Society Skills (LNSSs) on Social Media

Levels of Connectivist Learning	Six Learning Types	Applicability of Learning Types in the Use of Social Media	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/Digital Authoring**	None	None	None
3.4. Sensemaking Interaction	**5. Discussion**	None	None	None
	4. Collaboration	Share tasks digitally	None	Receiving work through an app from the teacher, receiving written and verbal comments digitally, blog commenting
	3. Practice	Learners operate social media to communicate, send and receive tasks	None	Implementing, carrying out, using, executing, downloading, receiving work through an app from the teacher
	2. Acquisition	None	None	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	None	None	None
1. Operation Interaction	**1.5. Inquiry: Web Searching**	None	None	None

Sources: Adapted from Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Shouman & Momdjian, 2019; Aldosemani, 2019; Rehman & Aurangzeb, 2021

Conclusion: Social Media

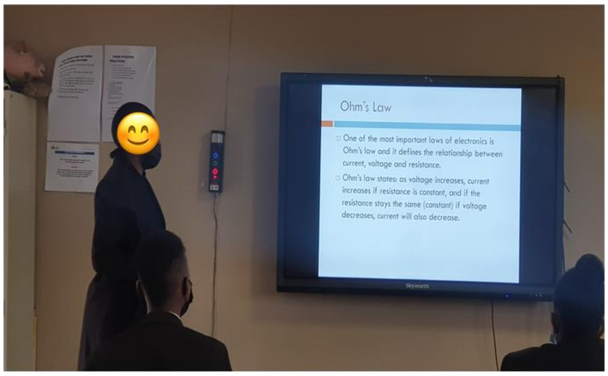
It is worth highlighting at this point that evidence of communication on social media was only received from the teacher because communication via social media was not part of the lesson plan, and, therefore, there was nothing readily available for learners to share. In addition, interaction on social media is confined to sharing and receiving tasks.

Overall Conclusion

Mr Cele's interview demonstrates his knowledge of how ICTs could be utilised in Technology to equip learners with LNSSs to participate meaningfully in the global community. However, the observation of his teaching and learning activities in the classroom revealed the development of LNSSs through passive guided learning. He mainly employs Hurley and Chater's (2005) **'I do'** modelling phase to demonstrate to learners how to perform a task or procedure. In addition, his demonstration is confined to web searches at Siemens' (2011) operation interaction and Laurillard's (2012) acquisition at Siemens' (2011) sensemaking level.

It is worth highlighting that despite this, Mr Cele's teaching and learning activities enabled the acquisition of LNSSs on a limited scale within operation interaction and sensemaking interaction in that the learners merely observed the procedures carried out by the teacher with the assumption that they would recall what they observed in the classroom and perform the tasks independently at home. In addition, there is no evidence of teaching and learning activities that promote the acquisition of LNSSs at advanced web search level, wayfinding, higher levels of sensemaking interaction, namely collaboration and discussion level, as well as at the innovation level to promote learning artefact creation digitally. Mr Cele attributed this to the scripted lesson plans and the compulsory assessment tasks provided by the DBE. This means the acquisition of LNSSs during the teaching and learning activities is incidental and not purposefully planned.

5.5 Teacher 3: Ms Sithole



Interview

Ms Sithole mainly uses the Smartboard and laptop to teach Technology as a subject, while her learners use tablets and laptops.

She associates the main aim of teaching Technology with problem-based learning, wherein learners acquire the knowledge and skills to address human needs:

> *"The main aim of teaching Technology as a subject is to make learners aware that Technology is part of our everyday life. There are many practical examples of Technology in our everyday [lives]. For example, in our homes, the gate has a mechanism, gears, used as part of Technology to allow it to open."*

Up to date knowledge

To realise this aim, learners are engaged in problem-based learning, wherein they are required to create a product to address the problem identified. She said,

> *"[In] the previous term, learners had to build a mine shaft headgear. The Technology Subject Facilitator provided teaching and learning material. Learners had to read through a scenario which required them to them to build a mine shaft headgear. During the next term, [the] focus will be on electricity. Learners will be required to build a model of a house and electrify it."*

Restricted LNSS acquisition

Production/Digital authoring

She understands that the CAPS document requires learners to acquire the necessary problem-solving skills in Technology at the end of the learning experience. She said,

"The one learning outcome that stands out for me is the application of the design process. Remember, learners are required to apply the design process based on the problem identified from the scenario. The design process includes the ability to investigate, design, make, evaluate and communicate."	Design process Problem-based learning

The four levels of the Connectivist Learning were used to determine the development of LNSSs throughout the teaching and learning activities.

Wayfinding and Operation Interactions

In the main, very minimal opportunities are created for learners to navigate through the ICT resources to promote the acquisition of LNSSs. The following dialogue depicts this:

Researcher: "What web resources do learners utilise to obtain information, communicate and collaborate with others to solve the problem or address the need identified?" *Ms Sithole: "Learners are provided with learning resources. For example, the Sasol Inzalo Books. The Department of Education website also provides resources for Technology Education. I download the resources and give them to learners. The challenge is that learners can't access the Wi-Fi so that they [can] download the resources on their own. I access the site and give learners the resources. The learners who have access to the Internet will go an extra mile to access the resources."*	Blended learning Web searching/Inquiry Restricted LNSS acquisition

She creates opportunities for learners to navigate through the ICT resources to promote the acquisition of LNSSs. For example, her learners access digital content, as well as tasks through Google Classroom:

Researcher: "What web-based activities have you designed for learners to enable them to utilise the available ICT resources, obtain information and understand information to solve the problem identified?" *Ms Sithole: "The PowerPoint Presentation is used for teaching and learning. Videos are utilised to explain concepts further. Learners access the activities that they have to do from the Google Classroom. For example, classwork activities, homework and the memoranda. To obtain information, learners are given homework. For example, to research on a mechanism or whatever work or topic [is] done in class. From the laptops, there are lessons for Term 1 to 4. The lessons are shared through Google Classroom and the LMS [learning management system] for learners to access. Lessons are also uploaded on the learners' devices. Learners log on to their devices to access the lessons."* *"To assess the level of understanding, in the past, I used the Moodle Platform to give learners a five-minute test/quiz, which has questions and answers to test their understanding. Currently, questions are in a written form from Google Classroom in the form of a quiz. As soon as learners have responded to the questions, they get the correct answers immediately."*	Substitution Acquisition Practice Web searching/Inquiry

Sensemaking Interaction

Ms Sithole utilises the Smartboard to present content in class. She also provides demonstrations to help learners grasp new concepts and ICT skills. She said,

"The PowerPoint Presentation is used for teaching and learning. Videos are utilised to explain concepts further. For some lessons, I go to the Internet on the Smartboard screen to search and get information while learners are watching. I also show them videos, which are already linked to the PowerPoint Presentation. Alternatively, I quickly log on to YouTube to find videos and demonstrate what I am referring to. I do everything. The challenge with our school is internet access. When learners are provided with internet facilities, they use the devices for [the] wrong reasons. Internet access is limited to D6, LMS and Google Classroom."	Substitution Acquisition Modelling Restricted LNSS acquisition

To make sense of the information obtained during teaching and learning in class, as well as promote a deeper understanding of what is required to solve the problem identified, the learners communicate and collaborate with one another through social media. She said,

"The learners use the Google Space to communicate and collaborate with each other and with the teacher "	Collaboration

Innovation Interaction

Planning, designing and creating prototypes to solve the problem identified, as well as showcasing the finished product, is done physically in class. Ms Sithole attributes this to the prescribed teaching and learning resources she receives from the DBE, as well as time constraints. The dialogue below depicts this.

Researcher: "In your lesson planning, what activities have you designed for learners to enable them to utilise the available web resources to plan, investigate, design, make and evaluate the artefacts/products made digitally?"	Restricted LNSS acquisition Web searching/ Inquiry

Ms Sithole: "The planning, designing, and making of artefacts/products is not done digitally. The Practical Assessment Tasks are provided by the Department, printed out and given to learners. When it comes to design, they do their drawings physically. The designs can't be done digitally as it must be a practical activity. There are no artefacts or products created digitally be learners. All products are created physically and brought to the classroom for the allocation of marks by the teacher. The physical artefacts/products made by [the] learner[s] are kept in class as evidence. In the main, the web space is utilised by learners for investigation. There is no luxury of time. Whatever they do, it must be shortened due to COVID-19."

She acknowledges that learners utilise the affordances on their devices to create videos. However, this is not part of the lesson plan. They do it voluntarily. The following extract from the interview depicts this:

"During their spare time, learners make videos and upload them [to] the Google Classroom. For example, they draw and make an advert on paper and then upload it [to] the Google Classroom."

Augmentation
Production

Conclusion: Interview

During her interview, Ms Sithole indicated that she utilises the Smartboard to substitute the chalkboard and traditional textbooks. She employs modelling to facilitate the understanding of concepts, as well as demonstrates to learners how to access multimedia content on the Internet. Work presented in class is tested through quizzes (practice). It is also shared on Google Classroom, as well as uploaded on learner devices (substitution). However, Ms Sithole revealed several impediments to the acquisition of LNSSs, including the inability to monitor the appropriate utilisation of the learner devices in the classroom, lack of connectivity, time constraints due to the COVID-19 pandemic and prescribed teaching and learning resources, as well as prescribed practical assessment tasks.

Ms Sithole's enacted practices depicted during the lesson observation, including the learning activities, are analysed in the next section.

Lesson Observed

Topic: Revision of Electrical Systems and Controls

ICTs used: The Smartboard and laptop

Overview of the lesson

This was a revision lesson on the components of electrical systems in preparation for the exams, focusing on Ohm's Law. The lesson also aimed to enable learners to combine "thinking and doing in a way that links abstract concepts to concrete understanding" (Department of Basic Education, 2011, p.9). Ms Sithole utilised blended learning in her classroom. She verbally explained the concept of Ohm's Law; then, she used a marker to write notes on the Smartboard for learners to copy into their notebooks (substitution). She played a video from YouTube to enhance the learners' understanding of the concept (acquisition). Ms Sithole then wrote and explained a formula to calculate Ohm's Law using a marker from the toolbar on the Smartboard (substitution).

To establish the learners' understanding, they were given a classroom activity to apply the formula explained to calculate the resistance, voltage and current. The learners worked individually and wrote the three activities in their exercise books. Upon completion of the classwork activity, a few learners were identified to write their calculations on the Smartboard using a marker from the toolbar (substitution).

The analytical tool was used to examine the different teaching and learning activities to determine the LNSSs acquired across the four levels of interaction in Connectivist Learning, described in the following section.

Operation Interaction

Learners did not have their tablets in class. Minimal opportunities were created for them to learn how to follow prompts on ICT devices to access and use multimedia content from the Internet.

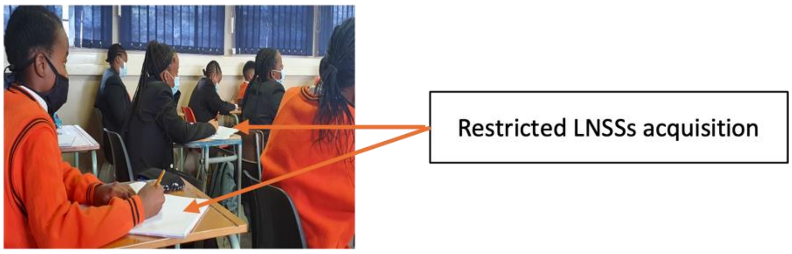


Figure 5.17: Learners Used their Notebooks to Write Notes and Copy Diagrams

Source: Author's photograph

Learners used their notebooks to write notes and copy diagrams drawn by Ms Sithole on the Smartboard using a marker from the toolbar (substitution) (Figure 5.17). The only opportunity learners utilised the ICT device was when they showed their calculations on the Smartboard using a marker from a toolbar (substitution) (Figure 5.18).

Figure 5.18: A Learner Showed Their Calculations on the Smartboard

Source: Author's photograph

Wayfinding Interaction

Teaching and learning activities in the classroom did not provide opportunities for learners to find multimedia content on their own (Figure 5.19).

Figure 5.19: Ms Sithole Showed an Image on the Smartboard to Illustrate a Concept

Source: Author's photograph

Ms Sithole found an image to illustrate the effect of Ohm's Law and presented it to the class (substitution), which learners observed passively. As a result, learners did not find and choose relevant images on their own from the complex and information-loaded web space (restricted ICT skill acquisition).

Sensemaking Interaction

Ms Sithole used the Smartboard to present content on Ohm's Law (substitution) (Figure 5.20).

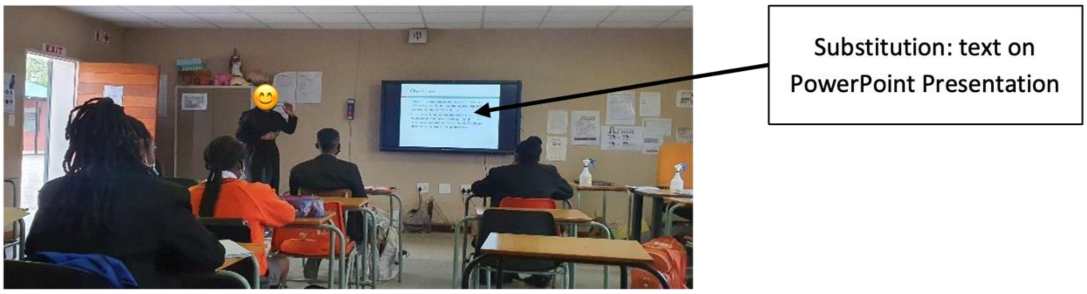


Figure 5.20: Ms Sithole Used a PowerPoint Presentation to Explain Ohm's Law

Source: Author's photograph

Ms Sithole used a PowerPoint Presentation to explain Ohm's Law (substitution). She also showed learners an image depicting the output of Ohm's Law to enhance the learners' understanding of the concept, as illustrated earlier (acquisition).

Figure 5.21: Ms Sithole Used a Marker from the Toolbar on the Smartboard to Demonstrate a Calculation to the Learners

Source: Author's photograph

Ms Sithole used a marker from the toolbar on the Smartboard (substitution) to demonstrate to learners how to calculate Ohm's Law (modelling) (Figure 5.21). To establish their understanding, learners were given a classroom activity to apply the formula explained to calculate the resistance, voltage and current (practice) (Figure 5.22).

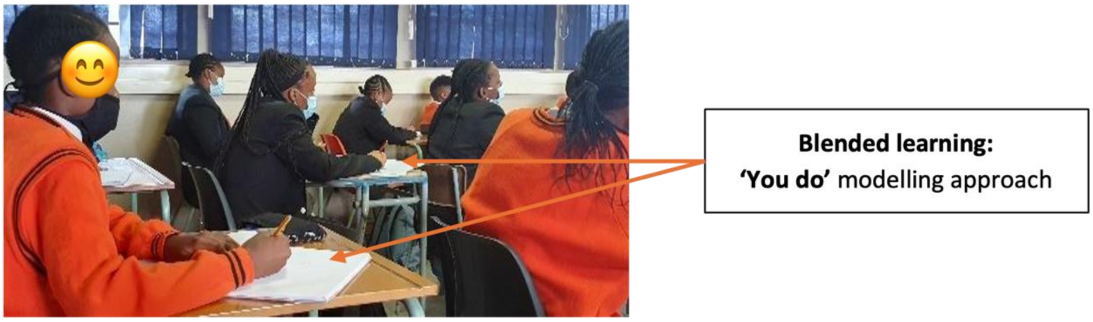


Figure 5.22: Learners Worked Individually on a Classroom Activity

Source: Author's photograph

The learners worked individually and wrote the three activities in their exercise books. Upon completion of the classwork activity, a few learners were identified to write their calculations on the Smartboard using a marker from the toolbar (substitution) (Figure 5.23).

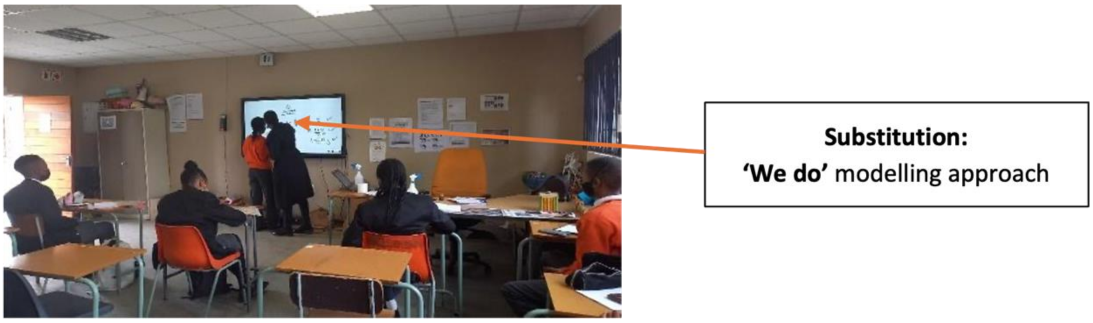


Figure 5.23: A Learner Wrote their Calculations on the Smartboard

Source: Author's photograph

The teacher then used the question-and-answer method to determine a clear understanding of concepts (discussion) (Figure 5.24).

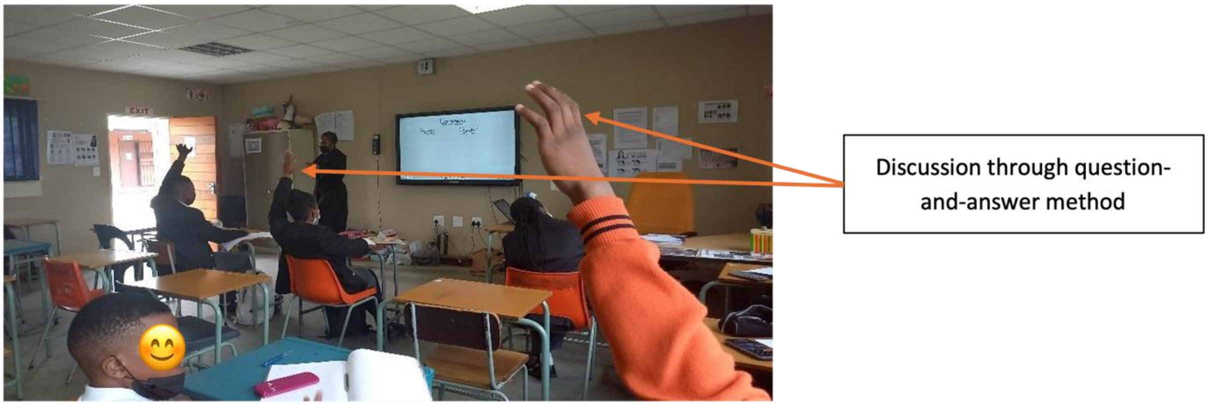


Figure 5.24: Ms Sithole Used Dialogue Through the Question-and-Answer Method to Determine a Clear Understanding of Concepts
Source: Author's photograph

Innovation Interaction

In Ms Sithole's classroom, there was no evidence of teaching and learning activities that create opportunities for learners to plan, design, make and evaluate the products made in the digital space.

The analytical tool in Table 5.10 depicts how Ms Sithole's teaching and learning activities incorporate Siemens' (2011) four levels of interaction in Connectivist Learning, Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types to promote the acquisition of the LNSS.

Table 5.10: Interpretation of Ms Sithole's Development of Learner Network Society Skills (LNSSs) During Classroom Observation

Levels of Connectivist Learning	Six Learning Types	Observation in the Classroom	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/Digital Authoring**	No evidence of opportunities created for learners to plan, design, make and evaluate learning artefacts online.	None	None
3.4. Sensemaking Interaction	**5. Discussion**	Use of question-and-answer method to determine understanding of concepts	Summarising, paraphrasing, explaining, describing	None
	4. Collaboration	Not observed	None	None
	3. Practice	Learners write calculations on the Smartboard using a marker from a toolbar	Implementing, carrying out, using, executing	None
	2. Acquisition	The teacher explains how to calculate resistance, voltage and current using Ohm's Law Use of the Smartboard to show multimedia content on Ohm's Law	Summarising, paraphrasing, explaining, describing	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	The teacher models how to access multimedia content on the Internet No learner devices; learners observe passively	None	None
1. Operation Interaction	**1.6. Inquiry: Web Searching**	No learner devices in class Learners use a marker from a toolbar on the Smartboard to calculate Ohm's Law	None	None

Sources: Adapted from Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Shouman & Momdjian, 2019; Aldosemani, 2019; Rehman & Aurangzeb, 2021

Conclusion: Lesson Observation

The data on classroom observation reveals that the teaching and learning activities focused mainly on content acquisition. Evidence of understanding concepts was observed at the acquisition and discussion levels. The development of LNSSs was only modelled for learners at the operation and wayfinding interaction levels. However, learners could not practice what they observed as they did not have their ICT devices in class.

Lesson plan

An extract from Ms Sithole's lesson plan for 18 – 22 October 2021, a revision exercise of an electric circuit and its components and Ohm's Law Calculations, is provided in Table 5.11.

Table 5.11: Extract from Ms Sithole's Term 4 Lesson Plan on Teaching and Learning Activities and Resources.

<table>
<tr><td colspan="3">CLASSROOM ACTIVITIES:</td></tr>
<tr><td rowspan="4">Teacher's Activities</td><td>Day 1: Suggested teacher's activities</td><td>Day 2: Suggested teacher's activities</td></tr>
<tr><td>• Revise: simple circuit components; input devices (electrochemical cell; generator; solar panel), output devices (resistor; lamp; heater; buzzer; motor); control device (switches).
Note: Some devices can serve as input, output, process or control devices.
• Correct connections and short circuits. Electrical components and their accepted symbols.
Emphasis on series connections of cells, switches and bulbs with the aim of explaining the AND gate.</td><td>• Revise: introduce Ohm's Law (using calculations). Learners use one cell, then two cells, and then three cells connected in series and note the effect on the brightness of a lamp. They must conclude that more cells in series (more voltage) will cause the current strength to increase if the resistance does not change</td></tr>
<tr><td>1 Facilitates
2. Guides
3. Assists
4. Demonstrates
5. Provides resources</td><td>1 Facilitates
2. Guides
3. Assists
4. Demonstrates
5. Provides resources</td></tr>
<tr><td colspan="2">Talk learners through concepts and ideas. Ask relevant questions to help them understand and interpret this information. Teach the specific meaning of all terms and talk learners through the concepts, ideas and calculations.</td></tr>
<tr><td rowspan="3">Learners' Activities</td><td>Day 1: Suggested learner activities</td><td>Day 2: Suggested learner activities</td></tr>
<tr><td>Enabling task 1
● Learners draw a circuit diagram using component symbols</td><td>Enabling task 2
● Learners should be given a chance to calculate using Ohm's Law
● Learners should be given a chance to set up circuits using a range of components.</td></tr>
<tr><td colspan="2">Actively participate with questions, where possible, practical examples, etc</td></tr>
<tr><td rowspan="3">Resources</td><td>DBE Workbook 2 Gr. 8, YouTube.</td><td>DBE Workbook 2 Gr. 8</td></tr>
<tr><td>CAPS</td><td>CAPS</td></tr>
<tr><td>Examples / Samples</td><td>Examples / Samples</td></tr>
</table>

The planned teaching and learning activities from Ms Sithole's lesson plan are geared towards the development of skills that learners could utilise in the future. Calculating Ohm's Law and applying it in designing electrical circuits is a skill that could be used, for example, in electrical engineering (Department of Basic Education, 2011). The resources for the lesson include the DBE workbooks, the CAPS document and, notably, YouTube. However, there was no indication of teaching and learning activities where YouTube would be used. The lesson plan is also silent on what learners would use to draw a circuit diagram and build circuits using a range of components, as well as calculate using Ohm's Law.

The analytical tool in Table 5.12 was used to determine how Ms Sithole's lesson plan incorporated Siemens' (2011) four levels of interaction in Connectivist Learning, Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types to promote the acquisition of LNSSs.

Table 5.12: Interpretation of Ms Sithole's Lesson Plan on the Development of Learner Network Society Skills (LNSSs)

Levels of Connectivist Learning	Six Learning Types	Applicability of Learning Types in the Lesson Plan	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/Digital Authoring**	None	None	None
3.4. Sensemaking Interaction	**5. Discussion**	None	None	None
	4. Collaboration	None	None	None
	3. Practice	None	None	None
	2. Acquisition	None	None	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	None	None	None
1. Operation Interaction	**1.7. Inquiry: Web Searching**	None	None	None

Sources: Adapted from Siemens, 2011; Laurillard, 2012

The planned activities from Ms Sithole's lesson plan are geared towards the development of skills that learners could utilise in future. For example, using Ohm's Law is a skill that could be used in electrical engineering (Department of Basic Education, 2011). However, column 3 in Table 5.12 reveals that there were no planned teaching and learning activities on the utilisation of ICTs to facilitate the development of LNSSs.

The last section presents how Ms Sithole used social media to develop LNSSs.

Social Media

Learners could operate, connect and communicate on social media. This is depicted in the WhatsApp messages in Figure 5.25.

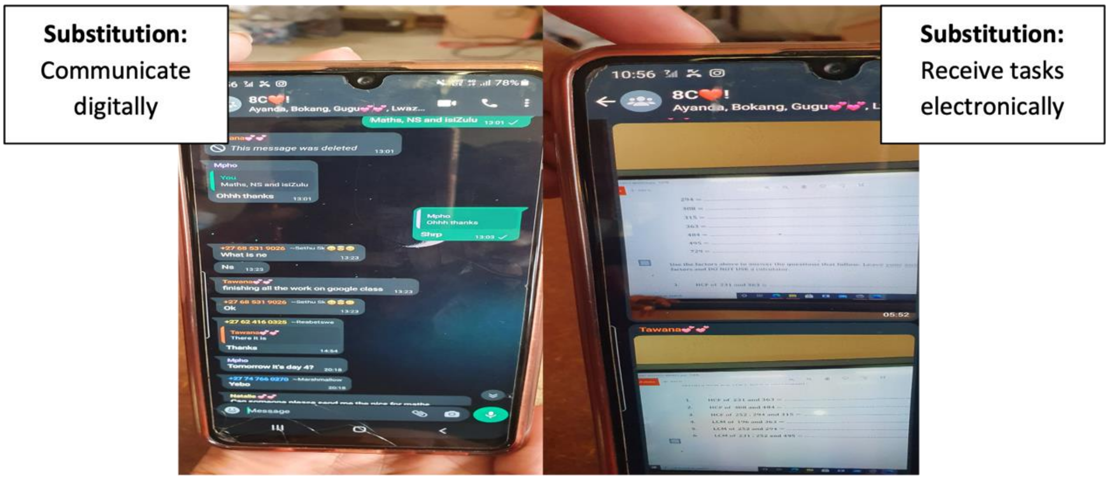


Figure 5.25: Learner Communicate and Receive Tasks Electronically

Source: Author's photograph

Learners could follow prompts from their smart cell phones to share and receive information digitally. At the same time, learners could receive and retrieve tasks digitally (operation interaction). It is worth highlighting at this point that the use of social media is confined to sharing tasks. In addition, Ms Sithole's learners demonstrated using social media at the end of classroom observation because the use of social media was not part of the lesson plan. As a result, it could not be observed in practice during teaching and learning activities. In addition, there was no evidence of wayfinding, sensemaking and innovation interactions on social media.

The analytical tool in Table 5.13 depicts how the use of social media promotes the acquisition of LNSSs.

Table 5.13: Interpretation of Ms Sithole's Development of Learner Network Society Skills (LNSSs) on Social Media

Levels of Connectivist Learning	Six Learning Types	Applicability of Learning Types in the Use of Social Media	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/Digital Authoring**	Not applicable	None	None
3.4. Sensemaking Interaction	**5. Discussion**	Not applicable	None	None
	4. Collaboration	Share tasks digitally	None	Sharing work digitally through a blog, sending and receiving work through an app to and from the teacher and peers, receiving written and verbal comments digitally
	3. Practice	Learners operate social media to communicate, send and receive tasks	None	Implementing, carrying out, using, executing, downloading, uploading and sharing, sending and receiving work through an app to and from the teacher and peers, sharing work digitally through a blog
	2. Acquisition	None	None	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	None	None	None
1. Operation Interaction	**1.1. Inquiry: Web Searching**	None	None	None

Sources: Adapted from Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Shouman & Momdjian, 2019; Aldosemani, 2019; Rehman & Aurangzeb, 2021

Conclusion: Social Media

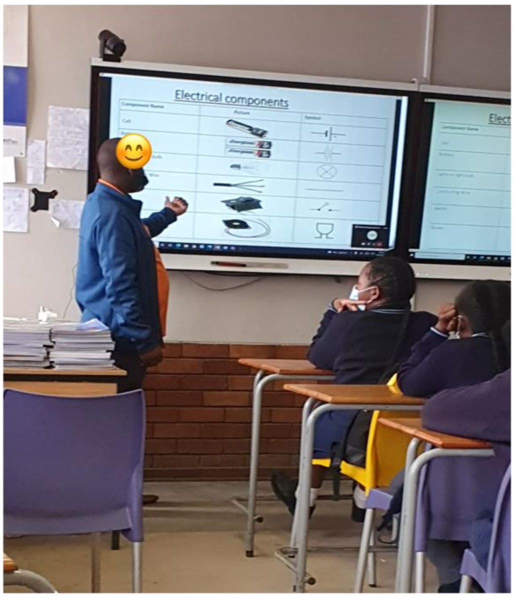
The learners showed the researcher that they could operate, connect and communicate via social media at the end of the classroom observation because communication via social media was not part of the lesson plan. Therefore, it could not be observed in practice in the classroom. Just as in Mr Cele's case, the researcher did not identify any evidence of discussions and innovation interaction to share ideas on the task to be completed. Instead, collaboration is also confined to sharing tasks.

Overall Conclusion

Ms Sithole's interview demonstrates her knowledge of how ICTs could be utilised in Technology to equip learners with LNSSs to participate meaningfully in the global community. However, observing her teaching and learning activities in the classroom revealed limited development of LNSSs. She mainly employed Hurley and Chater's (2005) modelling phases to demonstrate to learners how to perform a task. In addition, her demonstration was confined to Puentedura's (2009) substitution level and Siemens' (2011) sensemaking level. However, at the sensemaking level, the learning activities were confined to Laurillard's (2012) acquisition.

In addition, there is no evidence of teaching and learning activities that promote the acquisition of LNSSs at operation, wayfinding or higher levels of sensemaking, namely the collaboration and discussion levels, as well as at the innovation interaction level. Ms Sithole attributes the to the DBE's prescripts, such as the practical assessment tasks required for mark allocation. This means the acquisition of LNSSs during her teaching and learning activities is incidental and not purposefully planned.

5.6 Teacher 4: Mr Banda



Interview

Mr Banda mainly utilises the Smartboard and the laptop when teaching Technology as a subject. He also utilises the Smartpen to write on the Smartboard (substitution). His learners utilise mini laptops and smart cell phones for learning purposes.

According to Mr Banda, Technology as a subject is aimed at equipping learners with the knowledge and skills to solve human problems in the real-life situation. He said,

> *"The main aim of teaching Technology as a subject is to develop practical skills, designing skills to solve problems. For example, when learners are given a scenario, they need to identify the problem from the scenario, and they plan and design something to solve the problem."*

Problem-based learning

To realise this aim, learners are given projects to solve the problem identified. He understands that the CAPS document requires learners to acquire the necessary problem-solving skills in Technology at the end of the learning experience. He said,

> *"During the previous term, learners were given a project to develop a [mine] shaft headgear to lift a rock and carry miners up and down the mine shaft. Learners are required to acquire the*

Production

Technology design process

following skills: investigating skills, planning skills, designing skills and making skills."

The four levels of Connectivist Learning were used to determine the development of LNSSs throughout his teaching and learning activities.

Operation and Wayfinding Interaction

Mr Banda utilises blended learning through demonstrations in the classroom, as well as affords learners opportunities to navigate through the ICT resources to promote the acquisition of LNSSs. The following dialogue between the researcher and Mr Banda depicts this:

Researcher: "What web-based activities have you designed for learners to enable them to utilise the available ICT resources, obtain information, understand information obtained, to solve the problem identified?"

Mr Banda: "Most of the Grade 8 learners do not have mini laptops. The learners were given a research activity to find information about the project. For example, drawings. They were shown the website where they could obtain information, for example, on Google. They were shown what to do when they [were] searching for information, pictures, etc. I share information through a PowerPoint Presentation to make learners understand. We also have discussions on information obtained from the Smartboard. I also show them pictures and play videos downloaded from the Smartboard to make them understand."

Researcher: "How do you utilise the teacher ICT resources available in your classroom to guide learning and the acquisition of the desired ICT skills?"

Restricted LNSS acquisition

Web searching/Inquiry

Modelling

Substitution

Acquisition

> Mr Banda: "I make learners switch off their devices when I am using the Smartboard and teaching in class. This is because some of the learners could be doing other things on their devices [that are] not related to schoolwork. When doing corrections on classroom activities, opportunities are created for learners to write on the Smartboard, as well as search for information."

Learners voluntarily utilise a variety of ICT resources to communicate and collaborate with their peers to solve the problem identified. He said,

"Learners use WhatsApp only when they communicate and share information with others. The learners voluntarily communicate with others. It is not part of the teacher's lesson plan for learners to communicate and share information with others. It is not part of the teacher's lesson plan for learners to collaborate with others to solve the problem identified."	Collaboration Restricted LNSS acquisition

Sensemaking Interaction

Mr Banda utilises the Smartboard to present content in class, as well as engage learners in classroom discussions to make learners grasp new concepts and skills. He said,

"I share information through a PowerPoint Presentation to make learners understand. We also have discussions on information obtained from the Smartboard. I also show them pictures and play videos downloaded from the Smartboard to make them understand."	Substitution Acquisition

To make sense of the information obtained during teaching and learning in class, as well as promote a deeper understanding of what is required to solve the problem identified, the learners communicate and collaborate with one another through social media. Mr Banda said, *"Learners use WhatsApp only when they communicate and share information with others. The learners voluntarily communicate with others. It is not part of the teacher's lesson plan for learners to communicate and share information with others. It is not part of the teacher's lesson plan for learners to collaborate with others to solve the problem identified."*

Collaboration

Restricted LNSS acquisition

Innovation Interaction

Planning, designing and creating prototypes to solve the problem identified, as well as showcasing the finished product, is done physically. Mr Banda attributes this to the limited affordances of the ICT devices provided, as he explained in the following dialogue:

Researcher: "In your lesson planning, what activities have you designed for learners to enable them to utilise available web resources to plan, investigate, design, make, evaluate and showcase the artefacts or products made digitally?"

Mr Banda: "Learners use Google to research and to obtain information, as well as drawings to solve the problem identified. The learners plan, design and make products manually. The products made are evaluated through group discussions in the classroom. When evaluating the product, learners respond to the following questions:

- *Is the product made serving the purpose?*
- *The material used. Is it the correct material?"*

Web searching/Inquiry

Restricted LNSS acquisition

He further said,

"There are no ICT skills acquired for designing, making and evaluating products as learners perform these activities physically. After investigating a

Restricted LNSS acquisition

project, learners are required to present the product made to the teacher in class. The artefacts/products made are showcased in the classroom. No ICT platforms are created for learners to share and showcase the products made digitally."

Conclusion: Interview

During his interview, Mr Banda indicated that he utilises the Smartboard to substitute for his teaching and learning activities. He employs modelling to demonstrate to learners how to access multimedia content on the Internet. However, he indicated that he does not allow learners to utilise their devices in class. In addition, he pointed out that it is not a requirement for learners to collaborate on social media, as well as develop products digitally.

The lesson observed, depicting Ms Sithole's enacted practices, including the learning activities, is analysed in the next section.

Lesson Observed

Topic: Electrical Systems and Controls

ICTs used: The Smartboard and laptop

Overview of the lesson

This was a revision lesson on how electricity works. Mr Banda used a PowerPoint Presentation through the Smartboard to explain and illustrate to the learners the concept of an electrical circuit, a simple circuit and a circuit with a motor, a lamp and a switch. Like the other three teachers, his lesson was aimed at enabling learners to combine "thinking and doing in a way that links abstract concepts to concrete understanding" (Department of Basic Education, 2011, p.9). He used diagrams/pictures in the PowerPoint Presentation (acquisition) to remind learners of the important concepts in electrical systems and controls. He used the question-and-answer method (discussion) to assess the learners' understanding of the concepts.

He further demonstrated (modelling) how to draw a simple circuit and a circuit diagram with a motor, a lamp and a switch on the Smartboard using icons on the taskbar while learners observed (substitution). To demonstrate their understanding of the important concepts, a few learners volunteered to draw a line diagram on the Smartboard, representing a simple circuit and a circuit diagram with a motor, a lamp and a switch (practice).

The researcher used the four levels of interaction in Connectivist Learning, as depicted by Siemens (2011), to examine the different ICT skills learners could acquire as Mr Banda engaged them in teaching and learning activities.

Operation and Wayfinding Interaction

Notably, like Mr Cele and Ms Sithole, Mr Banda's learners, seen in Figure 5.26, did not have their tablets in class.

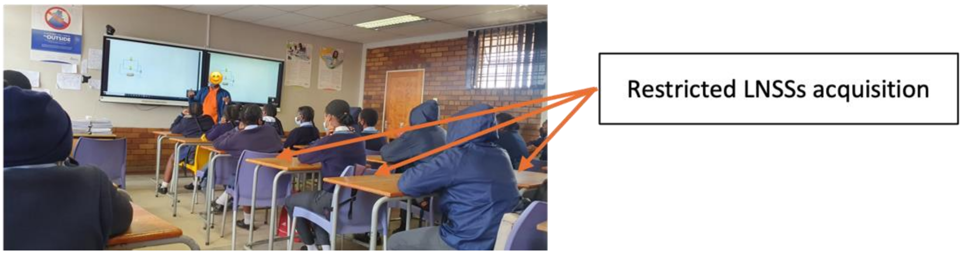


Figure 5.26: Learners Did Not Have Tablets on Their Desks

Source: Author's photograph

As a result, they had minimal opportunities to utilise ICT resources to learn to follow prompts to obtain information and combine and filter content from different digital social networks.

Instead, Mr Banda demonstrated how to draw a simple circuit and a circuit diagram with a motor, a lamp and a switch on the Smartboard using icons on the taskbar while learners observed (modelling) (Figure 5.27).

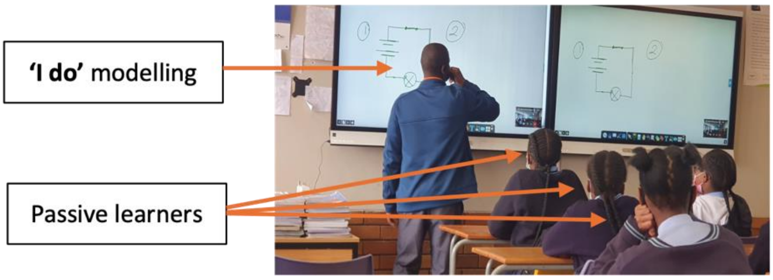


Figure 5.27: Mr Banda Demonstrated a Concept Using the Smartboard

Source: Author's photograph

Learners were afforded an opportunity to recall what the teacher demonstrated using the Smartboard. A learner volunteered to draw a line diagram on the Smartboard using an icon on the taskbar representing a simple circuit and a circuit diagram with a motor, a lamp and a switch (substitution) (Figure 5.28).

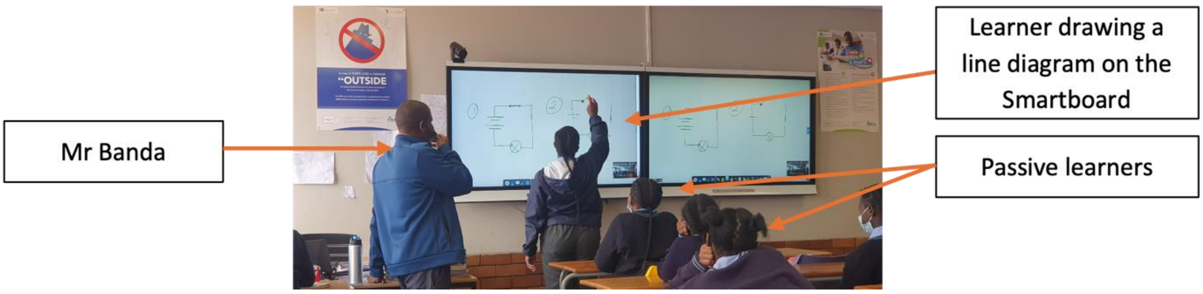


Figure 5.28: A Learner Recalled What Mr Banda Had Demonstrated on the Smartboard

Source: Author's photograph

A few learners with smart cell phones took a picture of the homework activity from a PowerPoint Presentation on a Smartboard (Figure 5.29).

Figure 5.29: Learners Took Photos of the Smartboard with Their Smart Cell Phones

Source: Author's photograph

Mr Banda accessed images on the Internet and presented these to the learners using the Smartboard (Figure 5.30).

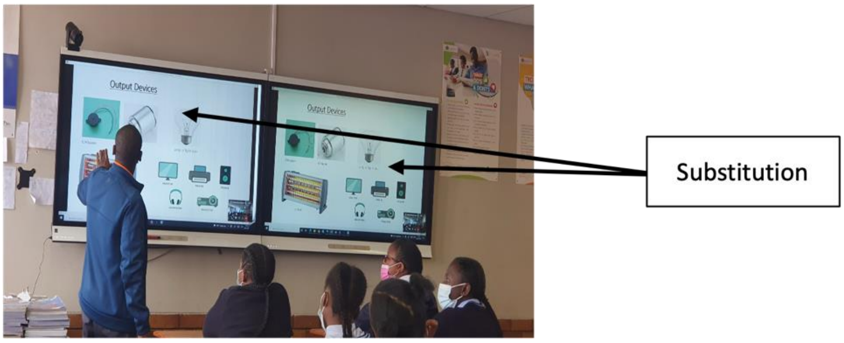


Figure 5.30: Mr Banda Showed Learners Images That He Accessed on the Internet

Source: Author's photograph

The learners passively observed the teacher (restricted ICT skill acquisition). Opportunities were not created for learners to navigate through complex and information-loaded environments using symbols to access images on electrical systems.

Sensemaking Interaction

Mr Banda presented multimedia content using the Smartboard, which included written content and diagrams/pictures on the PowerPoint Presentation, to help learners grasp important concepts (acquisition) (Figure 5.31).

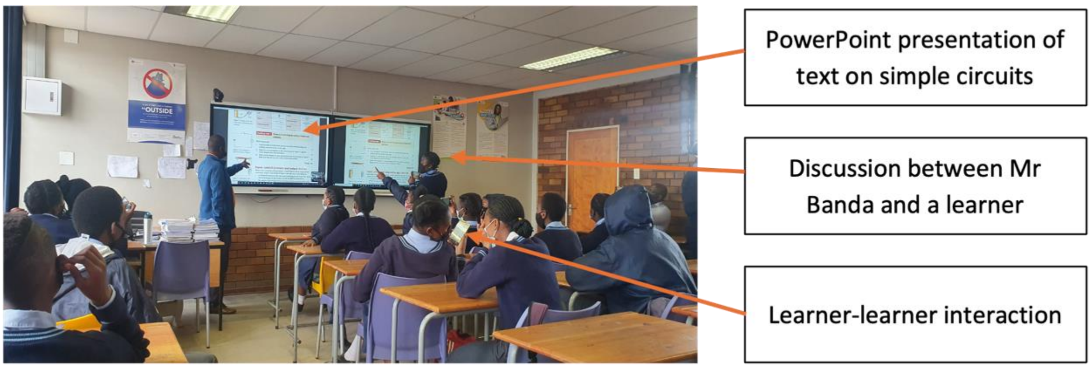


Figure 5.31: Mr Banda Presented Written Content and Pictures on the Smartboard

Source: Author's photograph

He employed the question-and-answer method to engage learners in discussion to promote the understanding of concepts (discussion). However, this was confined to learner-teacher interaction. Although learner-learner interaction was also observed, the researcher could not ascertain if the discussion was relevant to the lesson.

Innovation Interaction

Mr Banda's classroom did not present evidence of opportunities created for learners to plan, design, make and evaluate learning artefacts online.

The analytical tool in Table 5.14 depicts how Mr Banda's teaching and learning activities incorporate Laurillard's (2012) six learning types to promote the acquisition of the LNSSs.

Table 5.14: Interpretation of Mr Banda's Development of Learner Network Society Skills (LNSSs) During Classroom Observation

Levels of Connectivist Learning	Six Learning Types	Observation in the Classroom	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/Digital Authoring**	No evidence of opportunities created for learners to plan, design, make and evaluate learning artefacts online.	None	None
3.4. Sensemaking Interaction	**5. Discussion**	Use of question-and-answer method to determine understanding of concepts	Summarising, paraphrasing, explaining, describing	None
	4. Collaboration	Not observed	None	None
	3. Practice	Learners recall what the teacher has demonstrated and draw a line diagram on the Smartboard.	Implementing, carrying out, using, executing	None
	2. Acquisition	Use of Smartboard, to show multimedia content on simple circuits, to help learners grasp important concepts.	Summarising, paraphrasing, explaining, describing	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	Teacher accesses images on the Internet and presents these to the learners using the Smartboard Opportunities not created for learners to conduct web searchers	None	None
1. Operation Interaction	**1.2. Inquiry: Web Searching**	No learner devices in class Learners draw a simple circuit and a circuit diagram with a motor, a lamp and a switch on the Smartboard using icons on the taskbar	None	None

Sources: Adapted from Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Shouman & Momdjian, 2019; Aldosemani, 2019; Rehman & Aurangzeb, 2021

Conclusion: Classroom Observation

The data on classroom observation reveals that the teaching and learning activities focused mainly on content acquisition. Evidence of understanding concepts was observed at the acquisition and discussion levels. The development of LNSSs was only modelled for learners at the operation and wayfinding interaction levels. However, learners could not practice what they had observed as they did not have their ICT devices in class.

Lesson Plan

Mr Banda's lesson plan for 18 – 22 October 2021 was a revision exercise of electrical systems and controls. The main resources for obtaining information are the DBE workbook, the CAPS document and, notably, YouTube, as depicted in Table 5.15.

Table 5.15: Extract from Mr Banda's Term 4, Week 1 Lesson Plan on Teaching and Learning Activities and Resources

<table>
<tr><td colspan="3">CLASSROOM ACTIVITIES:</td></tr>
<tr><td rowspan="4">Teacher's Activities</td><td>Day 1: Suggested teacher's activities</td><td>Day 2: Suggested teacher's activities</td></tr>
<tr><td>• Revise: simple circuit components; input devices (electrochemical cell; generator; solar panel), output devices (resistor; lamp; heater; buzzer; motor); control device (switches).
Note: Some devices can serve as input, output, process or control devices.
• Correct connections and short circuits. Electrical components and their accepted symbols.
Emphasis on series connections of cells, switches and bulbs with the aim of explaining the AND gate.</td><td>• Drawing electrical circuits using accepted symbols.
• Set up circuits using a range of components. Draw the circuits using symbols.
Emphasis on parallel connections of cells, switches and bulbs with the aim of explaining the OR gate.</td></tr>
<tr><td>1 Facilitates
2. Guides
3. Assists
4. Demonstrates
5. Provides resources</td><td>1 Facilitates
2. Guides
3. Assists
4. Demonstrates
5. Provides resources</td></tr>
<tr><td colspan="2">Talk learners through concepts and ideas. Ask relevant questions to help them understand and interpret this information. Teach the specific meaning of all terms and talk learners through the concepts and ideas.</td></tr>
<tr><td rowspan="3">Learners' Activities</td><td>Day 1: Suggested learner activities</td><td>Day 2: Suggested learner activities</td></tr>
<tr><td>Enabling task 1
● Learners draw a circuit diagram using component symbols</td><td>Enabling task 2
● Learners should be given a chance to set up circuits using a range of components</td></tr>
<tr><td colspan="2">Actively participate with questions, where possible, practical examples, etc</td></tr>
<tr><td rowspan="3">Resources</td><td>DBE Workbook 2 Gr. 8, YouTube videos</td><td>DBE Workbook 2 Gr. 8</td></tr>
<tr><td>CAPS</td><td>CAPS</td></tr>
<tr><td>Examples / Samples</td><td>Examples / Samples</td></tr>
</table>

Mr Banda's teaching and learning activities from his lesson plan are aimed at the development of skills that learners could utilise in future. The ability to make correct connections of cells, switches and bulbs is a skill that could be used, for example, in electrical engineering (Department of Basic Education, 2011). Similar to Ms Sithole, the resources to be utilised for the lesson include the DBE workbook, the CAPS document and YouTube videos. However, there is no indication of teaching and learning activities where YouTube videos would be used. The lesson plan is also silent on what learners would use to draw a circuit diagram using component symbols.

The analytical tool in Table 5.16 was used to determine how Mr Banda's lesson plan incorporates Siemens' (2011) four levels of interaction in Connectivist Learning, Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types to promote the acquisition of LNSSs.

Table 5.16: Interpretation of Mr Banda's Lesson Plan on the Development of Learner Network Society Skills (LNSSs)

Levels of Connectivist Learning	Six Learning Types	Applicability of Learning Types in the Lesson Plan	Cognitive Skills Acquired	LNSSs Acquired
4. Innovation Interaction	**6. Production/ Digital Authoring**	None	None	None
3.4. Sensemaking Interaction	**5. Discussion**	None	None	None
	4. Collaboration	None	None	None
	3. Practice	None	None	None
	2. Acquisition	None	None	None
2. Wayfinding Interaction	**1.2. Inquiry: Advanced Web Searching**	None	None	None
1. Operation Interaction	**1.3. Inquiry: Web Searching**	None	None	None

Sources: Adapted from Siemens, 2011; Laurillard, 2012

Conclusion: Lesson Plan

The planned activities from Mr Banda's lesson plan are geared towards developing skills that learners could use in future. For example, the ability to make correct connections of cells, switches and bulbs is a skill that could be used in electrical engineering (Department of Basic Education, 2011). However, column 3 in Table 5.16 reveals that there are no planned teaching and learning activities on the utilisation of ICTs to facilitate the development of the LNSSs.

The last section presents how Mr Banda uses social media to develop LNSS.

Social Media

Mr Banda could not share evidence of the utilisation of social media. Although Mr Banda indicated during the interview session that his learners use social media to share information, he made it clear that learners collaborate and communicate voluntarily – it is not part of his lesson plan (restricted LNSS acquisition).

Conclusion: Social Media

Using social media is not part of Mr Banda's lesson plan. As a result, the analytical tool for the lesson plan on the teaching and learning activities using the platform for communication and collaboration could not be employed for Mr Banda.

Overall Conclusion

Mr Banda's interview demonstrated his knowledge of how ICTs could be utilised in Technology to equip learners with LNSSs to participate meaningfully in the global community. However, similarly to Mr Cele and Ms Sithole, his teaching and learning activities in the classroom revealed the development of LNSSs on a limited scale. He also employed Hurley and Chater's (2005) modelling to demonstrate to learners how to access multimedia content, as well as carry out written tasks on the Smartboard. His modelling is confined to Puentedura's (2009) substitution level and Siemens' (2011) sensemaking level. However, at the sensemaking level, the learning activities are confined to Laurillard's (2012) acquisition.

In addition, there was no evidence of teaching and learning activities that promote the acquisition of LNSSs at the operation and wayfinding levels or higher levels of sensemaking, namely collaboration and discussion, as well as at the innovation interaction level. This is implicitly attributed to departmental prescripts and lack of capacity.

5.7 Chapter Conclusion

The Grade 8 Technology teachers from the four Full ICT schools in the GDE utilise blended learning mainly to substitute the traditional chalkboard and textbooks (substitution). In addition, to enhance the learners' understanding of concepts (acquisition), they rely mainly on multimedia content such as text, images, audio, video and animations. Except for Mr Bozwana, the rest of the teachers access these for learners, share them with learners on Google Classroom or upload them to the learners' devices. In the main, ICT resources are utilised as a quicker way to find information, deliver it in the classroom during teaching and learning activities and share it with learners for assessment tasks.

Throughout the process of teaching and learning, the Grade 8 Technology learners are acquiring LNSSs. However, these skills are not maximally developed across all the levels of Connectivist Learning, as there is no deliberate effort by the four teachers to develop LNSSs across these levels, except for finding information (web searches) and the use of multimedia content to facilitate the understanding of concepts (acquisition). In other words, the development of LNSSs is incidental. The teachers attribute this to departmental prescripts, connectivity challenges and a lack of capacity.

6 Chapter Six: Analysis of Teachers' Espoused and Enacted Practices

6.1 Introduction

The study's main finding is that Grade 8 Technology teachers from the four Full ICT schools in Gauteng use the available ICT resources provided to these schools for teaching and learning activities. This chapter employs thematic analysis to interpret the data presented in Chapter Five on the development of LNSSs by the study's four participating teachers. It was analysed using predominantly the conceptual-driven codes from the analytical framework, as well as the data-driven codes where necessary (Ritchie & Lewis, 2003; Gibbs, 2007). The detail for the analytical framework in Table 6.1 is presented in Chapter Three.

Table 6.1: The Study's Analytical Framework

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities based on data
4. Innovation Interaction ● Redefinition ● Modification	**6. Production/ Digital Authoring**	**Online Creation**	
3.4. Sensemaking Interaction ● Augmentation	**5. Discussion**	**Online Evaluation**	
3.3. Sensemaking Interaction ● Augmentation	**4. Collaboration**	**Online Collaboration**	
3.2. Sensemaking Interaction ● **'I do', 'We do', 'You do'** Modelling Instructional Strategy ● Modification	**3. Practice**	**Online Practice**	
3.1. Sensemaking Interaction ● **'I do', 'We do', 'You do'** Modelling Instructional Strategy ● Modification	**2. Acquisition**	**Online Acquisition**	
2. Wayfinding Interaction ● **'I do', 'We do', 'You do'** Modelling Instructional Strategy ● Substitution	**Inquiry 2: Advanced Web Searching**	**Advanced Searches Boolean Searching**	
1. Operation Interaction ● **'I do', 'We do', 'You do'** Modelling Instructional Strategy ● Substitution	**Inquiry 1: Web Searching**	**Remembering**	

Figure 6.1 outlines the core content or meaning that emerged after reading the text in Chapter Five line-by-line and reflecting on the data at hand.

1. Utilising the Smartboard to present content in class
2. Demonstrating to learners how to access multimedia content on the Internet
3. Utilising multimedia content to facilitate the understanding of concepts
4. Learners find multimedia content on the Internet
5. Learners use social media
6. Assessment of learning through online quizzes
7. Learning artefact creation to solve real-life problems
8. Lack of connectivity and devices
9. Lack of capacity
10. Departmental prescripts

Figure 6.1: Sub-themes for Guided Blended Connectivist Learning

Source: Author's construct

Using the thematic charts, the core content is represented by each participant's quotes depicting their espoused practices. The researcher labelled the core content accordingly, using conceptual or data-driven codes. The quotes and codes are provided in the next section. Thereafter, a synopsis of the participants' excerpts is used to determine how and why they relate to the codes allocated, as shown in Table 6.2. This is followed by a brief overview of the teachers' espoused practices and enacted practices to determine their consistency in the development of LNSSs.

Table 6.2: Utilising the Smartboard to Present Content in Class

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"The teacher laptops are loaded with textbooks. I use the laptop in class and connect it to the Smartboard. In that way, I am able to share the textbooks on the Smartboard for learners to obtain relevant information." (Mr Bozwana). "I use the USB to take information from my laptop to the Smartboard." (Mr Cele) "I also use visual aids on the Smartboard to make learners understand. Learners also access learning material, for example, notes, classwork and homework from Google Cloud." (Mr Cele) "They also access e-books from their tablets." (Mr Cele) "The PowerPoint Presentation is used for teaching and learning." (Ms Sithole) "The lessons are shared through Google Classroom and the LMS [learning management system] for learners to access." (Ms Sithole) "Lessons are also uploaded on the learners' devices. Learners log on to their devices to access the lessons." (Ms Sithole) "I share information through a PowerPoint Presentation to make learners understand. We also have discussions on information obtained from the Smartboard." (Mr Banda) "When doing corrections on classroom activities, opportunities are created for learners to write on the Smartboard." (Mr Banda)	Substitution	Not applicable

These quotes (Table 6.2) portray the situation in the four participating Full ICT schools in Gauteng as conveyed by the teachers when responding to the question:

How do you utilise the teacher ICT resources available in your classroom to guide learning and the acquisition of the desired ICT skills?

The teachers' responses on the utilisation of ICTs for teaching and learning activities indicate that the Smartboard **substitutes** traditional methods and tools, namely the chalkboard and the textbooks, for content presentation. In other words, there is no change in the scope of the activities performed using these resources. In addition to utilising the Smartboard to substitute the traditional chalkboard and textbooks, the teachers indicated that they use the Smartboard to demonstrate to learners how to access multimedia content on the

Internet. Table 6.3 presents the codes derived from teachers' excerpts related to core content. They responded to the question:

What web-based activities have you designed for learners to enable them to utilise the available ICT resources, obtain information and understand information to solve the problem identified?

Table 6.3: Demonstrating to Learners How to Access Multimedia Content on the Internet

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"I demonstrate to learners in class how to obtain information, as well as access videos on YouTube and Google." (Mr Bozwana) "I use the laptop along with HDMI so that learners can see what I am doing. For example, [I] demonstrate to learners how to draw an object. I also demonstrate to learners how to get information from their Google Drive. Then, learners do it on their own from their tablets. They are also shown how to navigate the platform to obtain videos, notes, classwork/homework and School-Based Assessment Tasks." (Mr Cele) "For some lessons, I go to the Internet on the Smartboard screen to search and get information while learners are watching." (Ms Sithole) "They were shown the website where they could obtain information, for example, on Google. They were shown what to do when they [were] searching for information, pictures, etc." (Mr Banda)	Modelling	Not applicable

The verbatim quotes (Table 6.3) indicate that the participating teachers understood the need to show learners how to utilise the available ICT resources before giving them a task. Demonstrating a new concept or skill to be learnt indicates that teachers employ Hurley and Chater's (2005) **Modelling Instructional Strategy**.

Importantly, the four teachers alluded to interaction with multimedia content enhancing learner understanding of concepts, including the acquisition of the desired ICT skills. Table 6.4 summarises the conceptual-driven code derived from the teachers' quotes related to facilitating the understanding of concepts.

Table 6.4: Utilising Multimedia Content to Facilitate the Understanding of Concepts

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"I make learners find animations on YouTube and attach videos to make them understand certain concepts." (Mr Bozwana) "I also use visual aids on the Smartboard to make learners understand." (Mr Cele) "Videos are utilised to explain concepts further." (Ms Sithole) "I also show them pictures and play videos downloaded from the Smartboard to make them understand." (Mr Banda)	Acquisition	Not applicable

The teacher's responses indicate their employment of **acquisition** to enhance learners' understanding of concepts. Although Laurillard (2012) points out that acquisition includes the use of technological affordances, such as video, multimedia, amination, augmented reality and virtual reality, the four teachers rely on videos to facilitate the understanding of concepts. Table 6.5 summarises the conceptual-driven code derived from the teachers' quotes relating to finding multimedia content on the Internet.

Table 6.5: Learners Find Multimedia Content on the Internet

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"Practical Assessment Tasks make learners go onto the web to search for information [and] go on Google and YouTube to find information and see video[s] on what to do."(Mr Bozwana) "The project given to learners requires them to conduct research using Google, the Internet or YouTube." (Mr Cele) "Learners use Google to research and to obtain information, as well as drawings to solve the problem identified." (Mr Banda)	Web Searching/Inquiry Modification	Not applicable

The participants' excerpts (Table 6.5) were in response to the question:

How do you utilise the teacher ICT resources available in your classroom to guide learning and the acquisition of the desired ICT skills?

Web searching or inquiry is about creating opportunities for learners to use the Internet to enable the use of a variety of information sources for learning purposes without using a textbook. This is aimed at adding depth to the task to further enhance the learners' understanding of concepts. Mr Bozwana's excerpt best fits this description (Table 6.5), as he makes learners use a variety of information sources to promote the understanding of concepts and the tasks to be carried out. The teacher's excerpts related to learners using social media are given in Table 6.6.

Table 6.6: Learners Use Social Media

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"Learners like sharing. They use WhatsApp groups. For example, to remind each other of what the teacher said in class [and] share videos. Certain learners learn better from their peers. They teach each other through WhatsApp Group[s] and share information. For collaboration, learners are given homework. Groups are formed to enable learners to share information in responding to the task provided." (Mr Bozwana) "They use WhatsApp and Google Cloud to collaborate. They discuss their ideas, send pictures [and] videos for the compilation of their PowerPoint Presentations." (Mr Cele) "Learners access the activities that they have to do from Google Classroom. For example, classwork activities, homework and memoranda." (Ms Sithole) "The lessons are shared through Google Classroom and the LMS [learner management system] for learners to access." (Ms Sithole) "The learners use the Google Space to communicate and collaborate with each other and the teacher." (Ms Sithole) "Learners make videos and upload them [to] the Google Classroom. For example, they draw and make an advert on paper and then upload it [to] the Google Classroom." (Ms Sithole) "Learners use WhatsApp only when they communicate and share information with others." (Mr Banda) "Learners voluntarily communicate with others." (Mr Banda)	Augmentation	Not applicable

Augmentation is about using the Internet to make learning interactive. This could be achieved by sharing teaching, learning and researched material to promote deep learning. In other words, augmentation enables learners to share opinions and ideas and post real-time comments using their mobile devices. In that way, they could correct each other to enhance their understanding of concepts. However, such interaction could also be achieved without using ICT resources. Ms Sithole, Mr Cele and Mr Bozwana's quotes (Table 6.6) relate to augmentation better than Mr Banda's. This was in response to the question:

What web resources do learners utilise to obtain information, communicate and collaborate with others to solve the problem or address the need identified?

Mr Banda's learner's use of social media does not relate to augmentation as it is confined to sharing information. Table 6.7 summarises the teacher's quotes related to the assessment of learning through online quizzes.

Table 6.7: Assessment of Learning Through Online Quizzes

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"Opportunities are created for learners to use Auto-Correct from Google Form[s]. This is automatic feedback on learner practice activities from Google Form[s]. It tells the learner whether the response provided is correct or incorrect." (Mr Cele) "I used the Moodle Platform to give learners a five-minute test/quiz, which has questions and answers to test their understanding. Currently, questions are in a written form from Google Classroom in the form of a quiz. As soon as learners have responded to the questions, they get the correct answers immediately." (Ms Sithole)	Practice	Not applicable

According to Laurillard (2012), to promote deeper learning, teaching and learning activities should also create opportunities for learners to **practice** using design tools, digital simulations, games, assessment tools, analytical tools and learning analytics. The data analysis revealed that only two teachers, Mr Cele and Ms Sithole, create opportunities for learners to practice to demonstrate learning. However, practice in both cases is limited to using assessment tools (Table 6.7).

A summary relating to learning artefact creation to solve real-life problems is presented in Table 6.8.

Table 6.8: Learning Artefact Creation to Solve Real-Life Problems

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"They use WhatsApp and Google Cloud to collaborate. They discuss their ideas and send pictures [and] videos for the compilation of their PowerPoint Presentations. They also create a link on the PowerPoint Presentation to show a picture or a video during their presentation." (Mr Cele) "During their spare time, learners make videos and upload them [to] the Google Classroom. For example, they draw and make an advert on paper and then upload it [to] the Google Classroom." (Ms Sithole)	Redefinition Production/Digital Authoring	Restricted Learner Network Society Skills Acquisition

Redefinition, production or digital authoring enables the creation of new tasks that would be inconceivable without ICT resources. Only Mr Cele and Ms Sithole's responses to the interview question are related to the assigned conceptual codes:

In your lesson planning, what activities have you designed for learners to enable them to utilise the available web resources to plan, investigate, design, make and evaluate the artefacts/products made digitally?

This is because, to solve the problem identified, their learner activities include building and presenting new ideas, solutions, products and models on the OERs. This was in the form of developing PowerPoint Presentations, inserting pictures and videos on PowerPoint Presentations, making videos, drawings and objects, and sharing these on Google Classroom (Laurillard, 2012; Laurillard & Kennedy, 2017).

This analysis of the teachers' espoused practices identified three factors that restrict the development of LNSSs by Technology teachers in the participating four Full ICT schools: lack of ICT infrastructure, lack of capacity and departmental prescripts. The precepts, including the core content derived from the teachers' interviews on these factors, are presented in Tables 6.9 to 6.11. A discussion of this emerging trend follows in Chapter Seven.

Table 6.9 summarises the derived core content related to a lack of ICT Infrastructure, which is the first factor restricting the acquisition of LNSSs.

Table 6.9: Lack of ICT Infrastructure

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"…if there is connectivity to respond to practice questions on Google Form[s] to test learning that has taken place." (Mr Cele) "I download the resources and give them to learners. The challenge is that learners can't access the Wi-Fi so that they [can] download the resources on their own. I access the site and give learners the resources." (Ms Cele) "I do everything. The challenge with our school is internet access." (Ms Sithole) "Most of the Grade 8 learners do not have mini laptops." (Mr Banda)	Not applicable	Restricted Learner Network Society Skills Acquisition

Table 6.10 summarises the derived core content related to a lack of capacity, which depicts the second factor restricting the development of LNSSs.

Table 6.10: Lack of Capacity

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"We are not yet there where we make learners do things digitally. As teachers, we still need to be trained to make learners create things digitally." (Mr Bozwana) "The learner's tablets do not have the software to allow learners to plan, design and make products digitally." (Mr Cele) "When learners are provided with the Internet facilities, they use the devices for [the] wrong reasons. Internet access is limited to D6, LMS and Google Classroom." (Ms Sithole) "In the main, the web space is utilised by learners for investigation." (Ms Sithole) "I make learners switch off their devices when I am using the Smartboard and teaching in class. This is because some of the learners could be doing other things on their devices, not related to schoolwork." (Mr Banda)	Not applicable	Restricted Learner Network Society Skills Acquisition

The excerpts in Table 6.10 further denote restrictions in the development of LNSSs. This was in response to the question:

In your lesson planning, what activities have you designed for learners to enable them to utilise the available web resources to plan, investigate, design, make and evaluate the artefacts/products made digitally?

Table 6.11 summarises the derived core content related to departmental prescripts, which denotes the last factor restricting the acquisition of LNSSs. The excerpts (Table 6.11) clearly indicate that the Technology CAPS document does not facilitate the utilisation of ICTs in teaching Technology. This restricts the acquisition of LNSSs. This emerging trend is discussed in Chapter Seven.

Table 6.11: Departmental Prescripts

Representative Participant Quotes	Conceptual-Driven Coding	Data-Driven Coding
"We follow CAPS and what the Department provides. For example, the Department provides us with School-Based Assessment Tasks in the form of a template. That's why there are no digitally created products/artefacts. The products/artefacts are physically made. They are submitted physically in class, as well as showcased physically. This is done physically in the classroom. In the main, learners plan, design and make products physically. If learners can do all these things digitally, I would be so happy. What we are doing is outdated. We are not following the current economic trends." (Mr Cele) "We usually make learners do the above activities during extra time, after school hours. For example, learners do the Scratch Activity to allow learners to create animations/objects. However, these activities that are done by learners after school may not be counted as they are not compulsory." (Mr Cele) "The planning, designing, and making of artefacts/products is not done digitally. The Practical Assessment Tasks are provided by the Department, printed out and given to learners. When it comes to design, they do their drawings physically. The designs can't be done digitally as it must be a practical activity. There are no artefacts or products created digitally by learners. All products are created physically and brought to the classroom for the allocation of marks by the teacher. The physical artefacts/products made by [the] learner[s] are kept in class as evidence." (Ms Sithole) "Learners voluntarily communicate with others. It is not part of the teacher's lesson plan for learners to communicate and share information with others. It is not part of the lesson plan for learners to collaborate with others to solve the problem identified." (Mr Banda) "The learners plan, design and make products manually. The products made are evaluated through group discussions in the classroom." (Mr Banda) "There are no ICT skills acquired for designing, making and evaluating products as learners perform these activities physically. After investigating a project, learners are required to present the product made to the teacher in class. The artefacts/products made are showcased in the classroom. No ICT platforms are created for learners to share and showcase the products made digitally." (Mr Banda)	Not applicable	Restricted Learner Network Society Skills Acquisition

6.2 Consistencies in the Development of Learner Network Society Skills

This section delves into each of the teachers' espoused practices (from the interview data) and enacted practices (classroom observation, lesson plans and social media data) presented in Chapter Five. This is aimed at determining consistency in the development of

LNSSs between their espoused and enacted practices across the four levels of Connectivist Learning. To realise this, the researcher triangulated the interview, classroom observation, lesson plan and social media data. The triangulation allowed emerging trends for each educator to be used to determine each teacher's role in the development of LNSSs.

Table 6.12 juxtaposes Mr Bozwana's perceptions of the development of LNSSs against the analytical framework to determine the alignment between his espoused and enacted practices. Then, Mr Bozwana's perceptions of the development of LNSSs against the analytical framework are expounded across the four levels of Siemens'(2011) Connectivist Learning.

Table 6.12: Mr Bozwana's Espoused and Enacted Practices

Espoused Practices	Enacted Practices		
Interview	**Lesson Plan**	**Classroom Observation**	**Social Media[1]**
Operation Interaction Q2. Teacher's use of Smartboard to share textbooks for learners to obtain information Q2. Demonstrate the use of the Internet to find information and access videos Q2. Learners use Google to obtain information Q2. Learners use social media to communicate and collaborate with other learners Q3. Learners find information, animations and videos to understand concepts Q3. Assign projects to make learners utilise the Internet to obtain information and access videos	YouTube videos included in the resource list No planned activities to use ICT resources	Demonstrate to learners how to search and find information, diagrams and videos Learners follow prompts on the ICT devices to find information, diagrams and videos	Learners share information digitally Learners receive information digitally Learners retrieve digitally shared information
Wayfinding Interaction Q3. Learners find information, animations and videos to understand concepts Q3. Assign projects to make learners utilise the Internet to obtain information and access videos	YouTube videos included in the resource list No planned activities to use ICT resources	No evidence of advanced searching No evidence of Boolean searching	No evidence on social media
3.4. Sensemaking Interaction: Discussion Q2. Learners use WhatsApp Groups to remind each other of what was said in class or to teach each other	No planned activities to use ICT resources	No evidence in the classroom	No evidence of communication and collaboration to make sense of shared information
3.3. Sensemaking Interaction: Collaboration Q3. Form groups to promote the sharing of information and learning Q3. Provide homework to promote communication and collaboration using social media	No planned activities to use ICT resources	No evidence in the classroom	No evidence on social media
3.2. Sensemaking Interaction: Practice Q2. Use Google and YouTube to find additional information and access videos	No planned activities to use ICT resources	Learners use Google and YouTube to find information and watch videos	No evidence on social media
3.1. Sensemaking Interaction: Acquisition Q2. Use of Google and YouTube to find additional information and access videos to promote the understanding of concepts	No planned activities to use ICT resources	The teacher uses the Smartboard to explain concepts using a PowerPoint Presentation Learners use Google and YouTube to find information, watch videos and paraphrase definitions to demonstrate understanding of concepts	No evidence on social media
Innovation Interaction Q4. Opportunities created for learners to plan, design, make and evaluate the products made digitally	No planned activities to use ICT resources	No activities planned for digital plans, designs, creation and evaluation of products were observed	No evidence of digitally created products on social media

Operation Interaction and Wayfinding Interaction

Mr Bozwana uses the Smartboard to share e-textbooks for learners to obtain information. This is consistent with the substitution level in Puentedura's (2009) SAMR Model, as the use of the Smartboard substitutes the traditional chalkboard and hardcopy textbooks. He also employs Hurley and Chater's (2005) Modelling Instructional Strategy to promote the development of LNSSs. He uses the Smartboard to model how to use the Internet to find information and access multimedia content. In instances where some learners seem to be struggling, he employs Hurley and Chater's (2005) modelling strategy to demonstrate to learners how to find multimedia content to promote the understanding of concepts and the acquisition of LNSSs. Learners with devices in class are observed imitating him to access multimedia content, as depicted in Chapter Five. In addition, at the end of the lesson, he provides the following verbal instructions to remind learners how to search for videos after the lesson to understand how an electric circuit works:

> *"Type in 'simple circuit'."*
>
> *"Go to videos."*
>
> *"Click videos."*
>
> *"Scroll down."*

This compels learners to recall the guidance provided in the classroom to navigate the web space and find information on their own. This is consistent with the Department of Basic Education (2004, 2017), which propagates the creation of opportunities for learners to use digital tools to find wide-ranging information from a variety of sources through guided learning. Studies conducted describe this as finding information in complex and information-loaded environments using landmarks, symbols and information cues (Campione et al., 1984 in Schunk, 2012; Wang et al., 2014; Moll, 2021). This means his learners can receive tasks electronically, access, download and use multimedia content, save resources and work independently (Drennan & Moll, 2018). However, web searches are confined to Laurillard's (2012) level 1 inquiry. There is no evidence of advanced web searches. As a result, his learners may not acquire the skill of refining searches using features such as domain, country, language, file type and location on a page or use appropriate keywords with Boolean refinements like 'and' or 'not' to suit their needs. This means that although learners can conduct web searches, it may be time-consuming for them to find relevant information to respond to the tasks provided.

Sensemaking Interaction

During the interview, Mr Bozwana pointed out that he creates opportunities for learners to access worldwide content and resources. In addition, he employs Laurillard's (2012) acquisition to enhance the learners' understanding of concepts by incorporating images, animations and video recordings in his teaching and learning activities. His assertions are observed in the classroom, where Mr Bozwana shares his screen and presents preloaded content and e-books on the Smartboard. The whole class sees his presentation of text, diagrams and pictures as he utilises the question-and-answer method to determine the learners' understanding of the three main types of electric circuits: simple circuits, series and parallel connections. He encourages learners to utilise their devices to interact with the text, diagrams, pictures and videos to gain a better understanding of concepts. In this instance, his pedagogy aligns with the Department of Basic Education (2004, 2017). These two documents advance the use of multimedia content during teaching and learning activities to facilitate the understanding of concepts. As a result, learners use their own words to paraphrase and summarise the concepts presented in class (Anderson & Krathwohl, 2001).

Furthermore, during his interview, Mr Bozwana indicated that he establishes groups in class, and he creates a WhatsApp group for each group. Each group is given a task to complete outside the classroom. As a result, learners utilise their smart cell phones to share content, information and resources presented in class, learning from one another and showcasing their work upon completing the tasks provided. This is consistent with Puentedura's (2009) augmentation level, which explores the use of the Internet to make learning interactive through communication and collaboration (Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021). The Department of Basic Education (2017) supports this notion, encouraging teachers to create opportunities for learners to share knowledge and skills using social networks. In that way, the culture of collaboration and discussions, as well as learning from knowledgeable others digitally, as propagated by Vygotsky's Social

Constructivism, is inculcated among learners (Jaworski, 1994; Department of Basic Education, 2004; Bod, 2008; Laurillard, 2012; Moll, 2021).

However, the analysis of social media revealed that collaboration and discussions are confined to sharing information and examination question papers. Contrary to Mr Bozwana's assertion during the interview, there is no evidence of learners submitting complete work or showcasing their created products on social media. The reason advanced is that communication and collaboration via social media is voluntary, as it is not prescribed by the Technology CAPS document (Department of Basic Education, 2011).

Innovation Interaction

During his interview, Mr Bozwana indicated that learners use physical resources to plan, design and create products. As such, opportunities are not created for learners to plan, design, make and evaluate their products digitally. In other words, the utilisation of ICT resources does not progress to higher levels of Puentedura's (2009) SAMR Model, namely modification and redefinition. In other words, opportunities are not created for learners to engage in Laurillard's (2012) digital authoring.

This means learners would not engage in deep learning digitally, wherein they create and share learning artefacts, as well as present new ideas and solutions on the OER (Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021). In addition, this contradicts the Department of Basic Education (2004, 2017), which advances the need for teachers to create opportunities for learners to obtain new information and produce products by designing, adapting, applying and inventing and utilising the available ICT resources for digital authoring.

Conclusion: Mr Bozwana

Mr Bozwana's teaching and learning activities in the development of LNSSs are confined to the lower levels of the GBCL framework. Although ICT resources are utilised in the classroom and outside the classroom, his lesson plan is silent on activities that elicit learner utilisation of these resources, face-to-face and online through communication and collaboration to enhance learning. This is attributed to the Technology CAPS document, as well as the departmental scripted lesson plans, which are silent on the use of ICT resources for teaching and learning activities. In other words, the acquisition of knowledge and skills to address human needs is not purposefully linked to the acquisition of LNSSs. It is a by-product, as per the Department of Basic Education’s (2017) requirement.

It is worth highlighting at this point that the policy implications and the reasons advanced for teaching and learning activities pertaining to conducting web searches, the use of multimedia content, collaboration and discussions, as well as project-based learning are also applicable to the other three teachers.

Table 6.13 juxtaposes Mr Cele’s perceptions of the development of LNSSs against the analytical framework to determine the alignment between his espoused and enacted practices. Then, Mr Cele’s perceptions of the development of LNSSs against the analytical framework are expounded across the four levels of Siemens’(2011) Connectivist Learning.

Table 6.13: Mr Cele's Espoused and Enacted Practices

Espoused Practices	Enacted Practices		
Interview	**Lesson Plan**	**Classroom Observation**	**Social Media**
Operation Interaction Q2. Demonstrate to learners how to obtain information from Google Drive Q2. Demonstrate to learners how to make drawings using drawing affordances Q2. Demonstrate to learners how to obtain videos, notes and tasks Q3. Use auto-correct affordance from Google Forms to test learning Q2. Learners use WhatsApp and Google Cloud to communicate and collaborate Q2. Learners access learning material from Google Cloud Q2. Learners download and send pictures and videos Q2. Learners create a link on the PowerPoint Presentation	No planned activities to use ICT resources	Teacher displays websites on the Smartboard Demonstrate to learners how to search and find information, diagrams and videos Demonstrate to learners how to use drawing affordances	Sharing of tasks and material through Google Classroom Learners follow prompts on devices to access content and tasks Learners receive information digitally Learners retrieve digitally shared information
Wayfinding Interaction Q3. Learners access learning material from Google Cloud Q2. Use of Google and YouTube to conduct research Q3. Learners access pictures and videos from Google Q2. Learners access e-books from their tablets	No planned activities to use ICT resources	No learner devices in class Passive learning in class The teacher provides a link to download learning material Learners access material presented in class outside the classroom	Learners receive information digitally Learners retrieve digitally shared information
Sensemaking Interaction Q4. Learners use WhatsApp and Google Cloud to collaborate Q4. Learners discuss their ideas and send pictures and videos when compiling their PowerPoint Presentations Q4. Learners compile PowerPoint Presentations Q4. Learners show their PowerPoint Presentations using the Smartboard	No planned activities to use ICT resources	No learner devices in class Passive learning in class The teacher provides a link to download learning material Learners access material presented in class outside the classroom	Learners receive information digitally Learners retrieve digitally shared information
Innovation Interaction Q4. Learners send pictures and videos when compiling their PowerPoint Presentations Learners create a link on the PowerPoint Presentation to show a picture or a video during their presentation Q4. In the classroom, opportunities are not created for learners to digitally plan, design, make and evaluate their products Q4. Outside the classroom, learners use the Scratch programming language to create animations/objects	No planned activities to use ICT resources	No digital planning, design, creation and evaluation of products was observed	No evidence of digitally created products in the web space

Operation and Wayfinding Interaction

To guide learning and the acquisition of the desired ICT skills, Mr Cele indicated that he relies mainly on modelling to learners physically in class to explain how to get information from Google Drive, to use the links and follow prompts, to obtain text, diagrams, pictures, videos and tasks to be completed and how to draw objects (Hurley & Chater, 2005). In addition, to promote the acquisition of the desired ICT skills, he displayed websites on the Smartboard, which learners could utilise to obtain information on how electricity works. He also provides links and models how to use these to download and upload videos and access text, diagrams and pictures of all the concepts as he teaches them in class. He demonstrated how to draw parallel circuits using an application on his laptop while learners watched.

At the end of the lesson, he shared links on the Grade 8 Technology Google Classroom for learners to access multiple representations of the content presented in class, as well as the task to be completed. He expects learners to recall the guidance provided in class to access information from Google and YouTube and complete the School-Based Assessment Tasks provided. For learners to complete tasks outside the classroom, they must receive tasks electronically, work independently to search, recognise, access and use multimedia content and download and save resources (Churches, 2008; Laurillard, 2012; Drennan & Moll, 2018).

However, his lesson plan was silent on using web space to access information. It only cited textbooks as the resource to obtain information, and it hardly indicated if such textbooks would be e-books.

Sensemaking Interaction

The observation of his revision lesson on how electricity works revealed that learners do not have their tablets in class. Mr Cele used the Smartboard to present content as text, diagrams, pictures and videos to promote the understanding of simple circuits and their components and input, output and control devices. Learners used their writing notebooks to copy definitions from the Smartboard, which was the knowledge they would require to electrify the Christmas tree to be built as a project. Mr Cele engaged learners at Laurillard's (2008) discursive level through the question-and-answer method to assess their understanding of concepts. At the end of the lesson, he employed Laurillard's (2012) acquisition, wherein learners watched a video lesson demonstrating how to make a Christmas tree using the different components of an electric circuit.

In addition, Mr Cele asserted that his learners make sense of the information obtained during face-to-face teaching and learning activities by engaging in discussions on social media to augment learning that took place in the classroom (Puentedura, 2009; Laurillard, 2012). In addition, the learners demonstrate learning through PowerPoint Presentations with text, pictures and videos. This depicts modification, wherein learners transform learning by adding depth to the task (Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman and Aurangzeb, 2021). Importantly, he also engages learners in Laurillard's (2012) practice, using Google Forms to test their understanding of the work done in class, and he provides immediate feedback. This means his learners can complete tasks using an appropriate App, submit completed digital work and receive written comments digitally (Laurillard, 2012; Drennan & Moll, 2018).

However, according to his lesson plan, the Grade 8 Technology textbook was the only resource to be utilised for the teaching and learning activities. In addition, there was no evidence of learners collaborating and discussing on social media to demonstrate their learning. Instead, the analysis of social media revealed that Mr Cele only utilises the Grade 8 Technology Google Classroom to share content taught in class.

Innovation Interaction

Mr Cele's learners also use physical resources to plan, design and create products to solve the problem identified. As a result, there is no exposure for learners to engage in the digital design process. In other words, opportunities are not created for learners to engage in Laurillard's (2012) digital authoring. Mr Cele attributes this to departmental prescripts. He said, "*If learners can do all these things digitally, I would be so happy. What we are doing is outdated. We are not following the current economic trends.*"

This means his learners would also not engage in deep learning digitally, wherein they create and share learning artefacts, as well as present new ideas and solutions on the OER (Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman and Aurangzeb, 2021).

However, it is worth highlighting at this point that despite this, Mr Cele created opportunities for learners to use the Scratch programming software to create products after contact time (Laurillard, 2008; Puentedura, 2009; Laurillard, 2012). This is attributed to his innovative capabilities that transcend the prevailing departmental prescripts. This means the opportunities he creates for his learners in the utilisation of the available ICT resources go beyond gathering information online. However, learners, individually in a traditional classroom, follow step-by-step instructions from a textbook to design and make electronic dice. This means learners did not engage collaboratively in social networks to engage in digital authoring, yet this is an essential feature in Connectivist Learning (Churches, 2008; Puetendura, 2009; Siemens, 2011; Laurillard, 2012). As a result, learners have been deprived of the opportunity to engage in online discussions and reflections with their peers to achieve a coherent understanding of information and make informed decisions to solve the problem identified. This means learners were deprived of the opportunity to acquire the knowledge and skills to create learning artefacts digitally (innovation level) to solve the technological problem identified or modify existing artefacts (remixing) shared through the OER (Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012).

Conclusion: Mr Cele

Mr Cele's espoused and enacted practices promote the attainment of LNSSs. However, this is at lower levels of Siemens' (2011) Connectivist Learning. He attributes this to departmental prescripts. The role he played in developing the desired skills in the classroom is confined to modelling how to obtain multimedia content from the Internet (Hurley & Chater, 2005). At the practice level, he shared tasks to be completed outside the classroom through Google Classroom.

Table 6.14 juxtaposes Ms Sithole's perceptions of the development of LNSSs against the analytical framework to determine the alignment between her espoused and enacted practices. Then, Ms Sithole's perceptions of the development of LNSSs against the analytical framework are expounded across the four levels of Siemens' (2011) Connectivist Learning.

Table 6.14: Ms Sithole's Espoused and Enacted Practices

Espoused Practices	Enacted Practices		
Interview	**Lesson plan**	**Classroom Observation**	**Social Media**
Operation Interaction Q2. Use of the Smartboard to demonstrate to learners how to obtain information from the Internet Q2. Demonstrate to learners how to obtain videos from YouTube Q3. Use a five-minute quiz from Moodle Platform to test learning Q2. Learners use Google Space to communicate and collaborate Q2. Learners access learning material from Google Classroom Q4. Learners make videos and upload them to the Google Classroom Q4. Learners draw and make an advert on paper and then upload it to Google Classroom	No planned activities to use ICT resources	No learner devices in class The teacher presents content using the Smartboard Use of writing affordances on the Smartboard to make calculations Use of smart cell phones to take pictures	Learners communicate digitally using WhatsApp Learners share tasks and material using WhatsApp Learners follow prompts on devices to access tasks Learners receive information digitally Learners retrieve digitally shared information
Wayfinding Interaction Q3. Learners access learning material from Google Cloud Q2. Learners access e-books from their tablets Q4. Learners upload completed tasks and videos to Google Classroom	YouTube videos included in the resource list No planned activities to use ICT resources	No learner devices in class Passive learning in class	Learners receive information digitally Learners retrieve digitally shared information
Sensemaking Interaction Q4. Learners use WhatsApp and Google Cloud to collaborate	No planned activities to use ICT resources	No learner devices in class Passive learning in class Use of handwriting affordance on the Smartboard Teacher-learner Interaction through the question-and-answer method	No evidence of sensemaking in the social media evidence
Innovation Interaction Q4. In the classroom, opportunities are not created for learners to plan, design, make and evaluate the products made digitally Q4. Learners create videos	No planned activities to use ICT resources	No digital planning, design, creation and evaluation of products was observed	No evidence of digitally created products in the web space

Operation and Wayfinding Interaction

Ms Sithole uses the laptop and the Smartboard to upload multimedia content and present it in class. Multimedia content, including e-books, is also uploaded on the learners' tablets to promote access to digital content. She also uploads lessons presented in class onto the learner devices. Learners log onto their devices to access these resources. In addition, learners access digital content through the Department's zero-rated platforms. Ms Sithole acknowledged that she does everything for her learners. This practice depicts an element of learner dependency on the teacher to obtain information and resources for learning purposes. She attributes this to a lack of connectivity at her school. However, her assertion that learners use the Internet for the wrong reasons when access to the Internet is provided implies that she lacks classroom management skills in the context of utilising ICTs for teaching and learning. At the operation interaction level, this means her learners can save resources by accessing and using multimedia content (Drennan & Moll, 2018). In other words, her learners could not search, Google, locate, access, retrieve and use multimedia content, download and save resources, and work independently (Churches, 2008; Drennan & Moll, 2018). Only learners who have access to the Internet outside the classroom can gather information online. An element of social inequality also comes into play here in terms of restrictions on the acquisition of LNSSs.

Furthermore, there was no indication of opportunities created for learners to engage in advanced web searches. This means learners may not acquire the skill to refine searches using features of the advanced searches, such as domain, country, language, file type and location on the page, or use appropriate keywords with Boolean refinements, like 'and' or 'not', to suit their needs. As a result, finding the relevant information to complete tasks could be time-consuming.

Sensemaking Interaction

During her interview, Ms Sithole pointed out that she uses the Smartboard to present multimedia content to enhance the learners' understanding of concepts. She uses PowerPoint Presentations to present content in class using the Smartboard. In addition, she creates links on her PowerPoint Presentations and employs Laurillard's (2012) acquisition by playing videos to deepen learner's understanding of the concepts. Lastly, she indicated that she also creates opportunities for learners to practice and engage at this level through assessment activities on the Moodle Platform. In that way, learners complete tasks on an appropriate app and submit completed digital work (Laurillard, 2012; Drennan & Moll, 2018).

Observing Ms Sithole in her classroom revealed that learners did not bring tablets into the classroom. She argued that learners utilise devices for the wrong reasons in the classroom. Over and above the lack of internet access, the main reason why learners did not utilise their tablets in class could be attributed to her lack of capacity to manage active learner participation while using ICTs in class. As a result, she employed acquisition to promote the learner's understanding of concepts. For example, she used videos to illustrate concepts initially explained using text. Guided learning at Puentedura's (2009) substitution level was observed in her classroom when she used the Smartboard to write and explain the formula for Ohm's Law. She also used the Smartboard to model to learners how to calculate resistance, voltage and current using Ohm's Law (Hurley & Chater, 2005). Furthermore, she engaged learners at Laurillard's (2008) discursive level through the question-and-answer method to establish their understanding of the concepts presented. To promote deeper learner understanding, she employed Laurillard's (2012) acquisition as learners watched a video explaining Ohm's Law on the Smartboard. To establish if learning had taken place, she gave learners three activities to complete in their exercise books. In addition, she employed substitution, wherein a few learners were called to use the freehand application on the Smartboard to demonstrate their calculations to the teacher and the class. Learner-learner interaction was also observed as peers provided positive or negative feedback based on the calculation steps portrayed on the Smartboard.

Regarding social media to facilitate collaboration and discussions, Ms Sithole pointed out that she creates opportunities for learners to utilise various ICT resources to access multimedia and perform various tasks. This includes sharing the lessons presented in class, as well as videos and tasks to be completed, through Google Classroom. Upon completing their tasks, learners also share the videos they create, as well as the designs made on paper, digitally through Google Classroom. However, at the end of the lesson, only one learner used her smart cell phone to take a picture of the task, which was on the Smartboard, to be completed at home. The rest of the learners wrote the task from the Smartboard into their notebooks. Notably, the only evidence of social media was that of learners using WhatsApp to inquire and share information on the scope of the exam.

Innovation Interaction

Ms Sithole asserted that her learners use physical resources to plan, design and create products to solve the problem identified. The products created are also brought to class for mark allocation in preparation for the final year exam. Ms Sithole pointed out that there is no luxury of time to create space for learners to digitally plan, design and make products. She emphasises the need to shorten everything that is done in class to complete the syllabus and ensure that learners are ready for their final year exams. This means her learners would also not engage in deep learning digitally, wherein they create and share learning artefacts, as well as present new ideas and solutions on the OER (Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021).

Conclusion: Ms Sithole

Contrary to her beliefs, Ms Sithole's teaching and learning activities in practice are not pitched at levels that facilitate the acquisition of LNSSs across the four levels of Connectivist Learning (Siemens, 2011). This was evident during the classroom observation, as well as the lesson plan and social media data. She attributed this mainly to a lack of connectivity and departmental prescripts, mainly the school-based assessment tasks and the set timeframes to promote syllabus completion. This is not conducive to the development of the desired ICT skills, as aspired by the Technology CAPS Document (Ankiewicz, 2013; Khoza, 2015; Mapotse, 2015, 2017).

Table 6.15 juxtaposes Mr Banda's perceptions of the development of LNSSs against the analytical framework to determine the alignment between his espoused and enacted practices. Then, Mr Banda's perceptions of the development of LNSSs against the analytical framework are expounded across the four levels of Siemens' (2011) Connectivist Learning.

Table 6.15: Mr Banda's Espoused and Enacted Practices

Espoused Practices	Enacted Practices		
Interview	**Lesson Plan**	**Classroom Observation**	**Social Media**
Operation Interaction Q2. Use the Smartboard to demonstrate to learners how to obtain information from the Internet Q2. Demonstrate to learners how to obtain pictures and videos from Google Q2. Learners use the Smartboard to search for information Q2. Learners use handwriting affordance on the Smartboard	No planned activities to use ICT resources	No learner devices in class The teacher presents content using the Smartboard Learners use writing affordances on the Smartboard to draw line diagrams Learners use smart cell phones to take pictures	No evidence of operation interaction in the social media data
Wayfinding Interaction Q3. Learners search for information on the Smartboard Q3. Learners use Google to search for multimedia content	YouTube is included in the resource list No planned activities to use ICT resources	No learner devices in class Passive learning in class	No evidence of wayfinding interaction in the social media data
Sensemaking Interaction Q3. Learners voluntarily use WhatsApp to communicate and collaborate Q3. Teacher-learner interaction on information and multimedia content obtained from the Smartboard	No planned activities to use ICT resources	No learner devices in class Passive learning in class Learners use handwriting affordance on the Smartboard Teacher-learner interaction through the question-and-answer method Voluntary learner-learner interaction	No evidence of sensemaking interaction in the social media data
Innovation Interaction Q4. In the classroom, opportunities are not created for learners to digitally plan, design, make and evaluate their products	No planned activities to use ICT resources	No digital planning, design, creation and evaluation of products was observed	No evidence of digitally created products in the web space

Operation and Wayfinding Interaction

During his interview, Mr Banda pointed out that he gives learners projects so that they can conduct their own research to find information about the project. However, he indicated that since most of the Grade 8 learners do not have ICT devices, he personally downloads text, pictures and videos from various search engines and uploads these onto the Smartboard. He then presents these and has discussions with learners in the classroom. This practice depicts an element of creating learner dependency on the teacher to obtain information and resources for learning purposes. Only learners who have ICT devices can gather information online. An element of social inequality also comes into play here in terms of restricting the acquisition of LNSSs.

However, Mr Banda also pointed out that even for learners who have ICT devices, he does not allow them to use these in the classroom. He said, "*I make learners switch off their devices when I am using the Smartboard and teaching in class. This is because some of the learners could be doing other things on their devices not related to schoolwork."* This depicts his lack of capacity to monitor active learner participation during teaching and learning activities. If his learners can recall what he did in the classroom and complete tasks outside the classroom, it means they can receive tasks electronically, work independently to search, recognise, access and use multimedia content and download and save resources (Laurillard, 2012; Drennan & Moll, 2018). This calls for attentive observation and practice by learners (Eggen & Kauchak, 2001; Laurillard, 2012).

Mr Banda's assertions during the interview session are corroborated by his classroom observation. None of the learners had a tablet in front of them, so he found content and shared it with them through the Smartboard. For the greater part of the lesson, learners passively listened to the content presented in class and observed him demonstrating how to draw line diagrams on the Smartboard.

Although opportunities were created for learners to use the freehand application on the Smartboard to draw line diagrams, only two or three learners had the opportunity. However, this was at the substitution level. In other words, although learners used affordances on the Smartboard to draw line diagrams, there was no functional change in the task as it could still be completed without the Smartboard to achieve the same output (Puentedura, 2009).

Lastly, at the end of the lesson, Mr Banda displayed homework on the Smartboard. A few learners with smart cell phones were seen taking a picture of the homework activity while the rest of the learners passively observed. In this instance, an element of social inequality was evident.

However, on wayfinding interaction, there are no opportunities created for learners to engage in advanced web searches. As a result, Mr Banda's learners may also not acquire the skill to refine searches using features of the advanced searches, such as domain, country, language, file type and location on the page or use appropriate keywords with Boolean refinements, like 'and' or 'not', to suit their needs. As a result, finding the relevant information to complete tasks provided by their teacher could be time-consuming.

Sensemaking Interaction

To make sense of the content presented in class, Mr Banda indicated that he engages learners discursively through the question-and-answer method (Laurillard, 2008; Laurillard, 2012). Similar to the other three teachers, he uses multimedia content to promote the understanding of concepts. This means his teaching strategy at this level of interaction is aligned with Laurillard's (2012) acquisition level.

In practice, Mr Banda was observed sharing a screen with learners and using a PowerPoint Presentation to read and explain electrical components and their functions. He then used additional text, pictures and line diagrams to enhance the learners' understanding of the concepts (Laurillard, 2012). In addition, he engaged learners discursively and reminded them how to use a freehand application on the Smartboard to draw a line diagram of a simple circuit using symbols (Laurillard, 2008). He then used Puentedura's (2009) substitution level to create opportunities for some learners to use the freehand application on the Smartboard to draw a simple circuit diagram and a circuit diagram with series connections and parallel connections using symbols. At the end of the lesson, learners who had smart cell phones took a picture of the task to be completed from the Smartboard.

In addition, Mr Banda indicated that his learners use social media to collaborate and discuss the work done in class (Puentedura, 2009; Laurillard, 2012). However, he reiterated that the practice is voluntary. This means that although his learners could learn to receive work through any app from peers, receive written and verbal comments, engage in teamwork and collaborate digitally, this would be incidentally and not by design. The reason he advanced is that Laurillard's (2012) collaboration and discussions on social media are not a requirement in the Technology CAPS document. Hence, he neither plans nor provides guided learning to facilitate the development of LNSSs. This is an impediment on its own to the acquisition of LNSSs. This means opportunities are not created for learners to engage in teamwork, post work done, send and receive comments, critique, compare, reflect, make informed decisions and draw conclusions through sharing ideas (Churches, 2008; Puentedura, 2009; Laurillard, 2012).

Mr Banda's lesson plan was silent on teaching and learning activities that promote collaboration and communication among learners. It only depicted one-way teacher-learner-centred communication. This is intensified by the lack of evidence of any form of collaboration and discussions by the teacher and among the learners on social media.

Innovation Interaction

Mr Banda asserted that his learners use physical resources to plan, design and create products to solve the problem identified. Like the other three teachers, no opportunities are created for learners to engage in the design process digitally. He implicitly attributed this to the departmental prescripts. He said, *"There are no ICT skills acquired for designing, making and evaluating products as learners perform these activities physically. After investigating a project, learners are required to present the product made to the teacher in class. The artefacts/products made are showcased in the classroom."* This means his learners would also not engage in deep learning digitally, wherein they create and share learning artefacts, as well as present new ideas and solutions on the OER, to solve the problem identified (Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021).

Conclusion: Mr Banda

Mr Banda utilised blended learning in his teaching and learning activities. He employed technology-mediated learning in a traditional classroom (Ferdig et al., 2012; Senturk, 2021).

However, this was at Puentedura's (2009) substitution level in that his utilisation of the Smartboard simply replaced the use of the chalkboard and physical textbooks. There was no functional change in his teaching and learning activities. He attributed this to the departmental prescripts, particularly lesson planning, which focuses on content and syllabus completion. This stifles the acquisition of the requisite skills to thrive economically beyond learners' schooling careers (Ankiewicz, 2013; Mapotse, 2015, 2017; Khoza, 2015).

6.3 Chapter Conclusion

Blended learning cuts across teaching and learning activities in the four Full ICT schools in Gauteng in that the Grade 8 Technology teachers employed technology-mediated learning in a face-to-face teaching and learning environment, as well as online outside the classroom (Ferdig et al., 2012; Senturk, 2021). In addition, they use guided learning to facilitate content acquisition and the development of LNSSs (Hurley & Chater, 2005; Laurillard, 2008; Puentedura, 2009; Laurillard, 2012). However, the development of LNSSs is pitched at lower levels of Siemens' (2011) Connectivist Learning. This chapter served to highlight the emerging trends in the relationship between the teachers' beliefs and their enacted practices regarding the utilisation of the available ICT resources to facilitate the development of LNSSs. They include guided learning, blended learning, the use of ICTs mainly for content acquisition and the use of social media mainly for sharing tasks and resources, as well as restricted LNSS acquisition. Chapter Seven probes these emerging trends.

7 Chapter Seven: Emerging Trends

7.1 Introduction

Based on the four teachers' espoused and enacted practices discussed in the previous chapter, specific trends in the development of LNSSs were identified: guided learning, blended learning, the use of ICTs mainly for content acquisition, the use of social media mainly for sharing tasks and resources and restricted LNSS acquisition. The next section probes each of these trends, starting with guided learning. The process will culminate into a storyline, and later on draw conclusions to respond to the main research question (Gibbs, 2007; Maguire & Delahunt, 2017). The chapter concludes by highlighting the conditions that support the development of LNSSs by the four Technology teachers in the participating Gauteng Full ICT schools.

7.2 Guided Learning

In the context of Vygotsky's Social Constructivism, learning is acquired through scaffolding, wherein children first receive guidance from a knowledgeable other. This could be a teacher, a peer or any other expert in the subject (Jaworski, 1994; Bod, 2008; Moll, 2021). According to Bandura (1986, in Schunk, 2012), the scaffolding technique requires the teacher to initially model the skill to be acquired, provide support and slowly reduce it as learners steadily acquire the skill. In other words, scaffolding promotes the understanding of concepts and the acquisition of skills through guided learning by the knowledgeable other. The teachers who participated in the study successfully achieved this in the classroom as they guided learners on how to use technology so that they could access and search for information with their devices in classrooms and online outside the classroom.

Notably, all four teachers employ guided learning through Laurillard's (2008) Conversational Framework and Hurley and Chater's (2005) Modelling Instructional Strategy to facilitate content acquisition and the development of LNSSs. In the classroom, once the content has been presented on PowerPoint Presentation, learners are engaged at discursive and experiential levels through the question-and-answer method to facilitate the understanding of concepts and the development of LNSSs. This promotes learning as learners define, paraphrase and provide examples to demonstrate their understanding of concepts (Anderson & Krathwohl, 2001).

In addition, through modelling how to access multimedia content in the classroom, learners were seen operating their ICT devices and the Smartboard to carry out the tasks provided. As a result, learners search, google, recognise, identify, find and retrieve multimedia content (Churches, 2008). However, the acquisition of LNSSs is at the lower levels of Siemens' (2011) Connectivist Learning.

To promote maximum acquisition of LNSSs across the four levels of Connectivist Learning, the teacher should facilitate communication and collaboration among learners using social media (Neo et al., 2013). This should be an online platform for learners to deepen the knowledge and skills acquired discursively in the classroom by building ideas and concepts together and experientially outside the classroom (Neo et al., 2013; Opdecam & Everaert, 2018; Hussien, 2020). To bring out the best in learners requires teachers to design activities to facilitate online collaboration and discussions with others synchronously or asynchronously through an OER with digital and production tools. This will bring together ideas from knowledgeable others to gain a clear understanding of information and facilitate learning (Laurillard, 2012).

Opdecam and Everaert (2018) and Hussien (2020) support this notion, recommending that teachers must set standards that promote learner-content interaction, learner-learner interaction, learner-teacher interaction, individual accountability, group processing and social skills (Laurillard, 2008; Opdecam & Everaert, 2018; Hussien, 2020). Importantly, throughout the collaborative process, the teacher is required to motivate learners by providing feedback in class and asynchronously through online engagements. Furthermore, the learning process should be monitored on the blogs created and through ongoing assessment and evaluation of the learners' progress throughout the different stages of the technological process (Neo et al., 2013). Accordingly, this will facilitate reflective learner engagements, promoting teamwork and the acquisition of higher-order thinking skills such as critiquing, comparing, judging, negotiations, inferring, decision-making and problem-solving (Churches, 2008; Opdecam & Everaert, 2018; Salim et al., 2019; Hussien, 2020).

To realise this, an ICT teacher training framework on the development of LNSSs in South Africa in teaching Grade 7 – 9 Technology must be developed. In other words, the training provided to teachers has not sufficiently equipped them with the requisite skills to manage learner utilisation of ICT devices and prepare learners to participate meaningfully in the global economy (Minty, 2020; Msiza et al., 2020; Dlamini, 2022; Masango et al., 2022; Mokate, 2023). Hence, a training framework must be developed. Once developed, Technology teachers should be capacitated on how to design teaching and learning activities across the four levels of Connectivist Learning to facilitate the development of LNSSs. The next section focuses on the second trend identified, blended learning.

7.3 Blended Learning

Blended learning is defined as an approach to learning that merges face-to-face teaching with virtual or online learning (Doering, 2006; Garrison and Vaughan, 2008; Ferdig et al., 2012; Senturk, 2021). The current study's four participating teachers employed blended learning to facilitate the development of LNSSs. The utilisation of the available ICT resources predominantly takes place during face-to-face and online teaching and learning activities. This is evident when teachers model to learners in a traditional classroom how to access multimedia content from Google or YouTube to promote the understanding of concepts. All learners, with and without the ICT devices, observed and listened attentively. Those with devices in the classroom are afforded the opportunity to practice accessing multimedia content from these online platforms. In that way, learners acquire the skills to search, google, recognise, find, access and use multimedia content (Churches, 2008; Laurillard, 2012; Drennan & Moll, 2018).

Notably, online activities outside the classroom are confined to sharing content presented in the classroom, tasks, and learning material through Google Classroom. Learners with smart cell phones share the same using WhatsApp. To accommodate learners without access to Wi-Fi, teachers upload these to learner devices. In that way, learners receive tasks electronically and access and use multimedia content, as well as save resources electronically. However, learners without devices must hand-write notes in their exercise books on concepts presented on the Smartboard.

Similarly, they use pen and paper to copy notes and tasks to be completed from the Smartboard. This was in the hope that they would recall what they observed in class to practice and acquire the same skills at home.

Accordingly, the four teachers mitigated the challenges they cited around ICT infrastructure to accommodate learners from different socioeconomic backgrounds to promote the attainment of learning outcomes by all (Bersin, 2004; Garrison & Kanuka, 2004; Stein & Graham, 2014). Aghardien (2023) and Gachago et al. (2023) support this notion, propagating the customisation of existing models to accommodate different contexts. In this case, Siemens' (2005) Connectivist Learning. The next section focuses on the use of ICTs in the classroom.

7.4 The Use of ICTs Mainly for Content Acquisition

The current study's four participating teachers' teaching and learning activities are pitched at lower levels of Connectivist Learning. Mainly, they engage learners at Siemens' (2011) operation and sensemaking interaction levels. For Laurillard's (2012) six learning types, teaching and learning activities at the inquiry and acquisition levels dominated their lessons.

At the practice level, to cement the development of modelled LNSSs, they create opportunities for experiential learning physically and online in the classroom (Laurillard, 2002; Kop, 2011; Mackness & Bell, 2015; Goldie, 2016; Downes, 2019). Learners only use Google or YouTube mainly for **inquiry, to access information** and to complete the tasks provided. This is captured well by Mr Bozwana, who reminds learners that they have been provided with the devices to access information. In addition, they use their devices to access videos and images to enhance their understanding of concepts. Hence, the classroom observation instrument revealed that learners developed the following LNSS, experientially in the classroom or upon recall outside the classroom: search, google, recognise, identify, find and retrieve multimedia content (Churches, 2008). In addition, during discussions, through the question-and-answer method, learners mainly demonstrated the following cognitive skills: summarise, paraphrase, explain, describe and exemplify (Anderson & Krathwohl, 2001). Based on this finding, the teachers in the four Full ICT schools are doing well in terms of applying the knowledge and skills acquired during the training provided by the GDE on the utilisation of ICTs. This is taking into consideration that teachers received training on how to access multimedia content and e-books, develop lesson plans and present these using PowerPoint Presentations on the Smartboard to enhance the quality of teaching and learning (Gauteng Department of Education, 2019, 2020; Dlamini, 2022; Masango et al., 2022).

However, to assess learning, two teachers indicated that they use online assessment tools on the Google platform. Implicitly, their learners could complete tasks through an appropriate app and submit completed digital work (Laurillard, 2012; Drennan & Moll, 2018). However, this was neither observed during classroom observations nor was it part of the lesson plans. This means ICTs are mainly utilised for "…better understanding of the subject content" while "Technology skills are a by-product of this, unless the subject taught is CAT [Computer Applications Technology] or IT [Information Technology]" (Department of Basic Education, 2017, p.40). In other words, opportunities could not be created for learners to operate different media to demonstrate learning as it is not a requirement by the South African education policy. As a result, there was no evidence of learners completing tasks through an appropriate app, submitting completed digital work or sending and receiving work through any app to and from the teacher (Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018).

Notably, at the innovation level, the teachers all indicated that it is not a requirement for learners to create and present their products made to solve the problem identified by utilising ICTs. Instead, learners make products physically and share these physically in the classroom for mark allocation. As a result, learners could not acquire the network society skills at the modification and digital authoring level, as depicted in the analytical framework (Churches, 2008; Puetendura, 2009; Siemens, 2011; Laurillard, 2012). Although teachers are doing well in terms of modelling to learners how to access multimedia content on the Internet, as well as presenting content in class using the Smartboard, more needs to be done to capacitate teachers to facilitate the development of LNSSs at higher levels of Connectivist Learning (Minty, 2020; Msiza et al., 2020; Dlamini, 2022; Masango et al., 2022; Mokate, 2023). The next section focuses on the use of social media.

7.5 The Use of Social Media Mainly for Sharing Tasks and Resources

At the end of the lesson, teachers indicated that they use Google Classroom to share the content presented in class and tasks to be completed outside the classroom, including any other learning resources. In addition, learners use WhatsApp to communicate and collaborate. This means learners engage at Laurillard's (2012) collaboration and discussion levels. The former entails synchronous or asynchronous online discussions with peers, knowledgeable others or experts in the field of Technology to promote the sharing of information and facilitate learning. Implicitly, learners could receive and share work digitally through an app or a blog, receive written and verbal comments digitally, blog journaling, commenting and annotating, while the latter requires teamwork and bringing together ideas to gain a better understanding of information. This means learners could aggregate, reflect, critique, negotiate, infer and make informed decisions on the product to be made to solve the problem identified (Churches, 2008; Laurillard, 2008; Puetendura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll; 2018).

However, the current study's four participating teachers indicated that the use of social media is not a requirement stipulated in the Technology CAPS document nor by the Departmental officials. Hence, they confined the use of social media to sharing tasks and resources, as well as considered the use of social media voluntary. In other words, even if they were aware that learners did collaborate and discuss on social media, they did not monitor and support online learning outside the classroom. Neither did they allow learners to submit completed tasks online due to a lack of connectivity.

For learners to acquire the aforementioned skills associated with collaboration and discussions on social media, structured guidance and support to facilitate collaboration and discussions on social media must be provided. This could include providing clear instructions on how to access multimedia content, questions to facilitate discussions and step-by-step instructions to share ideas, images, videos, etc., to complete the tasks provided (Laurillard, 2012; Laurillard & Kennedy, 2017; Bod, 2018; Moll, 2021).

Bandura (1986, in Schunk, 2012) supports this technique, promoting the need for teachers to initially model the skill to be acquired, provide support and slowly reduce it as learners steadily acquire the skill. The next section focuses on the last emerging trend identified, namely, restricted LNSS acquisition.

7.6 Restricted Learner Network Society Skill Acquisition

The analysis of the individual teachers' espoused and enacted practices in Chapter Six found that the lack of ICT infrastructure, lack of capacity and departmental prescripts restrict the development of LNSSs. The following section probes these factors, starting with the lack of ICT infrastructure.

Lack of ICT Infrastructure

Two teachers implied that a lack of connectivity restricted the development of LNSSs. Mr Cele indicated that learners can't access the Wi-Fi; hence, he personally downloads the resources and gives them to learners. This was confirmed by Ms Sithole, who pointed out that she does everything for the learners due to a lack of internet access at her school. In addition, Mr Banda attributed the restriction in the development of the desired ICT skills to a lack of learner devices. He said, "*Most of the Grade 8 learners do not have mini laptops.*" This denotes an element of social inequality in the Gauteng Full ICT schools. Van Dyke and White (2019) in Rwodzi and de Jager (2021) caution that the levels of poverty in communities could restrict the utilisation of ICT resources outside the traditional face-to-face classroom due to financial constraints and lack of access to resources required to extend the use of ICTs outside the classroom. Hence, the use of blended learning to mitigate the risk of limited resources is appropriate. Aghardien (2023) and Gachago et al. (2023) support this notion, promoting shying away from a mechanistic application of models, as the practice disregards the context of the research participants.

Lack of Capacity

Mr Bozwana acknowledged the need for teachers to be trained to enable them to utilise the available web resources to digitally plan, investigate, design, make and evaluate the artefacts/products made. He said, "*We are not yet there where we make learners do things digitally. As teachers, we still need to be trained to make learners create things digitally.*" Minty (2020) and Rwodzi and de Jager (2021) concur with Mr Bozwana. According to the studies they conducted, the training provided to teachers was inadequate as it was generic and did not address the teachers' subject-specific developmental needs in the use of ICTs for teaching and learning. Similarly, the reasons advanced by the other three teachers for the non-utilisation of the available ICT resources to develop LNSSs imply a lack of capacity. For example, Mr Cele argued that learner devices do not have the necessary software to allow learners to plan, design and make products digitally. In addition, both Ms Sithole and Mr Banda indicated that they do not allow learners to use their ICT devices during teaching and learning activities in the classroom. The reason they both advanced is that learners use them for the wrong reasons. Implicitly, the two teachers believe that the use of learner devices in the classroom disturbs learning and places an additional burden on them to maintain classroom discipline. This means they lack the capacity to manage teaching and learning activities in the context of ICTs. In the main, teachers received basic training on how to utilise the available ICT resources, particularly the Smartboard, including the uploaded e-books (Dlamini, 2022; Masango et al., 2022). This was aimed at enabling the utilisation of multimedia content and e-books, the development of lesson plans using laptops and presenting these using PowerPoint Presentations predominantly to enhance the quality of teaching and learning activities in the classroom (Gauteng Department of Education, 2019, 2020; Dlamini, 2022). As indicated earlier, this means the training aligned with the Department of Basic Education (2017) has helped enable teachers to develop LNSSs, albeit at lower levels of Connectivist Learning. In other words, it did not sufficiently equip teachers to develop LNSSs (Minty, 2020; Msiza et al., 2020; Dlamini, 2022; Masango et al., 2022; Mokate, 2023). The next section focuses on departmental prescripts.

Departmental Prescripts

The silence of the Technology CAPS document (Department of Basic Education, 2011) on the utilisation of ICTs negatively impacts the utilisation of ICTs in teaching Technology. Evidently, the lesson plans prescribed by the Department are also silent on the utilisation of ICTs for content acquisition and the development of LNSSs. In other words, learners are not bound to utilise the available ICT resources to digitally plan, design, make and evaluate the learning artefacts. Instead, learners plan, design and make the products physically, as well as present these physically in the classroom for the allocation of marks. Ms Sithole said,

> "*The planning, designing and making of artefacts/products is not done digitally. The Practical Assessment Tasks are provided by the Department, printed out and given to learners. When it comes to design, they do their drawings physically. The designs can't be done digitally as it must be a practical activity. There are no artefacts or products created digitally by learners. All products are created physically and brought to the classroom for the allocation of marks by the teacher. The physical artefacts/products made by [the] learner[s] are kept in class as evidence.*"

Hence, the development of LNSSs by the current study's four participating teachers is not intentional but incidental. This restricts the acquisition of LNSSs.

It is worth highlighting at this point that the studies conducted by Khoza (2015) and Mapotse (2015, 2017) in Limpopo, Gauteng and KwaZulu-Natal revealed a similar challenge of departmental prescripts in teaching Technology. Accordingly, this challenge is not confined to the current study's four Full ICT schools in Gauteng. Implicitly, it could be a national problem. Chasing syllabus completion in the quest to prepare learners for the final year examinations appears to be an impediment to the development of LNSSs (Duran et al., 2011; Mokate, 2023)**.** This offsets the goal of the White Paper on e-Education, which advances the use of ICT resources to confidently and creatively help learners acquire the ICT "skills and knowledge they need as lifelong learners to achieve personal goals and to be full participants in the global community by 2013" (Department of Basic Education, 2004, p.17).

Considering these trends in the development of LNSSs, Siemens' (2005) eight principles of Connectivist Learning, highlighted in Chapter Two, may not all relate to teaching Grade 8 learners in these schools. In particular, the diversity of options, use of non-human connections, multiple connections fields and decision-making. This means learners use multiple sources of information to acquire content knowledge and come up with a solution to the identified problem. The information sources could be people, journals, books, articles, databases, social networks, etc. (Shrivastava, 2018). In other words, learners choose what to learn on their own from all these sources on the Internet. Siemens (2013) and Wang et al. (2014, 2017) support this notion, positing that the Connectivist Learning environment is more open, has widespread social and networking connection capabilities and is controlled by individual learners. This requires learners to judge which information is important and valuable to find their way in the digital space. All this could be time-consuming and overwhelming and pose security threats to young minds. In other words, connectivism requires independent learning, particularly for students at the university level (Laurillard & Kennedy, 2017). Hence the need for guided learning by a knowledgeable other, where interaction is confined to specific classrooms, discussion forums, blog sites or other established online spaces for learners (Wang et al., 2017).

The next section focuses on what should be done in the South African context to promote the maximum development of LNSSs across all levels of Connectivist Learning.

7.7 The Development of Learner Network Society Skills in the Gauteng Full ICT Schools

The developed GBCL framework (Chapter Three) could be instrumental in facilitating the development of LNSSs to enable learner participation in the global community and achieve learning outcomes (Department of Basic Education, 2004, 2011). Firstly, the development of LNSSs is spread across Siemens' four levels of interaction in Connectivist Learning to facilitate the acquisition of the desired ICT skills (Churches, 2008) and Anderson and Krathwohl's (2001) cognitive skills across all cognitive levels. Secondly, Hurley and Chater's (2005) Modelling Instructional Strategy demonstrates how ICTs could be purposefully engaged at the discursive level in a traditional classroom through guided learning to facilitate the understanding of concepts and the acquisition of LNSSs. Thirdly, Puentedura's (2009) SAMR Model integrates face-to-face learning and online learning to promote the effective integration of ICTs into teaching and learning that not only enhances the understanding of concepts but also incorporates the acquisition of higher-order thinking skills through collaborative learning at the augmentation level to solve real-life problems. Lastly, Laurillard's (2012) six learning types suggest various teaching and learning activities that could be employed to promote the understanding of the subject content, as well as the acquisition of LNSSs across all levels of Connectivist Learning. These learning strategies align with the current study's emerging trends in the development of LNSSs, particularly guided and blended learning. Understanding how these strategies could be employed in blended learning, which merges face-to-face teaching with online learning, makes it easier to identify the LNSSs to be developed across the four levels of GBCL.

Accordingly, the developed GBCL framework adapts Siemens' (2011) Connectivist Learning to suit the teaching and learning of Technology in the South African context. In addition, the adaptation accommodates learners from previously disadvantaged communities who were never exposed to ICT resources at the primary school level (Fawns, 2022). In that way, teaching and learning activities would be inclusive and address the diverse needs of all learners, taking into consideration the learners' home, educational and cultural backgrounds (Department of Basic Education, 2017; Korica & Nicolini, 2019; Fawns, 2022). In that way, customised Connectivist Learning becomes an enabler for all learners in the Gauteng Full ICT schools to acquire the requisite network society skills. Such could benefit them in their future careers, including collaborating in the global community to address human needs (Department of Basic Education, 2004, 2011; Shouman & Momdjian, 2019).

The next section depicts the four teachers' espoused and enacted practices in using the available ICT resources to develop LNSSs. It also highlights conditions that support the development of these skills.

7.8 Conditions that Support the Development of Learner Network Society Skills

Table 7.1 juxtaposes the four teachers' espoused and enacted practices to accentuate the conditions that support the optimum development of LNSSs in line with the indicators from the analytical framework developed in Chapter Three. For ease of reference, the enacted practices are highlighted in yellow in the second column, while the espoused practices are highlighted in green in the third column. The third column also depicts the nature of LNSSs, including the cognitive skills acquired through the teachers' enacted practices. The fourth column identifies the Technology learning outcome/s achieved, which responds to the question, *Which learning outcome is achieved*? making vivid the relevance of the developed GBCL Framework in the realisation of the South African curriculum policy aspirations. The last column provides emerging insights on conditions that support the development of LNSSs based on both espoused and enacted practices.

Table 7.1: Consistencies Between Enacted and Espoused Practices

Levels of Interaction	Enacted Practices	Espoused Practices	Technology Learning Outcomes	Supporting Conditions
Innovation Interaction ● **Production/Digital Authoring**	● Using a scratch programme to create an electric dice	● Produce and represent knowledge ● Create digital content ● Create sophisticated products ● Create a video ● Insert videos and images on a PowerPoint Presentation ● Share PowerPoint Presentations on social media	● To solve problems in creative ways ● To use various life skills in authentic contexts (such as decision-making, critical and creative thinking, cooperation, problem-solving and needs identification) ● To combine thinking and doing in a way that links abstract concepts to concrete understanding ● To evaluate products and processes and to evaluate their products	● Collaboration and discussions outside the classroom ● Learners use PowerPoint Presentations with researched content, images and videos ● Learners create videos ● Learners share work done on social media ● Availability of data and connectivity
Sensemaking Interaction ● **Acquisition** ● **Practice** ● **Collaboration** ● **Discussion**	● Paraphrasing information obtained online	● Insert text, pictures, audio material and videos into assignments/presentations ● Paraphrase information obtained online ● Summarise information obtained online ● Online teamwork/collaboration ● Share work digitally through a blog	● To work collaboratively with others ● To use and engage with knowledge in a purposeful way ● To combine thinking and doing in a way that links abstract concepts to concrete understanding ● To use authentic contexts in real situations outside the classroom	● Use PowerPoint Presentations on the Smartboard to guide and teach content ● Use multimedia content to promote the understanding of concepts ● Use social media to share tasks and resources (Google Classroom and WhatsApp) to facilitate collaboration and discussions ● Availability of data and connectivity ● Use e-books ● Assessment of learning through auto-correct on Google Forms ● Use online learner quizzes through the Moodle Platform ● Provision of projects and research activities

Levels of Interaction	Enacted Practices	Espoused Practices	Technology Learning Outcomes	Supporting Conditions
Wayfinding Interaction ● Inquiry (Advanced Web Searches)	● Work independently online ● Gather information/research online	● Work independently online ● Gather information/research online	● To use and engage with knowledge in a purposeful way	● Modelling how to access information through the Smartboard ● Provision of research activities ● Use the Internet to access multimedia content and resources in and outside the classroom (YouTube, Google)
Operation Interaction ● Inquiry (Web Searches)	● Receive work through an app from the teacher ● Gather information/research online ● Work independently online ● Receive written comments from the teacher and peers digitally ● Complete tasks through an appropriate application (i.e., writing on the Smartboard) ● Share work digitally through a blog	● Gather information/research online ● Save resources ● Use e-books ● Receive tasks electronically ● Record and replay spoken words ● Submit completed digital work ● Complete tasks through an appropriate app ● Receive written and verbal comments digitally ● Send and receive work through any app from the teacher and peers ● Work independently online ● Share work digitally through a blog	● To use and engage with knowledge in a purposeful way	● Both teacher and learners use ICT devices in the classroom ● Model how to access information through the Smartboard ● Verbal guided learning in the classroom ● One-on-one guided learning ● Use the Internet to access multimedia content and resources in and outside the classroom (YouTube, Google)

Interpretation of the Table

Table 7.1 aims to accentuate the supporting conditions for the development of LNSSs across the four levels of GBCL in the Gauteng Full ICT Schools. Had these conditions, as outlined in the last column, been met, the identified Technology learning outcomes would have been achieved. This would have been possible had the teachers' espoused practices in column 3 been enacted. However, as evident in the second column, the consistencies between the teachers' espoused and enacted practices are more pronounced at the operation interaction level. Hence the findings revealed learners could operate their ICT devices to receive work through an app from the teacher, conduct web searches and work independently to access multimedia content and perform the tasks provided. In that way, the learning outcome, "to use and engage with knowledge in a purposeful way", is achieved (Department of Basic Education, 2011, p.10). To realise this learning outcome, the supporting conditions include the utilisation of both teacher and learner ICT devices in the classroom, modelling accessing multimedia content through the use of the Smartboard, verbal guided learning in the classroom, one-on-one guided learning and activity-based use of learner ICT devices in the classroom. Importantly, the availability of data and connectivity must be considered. Notably, many of the teachers' espoused practices were not enacted at the higher levels of Connectivist Learning, namely, the sensemaking and innovation interaction levels. As a result, there was no evidence of the development of LNSSs at these levels. For learners to acquire the desired ICT and cognitive skills in the third column, the supporting conditions in the last column, which have been accentuated by the analysis of data in Chapter Six, need to be considered. Importantly, the availability of data, connectivity and capacity-building teachers have emerged as key levers in the development of LNSSs. This is supported by several studies conducted on the utilisation of ICTs for teaching and learning in Gauteng, South Africa, where teachers have also experienced problems with Wi-Fi connectivity and a lack of teacher capacity, as well as the inappropriate use of ICT devices by learners (Padayachee, 2017; Makwela, 2019, Minty, 2020; Mhlanga & Moloi, 2020; Msiza et al., 2020; Dlamini, 2022; Masango et al., 2022; Mokate, 2023).

7.9 Chapter Conclusion

This chapter discussed the development of LNSS by four grade 8 Technology teachers from four Full ICT schools in Gauteng, as depicted by the study's aim and objectives, outlined in Chapter One. The study aimed to understand how the Grade 8 Technology teachers from the participating Full ICT Schools in Gauteng utilise the available ICT resources during teaching and learning activities to create opportunities for learners to acquire LNSSs. To realise this aim, one of the study's objectives was "*To investigate how teachers purposefully utilise ICT resources to elicit learning activities in the classroom and online to develop the network society skills.*" Accordingly, one of the research questions this study intended to answer, *How do teachers utilise ICT resources to develop LNSSs?*, was aptly answered by Mr Banda, who said, "*They were shown the website where they could obtain information, for example on Google. They were shown what to do when they are searching for information, pictures, etc.*"

The classroom observation data revealed that the utilisation of ICTs to develop LNSSs in the participating Gauteng Full ICT schools is mainly at the operation interaction level to access information for content acquisition. Importantly, the acquisition of LNSSs is incidental. In addition, data analysis enabled the researcher to explore the teachers' espoused and enacted practices in the development of LNSSs to determine if teachers purposefully plan for learner utilisation of the available ICT resources to develop LNSSs, as well as understand the conditions that support the development of these skills.

The data confirmed pockets of excellence in the utilisation of the Smartboard, particularly in terms of content acquisition during face-to-face teaching and learning (Department of Basic Education, 2017; Mhlanga & Moloi, 2020). However, more needs to be done to equip learners with the desired ICT skills to communicate and collaborate in the network society and be full participants in the global community (Department of Basic Education, 2004). Mr Banda said, "*Learners voluntarily communicate with others. It is not part of the teacher's lesson plan for learners to communicate and share information with others. It is not part of the teacher's lesson plan for learners to collaborate with others to solve the problem identified.*"

Mr Bozwana's response sums up Mr Banda's assertion succinctly: "*We are not yet there, where we make learners do things digitally. As teachers, we still need to be trained to make learners create things digitally*."

The thesis' last chapter provides the conclusion derived from the findings, contributions and limitations and ends with recommendations for future research.

8 Chapter Eight: Contributions of the Study and Conclusions

8.1 Introduction

This study investigated the development of LNSSs by Technology teachers in Gauteng Full ICT schools. Chapter One provided an overview of why LNSSs are important in an era where there is an influx of digital technology. Chapter Two presented literature on the development of LNSSs, followed by describing the theoretical and conceptual frameworks. Chapter Three presented the study's analytical framework. The research methodology was described in Chapter Four. In Chapter Five, the data from the teachers' espoused and enacted practices on the utilisation of the available ICT resources to develop LNSSs was presented. Chapter Six employed thematic analysis to interpret the data presented in Chapter Five on the development of LNSSs by the study's four participating teachers to lift the core content. Chapter Six further discussed each teacher's espoused and enacted practices, including the themes that emerged from the participants' excerpts. Chapter Seven discussed the emerging themes in the development of LNSSs: guided learning, blended learning, using ICTs mainly for content acquisition, using social media mainly for sharing tasks and resources and restricted LNSSs acquisition. The chapter concluded by highlighting the conditions that support the development of these skills. The analytical framework presented in Chapter Three was used to understand how the development of LNSSs takes place in the traditional classroom and online outside the classroom.

Using the analytical framework helped me to understand how the participating teachers in the four Full ICT schools in Gauteng develop LNSSs during their teaching and learning activities. Their utilisation of learner devices in the classroom differed due to the contextual factors they cited. However, blended learning and guided learning in the development of LNSSs surfaced strongly from the data. It is important that they are incorporated in the proposed model below, which serves to guide the development of LNSSs in teaching Technology in Full ICT schools. The next section delves into the study's contributions.

8.2 Contributions of this Study

The model presented in Figure 8.1 is adapted from Neo et al.'s (2013) Web-Based Conversational Framework, discussed in Chapter Two. The framework introduces using the Internet in the classroom and expands it to online learning outside the classroom. Similarly, the GBCL Framework categorises the learning process into discursive and experiential levels. The former takes place in the traditional classroom. The teacher explains concepts and then engages learners in discussions. Feedback is provided through the question-and-answer method to promote the understanding of concepts. Learners are also given an opportunity to question and express their ideas to demonstrate their understanding of the concepts. The interaction and feedback are repetitive until the teacher is happy that learners have grasped the theories, concepts and principles and better understand the objectives of the project (Laurillard, 2002).

The teacher then proceeds to give learners tasks to create opportunities for them to engage in the next level of the learning process, namely experiential learning. At this level, learners work asynchronously to transform their understanding of concepts into practical adaptation and reflection of what was discussed and reflected in class (Neo et al., 2013). In other words, learners practice, action and apply the ideas, theories and concepts acquired through classroom discussions in the real-life situation to solve the problem identified. This would create a fertile ground for learners to collaborate and discuss with their peers, the knowledgeable others and particularly with their teacher anytime and anywhere. In addition, this would translate into the eventual application of the knowledge and skills acquired to gather relevant information online, communicate, collaborate, develop and share the learning artefacts created on the open network (Downes, 2012; Wang et al., 2014).

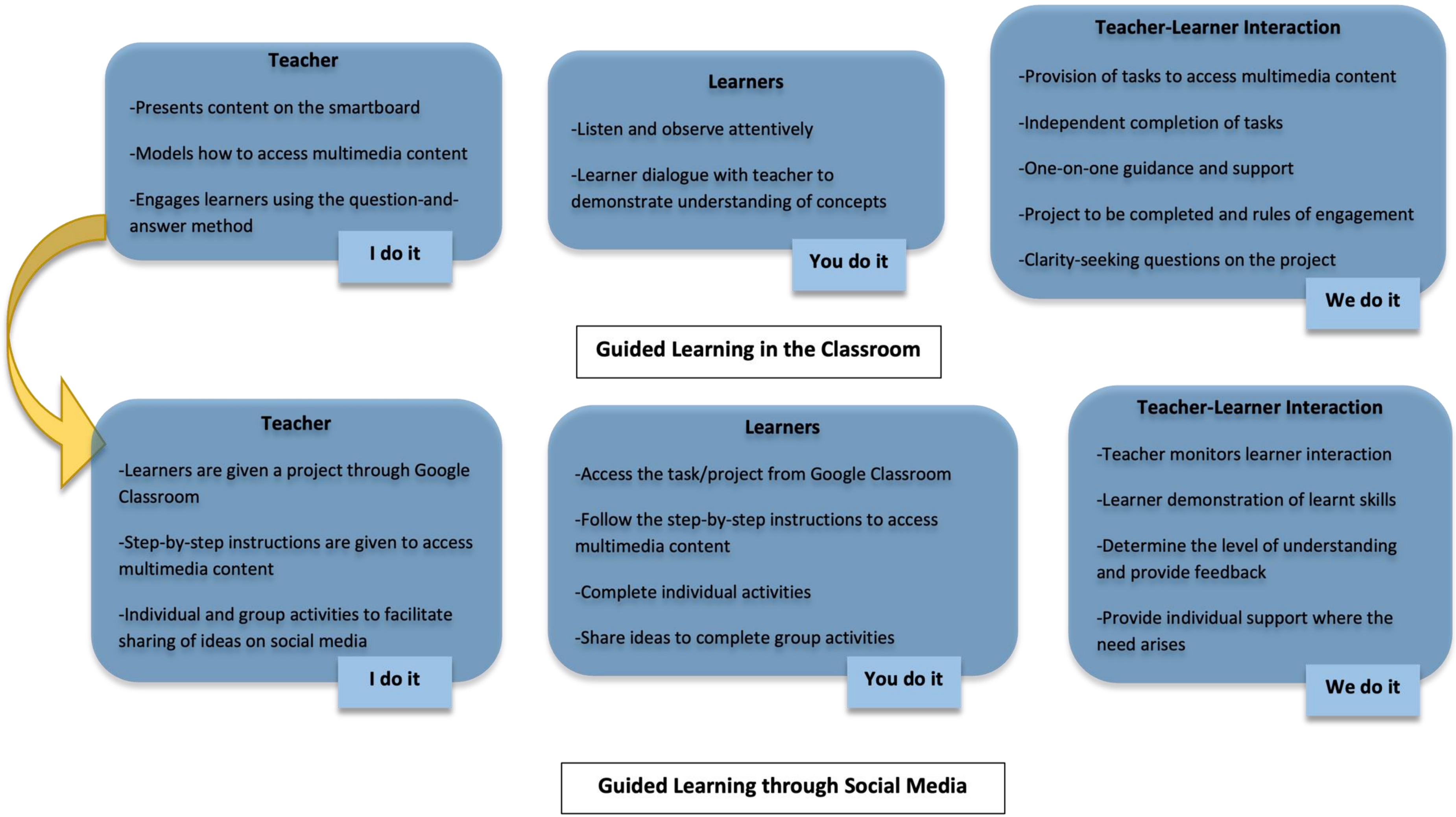


Figure 8.1: Guided Blended Connectivist Learning Model to Develop Learner Network Society Skills in Gauteng Full ICT Schools

Source: Author's construct

Throughout GBCL, learners would acquire LNSSs across the four levels of Connectivist Learning. Laurillard and Kennedy (2017, p.11) support this notion, asserting that "Teacher presence is important to learners, and so 'blended learning' is significant because it uses digital activities to supplement teacher-supported classroom work." In other words, for Connectivist Learning to achieve the desired learning outcomes in the teaching of Grade 8 Technology, teachers need to design teaching and learning activities that assist learners in building and making connections in their learning networks, directing them to appropriate experts and non-human resources (Laurillard, 2012; Neo et al., 2013; Kizito, 2016; Laurillard & Kennedy, 2017). Importantly, Laurillard's Conversational Framework capitalises on problem-based learning and collaborative learning as essential learning strategies in the acquisition of content knowledge and LNSSs, as well as the development of problem-solving skills. It is worth highlighting at this point that many scholars support this model. They assert that the presence of a teacher in blended learning is vital to learners as it makes use of online activities to enhance teacher-initiated classroom work. The non-progression of classroom practice into the online space diminishes the supportive and emotional value attached to teacher presence in the learning process (Puentedura, 2009; Laurillard, 2012; Neo et al., 2013; Kizito, 2016; Laurillard & Kennedy, 2017).

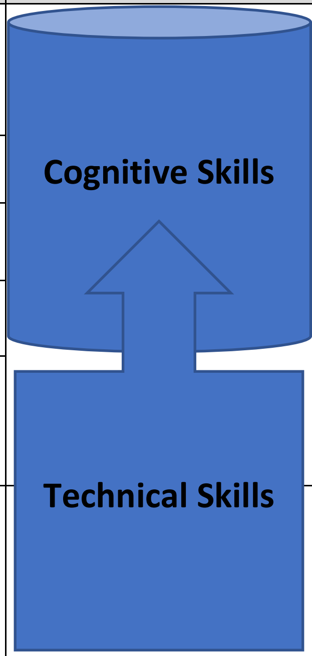
Importantly, teachers and learners need to understand their roles and responsibilities in this learning situation. According to Neo et al. (2013), the teacher must create the necessary environment for the acquisition of LNSSs, guide learners in the process of selecting and finding relevant content and facilitate learning that translates into the development of the desired ICT skills. Learners, on the other hand, must be selectors of the content, collaborators and creators of content. Each undertaking their roles and responsibilities would consequently help to show how the utilisation of the available ICT resources could translate into maximum acquisition of the LNSSs across the four levels of Connectivist Learning. The desired outcome would be technologically literate learners. The process is the GBCL Framework, which is this study's contribution, guiding the development of LNSSs in Gauteng Full ICT schools.

The framework employs connectivism, a learning theory of the digital age and employs three levels of interaction in Connectivist Learning, namely operation interaction, sensemaking interaction and innovation interaction, to facilitate teaching and learning activities across all cognitive levels and the eventual attainment of the Technology learning outcomes (Anderson & Krathwohl, 2001; Siemens, 2005; Churches, 2008; Siemens, 2011). Wayfinding interaction has been excluded since the teacher provides step-by-step instructions on how to navigate the complex and information-loaded environment to access relevant information (Neo et al., 2013; Kizito, 2016; Laurillard & Kennedy, 2017).

In addition, it customises Connectivist Learning to the context of the Gauteng Full ICT schools by infusing Hurley and Chater's (2005) Modelling Instructional Strategy, Puentedura's (2009) SAMR Model and Laurillard's (2012) six learning types. The three serve as contributors to the aspects relevant to this study. In the main, combining the four theoretical frameworks guides teachers in the South African context on how to use the available ICT resources beyond the substitution content acquisition levels, utilising them to enable learners to analyse, evaluate, integrate, communicate and collaborate, as well as create knowledge and new information by adapting, applying, designing, inventing and authoring information to solve identified real-life problems (Department of Basic Education 2004, 2011, 2017). This would address the gaps identified through the policy review of the South African curriculum policies highlighted in Chapter Two.

Table 8.1 illustrates the interpretation of the teaching and learning activities across the four levels of the GBCL Framework developed by this study and contextualised for the Gauteng Full ICT schools.

Table 8.1: Three Levels of Guided Blended Connectivist Learning

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Technical and Cognitive Skills
8. **Innovation Interaction** ***Redefinition*** ● Creating	6. Production/Digital Authoring	Online Creation	
8. **Sensemaking Interaction** ***Modification*** ***Augmentation*** ● Evaluating ● Analysing ● Applying ● Understanding '**I do**', '**You do**', '**We do**' Modelling Instructional Strategy	5. Discussion	Online Evaluation	
	4. Collaboration	Online Collaboration	
	3. Practice	Online Practice	
	2. Acquisition	Online Acquisition	
8. **Operation Interaction** ***Substitution*** ● Web Searching '**I do**', '**You do**', '**We do**' Modelling Instructional Strategy	8. Inquiry *(practice and recall how to operate different media)*	Web Searching	

Sources: Adapted from Anderson & Krathwohl, 2001; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012

In this context, the teachers design teaching and learning activities to facilitate the development of LNSSs during face-to-face learning activities in the classroom and online teaching beyond the classroom walls. Learners become active participants during teaching and learning activities aimed at promoting the understanding of concepts and the eventual development of the LNSSs.

This framework is developed from Siemens' (2011) four levels of interaction in Connectivist Learning, namely operation, wayfinding, sensemaking and innovation interaction. Puentedura's four levels of learning in the use of ICT resources have been woven into these levels to accommodate blended learning in the Gauteng Full ICT schools. These levels are elaborated by the six learning types, advanced by Laurillard (2012), namely inquiry, acquisition, practice, collaboration, discussion and production or digital authoring. The learning types make explicit the form of teaching and learning activities that facilitate the development of LNSSs across the four levels of interaction in the developed GBCL Framework. The infusion will improve LNSSs acquired during teaching and learning activities while the Modelling Instructional Strategy accommodates guided learning in the development of LNSSs during face-to-face teaching and learning activities in the classroom and online. Importantly, considering the blended learning approach stance taken, the current study infuses Anderson and Krathwohl's (2001) and Churches' (2008) cognitive levels to accommodate guided learning, promoting the understanding of concepts and the acquisition of LNSSs in the context of Gauteng Full ICT schools.

This study adopts the third column (LNSSs) as the key feature in the framework (Table 8.1). The six learning types in the second column in Table 8.1 incorporated across the four levels of interaction in the GBCL Framework help to indicate the envisaged use of the available ICT resources to promote the acquisition of the desired skills. These skills and the learning types are expounded in Chapter Two, as well as through the analytical framework in Chapter Three. The last column in Table 8.1 depicts the need for learners to first acquire technical skills at operation interaction through modelling by the teacher before they could engage with the other higher-level cognitive skills. These technical skills facilitate the acquisition of cognitive skills at the sensemaking and innovation interaction levels by using teaching and learning activities across the six learning types. Such requires guided online learning in the classroom to progress to online activities outside the classroom through communication and collaboration (Department of Basic Education, 2004, 2017; Laurillard, 2012; Neo et al., 2013; Laurillard & Kennedy, 2017). In other words, teaching and learning activities should enable learners to action and apply the knowledge and skills acquired during face-to-face learning to online learning outside the classroom through collaboration and discussions to solve the real-life problems identified.

As indicated in the literature review, to realise the above, it is imperative for pedagogy to accommodate modelling as a teaching approach, wherein the teacher demonstrates a new concept or a skill and learners learn by observing and practising during face-to-face teaching and learning activities in the classroom (Eggen & Kauchak, 2001; Hurley & Chater, 2005). Importantly, it is through a closer look at each of the learning types and the evidence of how the teacher designs guided learning activities across the three levels of the GBCL Framework that this study can determine the LNSSs acquired throughout the BTDP. For example, demonstrating to learners how to navigate the web space to access information enables learners to conduct web searches independently. Learner engagement across the six learning types is, therefore, inevitable.

The importance of using the six learning types can be confirmed when pedagogy is aligned to GBCL, which translates into the acquisition of the LNSSs and the eventual attainment of the Technology outcomes, as outlined in the policy.

Figure 8.2 graphically represents the basic teaching and learning activities and conditions that support the development of LNSSs. These have been accentuated by the findings and overall discussions in Chapter Seven. They also serve as the study's contribution.

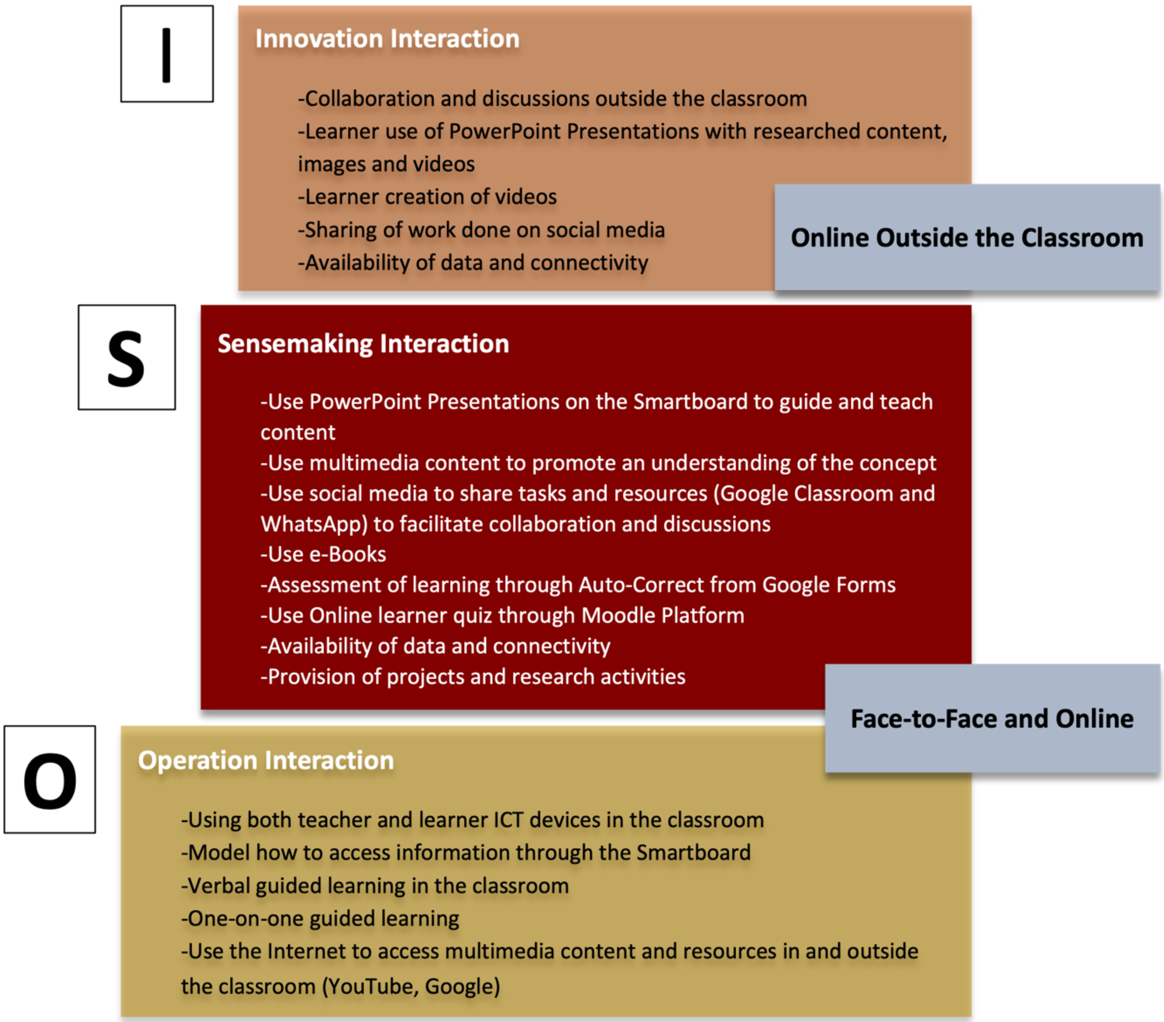


Figure 8.2: Conditions that Support the Development of Learner Network Society Skills in the Full ICT Schools

Source: Author's construct

Should these basic teaching and learning activities in the utilisation of the available ICT resources and the supporting conditions be satisfied, the teachers' espoused and enacted practices unique to GBCL would go a long way in promoting the acquisition of the desired ICT skills across the four levels of Siemens' (2011) Connectivist Learning.

Based on the above, the research questions centred around the teacher as the knowledgeable other in facilitating the development of LNSSs. The next section reflects on the findings in response to the research questions.

8.3 Reflection on the Findings in Response to the Research Questions

In trying to understand how teachers utilise ICT resources during teaching and learning activities to develop LNSSs, this study considered other studies that have been conducted internationally and locally. The following were the findings based on this study's research sub-questions.

1. What are the teachers' espoused and enacted practices in the development of LNSSs?

In the main, teachers' espoused practices are partially consistent with their enacted practices. The data analysis revealed the development of LNSSs in teaching Technology is mainly associated with finding and sharing information. Several contextual factors made it difficult for the teachers to enact their espoused practices in the development of LNSSs. These include a lack of connectivity, a lack of learner devices by some learners, lack of capacity to monitor and support learning in the context of utilising ICTs and departmental prescripts.

2. How do teachers **plan** for learner utilisation of ICT resources to develop LNSSs to solve real-life problems?

The four teachers do not purposefully plan for the utilisation of the web resources. This is because they depend on the prescribed Grade 8 Technology Lesson Plans, which are silent on teaching and learning activities that promote the utilisation of web resources.

3. How do teachers **utilise** ICT resources to develop LNSSs?

In the main, the teachers use the available ICT resources to present content in class, use the Internet to conduct web searches to find information and multimedia content to enhance the understanding of concepts, as well as share tasks to be competed outside the classroom.

4. What **conditions promote** the teachers' enactment of their espoused practices to promote **the acquisition of LNSSs** and realise the goals of education policies?

These conditions include the availability of data and connectivity, the availability of learner ICT devices in the classroom, the utilisation of both teacher and learner ICT devices in the classroom, capacity building of teachers to monitor and support learning in the context of utilising ICTs in the classroom and online, teacher demonstration using the Smartboard on how to search for information and access multimedia content, the provision of classroom activities for practice, assessing the understanding of concepts taught in class through online quizzes, one-on-one physical guided learning, using social media to provide tasks that facilitate independent web searches, and collaboration and discussions outside the classroom.

Importantly, the developed GBCL framework heightens the relevance of blended learning as a teaching and learning strategy to accommodate resource-constrained environments to help learners achieve their outcomes by using the available ICT resources (Bates, 2019; Fawns, 2019, 2022). However, as long as the teaching and learning activities are channelled by the restrictive departmental prescripts, which are more content-driven and exam-oriented, maximum acquisition of LNSSs across the four levels of the developed GBCL Framework will remain a distant reality (Duran et al., 2011). As a result, learners may not acquire the skills they need as lifelong learners to live and thrive in the global economy (Department of Basic Education, 2004; Voogt et al., 2013; Dlamini, 2022).

The next sections present the study's conclusions and limitations and offer recommendations for future research.

8.4 Conclusions

While the extent to which connectivism as a learning theory was initially developed for independent learning through the Internet and is more suitable for university students (Siemens, 2005; Wang et al., 2014; Laurillard & Kennedy, 2017), its use in the South African schooling system is debatable. Where there is capacity on the how component, ICT resources could be utilised effectively to promote the development of the LNSS as per the aspirations of the South African education policies (Department of Basic Education, 2004, 2011, 2017).

While connectivist theories have attempted to provide guidance on how LNSSs could be developed through various online interactions, this study required the theories to expound on how that can be observed and described in the South African context. Infusing Puentendura's (2009) SAMR Model, Hurley and Chater's (2005) instructional modelling approach and Laurillard's (2012) six learning types into Siemens' (2011) four levels of Connectivist Learning helped to make that explicit. This made it possible to notice the development of LNSSs from the teaching and learning practices in the four Full ICT schools in Gauteng. It is this visibility that has helped this study to have a deeper and clearer understanding of what it takes to develop LNSSs when teaching Grade 8 Technology in these schools.

However, in the study's participating four Full ICT schools in Gauteng, the development of these skills is varied. This means, the utilisation of the ICT resources provided in these schools does not necessarily translate into the acquisition of the desired skills, as is the case with Ms Sithole and Mr Banda. Therefore, the role played by the teacher in guiding and supporting the development of LNSSs is essential, thus contributing positively to the attainment of the e-Education mandate (Department of Basic Education, 2004). In that way, learners would acquire the necessary network society skills that would enable them "…. to be full participants in the global community" (Department of Basic Education, 2004, p.17).

Puentedura's (2009) SAMR Model, which expands face-to-face classroom teaching approaches to include online learning, social networking and collaborative activities, provides guidance to teachers on the how component to create opportunities for learners to acquire these skills. Similarly, Laurillard (2012) provides further guidance on the type of teaching and learning activities that could be employed to facilitate maximum development of LNSSs across the four levels of Connectivist Learning. In addition, she provides a broad outlook on the roles and responsibilities of the teachers and learners that promote the acquisition of the desired ICT skills. Importantly, without compromising content acquisition. Furthermore, the elements that emerge from this study are evident from the four Full ICT schools under the GDE, as ICTs are integrated into the teaching and learning activities of Technology as a subject.

Although the four Full ICT schools in Gauteng have ICT resources, they do not have access to some of the software that Puentedura (2009) and Laurillard and Kennedy (2017) refer to in their description of how online learning could support the development of LNSSs. As a result, the study has, therefore, helped to highlight the good practices that are already prevailing in the study's participating four Full ICT schools in Gauteng. The lessons learnt from the participating teachers clarify the role played by the teacher in the development of LNSSs. In the same breath, the absence of advanced software, including the capacity building of teachers in the utilisation of advanced technologies, does present a valid excuse for the non-acquisition of the desired ICT skills. Nonetheless, teachers need to be innovative, play their role as teachers and maximise the utilisation of the available ICT resources. For example, Mr Cele went out of his way to upload the Scratch Programming Software for learners to design and create digital dice to demonstrate their understanding of electric circuits.

Although this study does not consider the policy framework to be adequate as a workable account for the development of LNSSs in the context of this study, the study has learnt from both the positive and negative aspects of teacher practices despite their operating at varied levels. This, as already mentioned, is made possible by the GBCL Framework and the analytical framework developed by this study. Through the discussions engaged in this study, there are issues that have emerged that can help inform the ICT teacher training framework on the development of LNSSs in the South African context in the teaching of Grade 7 – 9 Technology to address the identified real-life problems (Department of Basic Education, 2011). It is hoped that this study will not only inform teacher beliefs about their practice but also how they should engage the available ICT resources to maximise the development of LNSSs across the levels of GBCL.

The South African government can benefit from this study by reviewing its current content-heavy Grade 7 - 9 Technology curriculum to incorporate ICT standards, skills and competencies learners should acquire as they engage in the standard technological design process to address real-life problems. Furthermore, teachers should be empowered accordingly to develop LNSSs in their pedagogy. This would translate into the attainment of Technology learning outcomes and contribute positively to the aspirations of the National

Development Plan in ensuring that South Africa does not fall victim to a “digital divide” (National Planning Commission, 2011, p.23).

8.5 Limitations

It was challenging to find a model that could be used in the study’s context. Firstly, Connectivist Learning requires independent learning where learners create their own interaction spaces in a type of personal learning environment to create, access and build networks (Siemens, 2005; Martindale & Dowdy, 2010). Secondly, the Connectivist Learning Models have been developed for Massive Open Online Courses for university students (Kizito, 2016; Laurillard & Kennedy, 2017). As a result, Connectivist Learning did not completely relate to the participating Gauteng Full ICT schools, especially on the teaching and learning practices associated with the development of LNSSs particularly considering that Grade 8 learners are still young. Leaving them on their own to navigate through a complex, information-loaded networked environment might not yield the desired learning outcomes. Hence, the study opted for the GBCL Framework.

Although Puentedura’s (2009) SAMR Model and Laurillard’s (2012) six learning types are relevant for any education sector, adapting these to blended learning may not completely suit the Grade 8 Technology teachers from the participating schools, especially in the development of LNSSs at higher levels of Connectivist Learning. This is due to the type of software applications installed on the teacher and learner devices in the Full ICT schools in Gauteng. This limitation called for teachers to think out of the box and be innovative in the utilisation of the ICT resources at their disposal. As a result of these variables, the interpretation of data was not easy, considering that the same phenomenon (the development of LNSSs) had to be recognised and connected to each teacher’s espoused and enacted practices. However, guidance and support from the study’s supervisor kept me, as the researcher, on track regarding the purpose of the study.

In addition, although the sample of the study could be small to arrive at the conclusions made, the criteria used were informed by the study’s intentions. The researcher attempted to pay attention to every small detail to establish if the participants were indeed what the study required: to get the best possible teaching and learning practices in the development of LNSSs. Furthermore, since Connectivist Learning was not designed for the basic education sector, I was not quite sure how the learning theory could be engaged to analyse ICT teaching and learning practices, wherein face-to face-learning utilising ICT resources is a dominant feature. This delayed me in establishing the contribution of this study to the teaching of Technology, considering the analytical framework that had to be developed. However, a relentless search of the literature helped to identify relevant frameworks, how they are applied in teaching the subject in the context of the Gauteng Full ICT schools and the eventual acquisition of the LNSSs across the four levels of Connectivist Learning.

8.6 Recommendation for Further Study

While this study has identified areas that must be considered when preparing teachers for meaningful engagement with ICT resources in the development of LNSSs in teaching Technology, there is a need to extend the study to the other of the subjects in the South African curriculum. This will ensure digital literacy is not a stand-alone subject. As a result, all teachers should have the requisite skills to prepare learners for the changing world in their respective subjects.

8.7 Final Word

This study aimed to clarify how teaching Technology can foster learners' technological literacy (Department of Basic Education, 2011). The introduction of ICTs in South African schools has largely focused on using these resources for content acquisition (Department of Basic Education, 2011, 2017; Mhlanga & Moloi, 2020), neglecting the broader e-Education mandates (Department of Basic Education, 2004). As a result, learners lack essential skills to compete in the global economy. Teacher training must go beyond content acquisition and equip educators to balance content knowledge with ICT skills, or the digital divide will persist (Department of Basic Education, 2011).

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10 APPENDICES

APPENDIX A: Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Shirindi

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H21/08/32**
PROJECT TITLE	The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools
INVESTIGATOR(S)	Mrs C Shirindi
SCHOOL/DEPARTMENT	Wits School of Education/
DATE CONSIDERED	20 August 2021
DECISION OF THE COMMITTEE	Approved Risk Level: Minimal
EXPIRY DATE	27 September 2024

DATE 28 September 2021 **CHAIRPERSON** J. Knight
(Professor J Knight)

cc: Supervisor : Prof N Ndlovu and Prof I Moll

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I agree to completion of a regular progress report. For Minimal and Low studies, this is due annually on 31 December. For Medium and High Risk studies, this is due twice annually on 30 June and 31 December.**

Shirindi
Signature

28 / 09 / 2021
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

APPENDIX B: Gauteng Department of Education Approval Letter to Conduct Research

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	**07 July 2021**
Validity of Research Approval:	**08 February 2021– 30 September 2021** **2021/192**
Name of Researcher:	**Shirindi C. D.**
Address of Researcher:	**02 Pontac Road**
	Sunward Park
	Boksburg
Telephone Number:	**071 474 6426**
Email address:	**Charlotte.Shirindi@gauteng.gov.za**
Research Topic:	**The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.**
Type of qualification	**Doctor of Philosophy**
Number and type of schools:	**4 Secondary Schools**
District/s/HO	**Ekurhuleni South, Johannesburg Central, Johannesburg North**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

07/07/2021

1

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

APPENDIX C: Learner Information Sheet

Learner Information Sheet

Study title: The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.

Dear Grade 8 Technology Learner

My name is Charlotte Shirindi and I am a PhD student in the field of Information and Communication Technology (ICT) in Education at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating the utilization of ICT devices in the teaching of Technology in Grade 8 under the supervision of Dr Nokulunga Ndlovu. The aim of this research project is to find out the extent to which opportunities are created for Grade 8 Technology learners to acquire ICT skills, to enable them to solve human problems in their society and contribute positively to the country's economy.

You are hereby invited to participate in this research study. With your permission, your participation in this research study will include:

- Allowing the observation and video recording of teaching and learning activities in your Technology classroom;
- Allowing access to the Grade 8 Technology Web Spaces created by the school, and using the ideas and work posted for this research study;
- Studying this Information Sheet and keeping a copy for your records;
- Completing and signing the Learner Assent Form.

The study will have no immediate benefit to you should you agree to participate. There will be no payment for participating in this research study; equally, participation will not cost you anything but your time. Even if you initially consent to take part in the study, you may subsequently withdraw at any time and would not be required to give any reasons. Should that happen, any data collected about you for the purposes of the study would immediately be destroyed, unless you give consent for it to be retained.

1

To protect your school and your confidentiality, information will be treated in the strictest confidence and will only be available to myself and the supervisors. A pseudonym will be used in the presentation of this report.

There will be no immediate benefit to you should you agree to participate in the study nor will you receive any payment; conversely, participation will not cost you anything but your time.

I wish to assure you that your participation in this research is voluntary. Even if you initially agree to take part in the study, you may subsequently withdraw at any time and would not be required to give any reasons. Should you withdraw from this study, any data collected about you for the purposes of the study would immediately be destroyed, unless you give consent for it to be retained.

Should you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,

Ms. Charlotte Shirindi
E-Mail Address: 585248@students.wits.ac.za
Phone Number: 071 474 6426

Supervisor:
Dr. Nokulunga Ndlovu
E-Mail Address: Nokulunga.Ndlovu@wits.ac.za
Phone Number: 063 205 9200

Thank you for reading this Study Information Sheet.

Date: September 2021

APPENDIX D: Parent or Guardian Information Sheet

Parent/ Guardian Information Sheet

Study title: The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.

Dear Grade 8 Parent/ Guardian

My name is Charlotte Shirindi and I am a PhD student in the field of Information and Communication Technology (ICT) in Education at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating the utilization of ICT devices in the teaching of Technology in Grade 8, under the supervision of Dr Nokulunga Ndlovu. The aim of this research project is to find out the extent to which opportunities are created for Grade 8 Technology learners to acquire ICT skills, to enable them to solve human problems in their society and contribute positively to the country's economy.

You are hereby requested to allow your child to participate in this research study. Participation in this research study will include:

- The observation and video recording of teaching and learning activities of your child in the Technology classroom by the researcher;
- The researcher gaining access to the Grade 8 Technology Web Spaces created by the school, and using the ideas and work posted by the learners for the research study;
- Studying the Information Sheet and keeping the copy for your records;
- Completing and signing the Parent Consent Form.

The study will have no immediate benefit to your child, should you allow him/her to participate. There will be no payment for participating in this research study; equally, participation will not cost your child anything. Even if your child initially consents to take part in the study, he/she may subsequently withdraw at any time and would not be required to give any reasons. Should that happen, any data collected about him/her for the purposes of the study would immediately be destroyed, unless consent is given for it to be retained.

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To protect the school and your child's confidentiality, information will be treated in the strictest confidence and will only be available to myself and the supervisors. A pseudonym will be used in the presentation of this report.
There will be no immediate benefit to your child, should you agree that he/she participates in the study, nor will he/she receive any payment; conversely, participation will not cost you anything.

I wish to assure you that your child's participation in this research is voluntary. Even if you initially agree for your child to take part in the study, you may subsequently withdraw at any time and would not be required to give any reasons. Should you wish your child to withdraw from this study, any data collected about your child, for the purposes of the study would immediately be destroyed, unless you give consent for it to be retained.

Should you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,

Ms. Charlotte Shirindi
E-Mail Address: 585248@students.wits.ac.za
Phone Number: 071 474 6426

Supervisor:
Dr. Nokulunga Ndlovu
E-Mail Address: Nokulunga.Ndlovu@wits.ac.za
Phone Number: 063 205 9200

Thank you for reading this Study Information Sheet.

Date: September 2021

APPENDIX E: Teacher Information Sheet 1

Teacher Information Sheet

Study title: The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.

Dear Sir / Madam

My name is Charlotte Shirindi and I am a PhD student in the field of Information and Communication Technology (ICT) in Education at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating the utilization of ICT devices in the teaching of Technology in Grade 8, under the supervision of Dr Nokulunga Ndlovu. The aim of this research project is to find out the extent to which opportunities are created for Grade 8 Technology learners to acquire ICT skills, to enable them to solve human problems in their society and contribute positively to the country's economy.

As part of this project, I would like to invite you to take part in an interview. This activity will involve obtaining information on your knowledge and understanding of the ICT Skills learners must acquire, as well as establishing if the teaching of Grade 8 Technology creates opportunities for learners to acquire the desired ICT skills to meet people's needs and wants. The interview will take around 45 - 60 minutes.

With your permission, I would also like to audio record the interview using a digital device and observe teaching and learning activities in the classroom through video conferencing facilities, as well as through the social media created by the school. This would afford me the opportunity to look out for evidence of the ICT skills acquired by learners as they utilise the ICT resources through guided teaching and learning activities. Furthermore, I would also need to interact with your Grade 8 Technology Lesson Plan, to establish if the lesson plans depict teaching and learning activities that facilitate learner utilisation of the available ICT resources, to promote a collaborative learning community, as well as the acquisition of the desired ICT skills.
The audio and video recordings will be stored safely on a laptop. Access to the recording would only be through a protected password, and only the researcher will have access to the recording.

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It will be securely retained for two (2) years if a scientific publication arises from the study and six (6) years if there is no publication. Thereafter it will be destroyed accordingly.

There will be no personal costs to you if you participate in this project. You will not receive any direct benefits but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. To guarantee anonymity in video recordings, the Snap Camera Filter on Microsoft Teams will be used to blur/ change faces. If you experience any distress or discomfort at any point in this process, we will stop the interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me at the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you. The data collected from this research project will be stored safely on a laptop. Access to data would only be through a protected password, and only the researcher will have access to the data. It will be securely retained for two (2) years if a scientific publication arises from the study and six (6) years if there is no publication. Thereafter it will be destroyed accordingly. With your permission, the data collected from this research project may be used by other researchers in an anonymised format.

If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,

Ms. Charlotte Shirindi
E-Mail Address: 585248@students.wits.ac.za
Phone Number: 071 474 6426

Supervisor:
Dr. Nokulunga Ndlovu
E-Mail Address: Nokulunga.Ndlovu@wits.ac.za
Phone Number: 063 205 9200

APPENDIX F: Teacher Information Sheet 2

Teacher Information Sheet

Study title: The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.

Dear Sir/ Madam

My name is Charlotte Shirindi and I am a PhD student in the field of Information and Communication Technology (ICT) in Education at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating the utilisation of ICT devices in the teaching of Technology in Grade 8 under the supervision of Dr Nokulunga Ndlovu. The aim of this research project is to find out the extent to which opportunities are created for Grade 8 Technology learners to acquire ICT skills, to enable them to solve human problems in their society and contribute positively to the country's economy.

You are hereby invited to participate in this research study. With your permission, your participation in this research study will include:

- Participating in one-on-one virtual interviews to obtain information on your knowledge and understanding of the ICT Skills learners must acquire, as well as establish if the teaching of Grade 8 Technology creates opportunities for learners to acquire the desired ICT skills to meet the people's needs and wants. The interviews will be audio-recorded via MS Teams after school or whenever you are available and will not last longer than an hour.
- Availing your Grade 8 Technology Lesson Plan to establish if the lesson plans depict teaching and learning activities that facilitate learner utilisation of the available ICT resources, to promote a collaborative learning community, as well as the acquisition of the desired ICT skills.
- Allowing the researcher access into the classroom through video conferencing facilities, to look out for evidence of the ICT skills acquired by learners, as they utilise the ICT resources, through guided teaching and learning activities
- Allowing the researcher access to the School Grade 8 Technology **Virtual/Online Platforms,** to look out for evidence of the ICT skills acquired by learners, as they utilize the ICT resources, through guided teaching and learning activities, as well as observe the

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- creation of social networks that stimulate meaningful dialogue and promote collaborative learning, geared towards addressing the identified human needs and wants.
- Studying this Information Sheet and keeping a copy for your records.
- Completing and signing the Teacher Consent Form
- Arranging a briefing session on this research project with learners, via MS Teams
- Assisting the researcher with the distribution of the Parent/ Guardian Information Sheet, which will be sent through via e-mail.
- Assisting the researcher with the distribution and collection of the following Consent Forms via e-mail:
  1. Parent/Guardian Consent Form
  2. Assent Form for minors

There will be no personal costs to you if you participate in this project. You will not receive any direct benefits but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. To guarantee anonymity in video recordings, the Snap Camera Filter on Microsoft Teams will be used to blur/ change faces. If you experience any distress or discomfort at any point in this process, we will stop the interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me at the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you. The data collected from this research project will be stored safely on a laptop. Access to data would only be through a protected password, and only the researcher will have access to the data.

I promise that I will make this report available to you for scrutiny before it is published, should you wish and present you with a copy on its publication. The findings of the research will bring more insight into the utilisation of the available ICT resources, in promoting the acquisition of the desired skills for the changing world. This will hopefully influence the development of an Educator Development Framework for the Acquisition of the Skills for the Changing World in Technology Education at your school. The Framework can also be used by the rest of the educators and any Department of Education interested in teaching and learning methodologies that prepare learners with the desired skills, to thrive in the modern world.

All data collected during the study will be securely retained for two (2) years if a scientific publication arises from the study and six (6) years if there is no publication. Thereafter it will be destroyed accordingly. With your permission the data collected from this research project may be used by other researchers in an anonymized format.

Should you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,

Ms. Charlotte Shirindi
E-Mail Address: 585248@students.wits.ac.za
Phone Number: 071 474 6426

Supervisor:
Dr. Nokulunga Ndlovu
E-Mail Address: Nokulunga.Ndlovu@wits.ac.za
Phone Number: 063 205 9200

Thank you for reading this Study Information Sheet.

Date: September 2021

APPENDIX G: Technical Assistant Information Sheet

Technical Assistant Information Sheet

Study title: The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.

Dear Sir/ Madam

My name is Charlotte Shirindi and I am a PhD student in the field of Information and Communication Technology (ICT) in Education at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating the utilization of ICT devices in the teaching of Technology in Grade 8 under the supervision of Dr Nokulunga Ndlovu. The aim of this research project is to find out the extent to which opportunities are created for Grade 8 Technology learners to acquire ICT skills to enable them to solve human problems in their society and contribute positively to the country's economy.

You are hereby invited to participate in this research study. With your permission, your participation in this research study will include ensuring that the researcher is able to view and observe the lessons virtually/online. This will include providing the following support to the Grade 8 Technology Educators from the Four Full ICT Schools in the Gauteng Department of Education:

- Create a Microsoft Invite Link that should be shared with the researcher and the teachers.
- Provide support to teachers on setting up the projector, laptop, Smartboard and wireless webcam to broadcast the lesson.
- Activate the "Transcript Functionality" during the MS Teams Interviews.
- Package all the recorded materials, including the recording link.

You will not be advantaged or disadvantaged in any way through this study. Furthermore, there will be no remuneration for the technical support provided in this study.

I wish to assure you that your technical support in this research is voluntary and that you may withdraw your involvement at any time without affecting your reputation as an employee of the Gauteng Department of Education.

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I promise that I will make this report available to you for scrutiny before it is published, should you wish and present you with a copy on its publication.

The findings of the research will bring more insight into the utilisation of the available ICT resources, in promoting the acquisition of the desired skills for the changing world. This will hopefully influence the development of an Educator Development Framework for the Acquisition of the Skills for the Changing World in Technology Education at your school. The Framework can also be used by the rest of the educators and any Department of Education interested in teaching and learning methodologies that prepare learners with the desired skills, to thrive in the modern world.

All data collected during the study will be securely retained for two (2) years, if a scientific publication arises from the study and six (6) years, if there is no publication. Thereafter it will be destroyed accordingly.

Should you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,

Ms. Charlotte Shirindi
E-Mail Address: 585248@students.wits.ac.za
Phone Number: 071 474 6426

Supervisor:
Dr. Nokulunga Ndlovu
E-Mail Address: Nokulunga.Ndlovu@wits.ac.za
Phone Number: 063 205 9200

Thank you for reading this Study Information Sheet.

Date: September 2021

APPENDIX H: Consent Forms

TEACHER CONSENT FORM

Project Title:	The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.
Name of the Researcher	Charlotte Dineo Shirindi

I, ……………………………………….., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

Please circle the relevant options below.

I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;	Yes	No
I was given time to read it, or had it read to me, in the language I best understand;	Yes	No
I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;	Yes	No
I agree that my participation will remain anonymous;	Yes	No
I agree that the researcher my use anonymous quotes in her research report;	Yes	No
I agree that the interview may be audio recorded;	Yes	No
I agree that the teaching and learning activities in my classroom may be video recorded;	Yes	No
I agree that the researcher can access the Grade 8 Technology Web Spaces created by my school, and use the ideas and work posted for this research study;	Yes	No
I agree that the information I provide may be used in an anonymized format after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	Yes	No

Signatures:

Name of the Participant:	
Signature:	
Date	

Name of the Person Seeking Consent:	
Signature	
Date:	

WITS UNIVERSITY

CONSENT FORM FOR AUDIO RECORDING OF STUDY PARTICIPATION

Project Title:	The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.
Name of the Researcher	Charlotte Dineo Shirindi

I, ……………………………………….., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

Please circle the relevant options below.

The recording will be stored in a secure location (a locked cupboard or password protected computer) with restricted access to the researcher and the research supervisor.	Yes	No
The recording will be transcribed and any information that could identify me will be removed,	Yes	No
The recordings will be erased within either (a) two (2) years of the publication of the research findings, or (b) six (6) years, if no publications arise from this research	Yes	No
Direct quotes from my interview, without any information that could identify me, may be cited in the research report or other write-ups of research.	Yes	No

Signatures:

Name of the Participant:	
Signature:	
Date	

Name of the Person Seeking Consent:	
Signature	
Date:	

WITS UNIVERSITY

CONSENT FORM FOR VISUAL RECORDING OF STUDY PARTICIPATION

Project Title:	The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.
Name of the Researcher	Charlotte Dineo Shirindi

I, ……………………………………….., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

Please circle the relevant options below.

The video recording will be stored in a secure location (a locked cupboard or password protected computer) with restricted access to the researcher and the research supervisor;	Yes	No
The video recording will be transcribed and any information that could identify me will be removed;	Yes	No
My face and voice will not be identifiable in any visual recording;	Yes	No
The video recordings will normally be erased within either (a) two (2) years of the publication of the research findings, or (b) six (6) years, if no publications arise from this research, or;	Yes	No
The video, with all identifying information directly linked to me removed, will be stored permanently and may be used for future research;	Yes	No
Direct quotes from my interview, without any information that could identify me, may be cited in the research report or other write-ups of research;	Yes	No

Signatures:

Name of the Participant:	
Signature:	
Date	

Name of the Person Seeking Consent:	
Signature	
Date:	

WITS UNIVERSITY

PARTICIPANT ASSENT SHEET FOR MINORS*

Project Title:	The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.
Name of the Researcher	Charlotte Dineo Shirindi

I, ……………………………………….., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

Please circle the relevant options below.

I have been given a Participant Information Sheet for Minors, which explains what this study is about;	Yes	No
I was given time to read it, or had it read to me, in the language I best understand;	Yes	No
I was given time to ask any questions I wanted to and was happy with the answers I was given;	Yes	No
I understand that I will not benefit from the study, should I agree to take part. I also understand that I will not be paid to take part in the study; taking part will not cost me anything either;	Yes	No
I agree that the teaching and learning activities in my classroom may be video recorded;	Yes	No
I agree that the researcher could access the Grade 8 Technology Web Spaces created by my school, and use the ideas and work posted for this research study;	Yes	No
I agree that the information I provide may be used in an anonymized format after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	Yes	No
My parent(s) or guardian(s) know that I have been invited to take part in the study. They agree that I may do so, but the decision to take part is also mine.	Yes	No

Signatures:

Name of the Participant:	
Signature:	
Date	

Name of the Person Seeking Consent:	
Signature	
Date:	

PARENT/ GUARDIAN CONSENT FORM

Project Title:	The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.
Name of the Researcher	Charlotte Dineo Shirindi

I, ……………………………………….., agree that my child, ………………………………….. could participate in this research project. The research has been explained to me and I agree to the following:

Please circle the relevant options below.

I have been given a copy of the Parent/Guardian Information Sheet, which explains what this study is about;	Yes	No
I have studied the contents of the attached Information Sheet and understand my child's involvement in the research study;	Yes	No
I understand that my child will not benefit from the study, should I agree he/she participates in the study. I also understand that he/she will not be paid to take part in the study; taking part will not cost him/her anything either;	Yes	No
I have been given a range of contact details, on the attached Parent/Guardian Information Sheet should I require further information at a later stage, or have any cause for concern over anything which is done to my child during the study;	Yes	No
I understand that even if I agree for my child take part in the study, I can change my mind later and stop him/her being a part of the study	Yes	No
I know that my child has been invited to take part in the study. Even if I agree that he/she participates in the study, the decision to take part in the study also lies with him/her.	Yes	No
I have been given a range of contact details, on the attached Information Participation Sheet. If I require further information or become concerned about any aspect of this study, I am free to speak to any of these contacts.	Yes	No

Signatures:

Name of the Parent/ Guardian:	
Signature:	
Date	

Name of the Person Seeking Consent:	
Signature	
Date:	

WITS UNIVERSITY

TECHNICAL ASSISTANT CONSENT FORM

Project Title:	The Development of Learner Network Society Skills by Technology Educators in the Gauteng Full ICT Schools.
Name of the Researcher	Charlotte Dineo Shirindi

I, ……………………………………….., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

Please circle the relevant options below.

I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;	Yes	No
I was given time to read it, in the language I best understand;	Yes	No
I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;	Yes	No
I believe I fully understand why the study is being conducted and what the intended outcomes will be;	Yes	No
I understand that there will be no immediate benefit to me, should I agree to provide technical support, nor will I receive any payment; conversely, the provision of the technical support will not cost me anything but my time;	Yes	No
I understand that, even if I initially consent to provide technical support in the study, I may subsequently withdraw at any time and would not be required to give any reasons;	Yes	No
I have been given a range of contact details, on the attached Information Participation Sheet. If I require further information or become concerned about any aspect of this study, I am free to speak to any of these contacts.	Yes	No

Signatures:

Name of the Participant:	
Signature:	
Date	

Name of the Person Seeking Consent:	
Signature	
Date:	

APPENDIX I: Interview Questions for the Grade 8 Technology Teachers

Name of the School: ___________________________________

Name of the Educator: _________________________________

Date: ____________________________

Section A

1. How many years have you been offering Technology as a subject at your school?

2. Which ICT Resources are you using as a teacher in your teaching of Technology as a subject?

3. Which ICT Resources do the learners utilise in your school for learning purposes?

4. What, in your understanding, is the main aim of teaching Technology as a subject?

5. What Technology project/s have learners been assigned to realise this aim?

6. What, in your understanding, are the learning outcomes, as outlined in the CAPS Document, that learners must achieve through Technology education?

Section B

7. What web resources do learners utilise to obtain information, communicate and collaborate with others to solve the problem/address the need identified?

8. What web-based activities have you designed for learners to enable them to:

    a. Utilise the available ICT resources?

    b. Obtain information?

    c. Understand the information obtained?

d. Communicate what they have learnt?

e. Collaborate with others to solve the problem/address the need identified?

9. How do you utilise the teacher ICT resources available in your classroom to guide learning and the acquisition of the desired ICT skills?

Section C

10. In your lesson planning, what activities have you designed for learners to enable them to utilise the available web resources to plan, investigate, design, make and evaluate the artefacts/products made digitally?

11. Which ICT skills would your learners acquire through the utilisation of the available web resources to plan, investigate, design, make and evaluate the artefacts/products made digitally?

12. What ICT platforms are created for learners to showcase digitally created artefacts/products to solve the problem/address the need identified?

APPENDIX J: Classroom Observation Analysis Instrument

Name of the School:	
Name of the Educator:	
Period of Observation:	
Topic:	

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Based on Data
4. Innovation Interaction ● Redefinition ● Modification	**6. Production/Digital Authoring** Create and share learning artefacts, present new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion	**Online Creation** Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making, creating and editing a video, transforming written tasks to visual form, developing material, creating content, using multimodal media to create sophisticated products, decision-making, teamwork/collaboration, compiling presentations, producing and representing knowledge, reference appropriately, inserting text, pictures, audio material and videos into assignments/presentations	
3.4. Sensemaking Interaction ● Augmentation	**5. Discussion** Through synchronous and asynchronous groups/ forums, bring together ideas from knowledgeable others to gain a clear understanding of information	**Online Evaluation** Posting, critiquing, checking, blog commenting and reflecting, tagging, inferring, networking, judging, moderating, monitoring, reviewing, receiving written and verbal comments digitally, decision-making, teamwork, collaboration	
3.3. Sensemaking ● Augmentation	**4. Collaboration** Collaborate with others synchronously or asynchronous in online discussion groups with digital and production tools (i.e., Open Education Resources) to facilitate learning	**Online Collaboration** Blog journaling, Twittering, commenting, annotating, subscribing, sharing work digitally through a blog, sending and receiving work through any app to and from the teacher and peers, receiving written and verbal comments digitally, teamwork/collaboration	
3.2. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification	**3. Practice** Operate different media (design tools, digital simulation, games, assessment tools, analytical tools, learning analytics) to demonstrate learning	**Online Practice** Implementing, carrying out, using, executing, downloading, uploading and sharing, editing, playing, hacking, inserting text, pictures, audio material and videos into assignments/presentations, completing tasks through an appropriate app, submitting completed digital work, sending and receiving work through any app to and from the teacher and peers, sharing work digitally through a blog	
3.1. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification	**2. Acquisition** Use of multimedia content (text, images, audio, video, multimedia, amination, augmented reality and virtual reality) to enhance the understanding of concepts	**Online Acquisition** Describing, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising	

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Based on Data
2. Wayfinding Interaction ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Substitution	**Inquiry 2: Advanced Web Searching** Navigate through complex and information-loaded environments through the use of landmarks, symbols and environmental cues to find relevant information and people directly	**Advanced Searches** Refining searches to suit needs, using features of the advanced search: domain, country, language, file type, location on a page; entering appropriate keywords or phrases **Boolean Searching** Entering multiple appropriate keywords with Boolean refinements 'and' or 'not', modifying keywords to refine the searches, categorising and tagging	
2. Operation Interaction ● '**I do**', '**You do**', '**We do**' Modelling Instructional Strategy ● Substitution	**Inquiry 1: Web Searching** Practice and recall how to operate different media to obtain information, combine and filter content from different digital social networks	**Remembering** Searching, googling, recognising, identifying, finding, retrieving, locating, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favouriting/local bookmarking, saving resources, accessing and using multimedia content, receiving tasks electronically, submitting completed digital work, recording and replaying spoken words, receiving written and verbal comments digitally, receiving tasks electronically, working independently	

Sources: Adapted from Anderson & Krathwohl, 2001; Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021

APPENDIX K: Lesson Plan Analysis Instrument

Name of the School:	
Name of the Educator:	
Date:	
Topic:	

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Based on Data
4. Innovation Interaction ● Redefinition ● Modification	**6. Production/Digital Authoring** Create and share learning artefacts, present new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion	**Online Creation** Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making, creating and editing a video, transforming written tasks to visual form, developing material, creating content, using multimodal media to create sophisticated products, decision-making, teamwork/collaboration, compiling presentations, producing and representing knowledge, reference appropriately, inserting text, pictures, audio material and videos into assignments/presentations	
3.4. Sensemaking Interaction ● Augmentation	**5. Discussion** Through synchronous and asynchronous groups/ forums, bring together ideas from knowledgeable others to gain a clear understanding of information	**Online Evaluation** Posting, critiquing, checking, blog commenting and reflecting, tagging, inferring, networking, judging, moderating, monitoring, reviewing, receiving written and verbal comments digitally, decision-making, teamwork, collaboration	
3.3. Sensemaking ● Augmentation	**4. Collaboration** Collaborate with others synchronously or asynchronous in online discussion groups with digital and production tools (i.e., Open Education Resources) to facilitate learning	**Online Collaboration** Blog journaling, Twittering, commenting, annotating, subscribing, sharing work digitally through a blog, sending and receiving work through any app to and from the teacher and peers, receiving written and verbal comments digitally, teamwork/collaboration	
3.2. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification	**3. Practice** Operate different media (design tools, digital simulation, games, assessment tools, analytical tools, learning analytics) to demonstrate learning	**Online Practice** Implementing, carrying out, using, executing, downloading, uploading and sharing, editing, playing, hacking, inserting text, pictures, audio material and videos into assignments/presentations, completing tasks through an appropriate app, submitting completed digital work, sending and receiving work through any app to and from the teacher and peers, sharing work digitally through a blog	
3.1. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification	**2. Acquisition** Use of multimedia content (text, images, audio, video, multimedia, amination, augmented reality and virtual reality) to enhance the understanding of concepts	**Online Acquisition** Describing, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising	

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Based on Data
2. Wayfinding Interaction ● ‘**I do**’, ‘**We do**’, ‘**You do**’ Modelling Instructional Strategy ● Substitution	**Inquiry 2: Advanced Web Searching** Navigate through complex and information-loaded environments through the use of landmarks, symbols and environmental cues to find relevant information and people directly	**Advanced Searches** Refining searches to suit needs, using features of the advanced search: domain, country, language, file type, location on a page; entering appropriate keywords or phrases **Boolean Searching** Entering multiple appropriate keywords with Boolean refinements ‘and’ or ‘not’, modifying keywords to refine the searches, categorising and tagging	
3. Operation Interaction ● ‘**I do**’, ‘**You do**’, ‘**We do**’ Modelling Instructional Strategy ● Substitution	**Inquiry 1: Web Searching** Practice and recall how to operate different media to obtain information, combine and filter content from different digital social networks	**Remembering** Searching, googling, recognising, identifying, finding, retrieving, locating, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favouriting/local bookmarking, saving resources, accessing and using multimedia content, receiving tasks electronically, submitting completed digital work, recording and replaying spoken words, receiving written and verbal comments digitally, receiving tasks electronically, working independently	

Sources: Adapted from Anderson & Krathwohl, 2001; Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021

APPENDIX L: Social Media Analysis Instrument

Name of the School:	
Name of the Educator:	
Date:	
Topic:	

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Based on Data
4. Innovation Interaction ● Redefinition ● Modification	**6. Production/Digital Authoring** Create and share learning artefacts, present new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion	**Online Creation** Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making, creating and editing a video, transforming written tasks to visual form, developing material, creating content, using multimodal media to create sophisticated products, decision-making, teamwork/collaboration, compiling presentations, producing and representing knowledge, reference appropriately, inserting text, pictures, audio material and videos into assignments/presentations	
3.4. Sensemaking Interaction ● Augmentation	**5. Discussion** Through synchronous and asynchronous groups/ forums, bring together ideas from knowledgeable others to gain a clear understanding of information	**Online Evaluation** Posting, critiquing, checking, blog commenting and reflecting, tagging, inferring, networking, judging, moderating, monitoring, reviewing, receiving written and verbal comments digitally, decision-making, teamwork, collaboration	
3.3. Sensemaking ● Augmentation	**4. Collaboration** Collaborate with others synchronously or asynchronous in online discussion groups with digital and production tools (i.e., Open Education Resources) to facilitate learning	**Online Collaboration** Blog journaling, Twittering, commenting, annotating, subscribing, sharing work digitally through a blog, sending and receiving work through any app to and from the teacher and peers, receiving written and verbal comments digitally, teamwork/collaboration	
3.2. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification	**3. Practice** Operate different media (design tools, digital simulation, games, assessment tools, analytical tools, learning analytics) to demonstrate learning	**Online Practice** Implementing, carrying out, using, executing, downloading, uploading and sharing, editing, playing, hacking, inserting text, pictures, audio material and videos into assignments/presentations, completing tasks through an appropriate app, submitting completed digital work, sending and receiving work through any app to and from the teacher and peers, sharing work digitally through a blog	
3.1. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification	**2. Acquisition** Use of multimedia content (text, images, audio, video, multimedia, amination, augmented reality and virtual reality) to enhance the understanding of concepts	**Online Acquisition** Describing, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising	

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Teaching and Learning Activities Based on Data
2. Wayfinding Interaction ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Substitution	**Inquiry 2: Advanced Web Searching** Navigate through complex and information-loaded environments through the use of landmarks, symbols and environmental cues to find relevant information and people directly	**Advanced Searches** Refining searches to suit needs, using features of the advanced search: domain, country, language, file type, location on a page; entering appropriate keywords or phrases **Boolean Searching** Entering multiple appropriate keywords with Boolean refinements 'and' or 'not', modifying keywords to refine the searches, categorising and tagging	
4. Operation Interaction ● '**I do**', '**You do**', '**We do**' Modelling Instructional Strategy ● Substitution	**Inquiry 1: Web Searching** Practice and recall how to operate different media to obtain information, combine and filter content from different digital social networks	**Remembering** Searching, googling, recognising, identifying, finding, retrieving, locating, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favouriting/local bookmarking, saving resources, accessing and using multimedia content, receiving tasks electronically, submitting completed digital work, recording and replaying spoken words, receiving written and verbal comments digitally, receiving tasks electronically, working independently	

Sources: Adapted from Anderson & Krathwohl, 2001; Hurley & Chater, 2005; Churches, 2008; Puentedura, 2009; Siemens, 2011; Laurillard, 2012; Wang et al., 2014; Drennan & Moll, 2018; Aldosemani, 2019; Shouman & Momdjian, 2019; Rehman & Aurangzeb, 2021

APPENDIX M: Validity Instruments

Rater 1

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Technology Learning Outcomes
4. Innovation Interaction ● Redefinition Affording learners an opportunity to work on projects that solve real life challenges allows learners to be innovative. Learners are in a position to invent and create using technological skills and knowledge.	**6. Production/ Digital Authoring** Create and share learning artefacts, present new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion Learners are given an opportunity to create artefacts, an example of constructing a bridge offers this opportunity.	**Online Creation** Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making, creating and editing a video, transforming written tasks to visual form, developing material, creating content, using multimodal media to create sophisticated products, decision-making, teamwork/collaboration, compiling presentations, producing and representing knowledge, reference appropriately, inserting text, pictures, audio material and videos into assignments/presentations Online creation limited as learners used Google for web-searching – digital content searching not creation. Clear demonstration of collaboration and teamwork through online platforms.	To solve problems in creative ways The concept of project-based learning is clearly demonstrated to solve real challenges.
3.4. Sensemaking Interaction ● Augmentation Leaners are given an opportunity to interact with different digital platforms to acquire information and knowledge, e.g., using YouTube, videos etc. Promotion of interaction between leaners using different social media platforms is evident.	**5. Discussion** Through synchronous and asynchronous groups/forums, bring together ideas from the knowledgeable others to gain a clear understanding of information. Utilisation of Google Classrooms offers an opportunity for both synchronous and asynchronous interaction.	**Online Evaluation** Posting, critiquing, checking, blog commenting and reflecting, tagging, inferring, networking, judging, moderating, monitoring, reviewing, receiving written and verbal comments digitally, decision-making, teamwork, collaboration Learners are afforded an opportunity to collaborate, solve problems and make decisions on online platforms.	To evaluate existing products and processes; and to evaluate their own products Evaluation of products was not really evident.

	Utilisation of social media platforms for communication and interaction.		
3.3. Sensemaking ● Augmentation	**4. Collaboration** Collaborate with others synchronously or asynchronous in online discussion groups with digital and production tools (i.e. Open Education Resources) to facilitate learning Utilisation of Google Classrooms offers an opportunity for both synchronous and asynchronous interaction. Utilisation of social media platforms for communication and interaction.	**Online Collaboration** Blog journaling, Twittering, commenting, annotating, subscribing, sharing work digitally through a blog, sending and receiving work through any app to and from the teacher and peers, receiving written and verbal comments digitally, teamwork/collaboration Collaboration is clearly demonstrated as opportunities were created in both face-to-face and online platforms. Online collaborations comes out clearly through utilisation of social media platforms like WhatsApp.	To work collaboratively with others Collaboration is clearly demonstrated as opportunities were created in both face-to-face and online platforms.

3.2. Sensemaking ● **'I do'**, **'We do'**, **'You do'** Modelling Instructional Strategy ● Modification Demonstrated a lesson on electric circuit through the Smartboard and PowerPoint presentation.	**3. Practice** Operate different media (design tools, digital simulation, games, assessment tools, analytical tools, learning analytics) to demonstrate learning Learners given an opportunity to digitally search for video that link to the concepts taught Simulation of electrical circuit were shown on the Smartboard. The 3D tools were manipulated by leaners for more practice.	**Online Practice** Implementing, carrying out, using, executing, downloading, uploading and sharing, editing, playing, hacking, inserting text, pictures, audio material and videos into assignments/presentations, complete task through an appropriate app, submitting completed digital work, sending and receiving work through any app to and from the teacher and peers, share work digitally through a blog Learners given an opportunity to digitally search for video that link to the concepts taught Simulation of electrical circuit were shown on the Smartboard.	Through practical projects using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles The stage of making things digitally is not yet achieved as indicated by the teacher. There is a need for digital training on this aspect.
3.1. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification Real-life examples from learner's immediate environment were highlighted	**2. Acquisition** Use of multimedia content (text, images, audio, video, multimedia, amination, augmented reality and virtual reality) to enhance the understanding of concepts Videos and multimedia used to facilitate acquisition of knowledge and skills	**Online Acquisition** Describing, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising By using their own devices (tablets) to search for related concepts, learners were offered an opportunity to enhance their knowledge on the content matter.	To use and engage with knowledge in a meaningful way This was easily done by making reference to the learners immediate environment.
2. Wayfinding Interaction ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Substitution Teacher demonstrated how to conduct the searches digitally. Application of Google Web-searches and research very evident.	**Inquiry 2: Advanced Web Searching** Navigate through complex and information-loaded environments through the use of landmarks, symbols and environmental cues to find relevant information and people directly After teacher demonstration and modelling conducted, an opportunity [was] created for learners to conduct their own	**Advanced Searches** Refine searches to suit needs, using features of the advanced search: domain, country, language, file type, location in page; entering appropriate keywords or phrases **Boolean Searching** Enter multiple appropriate keywords with Boolean refinements "and" or "not", modifying keywords to refine the searches, categorising and tagging	To combine thinking and doing in a way that links abstract concepts to concrete understanding Learners were able to conduct searches, think about different searching options and communicate the concepts.

	Google search and communicate their findings or information.	Advanced searches primarily using combining and filtering of content is evident.	
1.Operation Interaction ● 'I do', 'You do', 'We do' Modelling Instructional Strategy ● Substitution	Inquiry 1: Web Searching Practice and recall how to operate different media to obtain information, combine and filter content from different digital social networks Learners were given an opportuning to both explore and practice to use different digital platforms and social media for learning purposes.	Remembering Searching, googling, recognising, identifying, finding, retrieving, locating, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favouriting/local bookmarking, saving resources, accessing and using multimedia content, sending and receiving tasks electronically, submitting completed digital work, recording and replaying spoken words, receiving written and verbal comments digitally, receiving tasks electronically, working independently Most evident was the opportunity for social networking and utilisation of different digital platforms for digital content acquisition, both written and verbal communication opportunities were created.	To combine thinking and doing in a way that links abstract concepts to concrete understanding Learners were able to conduct searches, think about different searching options and communicate the concepts. This reinforced learners' comprehension and modified their digital skills

Rater 2

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Technology Learning Outcomes
4. Innovation Interaction ● Redefinition Learners create digital artifacts to demonstrate the knowledge acquired.	**6. Production/ Digital Authoring** Create and share learning artefacts, present new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion Learner expands on their knowledge acquired and provide solutions to their peers to create knowledge where they experience challenges.	**Online Creation** Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making, creating and editing a video, transforming written tasks to visual form, developing material, creating content, using multimodal media to create sophisticated products, decision-making, teamwork/collaboration, compiling presentations, producing and representing knowledge, reference appropriately, inserting text, pictures, audio material and videos into assignments/presentations Development of YouTube or digital content for online streaming or learning purposes.	To solve problems in creative ways Mediation of difficult concepts through real learner context.
3.4. Sensemaking Interaction ● Augmentation Learners embrace virtual and augmented reality to advance knowledge acquisition.	**5. Discussion** Through synchronous and asynchronous groups/forums, bring together ideas from the knowledgeable others to gain a clear understanding of information. Learners use online discussion forums to share their understanding of concepts	**Online Evaluation** Posting, critiquing, checking, blog commenting and reflecting, tagging, inferring, networking, judging, moderating, monitoring, reviewing, receiving written and verbal comments digitally, decision-making, teamwork, collaboration Learners provide feedback and comments on the information shared by their peers	To evaluate existing products and processes; and to evaluate their own products Development of an online interaction and collaboration space.
3.3. Sensemaking ● Augmentation	**4. Collaboration** Collaborate with others synchronously or asynchronous in online discussion groups with digital and production tools (i.e. Open	**Online Collaboration** Blog journaling, Twittering, commenting, annotating, subscribing, sharing work digitally through a blog, sending and receiving work through any	To work collaboratively with others Development of a learning portal for sharing and accessing resources.

	Education Resources) to facilitate learning Learners Identify learning resources that enhance and promote learning.	app to and from the teacher and peers, receiving written and verbal comments digitally, teamwork/collaboration Learners share best practices and resources through different online platforms	
3.2. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification Learners are able to see how the physical world is interrelated in terms of time and space. They are able to distinguish between an advanced and developing world and learn on how to operate at a higher level to survive in a digital space.	**3. Practice** Operate different media (design tools, digital simulation, games, assessment tools, analytical tools, learning analytics) to demonstrate learning Learners explore and use 3D digital tools to advance learning.	**Online Practice** Implementing, carrying out, using, executing, downloading, uploading and sharing, editing, playing, hacking, inserting text, pictures, audio material and videos into assignments/presentations, complete task through an appropriate app, submitting completed digital work, sending and receiving work through any app to and from the teacher and peers, share work digitally through a blog Creation of a digital repository as a collaboration space.	Through practical projects using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles Development of 3D content for mediation of digital content.
3.1. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification Learners are able to see how the physical world is interrelated in terms of time and space. They are able to distinguish between an advanced and developing world and learn on how to operate at a higher level.	**2. Acquisition** Use of multimedia content (text, images, audio, video, multimedia, amination, augmented reality and virtual reality) to enhance the understanding of concepts Learners are aware of the 3D digital space and how it can assist in the acquisition of knowledge.	**Online Acquisition** Describing, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising Learners operates in a full 3D digital space by sourcing and sharing 3D content.	To use and engage with knowledge in a meaningful way Learning is done through advanced digital tools.
2. Wayfinding Interaction ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Substitution Learners are able to find solutions to problems using knowledge and experience from interacting with their immediate environment.	**Inquiry 2: Advanced Web Searching** Navigate through complex and information-loaded environments through the use of landmarks, symbols and environmental cues to find relevant information and people directly Learners are able to source relevant information to solve problems. They	**Advanced Searches** Refine searches to suit needs, using features of the advanced search: domain, country, language, file type, location in page; entering appropriate keywords or phrases **Boolean Searching** Enter multiple appropriate keywords with Boolean refinements "and" or	To combine thinking and doing in a way that links abstract concepts to concrete understanding Learners value technology and use it to their advantage to understand how the world is interrelated.

	are capable [of seeing] the world from a broader perspective.	"not", modifying keywords to refine the searches, categorising and tagging Learners are able to use leading words to search through the world wide web (www).	
1.Operation Interaction ● '**I do**', '**You do**', '**We do**' Modelling Instructional Strategy ● Substitution Learners use their immediate environment and experience to make meaning of concepts and create knowledge.	**Inquiry 1: Web Searching** Practice and recall how to operate different media to obtain information, combine and filter content from different digital social networks Learners extend their immediate environment and use digital tools to get information.	**Remembering** Searching, googling, recognising, identifying, finding, retrieving, locating, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favouriting/local bookmarking, saving resources, accessing and using multimedia content, sending and receiving tasks electronically, submitting completed digital work, recording and replaying spoken words, receiving written and verbal comments digitally, receiving tasks electronically, working independently Learners are aware of different digital platform for sourcing, managing and sharing of information.	To combine thinking and doing in a way that links abstract concepts to concrete understanding Learners are capable [of functioning] in a full digital space (4IR) through acquisition of prerequisite skills

Rater 3

Levels of Connectivist Learning	Six Learning Types	Learner Network Society Skills	Technology Learning Outcomes
4. Innovation Interaction ● Creating The teacher has carefully chosen a marsh of technologies that learners may use to research (cell phones), and access lesson content and activity (smartboard) to construct a bridge and a tower.	**6. Production/ Digital Authoring** Create and share learning artefacts, present new ideas, solutions, theories, products and models on the open network where they remain persistent upon completion Learners access content through the smartboard (shared device) and individually interact with the activity through Google Classroom.	**Online Creation** Designing, constructing, producing, inventing, devising, animating, remixing, podcasting, directing, broadcasting, planning, producing, inventing, devising, making, creating and editing a video, transforming written tasks to visual form, developing material, creating content, using multimodal media to create sophisticated products, decision-making, teamwork/collaboration, compiling presentations, producing and representing knowledge, reference appropriately, inserting text, pictures, audio material and videos into assignments/presentations The Google Classroom allows learners to develop search and navigation skills	To solve problems in creative ways The platforms have been carefully used to provide redefinitions and alternative ways of presenting information.
3.4. Sensemaking Interaction ● Augmentation The use of technology appears to have provided new features that enhance learner interest and understanding.	**5. Discussion** Through synchronous and asynchronous groups/forums, bring together ideas from the knowledgeable others to gain a clear understanding of information. The use of face-to-face demonstration in tandem with Google Classrooms creates an	**Online Evaluation** Posting, critiquing, checking, blog commenting and reflecting, tagging, inferring, networking, judging, moderating, monitoring, reviewing, receiving written and verbal comments digitally, decision-making, teamwork, collaboration	To evaluate existing products and processes; and to evaluate their own products The use of synchronous and asynchronous interaction creates expanded opportunities for learning.

	opportunity to concretize knowledge.	Learners are allowed to reflect and journal through Google Classroom.	
3.3. Sensemaking ● Augmentation Technology has been used to manage lesson time and the pace of learning content	**4. Collaboration** Collaborate with others synchronously or asynchronous in online discussion groups with digital and production tools (i.e. Open Education Resources) to facilitate learning Learners have easy and quick access to learning resources and activities.	**Online Collaboration** Blog journaling, Twittering, commenting, annotating, subscribing, sharing work digitally through a blog, sending and receiving work through any app to and from the teacher and peers, receiving written and verbal comments digitally, teamwork/collaboration Digital annotation and journaling are skills that are enhanced through online learning and they get to collaborate with the teacher.	To work collaboratively with others Development of a learning portal for sharing and accessing resources.
3.2. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Modification The teacher utilises guided instruction to mediate learning	**3. Practice** Operate different media (design tools, digital simulation, games, assessment tools, analytical tools, learning analytics) to demonstrate learning Learners search for videos and images guided by the teacher.	**Online Practice** Implementing, carrying out, using, executing, downloading, uploading and sharing, editing, playing, hacking, inserting text, pictures, audio material and videos into assignments/presentations, complete task through an appropriate app, submitting completed digital work, sending and receiving work through any app to and from the teacher and peers, share work digitally through a blog Learners download and upload videos.	Through practical projects using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles Technology has been utilised for research and investigation.
3.1. Sensemaking ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy	**2. Acquisition**	**Online Acquisition**	To use and engage with knowledge in a meaningful way

● Modification There appears to be an assumption that learners redefine content through video and image search in essence it is through teacher guidance	Use of multimedia content (text, images, audio, video, multimedia, amination, augmented reality and virtual reality) to enhance the understanding of concepts Learners developed independent search skills using their tablets.	Describing, interpreting, summarising, paraphrasing, classifying, comparing, inferring, outlining, explaining, exemplifying, hypothesising Learners were able to exemplify required tasks through online search and research.	The teacher has redirected technology use which transposes learners.
2. Wayfinding Interaction ● '**I do**', '**We do**', '**You do**' Modelling Instructional Strategy ● Substitution Personal learning observed when learners could follow prompts when searching for information	**Inquiry 2: Advanced Web Searching** Navigate through complex and information-loaded environments through the use of landmarks, symbols and environmental cues to find relevant information and people directly Personalised learning using cues from the learning environment.	**Advanced Searches** Refine searches to suit needs, using features of the advanced search: domain, country, language, file type, location in page; entering appropriate keywords or phrases **Boolean Searching** Enter multiple appropriate keywords with Boolean refinements "and" or "not", modifying keywords to refine the searches, categorising and tagging Learners can use leading words.	To combine thinking and doing in a way that links abstract concepts to concrete understanding Technology is utilized as a research tool and platform to share content.

1.Operation Interaction ● '**I do**', '**You do**', '**We do**' Modelling Instructional Strategy ● Substitution The technology was used to structure content and provide guided learning instruction on how to use the technology to search for information	**Inquiry 1: Web Searching** Practice and recall how to operate different media to obtain information, combine and filter content from different digital social networks Learners had an opportunity to search for information and filter content.	**Remembering** Searching, googling, recognising, identifying, finding, retrieving, locating, bullet pointing, highlighting, bookmarking, social networking, social bookmarking, favouriting/local bookmarking, saving resources, accessing and using multimedia content, sending and receiving tasks electronically, submitting completed digital work, recording and replaying spoken words, receiving written and verbal comments digitally, receiving tasks electronically, working independently Learners were exposed to various ICT resources and developed searching, highlighting, and bookmarking skills including journaling	To combine thinking and doing in a way that links abstract concepts to concrete understanding Technology was used to sift abstract concepts into concrete for easier visualisation and understanding.

APPENDIX N: Lesson Plans

LESSON PLAN: Technology Grade__8___				
Name of School:	XXX	Term: 4		Week: 2
Name of Teacher(s):	Mr Bozwana		Date	18-22 October 2021
Focus	Electrical Systems and Control , Investigation & Design Skills			
CLASSROOM ACTIVITIES:				
Periods	1	2	3	4
Content, concepts and skills	• **Revise:** simple circuit components; input devices (electrochemical cell; generator; solar panel), output devices (resistor; lamp; heater; buzzer; motor); control device (switches). Note: Some devices can serve as input, output, process or control device. • Correct connections, short circuits. Electrical components and their accepted symbols. Emphasis on series connections of cells, switches and bulbs with the aim of explaining the AND gate.	• Drawing electrical circuits using accepted symbols (as in Grade 12 see Addendum C). • Set up circuits using a range of components. Draw the circuits using symbols. Emphasis on parallel connections of cells, switches and bulbs with the aim of explaining the OR gate.	• **Practical**: learners draw circuit diagrams AND connect circuits showing the effect of circuits with resistors connected in series and parallel. .	• **Investigation**: introduce Ohm's Law (*qualitatively – no calculations*). Learners use one cell, then two cells, and then three cells connected in series and note the effect on the brightness of a lamp. They must conclude that more cells in series(*more voltage*) will cause the *current strength* to increase, if the *resistance* does not change
Teacher's Activities	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources
Learners' Activities	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement
Type of Assessment	Formal / Informal	Formal / Informal	Formal / Informal	Formal / Informal
Resources	DBE Workbook 2 Gr. 8, YouTube videos	DBE Workbook 2 Gr. 8	DBE Workbook 2 Gr. 8	DBE Workbook 2 Gr. 8
	CAPS	CAPS	CAPS	CAPS
	Examples / Samples	Examples / Samples	Examples / Samples	Examples / Samples

IDENTIFIED LEARNERS' NEEDING SUPPORT:	**Name of learner(s)**	**Name of learner(s)**
Indicate the name(s) of learner(s) identified as having learning difficulties/not achieving or use the class list.	1.	5.
	2.	6.
	3.	7.
	4.	8.

CLASSROOM ACTIVITIES		
How are you going to include and differentiate Support for learners?		
Teacher Activities	Learner Activities:	**Resources**
It will be necessary to talk learners through concepts and ideas. Ask relevant questions to help them understand and interpret this information. Teach the specific meaning of all terms and talk learners through the concepts and ideas. Be aware of the different meanings a specific word may have (e.g., the word ‘stage’ can mean a period of time, a platform, a performance, a robbery)	Actively participate with questions, where possible practical examples, etc	
How are you going to include and differentiate Expanded opportunities for learners?		
Teacher Activities	Learner Activities:	**Resources**
Allocate learner more responsibility: actions / activities / leadership roles, etc Appoint learner as a mentor to another learner	Apply him / her to roles as appointed by the educator. Applies the Buddy System	

TEACHER REFLECTION:

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Teachers Signature : ___________________________ Date: _______________

Pre -Moderated by line manager e.g. HOD/Deputy Principal (attach a moderation tool?): Signature: _________________ Date: ___________

Post moderation by HOD:

Formal Assessment Feedback								
Assessment Results Analysis	**Level of achievement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Indicate number of learners per level achieved							

TERM 4 GRADE 8

This is an example of a weekly Grade 8 lesson plan. You are at liberty to use it or alter it to suit your own needs. You are also at liberty to have your own lesson plan which may be different to this one, but should include Focus area; Content, concepts and skills; objectives; teacher and learners activities; reflection as well as assessment.

Name of School:	XXXX	2hrs	Week: 1
Name of teacher	Mr Cele		Date:18-22/10/2021
Focus area	**Electrical systems and control** **Design skills**		

Content, concepts and skills	• **Revise:** simple circuit components; input devices (electrochemical cell; generator; solar panel), output devices (resistor; lamp; heater; buzzer; motor); control device (switches). **Note: Some devices can serve as input, output, process or control device.** • Correct connections, short circuits. Electrical components and their accepted symbols. • Drawing electrical circuits using accepted symbols (as in Grade 12 see Addendum C). • Set up circuits using a range of components. Draw the circuits using symbols.
Objectives of the lesson:	*Develop learners' Designing* skills

CLASSROOM ACTIVITIES:

	Day 1: Suggested teachers activities	***Day 2 Suggested teachers activities***
Teachers Activities	*The teacher revises:* ● *simple circuit components;* ● *input devices (electrochemical cell; generator; solar panel),* ● *output devices (resistor; lamp; heater; buzzer; motor);* ● *control device (switches*	*The teacher continues to discuss the following aspects with learners:* ● Correct connections, short circuits. ● Electrical components and their accepted symbols.
	Day 1: Suggested learner activities	***Day 2 Suggested learner activities***
learners Activities	***Enabling task 1*** ● *Learners draw a circuit diagram using component symbols*	***Enabling task 2*** ● *Learners should be given chance to set up circuits using a range of components.*

Resources (Add more)	*Textbook,* DBE Workbook 2 Gr. 8, YouTube videos, CAPS

ASSESSMENT:

Type of Assessment:	*Two Enabling task based on simple circuit, input devices, output devices and control device*		
Attached: support documents of assessments e.g. case study plus memo for marking		yes	no
Teacher Reflection:			
Expanded Opportunities			

Teachers Signature: _____________________ Date: _____________

Lesson Moderated by:______________________ Signature:______________ Date:___________

Brief comment Moderator: ____

LESSON PLAN: Technology Grade__8___

Name of School:	XXXX	Term: 4		Week: 1
Name of Teacher(s):	Ms Sithole		Date	18 - 22 October 2021
Focus	Electrical Systems and Control , Investigation & Design Skills			

CLASSROOM ACTIVITIES (generic planning):

Periods	1	2	3	4
Content, concepts and skills	• **Revise:** • Correct connections, short circuits. Electrical components and their accepted symbols. Emphasis on series connections of cells, switches and bulbs with the aim of explaining the AND gate.	• Drawing electrical circuits using accepted symbols (as in Grade 12 see Addendum C). • Set up circuits using a range of components. Draw the circuits using symbols. Emphasis on parallel connections of cells, switches and bulbs with the aim of explaining the OR gate.	• **Practical**: learners draw circuit diagrams AND connect circuits showing the effect of circuits with resistors connected in series and parallel. .	• **Investigation**: introduce Ohm's Law (*qualitatively – with calculations*). Learners use one cell, then two cells, and then three cells connected in series and note the effect on the brightness of a lamp. They must conclude that more cells in series (*more voltage*) will cause the *current strength* to increase, if the *resistance* does not change
Teacher's Activities	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources
Learners' Activities	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement
Type of Assessment	Formal / Informal	Formal / Informal	Formal / Informal	Formal / Informal
Resources	DBE Workbook 2 Gr. 8, YouTube videos CAPS Examples / Samples	DBE Workbook 2 Gr. 8 CAPS Examples / Samples	DBE Workbook 2 Gr. 8 CAPS Examples / Samples	DBE Workbook 2 Gr. 8 CAPS Examples / Samples

IDENTIFIED LEARNERS' NEEDING SUPPORT:	**Name of learner(s)**	**Name of learner(s)**
Indicate the name(s) of learner(s) identified as having learning difficulties/not achieving or use the class list.	1.	5.
	2.	6.
	3.	7.
	4.	8.

It will be necessary to talk learners through concepts and ideas. Ask relevant questions to help them understand and interpret this information. Teach the specific meaning of all terms and talk learners through the concepts and ideas. Be aware of the different meanings a specific word may have (e.g., the word 'stage' can mean a period of time, a platform, a performance, a robbery)	Actively participate with questions, where possible practical examples, etc	
How are you going to include and differentiate Expanded opportunities for learners?		
Teacher Activities	Learner Activities:	**Resources**
Allocate learner more responsibility: actions / activities / leadership roles, etc Appoint learner as a mentor to another learner	Apply him / her to roles as appointed by the educator. Applies the Buddy System	

TEACHER REFLECTION:

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Teachers Signature : ___________________________ Date: _______________

Pre -Moderated by line manager e.g. HOD/Deputy Principal (attach a moderation tool?): Signature: _________________ Date: __________

Post moderation by HOD:

Formal Assessment Feedback								
Assessment Results Analysis	**Level of achievement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Indicate number of learners per level achieved							

LESSON PLAN: Technology Grade__8___

Name of School:	XXX	Term: 4		Week: 1
Name of Teacher(s):	Mr Banda		Date	18 - 22 October 2019
Focus	Electrical Systems and Control , Investigation & Design Skills			

CLASSROOM ACTIVITIES (generic planning):

Periods	1	2	3	4
Content, concepts and skills	• **Revise:** simple circuit components; input devices (electrochemical cell; generator; solar panel), output devices (resistor; lamp; heater; buzzer; motor); control device (switches). Note: Some devices can serve as input, output, process or control device. • Correct connections, short circuits. Electrical components and their accepted symbols. Emphasis on series connections of cells, switches and bulbs with the aim of explaining the AND gate.	• Drawing electrical circuits using accepted symbols (as in Grade 12 see Addendum C). • Set up circuits using a range of components. Draw the circuits using symbols. Emphasis on parallel connections of cells, switches and bulbs with the aim of explaining the OR gate.	• **Practical**: learners draw circuit diagrams AND connect circuits showing the effect of circuits with resistors connected in series and parallel. .	• **Investigation**: introduce Ohm's Law (*qualitatively – no calculations*). Learners use one cell, then two cells, and then three cells connected in series and note the effect on the brightness of a lamp. They must conclude that more cells in series(*more voltage*) will cause the *current strength* to increase, if the *resistance* does not change
Teacher's Activities	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources	1 Facilitates 2. Guides 3. Assists 4. Demonstrate 5. Provides resources
Learners' Activities	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement	1. Participates 2. Complete tasks 3. Make notes 4. Active involvement
Type of Assessment	Formal / Informal	Formal / Informal	Formal / Informal	Formal / Informal
Resources	DBE Workbook 2 Gr. 8, YouTube videos	DBE Workbook 2 Gr. 8	DBE Workbook 2 Gr. 8	DBE Workbook 2 Gr. 8
	CAPS	CAPS	CAPS	CAPS
	Examples / Samples	Examples / Samples	Examples / Samples	Examples / Samples

IDENTIFIED LEARNERS' NEEDING SUPPORT:	**Name of learner(s)**	**Name of learner(s)**
Indicate the name(s) of learner(s) identified as having learning difficulties/not achieving or use the class list.	1.	5.
	2.	6.
	3.	7.
	4.	8.

CLASSROOM ACTIVITIES		
How are you going to include and differentiate Support for learners?		
Teacher Activities	Learner Activities:	**Resources**
It will be necessary to talk learners through concepts and ideas. Ask relevant questions to help them understand and interpret this information. Teach the specific meaning of all terms and talk learners through the concepts and ideas. Be aware of the different meanings a specific word may have (e.g., the word 'stage' can mean a period of time, a platform, a performance, a robbery)	Actively participate with questions, where possible practical examples, etc	
How are you going to include and differentiate Expanded opportunities for learners?		
Teacher Activities	Learner Activities:	**Resources**
Allocate learner more responsibility: actions / activities / leadership roles, etc Appoint learner as a mentor to another learner	Apply him / her to roles as appointed by the educator. Applies the Buddy System	

TEACHER REFLECTION:

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Teachers Signature : ___________________________ Date: _______________

Pre -Moderated by line manager e.g. HOD/Deputy Principal (attach a moderation tool?): Signature: _________________ Date: ___________

Post moderation by HOD:

Formal Assessment Feedback								
Assessment Results Analysis	**Level of achievement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Indicate number of learners per level achieved							