DESIGNING AND IMPLEMENTING A STRATEGY FOR BLENDED TEACHING AND LEARNING FOR PHYSICAL SCIENCE TEACHERS IN RURAL SCHOOLS

by

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12 JUNE 2023

DECLARATION

I, ***TEBOGO EDWIN NKANYANI***, hereby declare that the thesis: **DESIGNING AND IMPLEMENTING A STRATEGY FOR BLENDED TEACHING AND LEARNING FOR PHYSICAL SCIENCES TEACHERS IN RURAL SCHOOLS**, which I hereby submit for the degree of **DOCTOR OF PHILOSOPHY** at the University of South Africa, is my own work and has not previously been submitted by me for a degree at this or any other institution.

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TEBOGO EDWIN NKANYANI	12 June 2023 **DATE**

ABSTRACT

This study aimed to design and implement a Rural Blended Learning Strategy (RBLS) to assist Physical Sciences teachers with blended teaching and learning in rural schools. The study was navigated by the research question: What is the nature and impact of the designed strategy on blended learning of Physical Sciences teachers in rural schools? Literature was reviewed on available opportunities, challenges, and existing strategies from different contexts. Theories such as social constructivism, and community of inquiry were visited. The Analyse, Develop, Design, Implement, and Evaluation (ADDIE) model was key in developing the Rural Blended Learning Strategy (RBLS). A qualitative case study design was employed, relying on observation field notes and interview guides as data collection instruments and the conceptual framework, Detailed Analysis System, and literature as analysis methods. The purposeful sampling strategy was employed by selecting participants with the required features that the study targets. The findings revealed that network signals, lack of devices, poor institutional support, poor technology skills, workload, and teacher-centred methods acted as barriers for the implementation of the RBLS. However, the availability of devices and computer lab, exposure to the Learning Management Systems (LMSs), Social Media (SM), and Videoconferencing (VC) platforms by some teachers and learners presented a good opportunity for the implementation of the strategy. Even though some teachers tried to implement the RBLS, none did it with distinctions. It is recommended that the Department of Basic Education (DBE) provide schools with sufficient classes and computer laboratories with devices, employ more Educator Assistants (EAs) with sufficient Information and Communications Technology (ICT) skills, train teachers and all stakeholders on blended learning and its implementation, empower Senior Education Specialists (SESs) on the use LMSs, SM and VC platforms in teaching Physical Sciences and engage network service providers on the provision of zero-rated LMSs and VC platforms. The university should organise community engagement and in-service learning on the RBLS. It also recommended that the School Governing Bodies (SGBs) invest in back-up electricity, include in their policies the implementation of the RBLS, and strengthen their institutional support to both learners and teachers.

KEY TERMS: ***Blended learning, Network Connectivity and Devices, Fourth Industrial Revolution, Rural Physical Sciences classroom, Learning Management Systems, Social media-based learning, Videoconferencing, Technophobic, Flipped Classroom, Self-Directed Learning***

XIANAKANYIWA

Dyondzo leyi a yi kongomisiwile eka ku dizayina na ku tirhisa Qhinga ra Dyondzo yo Hlanganisiwa ya le Matikoxikaya (RBLS) leswaku ku ta pfuna vadyondzisi va Sayense ya Miri eka ku dyondzisa na ku dyondza loku pfanganisiweke, eswikolweni swa le makaya. Dyondzo leyi yi fambisiwa hi xivutiso xa ndzavisiso lexi nge: Hi wihi muxaka na vuyelo bya maqhinga lama endliweke eka dyondzo leyi pfanganisiweke ya vadyondzisi va Sayense ya Miri eswikolweni swa le makaya? Matsalwa ya kamberiwile eka minkarhi leyi nga kona, mintlhontlho, tindlela leti nga kona ku suka eka swiyimo swo hambana. Tithiyori to fana na social constructivism, community of inquiry ti endzeriwe. Modele wa Nxopaxopo, Hluvukisa, Dizayina, Tirhisa, na Ku Kambisisa (ADDIE) a wu ri wa nkoka eka nhluvukiso wa Qhinga ra Dyondzo yo Hlanganisiwa ya le Matikoxikaya (RBLS). Dizayini ya dyondzo ya xiyimo xa xiyimo yi tirhisiwile, ku titshege hi tinotsi ta nsimu ya ku langutisisa na swiletelo swa mimbulavurisano tanihi switirhisiwa swo hlengeleta datha, na rimba ra miehleketo, Sisiteme ya Nxopaxopo wa Vuxokoxoko na matsalwa tanihi tindlela ta nxopaxopo. Qhinga ra ku tekela swikombiso leri nga na xikongomelo ri tirhisiwile hi ku hlawula vatekaxiave lava nga na swihlawulekisi leswi lavekaka leswi dyondzo yi swi kongomisaka. Swikumiwa swa the swi paluxa leswaku swikombiso swa netiweke, ku pfumaleka ka switirhisiwa, nseketelo wo biha wa nhlangano, vuswikoti bya thekinoloji byo biha, ntirho, tindlela leti kongomisiweke eka vadyondzisi swi tirhile tanihi swihinga eka ku tirhisiwa ka RBLS. Hambiswiritano, ku kumeka ka switirhisiwa na lebu ya khompyuta, ku hlangana na tipulatifomo ta Tisisiteme ta Vulawuri bya Dyondzo (LMS), Vuhangalasi bya Mahungu bya Vanhu (SM), na Vhidiyokhonferense (VC) hi vadyondzisi van'wana na vadyondzi swi nyikile nkarhi lowunene wa ku tirhisiwa ka maqhinga. Hambi leswi vadyondzisi van'wana va ringeteke ku tirhisa RBLS, a nga kona loyi a swi endleke hi ku hambana. Swibumabumelo swa endliwa.

MILAWU YA NKOKA*: Dyondzo leyi pfanganisiweke, Vuhlanganisi bya Netiweke na Switirhisiwa, Nkutsulo wa Vumune wa Tiindasitiri, Tlilasi ya Sayense ya Miri ya le Matikoxikaya, Tisisiteme ta Vulawuri bya Dyondzo, Dyondzo leyi simekiweke eka swihangalasamahungu swa le ka social media, Vhidiyokhonferense, Thekinoloji, Tlilasi leyi hundzulukileyo, Dyondzo yo Tikongomisiwa*

NAGANWAGO

Thuto ye e be e ikemišeditše go hlama le go phethagatša Leano la Thuto ye e Hlakantšwego ya Dinagamagaeng (RBLS) ka nepo ya go thuša barutiši ba Mahlale a Mmele ka ga go ruta le go ithuta mo go hlakantšwego, dikolong tša dinagamagaeng.
Thuto e ile ya sepetšwa ke potšišo ya nyakišišo ye: Ke mohuta le khuetšo efe ya leano leo le hlamilwego go thuto ye e hlakantšwego ya barutiši ba Mahlale a Mmele dikolong tša dinagamagaeng? Dingwalo di ile tša lekolwa gape ka ga dibaka tše di lego gona, ditlhohlo, maano ao a lego gona go tšwa maemong a go fapana. Diteori tša go swana le social constructivism, setšhaba sa nyakišišo di ile tša etelwa. Mohlala wa Sekaseka, Hlabolla, Rala, Phethagatša, le Tekolo (ADDIE) e bile senotlelo sa tlhabollo ya Leano la Thuto ye e Hlakantšwego ya Dinagamagaeng (RBLS). Moralo wa thuto ya mohlala wa boleng o ile wa thwala, go ithekgile ka dintlha tša tšhemo ya go lebelela le ditlhahlo tša poledišano bjalo ka didirišwa tša kgoboketšo ya datha, le tlhako ya kgopolo, Tshepedišo ya Tshekatsheko ye e Dintši le dingwalo bjalo ka mekgwa ya tshekatsheko. Leano la go tšea mehlala leo le nago le morero le šomišitšwe ka go kgetha batšwasehlabelo bao ba nago le diponagalo tše di nyakegago tšeo nyakišišo e di nepišitšego. Dikutollo tša go utolla gore matshwao a netweke, go hloka didirišwa, thekgo ye mpe ya setheo, mabokgoni a theknolotši a mabe, mošomo, mekgwa ye e lebanego le barutiši e šomile bjalo ka mapheko a phethagatšo ya RBLS. Le ge go le bjalo, go hwetšagala ga didirišwa le laboratori ya khomphutha, go pepentšhwa ga Ditshepedišo tša Taolo ya Thuto (LMS), Methopo ya Leago (SM), le diforamo tša Videoconferencing (VC) ke barutiši ba bangwe le baithuti go tšweleditše sebaka se sebotse sa phethagatšo ya leano. Le ge barutiši ba bangwe ba ile ba leka go phethagatša RBLS, ga go le o tee yo a e dirilego ka dipharologantšho. Ditšhišinyo di a dirwa.

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  I HAVE LED THE RACE; YOURS IS TO FINISH IT!

- And my late father: **Hosi I.K Nkanyani.**

  YOU HAVE ALWAYS WANTED ME TO BE THE DR. I GUESS YOU ARE SMILING IN HEAVEN!

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LIST OF ACRONYMS

4IR	Fourth Industrial Revolution
ADDIE	Analysis, Design, Development, Implementation, and Evaluation
BBTs	Born-before-technologists
BSTL	Blended Synchronous Teaching and Learning
C1CL	Case 1 community leader
C1L	Case 1 learners
C1L1	Case 1 first learner
C1L2	Case 1 second learner
C1Ls	Case 1 leaners
C1P	Case 1 principal
C1S	Case 1 school governing body representative
C1T	Case 1 teacher
C2CL	Case 2 community leader
C2L	Case 2 learner
C2L1	Case 2 first learner
C2L2	Case 2 second learner
C2Ls	Case 2 learners
C2P	Case 2 Principal
C2S	Case 2 SGB representative
C2T	Case 2 teacher
C3CL	Case 3 community leader
C3L	Case 3 Physical Sciences learners
C3L1	Case 3 first leaner
C3L2	Case 3 second learner
C3Ls	Case 3 learners
C3P	Case 3 principal
C3S	Case 3 SGB representative
C3T	Case 3 Physical Sciences teacher
CAPS	Curriculum and Policy Statement

CBSP	Computer-Based Simulation instructional Package
CLC1	Case 1 community leader
CLC2	Community leader for case 2
CLC3	Case 3 community leader
DAS	Detailed Analysis system
DBE	Department of Basic Education
DoE	Department of Education
EA	Educator Assistant
EPSS	Electronic Performance Support System
FET	Further Education and Training
GC	Google Classroom
GET	General Education and Training
HOD	Head of Department
ICT	Information and communications Technology
IPO	Input-process-output
IT	Information Technology
IVC	Interactive Video-Conferencing
JSDT	Japanese Society for Dialysis Therapy
LCMS	Learning Content Management System
LDoE	Limpopo Department of Education
LMS	Learning Management System
LTE	Long-Term Evolution
MSP1	Mobile network service provider 1
MST	Mathematics, Science, and Technology
NWU	North-West University
PCs	Personal Computers
PGCE	Postgraduate Certificate in Education
PhET	Physics Education Technology
RBLS	Rural Blended Learning Strategy
SA	South Africa

SA-SAMS	South African School Administration Management System
SABC	South African Broadcasting Cooperation
SDL	Self-directed learning
SES	Sciences Senior Education Specialist
SGB	School Governing Body
SM	Social Media
SM-based	Social Media-based
SMT	School Management Team
TV-based	Television-based
UKZN	University of Kwa-Zulu Natal
UNESCO	United Nations Educational, Scientific and Cultural Organization
VC	Video Conferencing
Wi-Fi	Wireless Fidelity
WSPR	Wi-Fi network service provider representative

CHAPTER 1: STUDY OVERVIEW

"Curiosity is the wick in the candle of learning." – William Arthur Ward.

1.1. INTRODUCTION AND BACKGROUND

The reform of our education system required teachers to transform their teaching from a traditional teacher-centered strategy, which proved to be ineffective, to more learner-centered approaches (Department of Basic Education [DBE], 2011). The latter allows learners to be in the driving seat of their learning, consequently becoming "life-long learners" relevant for today's ever-transforming universe (Horn & Staker, 2014, p. 10). Moreover, learner-centered methods improve learners' communication and collaborative skills, Self-Directed Learning (SDL), and interactions (du Plessis, 2020). Further, with the emergence of the Fourth Industrial Revolution (4IR), teachers are expected to keep pace with current developments. Moreover, the same is expected from learners, principals, parents, and other role players to meet such initiatives halfway. It then raised a question: how well-equipped are all these role players for such emerging developments?

There are several strategies teachers employ in facilitating lessons in a technological manner, which include, amongst others, simulations, modeling, CDROMs, teacher publishing, word processing, spreadsheets, data logging, databases, email, smart boards, interactive whiteboards, and internet browsing (United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2010). Moreover, with the dominance of social media within the learners' networking environment, a WhatsApp lesson might be added to the list. However, one approach, among others, that supports learner-centeredness in teaching and learning in a technological sphere is a blended learning approach (Horn & Staker, 2014). It amalgamates the teacher's face-to-face lesson and an online approach (Thorne, 2003).

Furthermore, just like in regular teaching and learning, blended learning is offered through several strategies, which include, among others, station rotation blended learning, lab rotation blended learning, remote blended learning, flex blended learning, the 'flipped classroom' blended learning, individual rotation blended learning, project-based blended learning, self-directed blended learning, inside-out blended learning, and outside-in blended learning (Teachthought, 2019). Furthermore, Farah (2019) indicates how implementing blended learning eliminates the adverse outcomes shown by learners during and after traditional teaching lessons. Likewise, it is crucial to approach blended learning with learner-centeredness in mind (Cunningham, 2021). Moreover, one of his colleagues indicated how video-based blended learning allowed her to effectively issue instructions to her learners while allowing her to self-reflect (Farah, 2019).

1.2. STATEMENT OF THE PROBLEM

The COVID-19 pandemic has exposed, among other things, the necessity of skills teachers should possess in utilizing technological resources that would allow them to provide learning in a blended manner. Specialized techniques, when employed effectively in class, would, according to Savvidis (2019), enhance engagement and cooperation among learners, allow them to acquire knowledge, foster SDL, allow learners room to develop essential skills and innovations, and lastly, benefit teachers.

Moreover, with technology at everyone's fingertips, learning can occur anywhere, at any moment, and at one's own differentiated pace (White, 2019). Nonetheless, it appears that teachers struggle to come to terms with Information and Communications Technology (ICT) and logistics (Chandra & Lloyd, 2008). That is also amplified by Gomba (2019), who reports a gap in teachers' comfort with technology in that they are referred to as technophobic. Moreover, an educational specialist, Prof. Feza, adds by indicating challenges in implementing technology in education, especially in schools in rural areas (Kekana, 2019), a target for this study. Furthermore, some teachers label themselves as 'born-before-technologists' (BBTs)

and emphasize that as an excuse for not engaging in technological teaching methods but instead sticking to their traditional teacher-centered methods.
Studies by Cope and Ward (2002) indicate that despite teachers' experience if they are not trained in technology, they will not be interested in implementing it in class. This was amplified by Rijal (2023), who indicated that teachers, especially those in service for a long time, show poor knowledge of technology. Further, they do not see their reluctance as an inhibitor to preparing learners for the cooperative world, which is fully advanced in innovation. With the ever-changing world, one needs to keep abreast of technology, especially those who have our children's destinies in their hands.

Moreover, although the Curriculum Assessment Policy Statement (CAPS) document is silent on technology use in teaching and learning, it requires the teacher to improvise (DBE, 2011). Teachers need to be at the center of innovations in teaching and learning. A study by Mundy et al. (2012) demonstrated how incorporating technology in the classroom positively influences learning, engagement in class, and its outcomes. However, it remains a concern that even after the release of the White Paper on e-Education in 2003, South African teachers still struggle to integrate technology into class (Ramorola, 2013). Further, Jerry and Yunus (2021) also indicated how rural areas' conditions pushed teachers to avoid incorporating technology into their teaching.

This view is amplified by the United States Department of Education (2010) in Kastner (2020), which finds that learners exposed to an online learning system outperform those taught through traditional teaching classes. Creativity and bringing learners' interest into learning are crucial, which some teachers seem to lack. Now, the question is, "How do teachers perceive their challenges in technology? What solutions do they bring to address their challenges in implementing technological methods? The fact is that teachers in our country (South Africa) have been implementing the face-to-face aspect of teaching for decades now. It is the technology aspect of blended learning that has been lagging.

Further, blended learning is successful when both the face-to-face platform and the online context are successfully amalgamated (Jeffrey et al., 2014). Studies on blended learning in the higher education sector were conducted, but fewer were done pertaining to the basic education setting (Yapici & Akbayin, 2012; Haupt et al., 2010; Padayachee, 2010). This study designed and implemented a strategy for blended teaching and learning of Physical Sciences teachers in rural schools, which is named the Rural Blended Learning Strategy (RBLS).

1.2.1. Research question:

This study was guided by the research questions stated below:

1.2.1.1. Main research question

What was the nature and impact of the designed Rural Blended Learning Strategy (RBLS) on the teaching and learning of Physical Sciences in rural schools?

1.2.1.2. Sub-questions:

i. What were the challenges of Physical Sciences teachers regarding blended teaching and learning in rural schools?

ii. ii. What were the opportunities for Physical Sciences teachers regarding blended teaching and learning in rural schools?

iii. How did the designed RBLS shaped the teaching and learning of Physical Sciences in rural schools?

1.3. RATIONALE

This study had the potential to achieve the following:

- Informing all role players (teachers, learners, school governing bodies, school principals, the departments of education, and portfolio committees in parliament) of the existing challenges in facilitating blended learning in rural schools.
- Making all role players aware of opportunities that exist to facilitate blended learning in rural schools.
- Exposing the strengths and weaknesses of existing strategies that are there to help Physical Sciences teachers facilitate blended learning in rural schools; and
- Designing and implementing the RBLS to mitigate challenges and weaknesses that exist in Physical Sciences teachers in rural schools.

1.4. AIM AND OBJECTIVES

This study intended to achieve the following aim and objectives:

Aim: To design and implement the RBLS which was intended to assist Physical Sciences teachers with blended teaching and learning in rural schools.

Objectives: The study intended to achieve the following objectives:

i. To explore challenges that Physical Sciences teachers had on blended teaching and learning in rural schools.
ii. To explore opportunities that Physical Sciences teachers had in blended teaching and learning in rural schools.
iii. To understand how RBLS shaped the teaching and learning of Physical Sciences in rural schools.

1.5. DELIMITATIONS AND LIMITATIONS

This study was confined only to Sekgosese, the Sekgosese East II circuit, under the Mopani East district of Limpopo, South Africa. It, therefore, cannot be generalized to a more significant population. As mentioned earlier, the intention was to design and implement the RBLS for Physical Sciences in rural schools, which are schools in the circuit.

1.6. STUDY OUTLINE

Chapter 1: Study Overview

This chapter provided the background, problem statement, research questions, rationale, aims and objectives, delimitations, and limitations.

Chapter 2: Existing Research in Blended Learning

The focus of this chapter was to have a holistic review of blended learning, from the history of blended learning to the types of models and the current status quo concerning the progress made by the Department of Basic Education.

Chapter 3: Setting the Road Map

This chapter focused on outlining the theoretical framework and the conceptual framework.

Chapter 4: Entering the Site

In this chapter, I outlined the research design, approach, paradigm, sampling strategy, data analysis, rigour and ethical considerations.

Chapter 5: Challenges and Opportunities of Blended Learning in Rural Schools This chapter presented and discussed the data that was collected during phase one. The findings that were made were key to the designed RBLS.

Chapter 6: The Rural Blended Learning Strategy (RBLS) This chapter presented how the RBLS was designed.

Chapter 7: The Implementation of the Rural Blended Learning Strategy (RBLS) This chapter presented and discussed the implementation of the RBLS in the three schools. Findings were made on how the RBLS shaped the teaching of Physical Sciences in rural schools.

Chapter 8: The Finish Line

The answers to the three research questions, the contributions of the study, its limitations, and its recommendations were presented in this chapter.

1.7. CONCLUSION

This chapter shed light on the background of the study. This was done by introducing and stating the problem, giving rationale, and stating research questions, aims, and objectives. It also covered the delimitations and limitations. The next chapter reviews the literature on challenges, opportunities, benefits, types of blended learning, and the progress made by the Department of Basic Education in ICT.

CHAPTER 2: EXISTING RESEARCH IN BLENDED LEARNING

"If you want to understand today, you have to search yesterday." - Pearl Buck.

2.1. INTRODUCTION

The previous chapter outlined the study overview. This was accomplished by introducing and stating the problem, providing justification, and communicating research questions, aim and objectives. This chapter reviewed literature on blended learning's challenges, opportunities, benefits, variety of models and the ICT advancements made by the Department of Basic Education.

2.2. THE HISTORY OF BLENDED LEARNING IN INSTITUTIONS OF LEARNING

Kidd (2010) contends that 'e-learning' in the context of higher education institutions should be viewed from a software-based and online learning perspective. According to Pappas (2015), distance learning was initiated in 1840 by Sir Isaac Pitman, who used "shorthand texts" to instruct learners via "postcards" that they would return for marking and feedback. In the past, integrated learning consisted of a combination of traditional classrooms, laboratories, books, and pamphlets (Singh, 2003).

Further, in the decade between 1960 and 1970, the introduction of computer-based training became imminent, with many employees becoming capable of accessing training materials in soft copies (Pappas, 2015). During the 1970s, learners were trained using video-based platforms. Later-on, institutions such as Stanford University and Open University started to blend distance education, face-to-face learning and one-on-one tutorials together (Nicholson, 2019). In addition, they tested utilizing TV-based virtual graduations (Nicholson, 2019) (see Fig. 2.1 for more on the timelines).

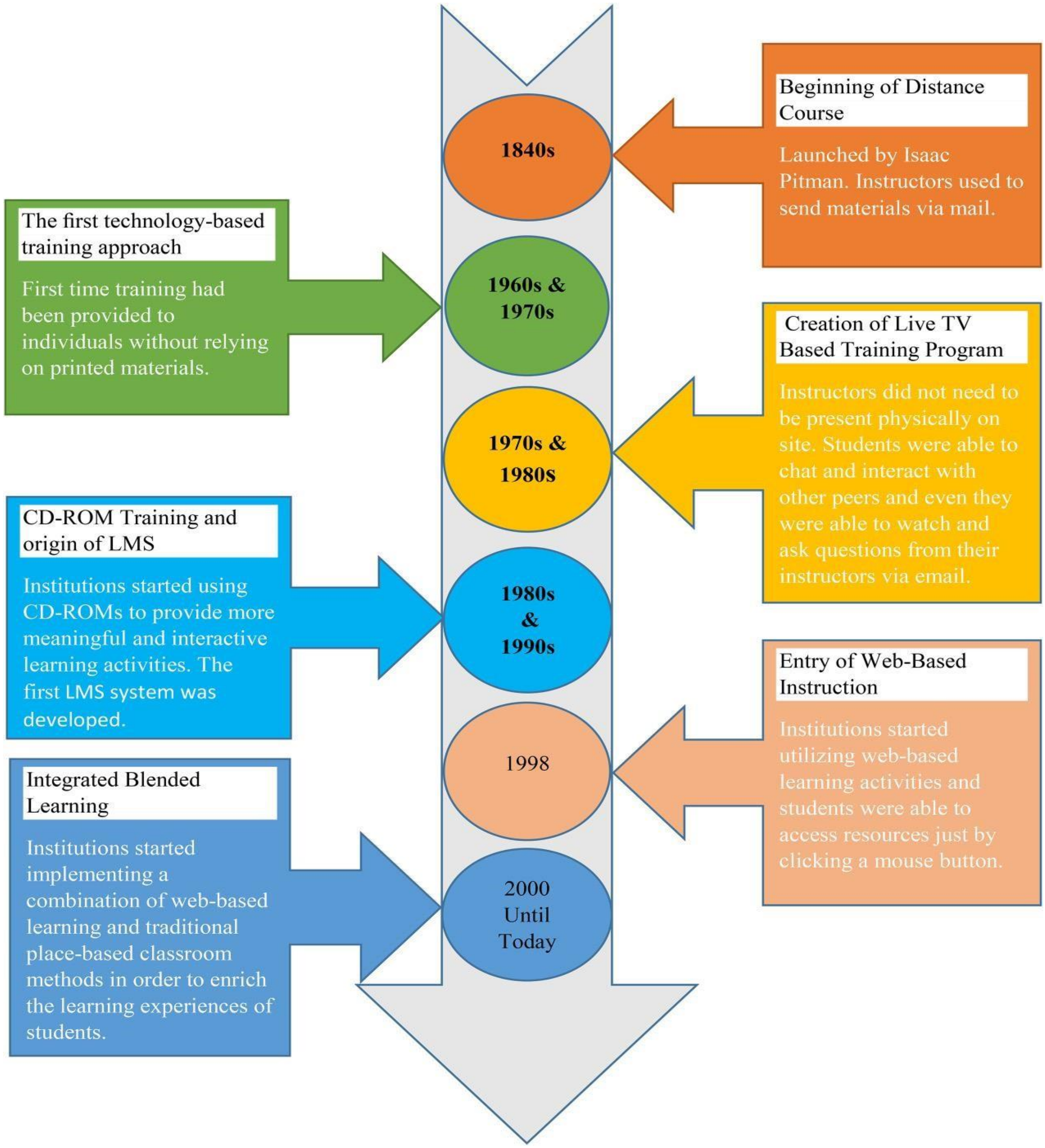


Figure 2. 1 Blended learning evolution timelines (adapted from Singh et al., 2021)

However, it was untraceable when blended learning was started in South African schools.

2.3. WHY BLENDED LEARNING?

There has been much "criticism" for online enrollments due to their inability to allow "socialization" and lack of positive influence on the gains of "traditional teaching" methods (Sheerah, 2020, p. 194). This has consequently led to the introduction a blended learning platform that combines traditional and technologically assisted facilitation (Akkoyunlu & Soylu, 2008). Further, blended learning provides teachers with various options due to its diversity and the nature of integrating different instructional platforms (Singh, 2003). For example, you can use it to simulate experiments, assess learners, teach learners, and create dialogues. Furthermore, having plenty at teachers' disposal can lead to a class characterized by plenty of alternatives, social feelings and interactions, appropriateness and suitability, and "context" that can advance progressive teaching and achievement (Singh, 2003, p. 51).

Likewise, blended learning allows learners to be the architects and utilizers of their knowledge and not just passive spectators in their learning (Sheerah, 2020). It is evident that blended learning is perceived as an opportunity to convert or translate knowledge, producing effective learning (Kastner, 2020). Thus, one would achieve learning outcomes and aims without worrying about the high costs of learning as much (Singh & Reed, 2001). Moreover, Singh (2003) indicates that mixing different teaching methods can neutralize the cost incurred during the institution and implementation of learning programs. In their study, Li et al. (2020) report that learners highly recommend blended learning based on their preferences, the depth of technology employed, and the gains thereof.

The e-learning platform gives open, inclusive, and equitable access, which is the expectation of the South African (SA) post-Apartheid policy (Bagarukayo & Kalema, 2015), assisting in rooting out the issue of inequality in education provision. Further, due to the availability of plenty of methods at the disposal, blended learning increases the audience by reaching out to those who cannot attend (Singh, 2003).

Moreover, educational technology may allow teachers to explore a range of eventualities relevant to their teaching preferences (Jaffer et al., 2007). Which is why they would allow for the employment of a series of assessment techniques that were never employed by the teacher before (Jaffer et al., 2007).

Studies do indicate a positive effect of blended learning on achievement for instance, Yapici and Akbayin (2012) explored the impact of the blended learning model on high school biology learners` achievement and their attitudes toward the internet. The study indicated a positive impact of blended learning compared to traditional teaching approaches. This is because learners` attitudes toward online connections "developed statistically significantly" (Yapici & Akbayin 2012, p. 235). As we live in an era where learners from a young age are exposed to devices and gadgets, which can act as an advantage to implementing blended learning.

2.3.1. Blended learning vs. online-only learning vs. face-to-face learning platform

Changchit and Klaus (2010) report a higher preference for online learning platforms over traditional face-to-face classes due to their learner-centeredness, allowing learners to construct and reconstruct knowledge effectively. Nevertheless, Lim et al. (2007) indicated that learners offered to learn in an online-only platform experience minimal support compared to those taught through the blended learning platform. Consequently, learning through the online platform created more work and strain on learners` learning than during the blended learning platform (Lim et al., 2007). Hence, this was the rationale for choosing a blended learning platform that diversifies learning.

2.4. SYNCHRONIZED AND ASYNCHRONOUS MODES OF BLENDED LEARNING

2.4.1. Synchronized blended learning

A synchronized mode of learning is present when both traditional face-to-face teaching takes place at the same time with online sessions or having one class catered to both traditional face-to-face and online participants (Li, 2020). This is done with the aid of sophisticated "synchronous technological" platforms such as "videoconferencing, web conferencing or virtual" platforms (Bower et al., p.1, 2015). Hence, this mode of learning is more "beneficial due to its flexibility" (Zydney et al., 2020, p. 1).

Taking advantage of these benefits can assist the Department of Basic Education to reach out to a more significant population during lesson facilitation. The teacher may teach, for example, the full-time matric learners during face-to-face and the repeaters/ part-timers through the online platform simultaneously. All that can occur without requiring more furnishers since only face-to-face learners will be present (White et al., 2010), hence a cost-effective approach. Additionally, this approach could be effective in pandemics like Coronavirus Disease 2019 (COVID-19), where learners attended in phases, and social distancing was considered in terms of class population.

Moreover, it can cater for engagement between teachers and learners (both faceto-face and online) and between learners themselves (face-to-face and online) (White et al., 2010). Consequently, it provides an arena for "social interactions" (Bower et al., 2015, p.2). However, Szeto (2014) indicated that this mode of learning can sometimes be time-consuming as a teacher might have to spend much time clarifying or even repeating what they said to the online class group due to technical glitches. Thus, Li et al. (2020) proposed the implementation of the Blended Synchronous Teaching and Learning (BSTL) framework in Figure 2.2 to provide "flexible learning opportunities" that assist learners in cases of unanticipated pandemics like COVID-19.

2.4.2. Asynchronous blended learning

Asynchronous blended learning is the mode that is still employed by several institutions (Li et al., 2020). Palloff and Pratt (2011) contended that in participatory learning environments, learners can achieve significant and efficient learning. Moreover, asynchronous online participatory learning takes form in a variety of activities which consequently allow learners to critically reflect and evaluate their regular learning while at the same time acclimatizing to the new learning experience (Palloff & Pratt, 2011).

Due to its flexibility in terms of time, asynchronous blended learning allows teachers to post announcements or assignments in their own time while also allowing learners to respond to other learners at their own convenient time (Hew et al., 2010). This approach can enable learners to gel through their learning irrespective of their pace, while they also develop their critical thinking skills and problem-solving skills in the process (Hew & Knapczyk, 2007).

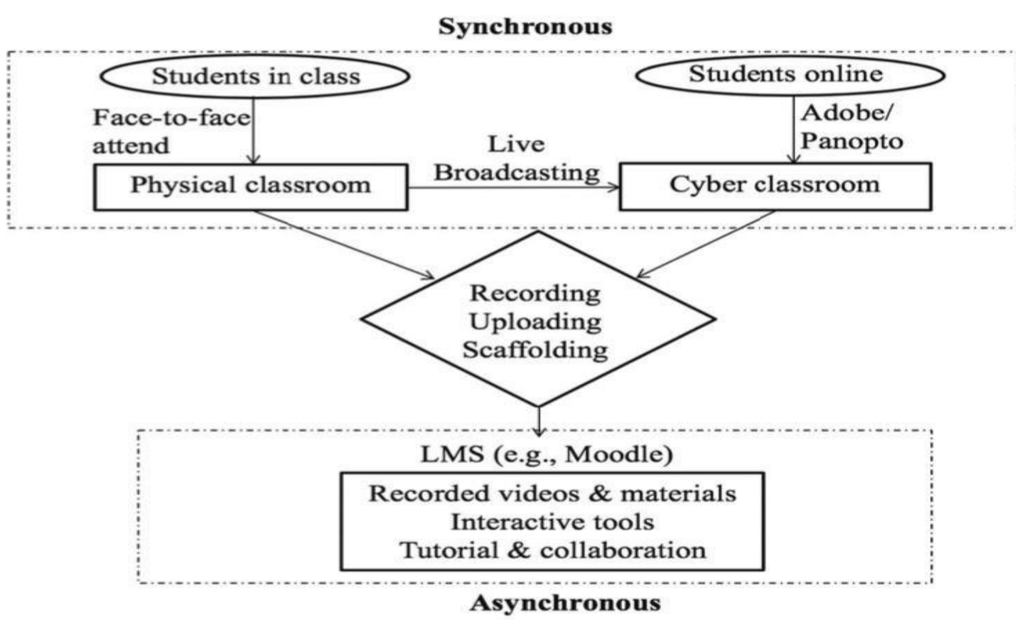


Figure 2. 2 The Blended Synchronous Teaching and Learning (BSTL) framework (adapted from Li et al., 2020)

2.5. TYPES OF BLENDED LEARNING DELIVERY METHODS

Blended learning is diverse and is offered in plenty of modes of delivery. This diversity is relevant for learners as they learn differently and have a variety of preferences (Singh, 2003). This section examined different blended learning modes such as: station rotation blended learning, lab-rotation blended learning, flipped classroom methods blended learning, and individual rotation model, their nature, and their effect.

2.5.1. Station rotation blended learning

This model allows learners to rotate during learning between different learning contexts or groups. For example, the class might be divided into groups where learners learn through online platforms, micro-group discussions, individual assignments which exposes them to all groups (Staker & Horn, 2012).

2.5.2. Lab-rotation blended learning

The lab-rotation model is a blended learning method, wherein learners can switch locations moving from one class where they do a particular activity and continue to the next activity stage in another learning setting like a laboratory or a computer laboratory (Staker & Horn, 2012). For example, learners can learn about acid and base indicators in class and move to the laboratory to continue with the practical part of testing different substances with their hands or move from doing practical’s and rotating to researching types of acids and bases online in the computer lab.

2.5.3. Flipped classroom methods

This is the type of blended learning method in which classroom exercises in a regular face-to-face classroom are carried over home as homework. In contrast, home exercises are converted into classroom exercises (Boubih et al., 2020). This method follows two parts: giving instructions through the online platform and more engaged learning in the classroom (Maher et al., 2015). Further, the two parts mentioned above give way to four approaches termed "the instructional design strategies"; how the learners` "preparatory" work is designed; how the "instructional content" is given post-classroom; how to develop active learning tasks to apply for scaffolding in class, recognize misconceptions, and provide room for learners to use "critical skills"; and how to facilitate learners` engagement to support "social learning and peer instruction" (Maher et al., 2015, p. 218)

2.5.4. Individual rotation model

In this approach, each learner is given a predetermined schedule wherein they must switch between different learning platforms, whether online or face-to-face (Staker & Horn, 2012). In this context, other learning stations are available where some might be engaged.

2.6. CHALLENGES AND OPPORTUNITIES OF USING BLENDED LEARNING

2.6.1. Challenges in blended learning

A challenge is something that is hard to complete (Merriam-Webster dictionary, 2017). For instance, teachers face multiple class challenges, including poor "classroom management, curriculum planning and implementation, conducting the assessment, and workload issues" (Lew & Nelson, 2016, p. 7). Authors like Bagarukayo and Kalema (2015) indicated the hindrances of employing teaching strategies, specifically in bigger classes. Wherein they showed poor or lack of relevant resources, poor access to the resources, insufficient skills from facilitators, and inability to create content as the main challenges that teachers face (Bagarukayo & Kalema, 2015). However, there is evidence of challenges teachers face in implementing blended learning as it requires teachers to learn technological logistics, develop classroom activities, and re-design subject content (Kastner, 2020).

Napier et al. (2011, p.29) identified poor "management of in-class time"; an inability to create equilibrium between traditional teaching and e-learning; a failure to inspire learners; an inability to provide post-classroom support, and failure to "assess student fitness for the online environment." Likewise, the teachers need to identify and work within their capabilities; their competence with technology; ability to create an online classroom environment that is inclusive and user-friendly to learners; offer learners mentorship and e-learning assistance as well as post-class administration (Napier et al., 2011). Moreover, the 'one size fits all' techniques should not be taken into consideration at all, as their success cannot be fully "guaranteed" (Moskal et al., 2013, p.16).

Conversely, learners experience challenges using numerous technologies in both in and post-classroom time (Napier et al., 2011). More specifically, technologically illiterate learners may become confused and unable to navigate a digital workspace (Napier et al., 2011). Therefore, scrutiny should be placed on the primary education system's capacity to provide innovative programs that expose learners and teachers from rural areas into using ICTs.

2.6.2. Opportunities in blended learning

The Merriam-Webser dictionary (2017) defines opportunity as "an amount of time or a situation in which something can be done." Most universities allow novice lecturers to acquaint themselves with the institutional operations through the induction program, such as North-West University (NWU), the University of Pretoria (UP), and the University of Johannesburg (UJ). Furthermore, due to the employee's introduction to the new environment, they need to be conversant with the institution's traditions, institutional policies, and visions (The Chartered Institute of Personnel and Development [CIPD], 2022). Moreover, novice lecturers become informed about various teaching and learning platforms (University of Kwa-Zulu Natal [UKZN], 2020). However, it is unclear how the Department of Basic Education supported teachers regarding online and blended learning platforms.

Further to that, "virtual" countries create "welcoming opportunities" to provide online classroom sessions for learners and their lecturers despite their distance from each other in terms of location (Tynan et al., p. xxxi, 2013). This was evident during the COVID-19 pandemic, wherein most universities pushed to include everyone by creating opportunities and support for lecturers to reach out to their learners through Zoom sessions, WhatsApp video meetings, and other online platforms. Lecturers were able to reach out to disadvantaged students through the provision of paperbased materials via the post office and courier system and telephone and mailing systems, a move that has been taking place for years.

Furthermore, Albano and Ferrari (2008) claim that the e-learning platform affords the following opportunities: for teachers to create learning approaches and activities that best match each learner's learning style, provide learners with a platform for knowledge construction through their engagements, and supports interaction between learners and teachers and learners themselves. This is evident that blended learning can potentially uplift teachers' competency (Yan Ju & Yan Mei, 2018).

Even though the Department of Basic Education has done much to reach out to children during the COVID-19 pandemic, for example, through television education programs such as the Mindset, South African Broadcasting Cooperation (SABC) education, and others, it is not clear how teachers reached out to their learners during the pandemic, which this study sought to understand, specifically in the context of rural areas.

With everyone trying to catch up with the 4IR, the paradigm in primary education teaching needs to be adjusted. Demir and Aknipar (2018) indicate how the employment of mobile devices led to the high rate of learners' progression. Which is the reason why Moskal et al. (2013, p.16) suggested the following for a school to implement successful blended learning:

- "Institutional goals and objectives" – this can be viewed from schools, departments (as in the Department of Mathematics, Science, and Technology at the school level), and learners` perspectives. The school-based goals may concern the effective employment of resources in class. The departmental goals can include enhanced teaching and the incorporation of learner-centered routines. Learner-centered goals include improved "convenience and flexibility, increased and improved "access," improved learners` achievement, and more stabilized "information literacy."

- "Alignment" – goals for both the management (principals, departmental heads, and other School Management Team (SMT) members) and all teaching staff should be aligned.

- "Organizational capacity" – the organization, which in this case is the school, should create a "learning support organization" by following one of these procedures: development of a "new blended learning support" structure that is adequately "resourced," amplify available structures to accommodate a variety of depth and capacity expected or combine available configurations and increase workforce where necessary. The structure will be responsible for structuring and creating blended subjects, designing and provision of school "development," synthesis of "instructional media content," facilitating assessment, and partnering with other school department structures (if they exist) or counterparts from other schools to increase capacity and expertise. Further, this requires "resources, time and patience" and employment of an "instructional designer".

- "a vocabulary and definitions" – all "stakeholders" should be consulted (be it the parent bodies, church bodies, community organizations, and even traditional house committees in the case of school) to decide on the vocabulary—issues like the subject "modalities"- their names and definitions, to acquaint all involved.

- Faculty (school) "development and subject development support" – faculty (school) development creates an arena to acquaint staff members with crucial dynamics like "copyright, accessibility," better efficient "assessment methods," and other relevant issues. The subject development process aims to develop an "online learning environment" that relies on "design goals" created during school development. It also provides an arena to delve into the employment of various media to discharge subject objectives. More significantly, a staff member and instructional designer are tasked with approving the subject at an early developmental stage. Consequently, an efficient developmental process will yield less staff workload, a well-amended design, effective learners, real-life assessment, and more student achievements (Dziuban et al., 2011 in Moskal et al., 2013).

- "Support for online learners" – online learners and teachers may have online sessions at their preferred times, irrespective of location. However, they will need assistance on "password matters" issues. Support may come in the form of call support, voice notes, email support, "instant messaging," "tutorial videos,” "walk-in-centers," or even hiring agencies that can provide support.

- "Robust and reliable infrastructure" – the sophistication of subject "management software" and supportive network demands repeated considerations and reliable technicians. The issue of software version and data storage in school computers should also be considered. Another crucial matter to take into cognizance is the issue of funding. Whether instituting blended learning is worth investing in by trying to respond to questions such as: if this can improve classroom practices, it can utilize resources effectively, create beneficial and adjustable learners’ opportunities, and increase school enrolment.

2.6.1.1. Computer-based Simulations as an opportunity

Gambari et al. (2014) developed and tested the effect of the Computer-Based Simulation Instructional Package (CBSP) on achievement. The outcomes showed a positive impact of CBSP on learning. The authors further recommended using computer-based simulation in their teaching to aid learners` success (Gambari et al., 2014).

2.6.1.2. Use of smart classrooms as an opportunity

A smart classroom is a type of face-to-face classroom that bring into stage sophisticated aspects of educational technology (Lu et al., 2021). Further, smart classrooms as an "initiative of EduCompt," which dramatically "transforms" the nature at which teaching and learning take place through its "innovative and meaningful" application of technology (Jena, 2013, p2). Smart classrooms are thriving resources with technical operations that allow science teachers to play different stages of diagrams animations through diagram drawer, access the teaching idea before the start of the lesson or even apply mind maps to instil a better understanding of the content; and provide worksheets, and links for further study (Jena, 2013).

Li et al. (2015) summarized smart classrooms properties as follows: the smart classroom is a technology-abundant, blended online and face to face context with a potential of "context awareness", and having the adaptation ability similar to that of light and temperature; may yield learning contents, engagement support, and constructive teaching and learning devices that accommodate a variety of activities such as individualized learning, group/collaborative learning, inquiry learning, collaborative learning, mobile e-learning and most importantly, provide adjustable learning support to promote learner-centered approaches such as active and constructive learning exercises; smart classroom has a potential of storing, gathering, computing and critically analyzing learners' data in its complexity in order to take enhanced pedagogical decisions and choices; the smart classroom is an inclusive learning platform that provides learners with real-life learning environments to trigger learners' motivation, foster learners' innovation, and offer learners sophisticated learning.

Jena (2013) identified the following benefits of Smart Class:

- Enhances teacher's efficiency and positive influence on learning.
- Introduces conceptual and complex subject matter content in class.
- Increases excitement to learning for learners.
- Has a positive contribution to learners' achievements.
- Creates room for immediate formative assessment of learning objectives in class.
- It allows teachers to examine the learning attainment of learners.

2.6.1.3. Audio and Video Conferencing as an opportunity

Audio conferencing is a teleconferencing platform that allows attendees to hear one another in a live meeting (Audio Conference, 2006). The audio needs to be "encoded, transmitted, and decoded in real-time," with "special compression and transmission techniques" being employed (Audio Conference, 2006). There is another form of video conferencing, the Interactive Video-Conferencing (IVC), which is a very efficient tool for the facilitator and has the potential to introduce learners to new learning environments (Anastasiades et al., 2010)

Hampel and Hauck (2004) identified the following areas to be highly considered in audio conferencing:

- Communication with learners both at the start and in the process;
- Series of workshops created for both teachers and support staff;
- Early comprehensive developmental testing with enough opportunities for transformation;
- Well-arranged ICT support which includes training, connectivity, and development of an internet-based help platform;
- Development of web addresses and their use by learners;
- Sufficient personnel responsible for any pressing issues; and
- Continuous analysis of task design

Another form of teleconferencing is videoconference (Audio Conference, 2006). It is a platform that connects two geographic areas through the online platform, which allows participants to be able to view and listen to each other live (Hopper, 2014). This is because videoconferencing has the potential of not only fostering collaboration among learners (Hopper, 2014), but it has been positively accepted by learners during their online learning (Ulfah Safitri & Asrining Tyas, 2022). Moreover, Anastasiades et al. (2010) claim IVC to be an efficient platform for the facilitator to create room for learners to enter a different perspective of learning and culture. With videoconferencing, learners from other geographical locations can gain not only the physical presence of one another but also the social presence (Anastasiades, 2009).

2.6.1.4. Blogs as an opportunity

Blogs and personal journals saved on an internet page allow users to bring together written words, pictures, and web links to other sites (Wolf, 2010). Blog usage has been transformed from an essential e-learning journal/logbook to a communication platform that instils "collaboration, knowledge sharing, reflection, and debate" (Dos & Demir, 2013, p. 1335). Blogs Improve learners' cognitive ability and afford intensive learning and knowledge creation (Dos & Demir, 2013) while at the same time allowing users to leave comments for others to interact with (Dos & Demir, 2013). Significantly, blogs are part of Web 2.0 technologies that support teaching in a blended learning mode (Edington & Holbrook, 2010).

2.6.1.5. Podcasts as an opportunity

Mostyn et al. (2013) explored nursing learners' experience using biology podcasts in their study. The study found that a higher number of learners highly rated podcast usage and felt that the platform helped them control their learning and knowledge retention (Mostyn, 2013). This was amplified by Holbrook and Dupont (2011) who found a positive impact of podcasts on learning and further recommended this approach for administration by the instructor.

2.6.1.6. Social bookmarking as an opportunity

Social bookmarking is a platform that allows participants to save internet links to resources in a manner that accessibility is flexible and well-organized (Scerbakov et al., 2018). Learners in the process, share and use those links. The service can be used in two folds: firstly, learners can describe bookmarks, leave comments, and analyze and categorize bookmarks in "a hierarchy of folders" (Scerbakov et al., 2018). Its reliance on "collaborative classification" gives it an advantage over old methods of encoding links. (Scerbakov et al., 2018)

2.6.1.7. Wikis as an opportunity

Another member of web 2.0 technologies (Edington & Holbrook, 2010), wikis through famous platforms like Wikipedia, allow users to collaborate. (Richardson, 2010). However, wiki platforms cannot be trusted since they allow unidentifiable users to edit information and are not peer-reviewed (Richardson, 2010).

2.6.1.8. Mobile learning as an opportunity

Learning through mobile devices is found to have a positive impact on blended learning. According to Ustun (2019) the use of mobile devices has a positive impact on learners' achievement. This allows learners to become more inspired and motivated when using mobile devices in learning (Ustun, 2019). Hence, Sophonhiranrak (2021) indicated that mobile devices could be used as an instrument for learning in assisting learners in uploading homework, self-reflection on one's learning process, and sharing views.

2.6.1.9. Social media (SM) based-learning as an opportunity

Social media plays an integral part in learning. According to Akgündüz and Akınoğlu (2017), SM based learning has a positive effect on academic success and motivation. Chang and Leung (2017) indicated the role of SM on learner engagement, promoting learner-centeredness in the learning process. However, their preference is not the same among learners. Learners found Twitter easy to use and advanced knowledge sharing during its acquisition whereas Facebook was more popular (Chang & Leung, 2017).

2.6.1.10. Learning Management System/s (LMS) as an opportunity

There are several LMSs. Amongst them are the likes of Google Classroom, Moodle, and Blackboard.

a) Google Classroom (GC)

According to Kumar et al. (2020) GC is a preferred LMS due to its user-friendliness and ease of use. Additionally, it is reported to increase learners' motivation (al Yakin et al., 2022). It serves as a medium for linking learners to the authentic world. In their study, Mohamad et al. (2022) discovered that most learners believed that employing GC as an LMS can amplify learners' ability to use their knowledge and comprehension effectively.

b) Moodle

Researchers, Mpungose and Khoza (2022) argue that Moodle has limited functionality as it only allows learners to download resources and engage in discussions. However, Darari and Saputra (2022) claim that Moodle LMS can enhance learners` performance and motivation. Learners' motivation and achievement are crucial for determining the success of the learning process.

c) Blackboard

Blackboard is one of the leaders in the technological front at our universities (Makena et al., 2022) as it allows learners to learn at their own pace (Ali, 2017). It is the highly utilized LMS due to ease of access, speedy feedback, more advanced engagements, tracing, and creativity-supporting features (Makena et al., 2022). In addition, Blackboard LMS platform allow users to access tools such as portfolios, subject contents, "virtual classroom, discussion forum, assignment and test, emails and grader center" (Almekhlafy, 2020, p. 19). Hence, learners using the LMSs are highly motivated, improving their learning in the process (Ali, 2017)

2.7. DEPARTMENT OF BASIC EDUCATION'S ROLE IN THE PROVISION OF BLENDED LEARNING OPPORTUNITIES

Despite DBE outlining the seven roles of a teacher in a school, it also indicates the ten essential competencies of a beginner, which include, amongst them, an expectation for novice teachers to "have highly developed literacy, numeracy, and Information Technology (IT) skills" (DBE, 2018). Further, teachers' trainers need to address these components in their facilitation to allow teachers to: "acquire the skills that meet their needs and interests as teachers; become more efficient in their basic competencies, become more productive in their roles as both pre-service teachers and in-service" teachers (DBE, 2018).

The DBE (2018) expects teachers to be more "proficient and effective" in applying the following digital learning competencies, amongst others:

- Digital learning competency 1 - Adopt the habit of inquiring about the educational value of using digital tools and resources.
- Digital learning competency 2 – Reflect on challenging current digital learning and teaching practice.
- Digital learning competency 3 – understand the role of the teacher, the learner, and the digital resources during digital learning.
- Digital learning competency 4 – participates in local and global professional learning communities.
- Digital learning competency 5 – select appropriate digital tools and resources when fulfilling the roles of the educator.

- Digital learning competency 6 – integrate digital tools and resources to enhance learning objectives in various learning environments.
- Digital learning competency 7 – develop learners' global awareness and understanding using digital communication and collaboration.
- Digital learning competency 8 – transform learning through the innovative use of digital tools and resources.
- Digital learning competency 9 – enhance class management, assessment, and feedback processes using digital resources
- Digital learning competency 10 – integrate learners' skills development in terms of digital literacies with curriculum-based learning

The DBE (2018) recognizes the value of having "well-facilitated and supported blended-approach courses" that help for addressing: the issue of learner isolation, "the unequal distribution of capacity to facilitate courses; the need for flexibility of content, and the need for flexibility of access regarding participation in courses." But how prepared are Physical Sciences teachers and schools to implement these programs?

The Limpopo Department of Education (LDE, 2020) devised a plan to implement ICT training for its teachers. It intended to provide tools such as tablets and laptops with trackers; full utilization of teacher centers for professional development; provision of electronic/digital content; establishment of digital libraries and multimedia resources; broadcast of electronic content through SABC and community radio stations; Online training of officials, teachers, parents, and learners; technical support and troubleshooting in educational institutions and schools.

The LDE (2020) further reported that it had appointed teachers who will be trained by the end of the 2020/2021 financial year to become ICT champions. The established ICT champions will be required to train other teachers at the respective schools. However, with reports of technophobic teachers (majority of teachers) in our schools, especially in rural schools, it becomes unlikely that the plan is feasible. With the department only reporting on the availability of devices and connectivity in some schools, it failed to report on the challenges faced by other schools, specifically those in rural areas.

2.8. INTERVENTION STRATEGIES TO STRENGTHEN OR MITIGATE WEAKNESSES IN BLENDED LEARNING

Before delving into intervention strategies, one must emphasize that learners are at the center of learning. Therefore, one should look out for frameworks that are learner-centered.

2.8.1. Blended whole brain learning (adapted from Eagleton, 2017)

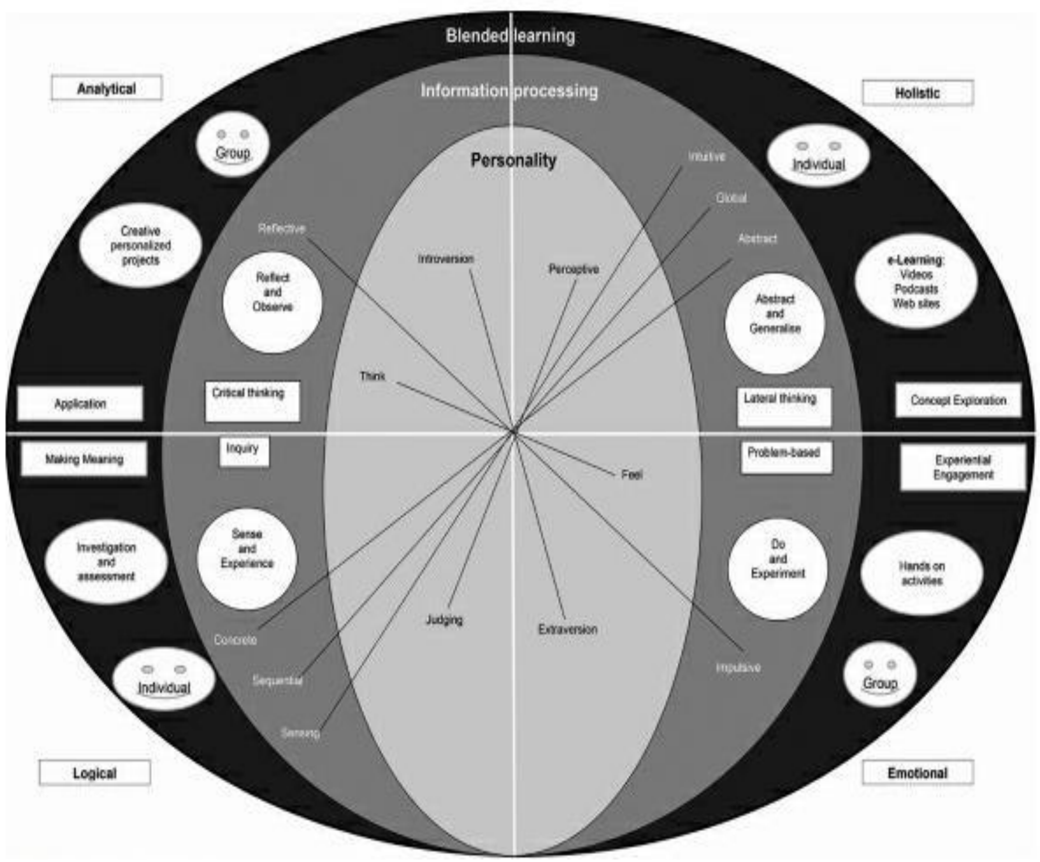


Figure 2. 3 Blended whole brain learning (adapted from Eagleton, 2017)

According to Eagleton (2017) for one to design intervention strategies that deal with how knowledge is attained, two things should be considered: how knowledge is assimilated and how it is cognitively digested, which can be seen as the center circle in Figure 2.3. To conform to "perceptual preference" when developing intervention strategies, learners' diversity in learning, such as visual, auditory, or kinesthetic learners, should be considered (Eagleton, 2017).

Visual learners learn by better knowing and understanding through graphics or visual media such as "printed words, drawings, video, television, graphs, charts" (Philominraj et al., 2017, p.55). Further, they like conducting their learning in a quiet area (Eagleton, 2017). Auditory learners enjoy spoken engagement with a teacher and with their peers and find it challenging to learn only from written instructions (Eagleton, 2017). The last group, Kinesthetic learners, learn from an authentic environment and prefer mobility and noise, preferably music, in their learning (Eagleton, 2017). One needs to structure blended learning content that accommodates the above student diversities.

2.9. CONCLUSION

This chapter has revisited literature by focusing on the history of blended learning in institutions of learning; the rationale for blended learning; synchronized and asynchronous modes of blended learning; challenges and opportunities in blended learning, and intervention strategies to strengthen or mitigate weaknesses. It has also reviewed the current policies and plans of the Department Basic of Education in implementing ICT in schools. The next chapter focuses on the theoretical and conceptual frameworks and their application in this study.

CHAPTER 3: SETTING DOWN THE ROAD MAP

"No theory is good unless it permits not rest but the greatest work. No theory is good except on condition that one use it to go on beyond" – André Gide

3.1. INTRODUCTION

The theoretical framework is a road map or a plan the researcher adopts to construct their infrastructure, which is the research study (Adom et al., 2018). The theoretical underpinning of this study is social constructivism. Even though social constructivism is highly focused on learners rather than teachers, this study designed and implemented the Rural Blended Learning Strategy (RBLS), making teachers and learners the learning process's main participants (Al-Huneidi & Schreurs, 2013). Furthermore, some aspects of the community of inquiry and the Khan-Octagonal framework were reviewed as theoretical lenses (Kastner, 2020). The focus is on how these theories can provide a better understanding of their practical implications in e-learning and blended learning platforms in schools. The Analyze, Development, Implementation, and Evaluation (ADDIE) model was critical in the designed and implemented RBLS for Physical Sciences classrooms.

3.2. SOCIAL CONSTRUCTIVISM

Social constructivism implies that learners build on their knowledge through engagement with their counterparts (Ardiansyah & Ujihanti, 2018) and their teachers (Kola, 2017). This is easily achieved when learners exchange, critique, concur, and compare ideas dialogically (Ernest, 1999) while their teacher facilitates engagement. Moskal et al. (2013) indicate how the RBLS, which this study designed and implemented, provides an arena for engagement, as mentioned above. Consequently, this agrees with the Physical Sciences curriculum, which indicates that learners should continuously learn from their peers (DBE, 2011). Having learners learn through an online platform which is something that they are well accustomed to due to social media, allows the above-mentioned to be quickly affected. For this reason, a learner can self-discover through acquaintances (Vall, 2016), allowing thinking to evolve from an individual's perspective (Barak, 2016).

As a learner should be thoroughly committed to the learning course and engage his/her thinking with the authentic universe (Beck & Kosnik, 2006), which is the world of technology. Therefore, the teacher should facilitate learning in a way that caters to social interactions, both in the class and outside (Tarnopolsky, 2012) through the blended learning platform. The social context in mind provided foundation for the designed and implemented RBLS.

Furthermore, social constructivism follows the relativism epistemology (Ernest, 1999; Kukla, 2000). Constructivists do not see any law or theory as a definitively acceptable entity (Kukla, 2000). This allows a teacher to instil robustness and objectivity in learners, guiding them to areas they have never reached before without restrictions and hesitations. That can build on their knowledge, a rich and vital experience for future endeavours. It was important for the context of this study to understand how this theory underpinned the designed RBLS and its implementation.

3.3. THE KHAN-OCTAGONAL FRAMEWORK

On the other hand, the Khan-Octagonal framework devised by Badrul Khan provides "ingredients" that a teacher can pick from in designing blended learning programs (Singh, 2003, p, 51). The framework provided the researcher with a "guide to plan, develop, deliver, manage, and evaluate those programs" (Singh, 2003, p. 51). The said blended learning 'ingredients' include, among others, live virtual/collaboration software, personalized internet-based courses, an "Electronic Performance Support System (EPSS)" embedded within a job task environment," and a knowledge management system.

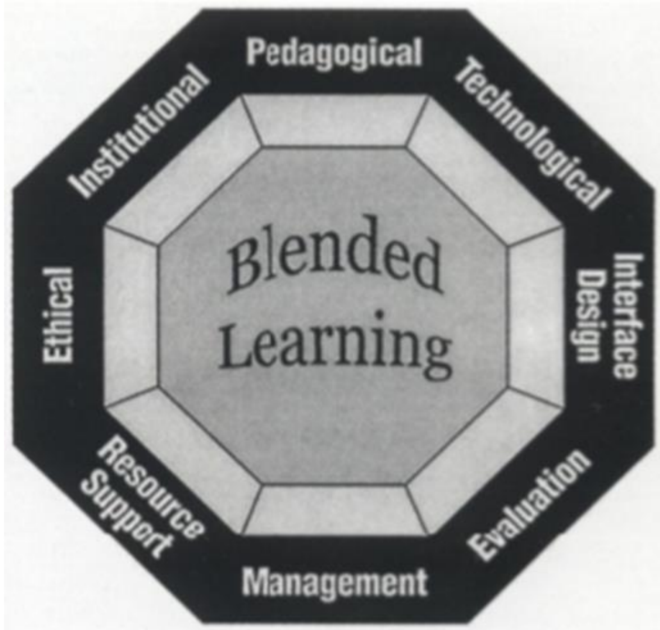


Figure 3. 1 Khan-Octagonal framework (adapted from Singh, 2003, p. 51)

The following table outlines and categorizes the ingredients:

Table 3. 1 Learning approaches and choices (adapted from Singh, 2003, p. 52)

Synchronous physical formats	Instructor-led Classroom & Lectures Hands-on Labs & Workshops Field trips
Synchronous online formats (live e-learning)	Online meetings Virtual Classrooms Web Seminars and Broadcasts Coaching Instant messaging Conference Calls

Self-placed, asynchronous formats	Documents & Web Pages Web/Computer Based Training Modules Assessment/Tests & Surveys Simulations Job Aids & Electronic Performance Support System (EPSS) Recorded Live Events Online Learning Communities and Discussion forums Distributed and Mobile Learning

The Khan-Octagonal framework was developed with characters in mind that have the potential to create significantly meaningful learning contexts. The following dimensions are identified as components of the octagon and explained below: institutional, pedagogical, technological, interface design, evaluation, management, resource support, and ethical (Singh, 2003, p. 54):

- **Institutional** – this dimension focuses on "organizational, administrative, academic, affairs, and student services." Staff responsible for developing learning programs will focus on the organization's readiness, accessibility of subject matter and resources, and accommodation of learners' needs. I needed to understand the institutional support or shortcomings teachers experience in blended learning and teaching. As institutional support can prevent impediments to the implementation of blended learning (Tuiloma et al., 2022) since institutional support can yield high-impact blends (Alammary et al., 2014)

- **Pedagogical** – amalgamate "content analysis, audience analysis, and goal analysis." It provides a situation wherein the learning objectives of a given learning program are offered and where the most relevant learning platform is picked. This study designed and implemented the RBLS for the rural Physical Sciences.
- **Technological** – this dimension focuses on creating conditions for learning and relevant resources that can provide learning programs. The focus is the most pertinent and efficient Learning Management System (LMS) to facilitate various delivery types and a Learning Content Management System (LCMS), which registers the relevant content of the learning programs. Technical issues such as the "server," bandwidth and accessibility, security, and other hardware, software, and infrastructure" are considered.
- **Interface design** – the interface design should be "sophisticated" in such a way that it supports all components of blended learning. It should provide an arena for learners to utilize and shift between different blended learning modes. Additionally, issues like "usability of the user interface, content structure, navigation, graphics, and help should be considered.
- **Evaluation** – just like any program, the blended learning program should be assessed to measure its quality and, most significantly, its impact on learners' achievements. The implementation stage allowed me to evaluate the designed RBLS.
- **Management** – this aspect focuses on the "management of the blended learning programs" in their diversity. Factors such as "infrastructure, logistics, registration and notification, and scheduling of different " in managing different blended learning methods are taken into cognizance, considering their complexity. For this study, the focus was on infrastructure and logistics.
- **Resource Support** – in this aspect, the focus is on the organization of resources (whether online or offline) and their availability to learners. This support may be provided by a "tutor" available in an office, through email, or via chat.

- **Ethical** – the focus here is on ethical aspects related to the institution of a blended learning program. This includes "equal opportunity, cultural diversity, and nationality."

This background was crucial, providing a clear picture for exploring opportunities and challenges in blended learning and the design phase.

3.4. THE ANALYSIS, DESIGN, DEVELOPMENT, IMPLEMENTATION, AND EVALUATION (ADDIE) MODEL OF INSTRUCTIONAL DESIGN

Figure 3. 2 The ADDIE model (adapted from Kurt, 2017)

As this study designed and implemented the RBLS for Physical Sciences teachers in rural areas, I felt the significance of taking the journey through the ADDIE model. According to Kurt (2017) this model found more popularity among most teachers, "instructional designers, and training developers." The ADDIE model adopts the

Input-process-output (IPO) paradigm (Branch, 2014). That would be the design implement-evaluate in the context of this study. As shown in Figure 3.2, the model is a five-stage cycle of Analysis, Design, Development, Implementation, and Evaluation (Shelton & Saltsman, 2006).

3.4.1. Analysis phase

The first phase, analysis, involves defining a learning theory (Nadiya & Faaizah, 2015), which in the context of this study is social constructivism. This step is crucial in analyzing needs (Misesani et al., 2020) and possible “performance gap” (Branch, 2014, p. 24), which were the challenges in blended learning of rural Physical Sciences teachers in the context of this study. I analyzed the interview and observation transcripts on challenges faced and opportunities for blended learning available to rural Physical Sciences teachers before going into the design and development stages. It was significant to note participants` existing knowledge and skills and those they lack (those they should have) (Kurt, 2017). The analysis phase allowed me to determine the learning outcomes to be achieved and review existing strategies and some limiting factors in implementing the RBLS (Kurt, 2017).

3.4.2. Design phase

For this study, the Design and Development phases were tight and collectively called the Design phase. This stage outlines “tools” that were employed to assess performance, “subject matter analysis, lesson planning, and media selection” (Kurt, 2017). This process demonstrated a logical flow, specifically aiming to achieve the desired project goals (Kurt, 2017). Data from the semi-structured interviews and observations were then utilized to craft a “logical model” (Danks, 2011). During this stage, the following was determined (Kurt, 2017):

- The type of media to be employed: whether audio, video or graphics or third-party resources, if necessary
- Availability of resources in their diversity to make the process/design possible.

- Nature of activities that will form part of the implementation phase.
- The teaching style approach, which is constructivist in this study.
- The time frame for the implementation is divided, of course, as per the activity/lesson.
- The type of user interface for web-based instructions and activities.
- How feedback is given; and
- How does the design address learners` preferences and diversity of learning styles?

During this stage, “functional specification” was determined to mitigate “performance gaps” (Branch, 2014, p. 59) whereby appropriate learning resources were established and determined (Branch, 2014). The “content is generated,” supporting media is chosen and developed, instructions for learners and learners are developed, “formative revision” and pilot tests are administered (Branch, 2014, p. 84). This stage relied on the data from the Analysis stage to devise the RBLS that was used by participants (Kurt, 2017). Thus, Kurt (2017) refers to this stage as the “putting in action” stage, which comprises the drafting, production, and evaluation stages.

3.4.3. Implementation

This is the stage of setting up the scene, the learning environment (Branch, 2014). During this stage, the program's continuous adaptation is key to ascertaining the quality and effectiveness of the desired outcomes (Kurt, 2017). The “instructional materials are developed, and procedures” for implementing the RBLS are specified (Dousay & Logan, 2011). This is the most significant stage, as more work was done here (Kurt, 2017). In this context, the teacher, who is a participant and facilitator (Branch, 2014), assumed the role of the implementer when implementing the RBLS in the Physical Sciences class.

3.4.4. Evaluation

The purpose of the evaluation phase was to verify if the RBLS is well suited for the task it has been designed for in both pre-and post-implementation phases (Branch, 2014). The stage allowed me to alter the RBLS if, ever, during the process, the inefficiency of the RBLS is noted (Cheung, 2016). The evaluation aspect was employed in phase 2.

3.5. THE CONCEPTUAL FRAMEWORK

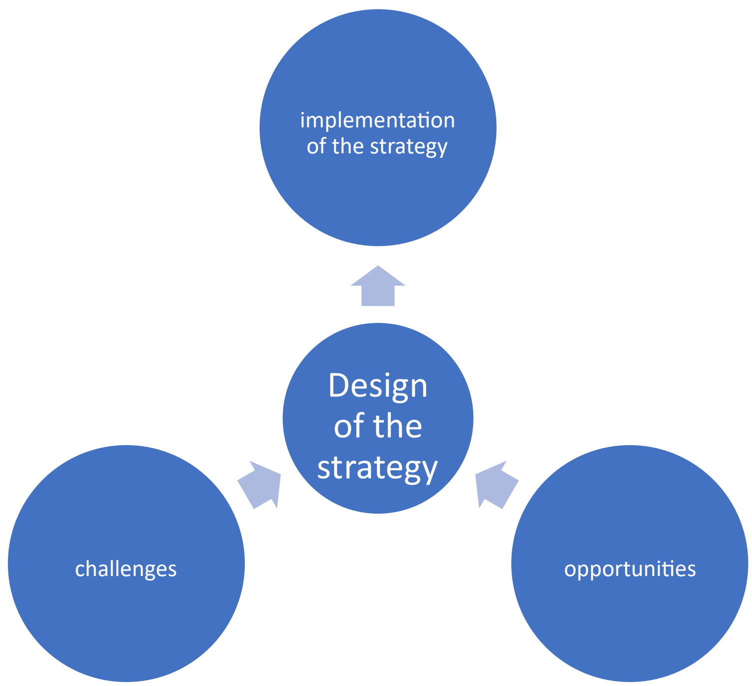


Figure 3. 3 The blended learning interventions framework

According to this framework, exploring challenges and opportunities in blended learning provided me with an arena to design the RBLS that would shape teaching and learning in the Physical Sciences class in a rural context. The identified challenges and opportunities gave me more information about what was expected in a successful class. The design process led to continuous evaluation and redesign.

The last process was the implementation phase in the Physical Sciences classroom with the teacher applying the RBLS.

3.6. APPLICATION OF THE THEORETICAL FRAMEWORK

3.6.1. Social constructivism

This study designed and implemented the RBLS in the Physical Sciences context. The focus was on the rural schools and how teaching and learning would partake with the designed RBLS. The key was how the RBLS shaped the teaching and learning of Physical Sciences. Therefore, I chose the social constructivism theory as the primary theory. This is so since blended learning provides room for learners' and teachers' engagement (Picciano et al., 2014). That is what social constructivism is embedded in (Ardiansyah & Ujihanti, 2018; Kola, 2017). During blended sessions, learners were expected to interact with the content, debate, compare and agree on ideas throughout their engagements and their engagement with the teacher.

I needed to see the social interactions unfold in class using the RBLS as social constructivism adopts a relativist approach, which does not see any law or theory as a single acceptable entity (Kukla, 2000). I was also interested to see how the RBLS would create a classroom open to various views and opinions. Which is why during the constructivist engagement, it was expected that learners would be able to construct new knowledge from their previous knowledge, which assisted in learners in achieving their outcomes (Al-Huneidi, & Schreurs, 2012). The engagement of learners with their environment, which was composed of technology, among others, could assist in developing new understanding through their engagement with group activities such as simulations and hands-on activities. For example, in this context, learners may be allowed to construct an electric circuit using the Physics Education Technology (PhET) simulation application and balance chemical reactions using the application.

Hence applying problem-based learning, which encouraged collaborative/group work/simulation as learners were taught in a flipped classroom method, upheld social constructivism (Idaresit Akpan et al., 2020). The RBLS was expected to open a way for teachers to provide an environment for discussions throughout and in between activities.

In summary, the following were expected to unfold:

- Group cohesion and collaboration between learners
- Discussions between the teacher and learners in between activities
- New experience and understanding of content and achievement of the outcomes.

3.6.2. Community of Inquiry

The framework of the community of inquiry was also applied. This was so since blending learning required the teacher to combine traditional face-to-face classes with online platforms. The framework views the learning context as a community where engagement, debates, deliberations, discourses, and inquiries should be the order of the day. During the implementation phase, I wanted to understand how the RBLS shaped the teaching by focusing on engagements and discourses. Moreover, the framework sees learners as individuals who should develop communication skills while becoming active learners. They engage in group work and simulation activities in the blended learning platform. It was, therefore, imperative to see how the teacher could provide an arena where learners engage in mutual respect through the tasks given.

The teacher, therefore, was expected to provide an educational experience for learners through his/her facilitation. Hence, the framework played a crucial role in developing observation tools. In preparation for the design of the RBLS, teachers, principals, School Governing Body (SGB) representatives, community leaders, and network service providers were interviewed. This was done to understand the school's preparedness for blended learning and teaching. The Khan-Octagonal framework was key in making me understand which component I should focus on in preparation for the designed and implemented RBLS. In this context, the focus was more on the ingredients of learning rather than the final product – meaningful learning itself.

The ingredients were labelled or categorized from an Institutional; Pedagogical; Technological; Interphase design; Management; and resource support`s perspective.

The following table summarized how the Khan-Octagonal framework was applied to this study:

Table 3. 2 A table summarizing the different components of the Khan Octagonal framework and how they were applied in this study

Component of the framework	Aspects focused on	Participant /s	Mode of data collection
Institutional	-Organization -Administration -Learning development and support staff	Teachers, Principals, SGB representatives	Semi-structured interviews and observations
Pedagogical	-content -context -goals and outcomes -audience (leaners)	Teachers	Semi-structured interviews and observations

Technological	-server -connectivity	Learners, Teachers, Principals, SGB	Semi-structured
	-devices -devices -software and applications, infrastructure	representatives, community leaders, and network providers	interviews and observations
Interface design	-modes of blended learning -types of Applications -user-friendliness or complexity of the chosen Applications	Teachers (as facilitators)	Observations
Management	Management of the blended learning programme – infrastructure, logistics, data, among others	Teachers, Principals, and SGB representative	Semi-structured interviews and observations
Resource support	Organization of resources	Teachers and Principals	Semi-structured interviews and observations
Ethical	-Equal opportunities -inclusivity -diversity	Teachers, Principals, and SGB representative	Semi-structured interviews

3.6.3. The ADDIE Model

The last framework applied in this study was the ADDIE model (Kurt, 2017). The framework was key before and during phase 2 of data collection as it was used to design the RBLS. The first aspect of the ADDIE model, the Analysis phase, assisted me in gauging the learning environment at the chosen schools through the analysis of the semi-structured interviews and observation transcripts. Moreover, the analysis phase allowed me to appropriately align the existing blended learning strategies to accommodate existing conditions. In this context, depending on the responses from the semi-structured interviews allowed me room to decide on the relevant strategy to use from a pool of existing strategies.

The analysis phase was key in preparation for the design phase as it allowed me to select relevant media and appropriate tasks and activities crucial to the facilitation process. During the design process, the focus was on how long the lesson should take place, which instructional models would be used, the type of resources to be employed, the type of devices, the type of LMS, and the type of tasks and activities. The last aspect of the ADDIE model applied was how the RBLS was implemented. The focus was more on how the RBLS shaped the teaching and learning. The Physical Sciences teachers assumed the implementer role while learners remained active participants in the teaching and learning process.

3.7. CONCLUSION

This chapter explored constructivism, a community of inquiry, the Khan-Octagonal framework, and the ADDIE model as the theoretical lens (Kastner, 2020). The theories provided an in-depth understanding of the practical implications of eLearning and blended learning platforms in schools to shed light on the exploration, design, and implementation phases of this study. The chapter concluded with the theoretical framework that presented key ideas from the researcher`s point of view and which gave direction to the study. The next chapter will report on the research design and instrumentation, sampling strategies, and ethical considerations.

CHAPTER 4 ENTERING THE FIELD

“Data! Data! Data! I cannot make bricks without clay!” – Author Conan Doyle

4.1. INTRODUCTION

The previous chapter highlighted how and why this study followed social constructivism as a theoretical paradigm. Frameworks such as the community of inquiry, the Khan-Octagonal framework, and the ADDIE model were reviewed as theoretical lenses. These theoretical perspectives, research objectives, and literature review chapters were key in the design of the conceptual framework.

This chapter outlined the methodological perspectives followed as I entered the research field. It includes the research paradigms, research design, sampling strategies, data collection methods, data analysis, rigor in research, and ethical perspectives. This study adopted a two-phased approach, whereby in phase one I explored challenges and opportunities in blended learning which assisted in the designed Rural Blended Learning strategy (RBLS). The second phase focused on the implementation of the designed RBLS.

4.2. RESEARCH METHOD

This study ensued through a qualitative approach to research (McMillan & Schumacher, 2010). It was a multiple case study on the designed and implemented RBLS in the Physical Sciences teaching and learning context. Through the qualitative method, I employed semi-structured interviews and observations to gather data in the form of words. The diary was continuously employed to gather daily occurrences. The data was mainly composed of participants’ interview transcripts on their challenges and opportunities in blended learning and observation field notes - for first, verifying the interview responses and, secondly, implementing the RBLS.

4.3. RESEARCH PARADIGM

It was imperative that I place on record my understanding, beliefs, and steps to be taken to acquire knowledge regarding the nature of reality. In this study, I followed an interpretive research paradigm (Patton, 2015) since the study is embedded in the social constructivism perspectives (Leavy, 2017). This paradigm is presented below in the form of ontology, epistemology, methodology, and methods (Rehman & Alharthi, 2016).

4.3.1. Interpretive Ontology

As an interpretivist, I approached this study with an attitude that rejects the claim that there is one reality that all of us should stick to (Guba & Lincoln, 2005). Therefore, I viewed the world as a socially created area with a variety of outcomes (Rehman & Alharthi, 2016, p. 55). As a result, I approached the schools and the Physical Sciences classrooms with a view that these are places where I could find answers to the research questions and where new understanding/knowledge would be created. I did not allow the nature of the data gathered from the previous participant/s to create a prejudice in me as I was entering the next participant`s research context. As such, I viewed all participants as individual cases that needed to be explored from an individual`s perspective.

4.3.2. Interpretive Epistemology

On this aspect, I was concerned with the nature and diversity of knowledge and how it can be attained and reported (Rehman & Alharthi, 2016). Through research inquiry with the eight participants per three schools, namely: Physical Sciences teachers and learners, principals, School Governing Body (SGB) representatives, Physical Sciences Senior Education Specialist (SES), Community leaders, and network service providers. I was able to design the RBLS and that was implemented in the rural classroom context. The idea was to gather data from their individual perspective.

4.3.3. Interpretive Methodology

This study designed and implemented the RBLS with participants in their rural context (Rehman & Alharthi, 2016). Qualitative data was collected from participants through a case study design. What was important was that the instruments used allowed me to gather data from a participant`s perspective. This was easily achieved since the semi-structured interviews and observations allowed the participant to express themselves freely. The data was analyzed inductively to figure out patterns that made me understand the study better.

4.3.4. Interpretive Methods

The qualitative methods I employed included the use of semi-structured interviews protocol and observations that contributed to the designed and implemented RBLS. The use of semi-structured interviews and observations protocols allowed me to gather information from multiple participants – stretching their perspective, that is, gathering data from multiple points of view.

4.4. RESEARCH DESIGN

I employed a multiple case study design (Yin, 2018) which did not only allow me to identify themes and categories in the topic at hand, but it also created an arena for me to collect data through a variety of instruments – interviews (semi-structured protocol and focus groups) and observations (Hanckoch & Algozzine, 2006). The intention was to collect data from participants in their everyday working context (rural schools' context) in order to answer the research questions.

Using a multiple case study design, allowed me to focus on the parameters faced by participants individually instead of comparing the research aspects between participants, as this was not a comparative study. That consequently allowed me to answer the following research question:

What was the nature and impact of the RBLS on Physical Sciences teachers in rural schools?

Through the following research sub-questions:

a. What were the challenges of Physical Sciences teachers regarding blended teaching and learning in rural schools?
b. What were the opportunities for Physical Sciences teachers regarding blended teaching and learning in rural schools?
c. How did the RBLS shaped the teaching and learning of Physical Sciences in rural schools?

4.5. RESEARCH CONTEXT

This section covers the research setting, the sampling strategy, and the sample size. The intention was to justify the choices in selecting participants for this study and how relevant they were in achieving research objectives.

4.5.1. Research settings

The study occurred in the Sekgosese area of the Limpopo Province of South Africa, belonging to the Mopani East district. The Sekgosese area comprises ten villages and one township. It is under the Greater Letaba local municipality, whose headquarters are in Modjadjiskloof town, about 42 km from the first village in Sekgosese. The villages include Mamaila, Rotterdam, Sephukubje (Hartebeesfontein), Ga-Phooko, Ga-Raphahlelo, Tshabelang, Itieleng, Lemondokop, Senwamokgope (township), and Thakgalang (see fig 4.1- demarcated with the orange line). The area comprises two circuits: Sekgosese East I and Sekgosese East II. Sekgosese East I comprise nine secondary schools, while Sekgosese East II houses seven secondary schools.

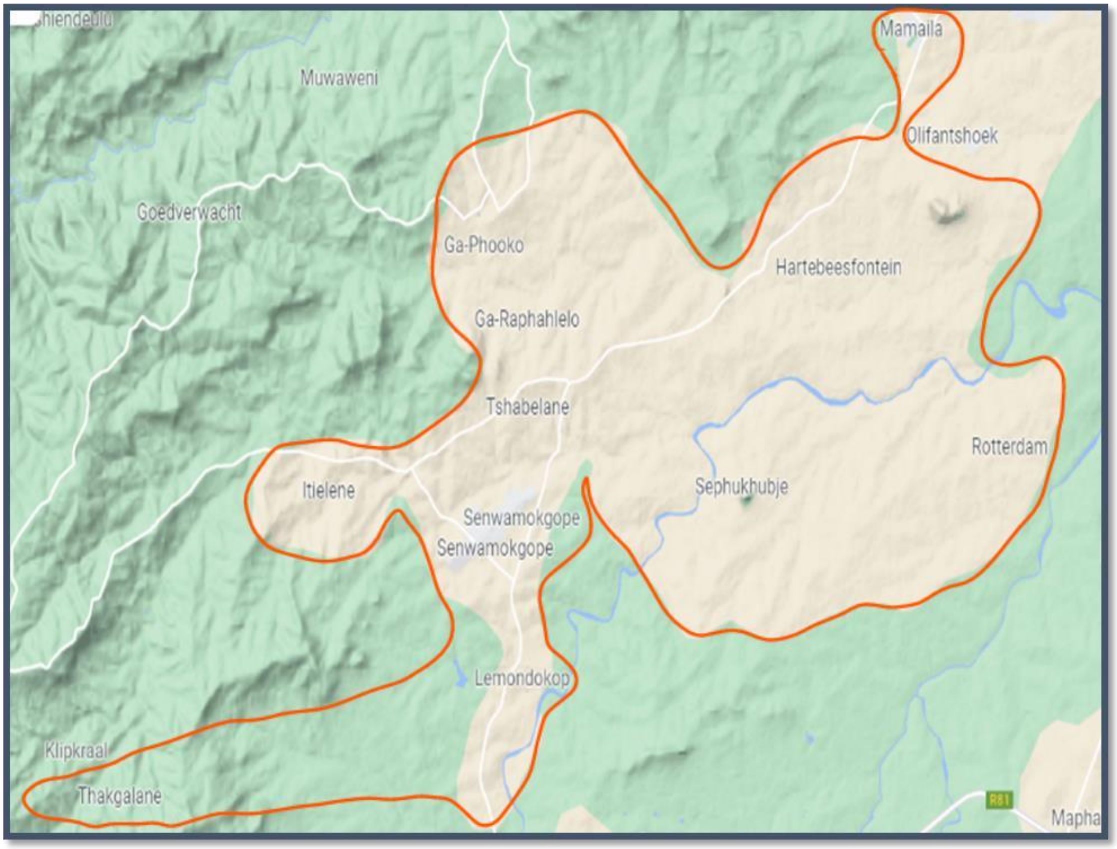


Figure 4. 1 Topographical map of the Sekgosese area [adapted from Google (n.d)]

It should be noted that according to LDE (2020), all secondary schools under the Sekgosese area belong to quintiles 1 and 2, meaning they are poor, non-fee-paying schools (Ogbonnaya & Awuah, 2019). As a result, all these schools rely on the government for funding and have a poor socio-economical standing. The area is under the Mopani District Municipality, which according to Businesstech (2016), is one of the top 15 poorest municipalities in South Africa. According to the report (see Table 4.2), the poorest district municipalities are ranked according to the Depreciation Index, which focuses on the percentage of households earning between R1 and R1 600. Mopani district municipality, which the schools in the area of my study fall under, has 83.5 % of the population earning between R1 and R1 600 as their monthly income. That creates a picture of the poverty level the schools in this area are exposed to. The expectations are that the poorer the schools, the more under-resourced they are. As a result, poor households may lack adequate resources to support remote learning.

Likewise, unlike it is the case with metropolitan municipalities, the Mopani district municipality is predominantly rural. It was because of these reasons, pertinent that I used participants from this area.

Table 4. 1 The poorest municipalities in South Africa - according to the Comfort/ Depreciation Index [adapted from businesstech (2016)]

Municipality	Town/City	Province	% earning less than R1 600
1. Alfred Nzo	Mount Ayliff	Eastern Cape	90.2
2. Amathole	East London	Eastern Cape	89.5
3. UMzinyathi	Dundee	Kwazulu-Natal	89.2
4. O R Tambo	Mthatha	Eastern Cape	88.7
5. uMkhanyakude	Mkuze	Kwazulu-Natal	88.6
6. Zululand	Ulundi	Kwazulu-Natal	87.7
7. Chris Hani	Queenstown	Eastern Cape	86.3
8. Sisonke	Ixopo	Kwazulu-Natal	85.9
9. Dr. Ruth Segomotsi Mompati	Vryburg	Northwest	85.3
10. Joe Ggabi	Barkly East	Eastern Cape	85.1
11. Vhembe	Thohoyandou	Limpopo	84.8
12. Greater Sekhukhune	Groblersdal	Limpopo	84.1
13. Mopani	Giyani	Limpopo	83.5
14. uThukela	Ladysmith	Kwazulu-Natal	83.4
15. Thabo Mofutsanyana	Phuthaditjhaba	Free-State	81.2

4.5.2. Purposeful Sampling strategy

I employed a purposeful sampling strategy (Best & Khan, 2006) to pick participants (cases) with specific features that I was interested in (Cohen et al., 2018) and that assisted me in answering the research questions. The target was rural schools. Hence, it was a criterion sampling strategy and was based on the following criteria:

- The participants were Physical Sciences teachers in a rural area with work experience of at least one year to eliminate inexperience as a factor.
- The participants were fully qualified teachers, having either a Bachelor of Education (B.Ed) degree, a professional degree plus a Postgraduate Certificate in Education (PGCE), or a Diploma in Education.

Other participants were Physical Sciences learners, Principals, SGB representatives (from the chosen schools), SES, community leaders, and network service providers.

4.5.3. Sample Size

The setting was in three schools wherein the sample was made of three Physical Sciences teachers, three groups of learners, three principals, three SGB representatives, three community leaders, two network service providers (one for mobile network and one for WI-FI network), and one SES. All these participants (except some service providers) per school were based in the same geographical area – the Sekgosese area, making the research sites easy to access.

4.6. DATA COLLECTION ASPECTS

This section focuses on the data collection aspects. The focus is on the instruments employed, the rationale for choosing those instruments over others, methods used to collect data and why those methods, and how data was presented and analyzed. It should be noted that the data collection and analysis were two-phased.

4.6.1. Data collection instruments

The qualitative approach was initiated with semi-structured interviews (Leavy, 2017) wherein participants who were deemed to have “first-hand” information about the topic under study (Patton, 2015) were asked questions seeking to understand the challenges and opportunities in blended learning. The interviews stage provided me room to gain an in-depth understanding of experiences and views on blended learning of Physical classes teachers, learners, principals, SGB representatives, SES, Community leaders, and network providers (Patton, 2015).

The rationale for selecting semi-structured interviews was due to their adaptability during the interview process (Ryan et al., 2009). In this context, an interview schedule was developed to align to subtopics (Ryan et al., 2009) which seek to understand the challenges and opportunities in blended learning. However, due to the nature of semi-structured interviews, I was able to play around with one question in many ways, depending on the nature of the participant’s responses. I was able to adapt to different languages and sought clarity where required (Ryan et al., 2009). In cases where words were too complex or difficult to understand, they were simplified in a language that was easy for participants to comprehend. For example, some participants were more comfortable responding in Sepedi than in English, while others mixed the two languages.

In addition to that, I enjoyed more control throughout the process (Ryan et al., 2009) as I could ask follow-up questions based on how participants had already responded (Flick, 2018). The participants felt much in the driving seat as the inquiry partook from an individual’s point of view (Ryan et al., 2009). That led to gathering of in-depth data that structured interviews would not (Ryan et al., 2009). More so, conducting a one-on-one interview provided more advantages as I was able to read gestures from participants such as “body language, facial expressions” and, most importantly, have “eye contact” with the participant (Ryan et al., 2009). In the process, I could then read “hidden meanings and understanding” (Ryan et al., 2009).

The semi-structured interviews were recorded through a voice recorder, ensuring rigor and reliability (Rutakumwa et al., 2020). The choice for the voice recorder over field notes is that even though they are cost-effective, user-friendly, and not time-consuming, they cannot be replayed/repeated in case where I want to verify/confirm something I might have missed (Tessier, 2012). Consequently, important information was not missed.

The second instrumentation was observations (Patton, 2015). This technique was employed to check the posting of media and content-based resources on the online platforms and check whether what the participants indicated they use is indeed being used. The field notes were used to record enough data and to indicate details (Patton, 2015) about the contents being verified. In other words, field notes acted as a checklist to verify documents and media such as Wi-Fi routers, computer laboratories, policies, social media (SM) platform(s), Learning Management Systems (LMSs), Videoconferencing (VC) platforms, amongst others, that the participants indicated.

4.6.2. Data collection methods

The data was collected in two folds: firstly, using interviews and observations with the help of a diary and field notes (phase one); and secondly (phase two), through classroom observation; and post-observation interviews as represented in Fig. 4.1.

The following is an outline of the steps of data collection.

- Qualitative interviews,
- Qualitative observations
- Design of the RBLS
- Implementation of the RBLS -qualitative observation and interviews

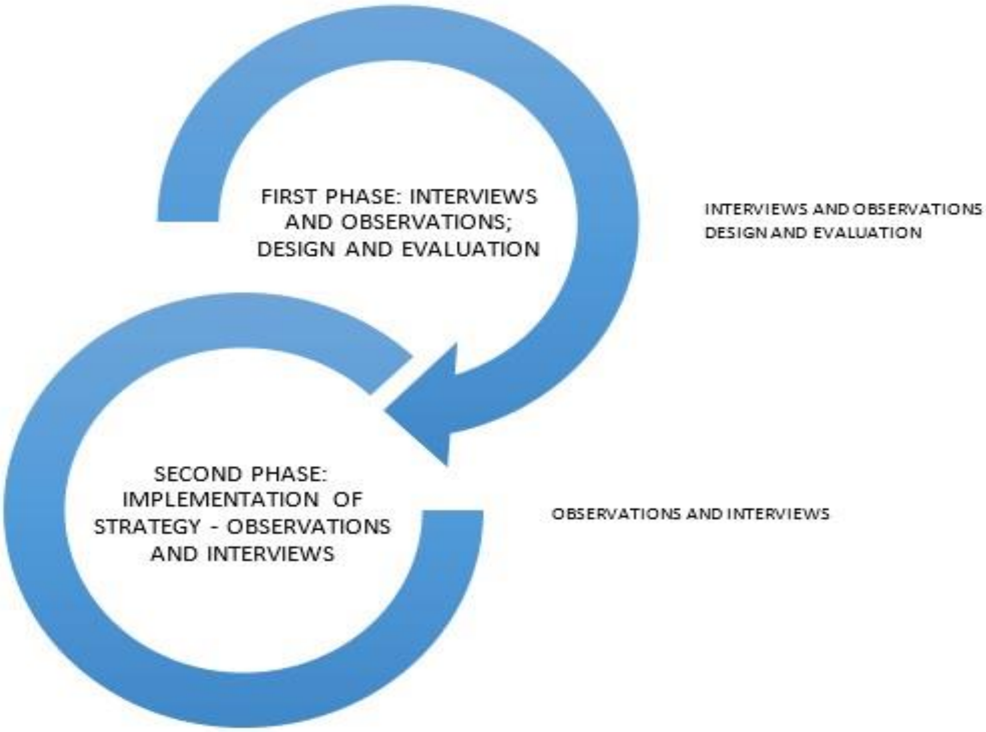


Figure 4. 2 The research plan for this study

4.6.2.1. Phase 1

The first phase of data collection was initiated through semi-structured interviews (Leavy, 2017) with three Physical Sciences teachers, three groups of Physical Sciences learners, three principals, three SGB representatives, three community leaders, and three network service providers. The voice recorder was employed throughout the semi-structured interviews, ultimately allowing me to generate transcripts for analysis which was followed by observations. The field notes containing a checklist were employed to verify the presence or absence of resources such as lesson plans, devices, internet routers, projectors, and modes of connectivity mentioned by the participants. The diary was employed throughout the process to note all occurrences. Likewise, the video recorder was used to gather data from the classroom.

The aim was to answer the first and second research sub-questions:

i. What were the challenges of Physical Sciences teachers regarding blended teaching and learning in rural schools?
ii. What were the opportunities for Physical Sciences teachers in blended teaching and learning in rural schools?

This served as a preparation for the designed RBLS with the ADDIE model's help. The contents from the interview transcripts and observation field notes were key.

4.6.2.2. Phase 2

Phase two of data collection occurred during the implementation stage, wherein the designed RBLS was introduced into the Physical Sciences classroom. Unlike in phase one, teachers and learners were the only participants. Each participant (teacher) was required to teach at least three lessons with the RBLS. The intention was to observe how the RBLS shaped teaching and learning in the Physical Sciences classroom, hence answering research sub-question 3:

iii. How did the RBLS shaped the teaching and learning of Physical Sciences in rural schools?

The video recorder was employed to record all the occurrences in class while the field notes were employed for jotting down occurrences noted that were crucial in answering the research question. The teachers and learners were interviewed post the observations to understand their experience with the designed RBLS.

4.6.3. Data presentation

4.6.3.1. Phase 1

The data was presented and discussed simultaneously in paragraphs (narrative) per case. It was collected during phase 1 through interviews, field observations, and classroom observations - of three consecutive lessons per Physical Sciences teacher. The data was collected from external stakeholders such as community leaders, mobile network service provider, Wi-Fi network service provider, and the SES. Likewise, having data from both interviews and observations allowed me to triangulate.

The following Detailed Analysis System (DAS) represents the themes and subthemes which were used to present and analyze the data for phase 1:

Figure 4. 3 The Detailed Analysis System (DAS) for Phase 1

4.6.3.2. Phase 2

Similar to phase one, the data from Phase 2 was presented in a paragraph form. The data emerged from two sources – predominantly narrated observations, focusing on how the designed strategy, the RBLS, shaped blended learning and teaching in a Physical Sciences rural classroom, and from the post-observation interviews for triangulation. Figure 4.4 was the DAS used for presenting and analyzing the data:

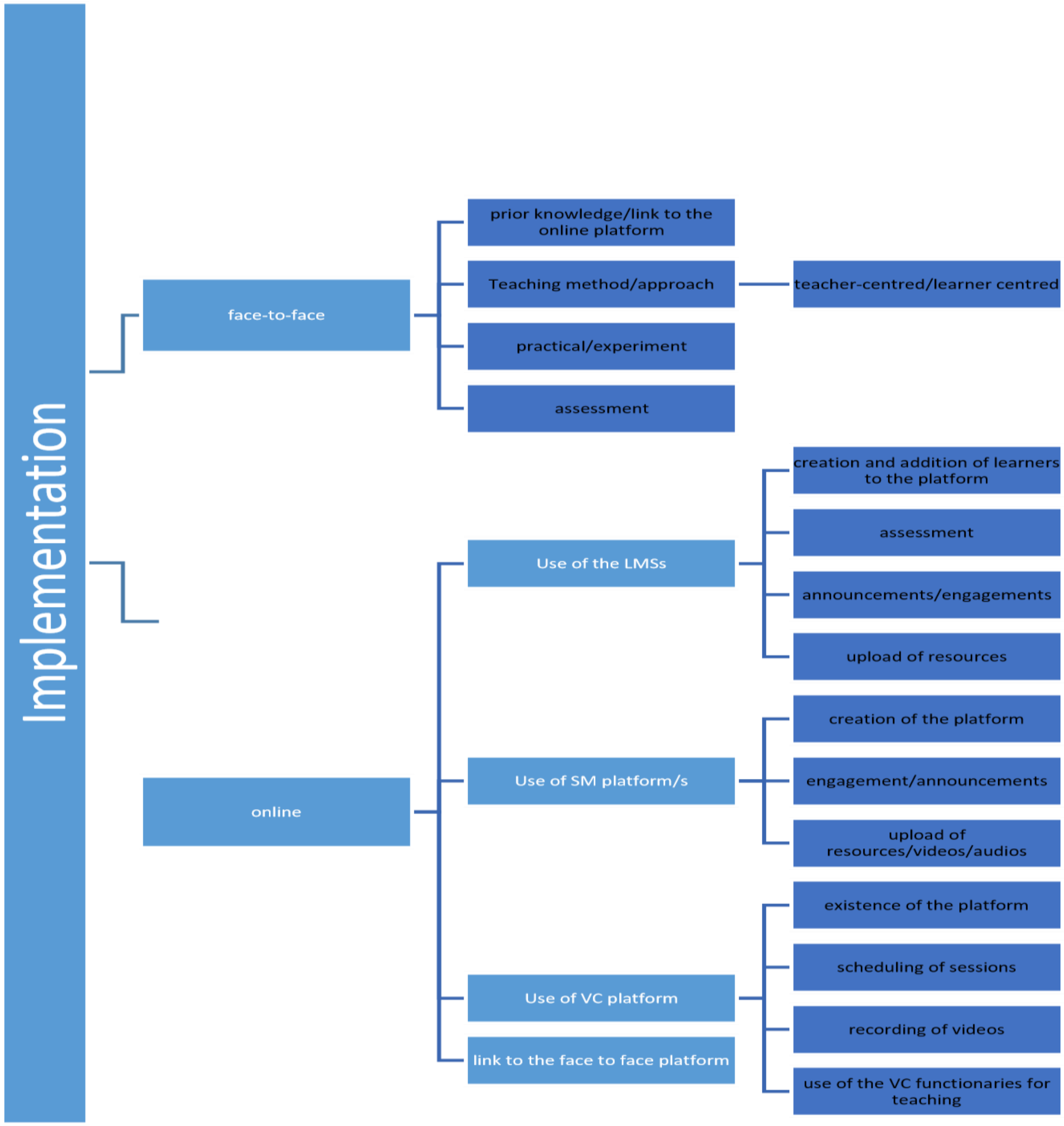


Figure 4. 4 The Detailed Analysis System (DAS) for Phase 2

4.7. DATA ANALYSIS

Similar to data collection, the data analysis was two-phased. The first phase was initiated by acquainting myself with the data through "reviewing, reading, listening" to the audio recordings (Lacey & Luff, 2009, p.6). This allowed me to transcribe the verbatim interviews (Creswell, 2014) and create a narrative from what was observed. The data was categorized and listed for easy recovery and access (Lacey

& Luff, 2009) which was then coded and grouped into a table for easy identification (Merriam & Tisdell, 2016). Coding allowed me to design data elements accordingly, categorizing and summarizing them in the process (Flick, 2014). In my designations, I used letter abbreviations (Merriam & Tisdell, 2016, p. 199).

The following table summarized the data analysis in both phases:

Table 4. 2 Table summarizing data analysis in phases one and two.

<table>
<tr><th>Phase one</th><th>Phase two</th></tr>
<tr><td>Interview transcripts</td><td rowspan="2">Familiarizing with recorded video, interview transcripts, and field notes from observations</td></tr>
<tr><td>Field notes narrative</td></tr>
<tr><td>Formation of categories</td><td rowspan="2">Confirmation of categories developed post phase one</td></tr>
<tr><td>Coding</td></tr>
</table>

4.8. RIGOR

Rigor or trustworthiness in research implies the study's credibility, transferability, and dependability (Ryan et al., 2009). Shenton (2004) adds confirmability, which denotes objectivity to the study. Additionally, Shenton (2004) asserted credibility to be associated with internal validity, transferability to external validity, and dependability to reliability. It was therefore important to demonstrate the "transparency, integrity, and reflexivity of the study" (Sinkovics & Alfoldi, 2012, p. 827). This was achieved by developing clear interview schedules (Ryan et al., 2009).

4.8.1. Credibility

Rigor was achieved through the triangulation of data (Johnson et al., 2020), upholding credibility in the process (Guba & Lincoln, 2018). Triangulation in the research focuses on a certain aspect/s of the study from more than one point of reference (Flick, 2018). This was easily implemented by merging data, i.e., the interview transcripts and observations field notes. Multiple analysis was done, from simpler themes, to complex and then denser themes (Creswell, 2014).

Credibility was amplified through extended discussion in interviews and determined observations (Guba & Lincoln, 2018). This notion is amplified by Creswell (2014), who indicates that spending more time in the field efficiently achieves rigor. As a result, spending extended time at the research site allowed me to familiarize myself with the culture and nature of the school environment (Shenton, 2004), which was predominantly rural. I managed to return to the questions that could not be confirmed by field notes to check with the participants about the contradictions, discarding such information where no clarity was given.

4.8.1.1. Pilot study

The instruments (interview protocol, observation field notes) were first exposed to the pilot method. The intention was to assess whether participants were comfortable with the instruments employed (Janghorban et al., 2014) and whether the instruments are measuring what they are supposed to be measuring. As such, pilot participants for the first phase (phase 1) were interviewed telephonically in a one on-one approach (for the teacher, principal, and SGB representative) and in a focus group approach with learners. This allowed me to identify different behaviour portrayed by the participants, such as reluctance to answer some questions and joy demonstrated when answering other questions. Consequently, the following was observed during the pilot study:

- Most participants found words like devices, blended learning, Microsoft Teams, and Zoom meetings to be alien to their knowledge base.
- There was also confusion from the participants’ perspective regarding mobile networks for surfing the internet and mobile network for calls.
- Some candidates confused blended learning with online learning.

- Questions about the number of learners in a class were not fair to the participants since numbers vary per class and band.
- A question like “Do you blend your teaching?” confused the participant.
- Some participants wanted more explanation if they did know what I was asking.
- Piloted SGB representative was more comfortable answering questions in Sepedi than in English, whereas other participants liked mixing the two languages.

To remedy this, the following were modified:

1. Instead of using the word ‘devices,’ I mentioned those devices in my questions.
2. Used more familiar words like ‘Teams’ and ‘Zoom’ instead of Microsoft Teams and Zoom meetings in my questions.
3. I put more clarity in my line of questioning whether I am asking about mobile networks for surfing the internet or making calls.
4. Avoided using words like ICT, technology, and online as they created more confusion for the participants.
5. Asked about the average number of learners in the Physical Sciences classroom as some teachers teach across the band (Grade 10-12) instead of teaching one class.
6. A question like “Do you blend your teaching?” is replaced with “Do you use blended learning in your teaching of Physical Sciences?”
7. Indicated to the participants to answer what they knew and indicated if they did not know what I was asking instead of them asking me to define what I was asking.
8. Allowed participants to answer questions in their preferred language.

The pilot study allowed me to recalibrate my instruments to gather more sufficient data to answer the research questions. It was enjoyable, and the feedback was so overwhelming that some of the participants requested a repeat of the interviews, whereas others wanted to know when I would return. It created more enthusiasm, curiosity, and optimism as I entered the main study.

4.8.2. Dependability

The study's dependability takes into cognizance that the research context is continuously changing and cannot be viewed as a “priori as a singular moment in time” (Given, 2008, p. 208). The semi-structured interviews protocols were employed in the study due to their flexibility. As a result, I was able to adapt the interview protocol based on the content. Furthermore, flexibility was also applied in the field notes, noting aspects that were never in mind prior to the observation but were relevant to the study.

4.8.3. Confirmability

Confirmability in qualitative research, as indicated earlier, is similar to reliability and objectivity in a quantitative study (Given, 2008). It is an effective way of affording “evidence that the researcher’s interpretation” of the views and responses of the participants are based on participants’ views and responses and that the analyzed data, research findings, and conclusion reflect the participants’ responses (Given, 2008, p. 112). Confirmability was upheld by clearly explaining how the data was collected and analyzed with developed codes clearly indicated. The participants were given a ‘second bite of the cherry’ by sharing the transcripts with the participants to allow them to ascertain if those responses were indeed theirs.

4.9. ETHICAL CONSIDERATION

The following study involved human beings, hence the necessity to consider the ethical and legal aspects during the research (McMillan & Schumacher, 2010), as their ignorance may result in “harm” to participants (Kiula, 2013, p. 4). Likewise, one cannot disregard the issue of respect for the rights of the people as enshrined in the Bill of Rights of the SA constitution of 1996 (Ramrathan et al., 2016). The study went through both the University of South Africa (Unisa) and the LDE ethics committees and approval was given (as can be seen in appendix 2 and 3), after sending the detailed applications, with the methodologies, instruments to be used in the study together with potential risk to participants clearly indicated.

Kiula (2013, p. 4) outlined the following aims of upholding ethics in research:

- Advance "aims of research such as knowledge, truth" and elimination of error.
- Advanced values that are significant for collaborative work – such as "trust, accountability, mutual respect, and fairness;"
- Guarantees the accountability of the researcher to the public.
- Assist in "public support building for research through" certainty of "trust in the quality and integrity of research"; and
- Advance a diversity of crucial moral and social values, for example, "human rights, animal welfare, compliance with the law, and health and safety."

Ethics were upheld in this study in the following manner:

4.9.1. Full disclosure and honesty

It is expected that I uphold honesty by "reporting data, results, methods, and procedures, and publication status" and further refrain from "fabrication, falsification or misrepresentation of data" (Kiula, 2013, p. 5). I had an 'open-cards' approach with participants by being "open and honest" about what the study intends to achieve and other research details (McMillan & Schumacher, p.117, 2010).

4.9.2. Voluntary participation, Informed consent, and Integrity

I stuck to promises and agreements and remained sincere and consistent in thought and action (Kiula, 2013, p.6). Also, participants were informed that their involvement in the study was voluntary and that they could withdraw whenever they felt so (McMillan and Schumacher, 2010).

4.9.3. No risk or harm to participants

I ascertained that the study in its entirety does create harm to participants- whether physical or psychological (McMillan & Schumacher, 2010).

4.9.4. Objectivity

I refrained from bias in stages such as the design, data analysis, data interpretation, and other steps.

I also demonstrated respect for participants' privacy through the following practices:

- Confidentiality – I ensured the participant's identity remained known to him/her alone and made such assurance to participants before they participated in the study. The participants were allocated pseudonyms such as C1T, C2P, C2S, etc., to protect their identity.
- Storage of data – all correspondences, participant's views and responses, and any other data was sealed with a computer password, and the hard copies were locked inside the storage cabinet for 5 years.

4.10. CONCLUSION

This chapter reported on the methodological perspectives followed in the data collection period. The research paradigms, research design, sampling strategies, data collection methods, data analysis, rigor in research, and ethical perspectives were outlined. The next chapter presents and discusses the data collected during phase one.

CHAPTER 5: CHALLENGES AND OPPORTUNITIES OF BLENDED LEARNING IN THE RURAL SCHOOLS

“Victory comes from finding opportunities in problems” – Sun Tzu

5.1. INTRODUCTION

The previous chapter presented the methodological perspectives followed in the data collection period. This chapter reported on the data collected during Phase 1. This was aimed at presenting and analyzing data in such a way that it answered the following research questions:

i. What were the challenges of Physical Sciences teachers regarding blended teaching and learning in rural schools?
ii. What were the opportunities for Physical Sciences teachers regarding blended teaching and learning in rural schools?

The data was presented and discussed simultaneously in paragraphs (narrative) per case. It was collected from phase 1 through interviews, field observations, and classroom observations - of three consecutive lessons per Physical Sciences teacher. Likewise, the data from the interview transcripts of the principals, SGB representatives, community leaders, mobile network service provider representatives, Wi-Fi network service providers, and the Physical Sciences Senior Education Specialist (SES) was presented, and findings were made from it. The focus was on the following themes: Challenges and Opportunities in blended learning.

To observe the ethics, I used the following pseudonyms throughout my data presentation, discussion, and findings:

Table 5. 1 A table indicating the pseudonym for each participant

CASES	PARTICIPANTS	PSEUDONYM/ ACRONYM
CASE 1 MAKWALENI A THABA SECONDARY SCHOOL	Teacher	C1T
	Learner Learners	C1L C1Ls
	Principal	C1P
	SGB representative	C1S
CASE 2 MATHOKO SECONDARY SCHOOL	Teacher	C2T
	Leaner Learners	C2L C2Ls
	Principal	C2P
	SGB representative	C2S
CASE 3 BAFETI BA TSELA SECONDARY SCHOOL	Teacher	C3T
	Learner Learners	C3L C3Ls
	Principal	C3P
	SGB representative	C3S
EXTERNAL STAKEHOLDERS	Community leader for case 1	CLC1
	Community leader for case 2	CLC2
	Community leader for case 3	CLC3
	Mobile network service provider 1 representative	MSP1
	Wi-Fi network service provider representative	WSPR
	Physical Sciences senior education specialist	SES

5.2. CASES.

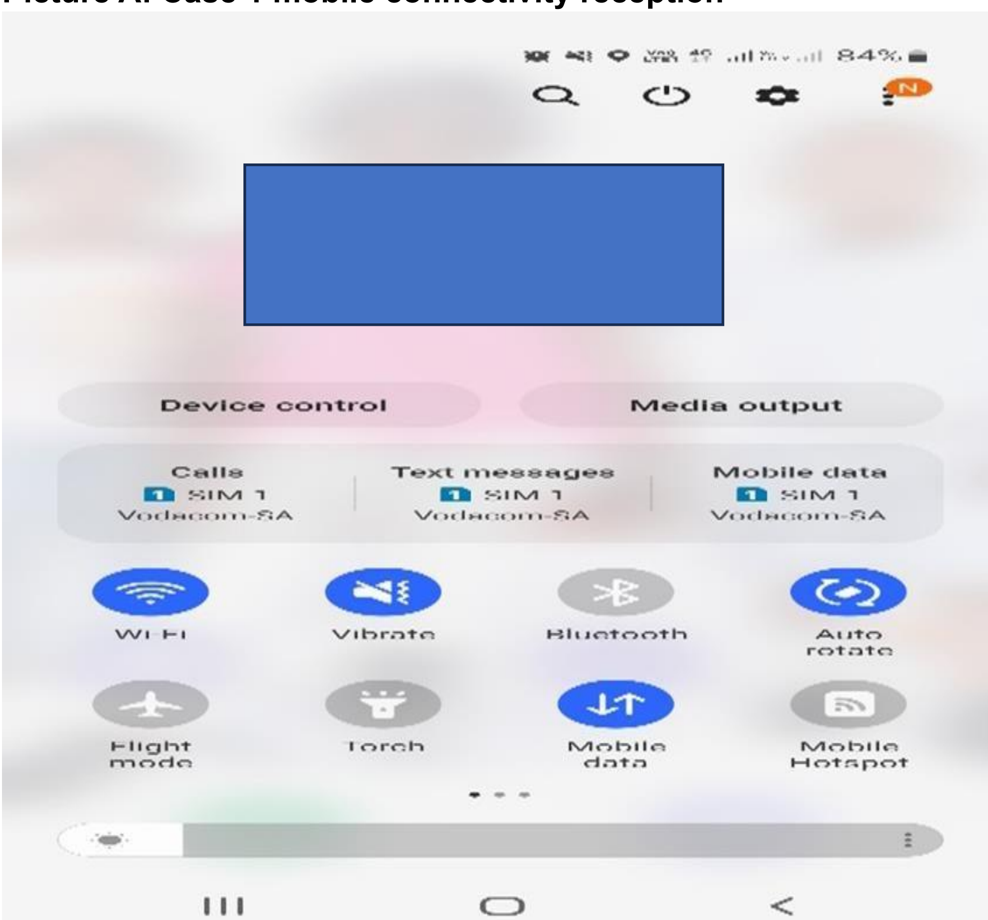
The teacher, the learners, the principal, and the SGB representative represent each case. Each participant is given pseudonyms, as indicated in Table 5.1.

5.2.1. CASE 1 - MAKWALENI A THABA SECONDARY SCHOOL
5.2.1.1. DATA PRESENTATION AND DISCUSSION

Connectivity

The school enjoyed a better reception of the mobile network. I have had the opportunity to check the reception as presented in picture A.

Picture A: Case 1 mobile connectivity reception



However, it becomes unstable when load shedding is in place. This was according to C1T, who further expressed the extent of the problem in the surrounding community during the pre-observation interviews:

> ***"Ehmmm (well), I can say it is poor because of load shedding. When there is eh load shedding. There's no network"- C1T***

The same sentiments were shared by C1L, who expressed the extent of the impact of load shedding:

> ***"Network is always unavailable because of load shedding"-C1L***

The C1P added that, indeed, load shedding affected the mobile network connectivity. However, the impact is not the same in both the mobile network providers:

> ***"Unless if we are having load shedding, that is where eh, let's say [mobile network 2], that's where we have a problem, but with [mobile network 1], most of the time we use it even when electricity is off" – C1P***

However, according to C1P, the mobile network is always available, even without load shedding. The load-shedding problem on the mobile network extends to surrounding homes where many learners reside. It was important to understand that, to have a clear picture of the potential challenges it poses to implementing the Rural Blended Learning Strategy (RBLS). I therefore, asked the C1T about the mobile network reception in learners' homes. The C1T indicated that the impact of load shedding on mobile networks extends to the surrounding community.

The C1Ls corroborated the testimony:

> ***"At home there`s poor network because there no Wi-Fi". – C1L***

It was therefore noted that the issue of load shedding was common in the area and impacted the network connectivity. This was noted by researchers, Manurung et al. (2020), who indicated that the issue of power cuts has a negative effect on internet connectivity. Consequently, due to its effect, this can be a barrier during the implementation of the RBLS.

Fortunately for the C1Ls and their classmates, the school enjoys reliable Wi-Fi connectivity. This was emphasized by the C1P, who also indicated the cons of that Wi-Fi connectivity:

> ***"Eh network is Wi-Fi, of [Wi-Fi network provider] which is reliable, then unless if we have rain or strong winds, but majority or most of the time we rely on it." – C1P***

The C1Ls also added to that aspect with enthusiasm by indicating that they are connected and have access to several online sites:

> ***"We are connected to Wi-Fi which is password protected. Then we are able to search thing online" – C1L***

The C1S also alluded to the presence of the Wi-Fi network, which is SGB sponsored. He further indicated that some learners and teachers are connected, corroborating with what was indicated by the C1Ls. I can confirm that, indeed, the Wi-Fi router does exist, something which I noted during my field observations as presented in pictures B and C.

Picture B: Wi-Fi router for Case 1

Picture C: Outdoor wall-mounted Wi-Fi antenna for Case 1

Further to that, the C1T has Wi-Fi installed at his home, which would allow him to connect with his learners even in the comfort of his home:

> ***"no at my place? I also do have eh, Wi-Fi" – C1T***

During interviews, the C1T and his C1Ls indicated that they own smartphones, which would be key as one of the devices that could easily manage the chosen Learning Management System (LMS) during the implementation of blended learning. What I found to be more positive is that according to the C1T, learners are, in some instances, allowed to bring devices to school:

> ***"Ah, normally we don't allow them, but at some point, we do allow them especially during exams towards or towards exams, we do allow them." – C1T***

One of the C1Ls did amplify that during the interviews:

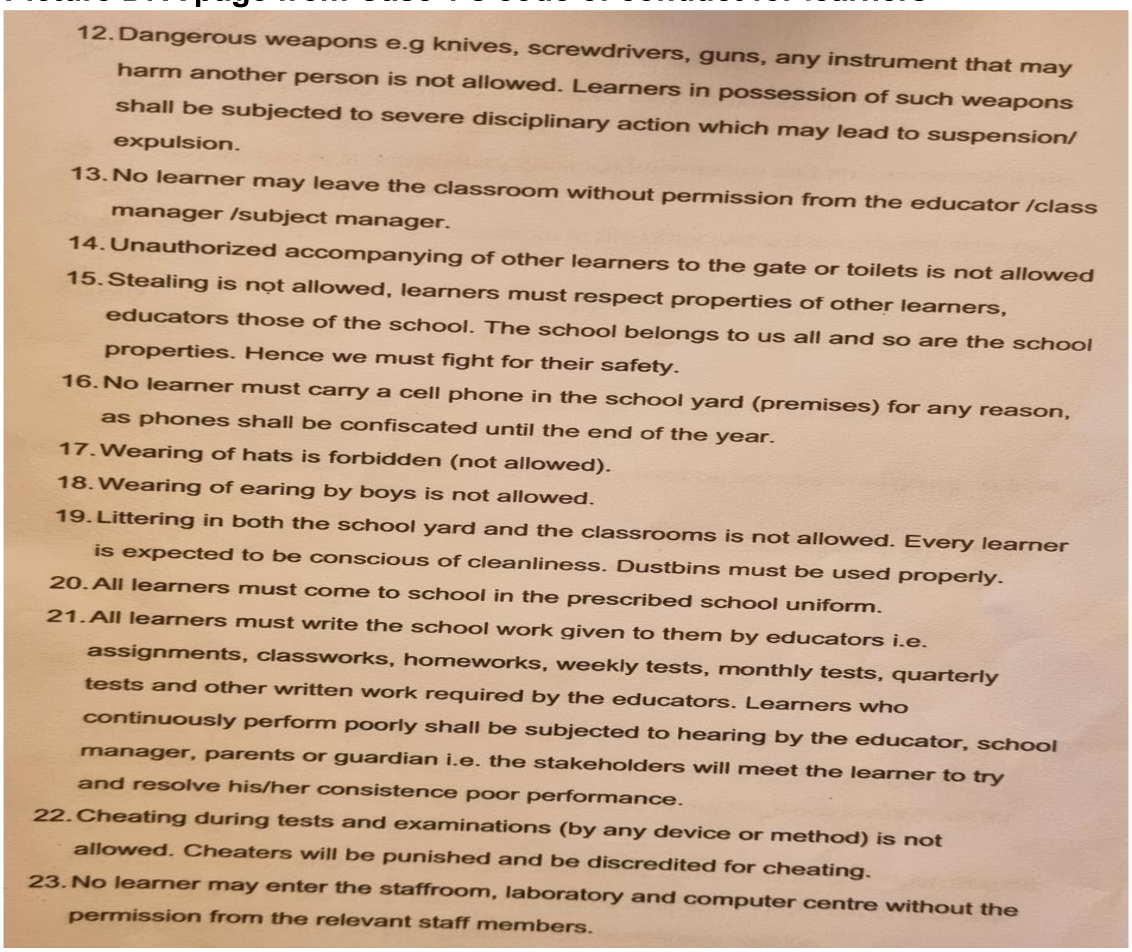
> ***"On certain moments." – C1L***

The same was alluded to by the C1S that they allow them to come with phones but on arrangements. The C1P, however, placed a picture that despite all this flexibility, the policies do not permit them:

> ***"No according to the policy. The policy – the code of conduct for learners, it is speaking of – cell phones are not allowed at school." – C1P***

I also managed to take a picture of the policy, specifically the page where the issue of cell phones is addressed as presented in picture D, paragraph no. 22.

Picture D: A page from Case 1's code of conduct for learners



12. Dangerous weapons e.g knives, screwdrivers, guns, any instrument that may harm another person is not allowed. Learners in possession of such weapons shall be subjected to severe disciplinary action which may lead to suspension/ expulsion.
13. No learner may leave the classroom without permission from the educator /class manager /subject manager.
14. Unauthorized accompanying of other learners to the gate or toilets is not allowed
15. Stealing is not allowed, learners must respect properties of other learners, educators those of the school. The school belongs to us all and so are the school properties. Hence we must fight for their safety.
16. No learner must carry a cell phone in the school yard (premises) for any reason, as phones shall be confiscated until the end of the year.
17. Wearing of hats is forbidden (not allowed).
18. Wearing of earing by boys is not allowed.
19. Littering in both the school yard and the classrooms is not allowed. Every learner is expected to be conscious of cleanliness. Dustbins must be used properly.
20. All learners must come to school in the prescribed school uniform.
21. All learners must write the school work given to them by educators i.e. assignments, classworks, homeworks, weekly tests, monthly tests, quarterly tests and other written work required by the educators. Learners who continuously perform poorly shall be subjected to hearing by the educator, school manager, parents or guardian i.e. the stakeholders will meet the learner to try and resolve his/her consistence poor performance.
22. Cheating during tests and examinations (by any device or method) is not allowed. Cheaters will be punished and be discredited for cheating.
23. No learner may enter the staffroom, laboratory and computer centre without the permission from the relevant staff members.

That provided a negative impact on the implementation of blended learning. In his study, Ustun (2019) indicated that the use of mobile devices has a positive impact on learners’ achievement. In the process, learners become more inspired and motivated when using mobile devices in learning (Ustun, 2019).

However, the C1S did highlight the significance of revisiting or revising the policies to accommodate that flexibility:

> ***“We have to look at the code of conduct, when it is eh, amended we will need to bring all stakeholders involved.” – C1S***

Not allowing learners to bring along phones or any other device can be a disadvantage to effective learning. In fact, according to Ustun (2019), the use of mobile devices has a positive impact on learners’ achievement. Despite the availability of smartphones, which are owned by the C1T and some of the C1L, the school had a number of laptops that could be key in the implementation of blended learning in a Physical Sciences classroom. According to the C1P, the school housed eight laptops, one of them was used by the C1T:

> ***“Eh! (pauses a second) let me check (thinking deeply). I’m having one that is used by myself, then one for the admin clerk, two for the HOD`s and we still have one meant for commercial subjects. We have one also which is used by [C1T], one, roughly about eight.” – C1T***

The school also consists of a number of personal computers which are currently dysfunctional due to them being unused for a long time as presented in picture E.

Picture E: Old dysfunctional personal computers (PCs) for case 1

Further to that, even though the school was able to provide the C1T with a device like a laptop, the school does not have a program or plan on how to assist learners who lack devices. These provided many challenges during the implementation as some learners were not able to access the LMS. This is so since it implied that the school did not have effective institutional support in the case of learners (Alammary et al., 2014)

The knowledge of blended learning, social media, and LMS and their uses in the teaching and learning of Physical Sciences

As a consequence, I saw it necessary that during my data collection, I should explore more aspects, with my questions ranging from the knowledge of blended learning, social media, and LMS and their uses in the teaching and learning of Physical Sciences. I started by asking my participants questions regarding blended learning. The C1T was alarmed about the concept when I asked if he had ever trained in blended learning. He responded with a question:

> ***"Can you explain what is blended?" – C1T***

After I explained what blended learning is, he responded by indicating his lack of training in blended learning. However, he indicated one of his colleagues used to employ blended learning in her teaching:

> ***"Yes. There was a teacher who was using it. I think during, during COVID, I think that was 20, 2020." - C1T***

Moreover, it was established that he was never exposed to blended learning at all when I asked him if the teacher he was referring to has ever shown him or any of his colleagues how blended learning works:

> ***"She, she. She never" - C1T***

The C1P also seemed to be confusing the concept of blended learning with the implementation of technology in the classroom:

> **"*what I can say about it, you know, I say I don't know much about it. But, eh usage of eh (pauses) of, of this technological devices…. Eh, I don't know if this one of using the what we say the one thing of uh using projectors out of all the teachers are 2 who are able to use the projector in class." – C1P***

After this, I had to repeat asking if she knew blended learning. It was also clear to note from the C1S that he did not know about blended learning when I posed the question to him:

> ***"Eh, No, no, no don't." – C1S***

The school also did not have any support staff or support committee to assist teachers during the implementation of blended learning. The C1P and the C1T conveyed this information. Again, the school lacked institutional support (Tuiloma et al., 2022; Alammary et al., 2014;).

I further wanted to understand the exposure of the C1P and C1Ls to social media and its usage during the Physical Sciences learning process. I, therefore, asked questions on the knowledge and use of WhatsApp, Facebook, Twitter, and other social media platforms the teacher or learners may be using. It was therefore established during the pre-observation interviews that the C1T knows and does use the WhatsApp platform. However, he uses it with the Physical Sciences circuit group and the school staff group but not with the learners:

> ***"No, I don't have a group with my learners." – C1T***

Nonetheless, C1Ls indicated the existence of a Physical Sciences WhatsApp group that they use with their teacher. One C1L indicated the extent to which they engage with each other using the platform:

> ***"Somebody can send me a problem, and if I understand it, I give solution" - C1L***

They also indicated that their Physical Sciences teacher is also involved in the engagements on the WhatsApp group, contrary to what was said by the teacher. I later discovered that the C1Ls were Physical Sciences learners belonging to a different teacher. It was, however, refreshing to note the existence of such opportunities in Physical Sciences. The C1P concurred with what the learners shared with us. What is interesting to note is that teachers at school can use the platform to communicate or make announcements to learners, like asking them to do a certain task or even calling them to school for enrichment purposes:

> ***"For teaching? No. What we use WhatsApp for, it's eh, when we communicate with learners, let's say, eh giving a task or an activity to***

learners? If let's say I decide to give tasks on a weekend if I didn't have time to give them on a Friday. So I would use WhatsApp to the specific group of learners that I'm teaching, so besides that, ah, no teachers are using WhatsApp for teaching…. Yes, they use WhatsApp groups. They are able to communicate with learners, even eh, if one wants to bring learners to school on a weekend,. we do communicate with, we do communicate with learners that, tomorrow I need you, come to school, we are going to do this and this." – C1P

The learners indicated using the WhatsApp group to share previous question papers with documents such as study guides. Regarding the use of Facebook, it was only the C1S who indicated its use by learners during the writing of tasks and activities at home.

"Sure, some of the learners yeah. Yeah, they do. It said them through Facebook so that must be able to get information which they can they're in need of so that when they come to the school and then they are already in in knowing what is expected of them" – C1S

However, his story could not be corroborated by the C1T, C1L, and C1P, who indicated no use of Facebook social media in teaching and learning at the school.

"Yes. But in our school, no teachers." - C1P

Additionally, the C1T indicated not having a Twitter account:

"I don't have a twitter account." – C1T

Further, the C1Ls, along with the C1P and the C1S, indicated no use of Twitter in teaching and learning of Physical Sciences:

"same thing that I have explained. I don't know of any teacher using Twitter." - C1P

From the learner's perspective, it was positive to note that they indicated to be using YouTube for educational purposes. They indicated to be using it to access Physical Sciences lessons:

"The lessons, we just type in the topics" – C1Ls

Akgündüz and Akınoğlu (2017) reported that the use of social media for learning has a positive impact on the learning process. Therefore, its use in this case bolded well for the implementation of the RBLS.

I also posed questions regarding the use of the LMS to facilitate the learning and teaching of Physical Sciences. It was discovered that none of the participants (the C1T, the C1Ls, and the C1S) knew Google Classroom (GC). However, the C1P had some information about it but did not know of anyone using it at school:

"I heard of it……I just heard of it." – C1P

Further, all 4 participants (the C1T, the C1Ls, the C1P, and the C1S) were unaware of the existence of an LMS called Moodle. This presented an undesirable situation since Moodle provides a lot of advantages to learners during their learning (Kizito Bada, 2022).

The participants, except for the C1P, did not know an LMS called Blackboard. Fortunately for the school, the C1P was aware of the blackboard LMS as she is exposed to some of the learners using it at a university level:

"Blackboard. I just heard a Blackboard, being used by learners outside the school. But with us (she shook the head)" – C1P

According to Makena et al. (2022) Blackboard is not only the most used LMS at the institution of higher learning, but it provides learners with the ease of access, quick feedback, more advanced engagements, tracing, and promotion of creativity. It would be recommended if it was practiced in this case.

It was further refreshing to note the C1T`s exposure to LMSs such as the Microsoft teams and Zoom meetings which he used during Physical Sciences, circuit, and district meetings:

> ***"I don't use it but eh for, for meetings with the district or circuit level we sometimes use it." – C1T***

This was supported by the C1P, who indicated that her teachers are using Zoom Meeting for attending subject support meetings:

> ***"Eh, they are using it, but not to teach. They are using it let's say if there is a circular indicating that an educator should attend a meeting using either Zoom or Teams. They are able to use it, but not for teaching." – C1P***

It was also interesting to note that even the C1Ls are aware of Zoom meetings even though they were never exposed to it through teaching and learning.

However, during my three classroom observations, the C1T had never used that nor even referred to the C1Ls to the recorded Physical Sciences lessons. Using that opportunity would have been more beneficial to learners as Videoconferencing (VC) can potentially link participants from distant areas, which are learners' different homes (Hopper, 2014). Furthermore, VCs promote cooperative learning among learners (Hopper, 2014).

5.2.1.1. FINDINGS
5.2.1.1.1. CHALLENGES

a) Load shedding aided network issues.

The school and the area around it were not spared from pre-existing issues of power cuts. As such, the network was unstable, from being normal when there is no load shedding to being weak or unavailable during the load shedding period. This was due to the fact that the backup batteries in the towers lasted for 2-4 hours, which led the towers to heat up and became dysfunctional (Jacobs, 2021). Therefore, the mobile network, in this case, cannot be entirely relied on due to this instability.

The school had installed a reliable Wi-Fi network. According to C1P, the network is working, unless in the case of winds and rain where its signal is poor. The C1Ls also concurred with that, indicating that the Wi-Fi is password protected and they had access to it. I had an opportunity during my field observation to access the Wi-Fi router, which had a stronger signal. The Wi-Fi router relied on an external antenna. The C1T also indicated he had Wi-Fi at his home. This presented the teacher with an opportunity to engage his learners from the comfort of his home. This is a positive for learning since, according to Yapici and Akbayin (2012), a well-working internet connection can improve learners' attitudes.

However, the Wi-Fi is not spared from power cuts. The Wi-Fi router becomes useless during load shedding as it relies on the electricity connection. Unless there is an existing power backup, which is not present in the current school. This did not work in favor of the implementation of the RBLS as unstable electricity, which leads to an ineffective internet connection, has the potential to act as a barrier (Manurung et al., 2020).

b) Lack of institutional support for learners

Even though the school had provided support to the C1T by giving him devices such as a laptop and access to the Wi-Fi, the same privilege was not afforded to learners. The C1T indicated during the interviews, that there are no devices reserved for learners. The principal also alluded to the absence of programs where learners without devices are supported. During my field observations in a Physical Sciences classroom, I did not see learners using devices that the school perhaps owned. This demonstrated poor institutional support to the learners (Alammary et al., 2014). Research has proven that, if effective, institutional support can prevent impediments to implementing blended learning (Tuiloma et al., 2022).

c) Poor knowledge and lack of exposure to blended learning

There was little to no knowledge of blended learning. The C1T was alarmed when I asked about his knowledge of blended learning. He had asked me to explain blended learning first before he could answer my question. Even after the explanation, the C1T did not know about blended learning. The C1P also thought she understood what blended learning is all about until it was clear during her explanation that she had a misconception of blended learning. C1P confused blended learning with the implementation of technology.

The C1S also did not have any idea at all what blended learning is all about. This created a picture that blended learning alienates the school learning environment. However, the C1T indicated that one of his former colleagues used to apply blended learning as an approach to support teaching and learning. Unfortunately, he was seeing that from a distance. The C1T has never received any training in blended learning. This implied that the C1T was never exposed to this concept of blended learning. As a result, I viewed this as a challenge since research reports that knowledge of blended learning improves teachers' competence (Yan Ju & Yan Mei, 2018).

d) LMS non-exposure

Even though the C1P had some information about GC, none of the other participants knew what GC was all about. GC is a preferred LMS due to its user-friendliness and ease of use (Kumar et al., 2020). Moreover, in their study, Mohamad et al. (2022) discovered that most learners believed that employing GC as an LMS can amplify their ability to use their knowledge and comprehension effectively.

Likewise, none of the four participants (C1T, C1S, C1P, and C1Ls) had any idea what Moodle is. This was an unfortunate scenario as, according to Kizito Bada (2022), Moodle provides a number of advantages to the learning process. Further, it was only the C1P who had some information about the Blackboard LMS. This also impeded the advancement of effective blended learning as this LMS provides learners with ease of access, quick feedback, more advanced engagements, tracing, and promotion of creativity (Makena et al., 2022). Additionally, Blackboard allows learners to learn independently (Ali, 2017). Therefore, I must provide intervention in the form of training/induction to the C1T on that aspect.

5.2.1.1.2 OPPORTUNITIES

a) Availability of devices

Even though the school had several dysfunctional computers, it had a number of laptops that may be useful during the implementation of the RBLS. The eight laptops that the school had, belonged to different departments. As a result, they had the potential to come in handy during the implementation stage, because learners from this school come from disadvantaged rural backgrounds. Wherein some of them, if not the majority, owned smartphones. This worked in favour of effective learning as the use of mobile devices positively impacts learners' achievement (Ustun, 2019). That was substantiated by authors, Simões et al. (2022), who indicated that learners' use of computers is directly proportional to their academic success.

b) The flexibility of bringing along devices

The school's policies do not permit learners to bring devices to school. This impedes effective learning as mobile devices are reported to be too beneficial to the learning process (Ustun, 2019). However, the C1T did indicate a level of flexibility in the approach wherein learners are sometimes allowed to bring devices to school. The C1Ls shared the same sentiments. This flexibility could have come in handy in the implementation of the RBLS, since it provides learners with an opportunity to do many things, like uploading schoolwork and engaging with other learners (Sophonhiranrak, 2021).

c) Exposure to social media for learning

Social media is known to have a positive impact on learning (Akgündüz and Akınoğlu, 2017). It was important to understand its use in the teaching and learning of Physical Sciences. Moreover, how it could assist in aiding the implementation of blended learning. It was then discovered that even though the C1T had WhatsApp as one of the applications on his phone, he did not have a WhatsApp group with his Physical Sciences learners. This denoted a disadvantage for the advancement of effective implementation of the RBLS since WhatsApp has the ability to create a discourse in blended learning which is dialogic and interactive (Qamar et al., 2019).

However, it was refreshing to note that the WhatsApp group does exist in the school with the same subject – Physical Sciences, even though it was not with the C1T. This was according to C1Ls, who indicated that they use the group to engage with each other on concepts that may be difficult for some and easy for others, which correlated with Qamar et al. (2019) 's findings. The same sentiments were shared by the C1P, who indicated that the usage of WhatsApp is expected in the school, where teachers conveyed messages such as communication with learners to inform them to come to school for additional lessons. It was also exciting to note that teachers can send learners tasks through WhatsApp. According to Gon and

Rawekar (2017) WhatsApp is more supportive of the instructional, educational, and technical aspects of learning.

It was also exciting to note from the learners' perspective that they are exposed to YouTube for educational purposes. Learners indicated that they were able to watch lessons on the YouTube platform. According to authors, Moghavvemi et al. (2018), YouTube can be the most efficient when employed in the relevant subject, which is Physical Sciences in this case. Further, in their study, Fleck et al. (2014) found that learners have supportive views regarding YouTube. It would then be prudent for YouTube to supplement blended learning during implementation.

Even though research reported Facebook as popular (Chang & Leung, 2017), it was never used to support the teaching and learning process of Physical Sciences by the C1T. Neither was Twitter or any other social media utilized. Nevertheless, it was positive to note the opportunity for social media usage in blended teaching and learning of Physical Sciences through WhatsApp and YouTube.

d) VC software exposure

Even though the C1T does not use Microsoft Teams and Zoom Meetings to facilitate teaching and learning with his learners, he uses them to attend circuit and district meetings. This provided the C1T with exposure to the video conferencing software, which may be applied in the teaching and learning of Physical Sciences. This created an opportunity for blended learning as learners are reported to be positively responding to VC (Ulfah Safitri & Asrining Tyas, 2022).

Table 5. 2 A summary of challenges and opportunities for Case 1

CHALLENGES	**OPPORTUNITIES**
Load shedding aided network issues	Availability of devices

Lack of institutional support for learners	Flexibility in bringing devices to school
Poor knowledge and lack of exposure to blended learning	Exposure to social media for learning
LMS non-exposure	VC software exposure

5.2.2. CASE 2 – MATHOKO SECONDARY SCHOOL

5.2.2.1. DATA PRESENTATION AND DISCUSSIONS

The school and surrounding community were experiencing unstable mobile network connectivity from any of the mobile network providers. That is according to the C2T and C2Ls. The C2T indicated that the network was generally weak whether they were at home or even at school:

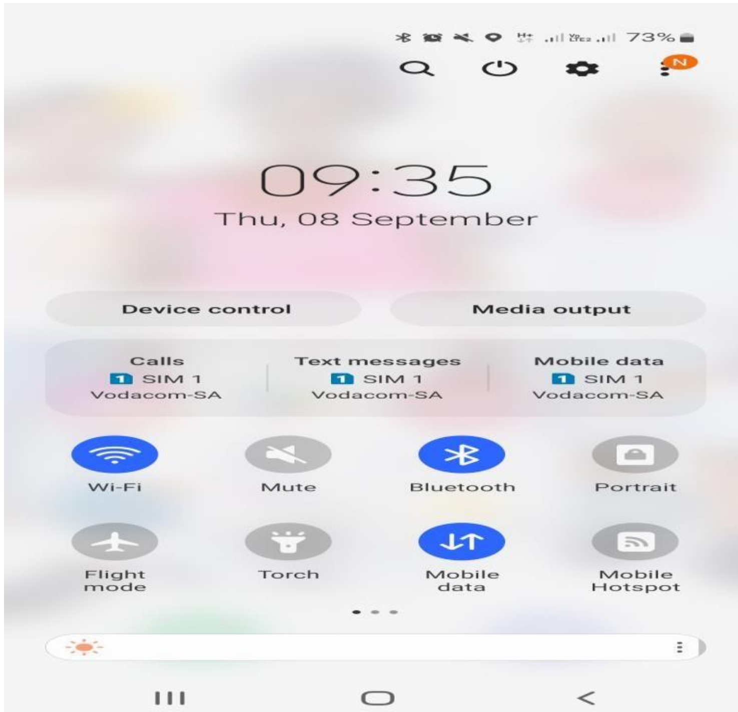
"The connectivity eh it's a bit weak." – C2T

That information was attested by the C2L, who indicated that:

"..at home sometimes it's, troubling" – C2L

During my field observations, I managed to check the mobile network signal, which was not as poor as indicated by C2T and C2L. The mobile signal was presented in picture F. Furthermore, it was the C2P`s testimony that aligned with what I observed.

Picture F: Mobile network signal for Case 2



The C2S gave a full picture of the extent of the problem:

> ***"No, at school we don't have a reliable network connectivity. Given eh load shedding and everything but we have to stretch ourselves to make sure that we, we address the internet and other things." – C2S***

Something that was initially mentioned by the C2T and the C2Ls:

> ***"eh because if there's load shedding is even worse."- C2T***
>
> ***"because load shedding, starts to give trouble…." - C2L1***
>
> ***"Yah (yes) it's the same because when it starts, it goes…." - C2L2***

Load shedding appears to be a common issue, as all participants are highlighting it. Manurung et al. (2020) have indicated in their study how electricity instability can impede effective blended learning. This was also alluded to by Babajide et al.

(2016), who indicated that power outages affect learners' way of learning negatively in such a way that they can no longer study effectively and engage in discussion forums and tutorials, which are consequently cancelled. The positive side of the story is that the school enjoyed a wonderful and reliable connection through a Wi-Fi network. According to the C2P, the school depends fully on the Wi-Fi network:

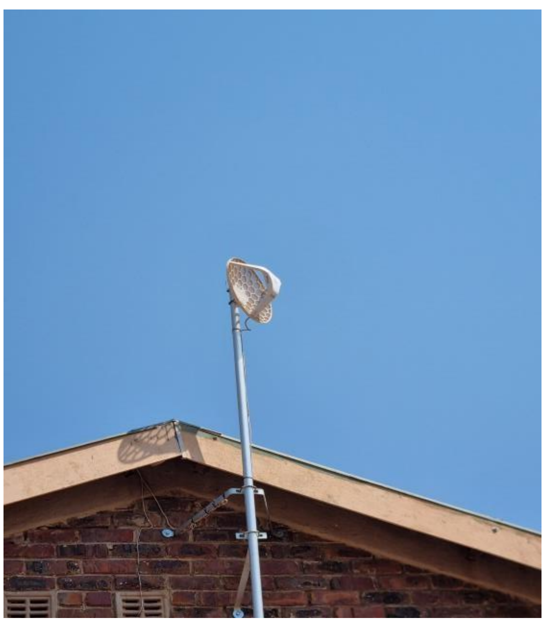
> ***"No, we only rely on the Wi-Fi that is there..." – C2P***

I was given access to the Wi-Fi connection during my field observation, and I can attest that it had a perfect signal. Further, according to C2T`s testimony, the router has a bigger radius that it can even reach classrooms:

> ***"Ah it's, 25 meters……25 meter radius….Yah, on classes yes it can reach us." – C2T***

I also managed to capture pictures of Wi-Fi antennae and a router which displayed a perfect signal as presented in pictures G and H.

Picture G: A Wi-Fi antenna for Case 2 Picture H: A Wi-Fi router for Case 2



Further to that, the C2P added that learners are connected and have access to the Wi-Fi, for as long as they are doing Grade 12:

> ***"No! Learners we don't buy them data they only have access from the Wi-Fi at school……Especially Grade 12 learners" – C2P***

Moreover, the C2T himself enjoys Wi-Fi connectivity even at his residence:

> ***"Yah (Yes) at home I've got Wi-Fi connectivity, plus mobile connectivity. Even at work." – C2T***

It was further refreshing to note during the interview with the C2P that, as a school, they can purchase data for teachers to be able to carry work from the comforts of their homes:

> ***"Yes, yes the school buys them data. So that they can connect even if they are away from school" – C2P***

The C2P further elaborated on the circumstances under which they buy them data:

> ***"No, we normally buy as per, per request. If the teacher wants to download something we buy data for that one." - C2P***

That was exciting to note as it implied that the school was doing all it could to support teaching to facilitate the proper delivery of learning. The school, therefore, had positive institutional support (Singh, 2003) for teachers. Researchers, Tuiloma et al. (2022) indicated that institutional support can prevent impediments to implementing blended learning. Unfortunately, the same leverage did not apply to learners. Unlike in the case of teachers, the school did not buy them data.

The C2T owns a smartphone which may assist him in accessing specific applications that may aid the implementation of blended learning. Regarding devices, the school had one laptop and one PC. However, according to the C2P, the school only had three laptops:

"No, we only have laptops" - C2P

The C2S expatiated more on this when I asked him if the school has devices like laptops and computers:

"Yah Yah! Obviously given the fourth industrial revolution and these things of robotics, and coding….Teachers as, as a phase and subject groups, have got their own, eh eh eh laptops…….Yah! But others have got their own personal, laptops. We ensure that each and every department, has got their own laptop for, purposes of eh teaching and learning." -C2S

The C2S further indicated the school to be having about four laptops in total:

"Yah! Yah. As far as I know we have got eh 3, the forth one is for the administration." – C2S

During my field observations, I managed to see four more PCs, apart from the four indicated laptops as presented in picture I.

Picture I: Mini-computer station for case 2

Another aspect to note was that the school's policies do not allow those learners with devices like phones, laptops, tablets, etc., to bring them to school. The C2S gave reasons during the interviews as to why:

> ***"We don't accept learners to, bring laptops. For purposes we feel somewhere they might misuse them. That's because we understand eh laptops can be used as, teaching and learning device, but ah for now to manage the learners, we don't accept them. We don't allow them to, to bring the laptops." - C2S***

The C2Ls also gave the same testimony but added that they are allowed to bring in devices in specific instances:

> ***"certain events, they sometimes do allow us to come with our mobile devices." -CSLs***

The same sentiments were mentioned by the C2P when I posed the same question to him during interviews:

> ***"Some! Not all of them. Especially those who are doing Science." – C2P***

Allowing learners to bring their own devices to school for learning may benefit the learning process as it is known to advance learners' achievement (Ustun, 2019).

What was also interesting is that learners were allowed to go to the computer minilab with the teacher to learn things like how to use a computer, surf the internet, and others. However, they do that with their teachers` supervision and assistance:

> ***"Yah we do, like I said we have got a mini, what can I say a mini computer lab where we normally take the laptops, like the computers there. So during study they go there with the educator and then they train them how to use them." – C2P***

This opportunity provided an advantage for implementing the RBLS as it relies on using computers (Al-Tamimi et al., 2022). Further, Simões et al. (2022) contended that the more learners use computers in their learning, the more they are likely to progress.

However, the C2P and the C2S did not know what blended learning is. This was established during the interviews. In fact, the C2P indicated to be hearing it for the first time, whereas the C2S had to ask me to explain more:

> ***"I am not sure about what you, you want, yes! Can you explain to me so that I give the correct answer?" – C2S***

It was then, after my explanation, that the C2S gave a response:

> ***"No, we don't, we don't do that. We rely much on, face-to-face." – C2S***

It did not surprise me that not only the teacher indicated his no use of teaching in blended learning, but he never used blended learning during classroom observation when he taught Physical Sciences. It was easy for me to note that he did not refer learners to what he posted or announced on the online platform in any of his three lessons on Electromagnetic radiation.

I also wanted to understand if the Physical Sciences teachers use social media to teach and learn Physical Sciences. I started by determining if the Physical Sciences teachers or any teachers at the school use Facebook for teaching. The C2P indicated that three teachers are using Facebook for teaching:

> ***"Uhmmmm the, but very few, I think they are about 3 that are using those. Uhmmmm (yes) ah the rest don't" – C2P***

It was clear during the interviews that the C2T is not one of those teachers who use Facebook to aid the teaching and learning of Physical Sciences. Further, I continued by asking if the C2T has WhatsApp and if he uses WhatsApp for Physical Sciences teaching and learning. The C2T responded as follows:

> ***"Yah I do use WhatsApp. Yah I do use it for the Physical Sciences group" – C2T***

The C2L confirmed that indeed there is a WhatsApp group for Physical Sciences in existence:

> ***"Yes, we do have a WhatsApp group" - C2L***

I therefore asked the C2T the purpose of the group. He indicated that its purpose ranges from giving announcements and information to uploading Physical Sciences previous question papers:

"No to communicate with the learners, share information, give them work, while they are at home. Give them notes, past papers questions. That's what I use it for." - C2T

That response was corroborated by the C2Ls, who highlighted the issue of receiving past papers and getting instructions to come to school for enrichment purposes:

"Ah we are given question people's to like practice. so that we can be able to get what we're going to write about in exams and common tests." - C2L1

"Sometimes they send out question papers. Sometimes they tell us to come to school on, weekends." – C2L2

That is consistent with the information the C2T gave when he was asked about how he gives instructions to the learners:

"WhatsApp! Maybe when they are not at school, I communicate with them through WhatsApp." – C2T

The C2S also added to that by indicating that learners (their children) do indeed receive work instruction through WhatsApp from the comfort of their homes and send the work back to the teacher in a hard copy. The C2S further highlighted the significant role WhatsApp plays in fuelling engagement between the teacher and his learners:

"No, they normally connect learn- they have a chat group with learners then in case, learners have a problem then, they pose their problem in the WhatsApp group and then the teacher will respond" – C2S

This is so since, according to Gon & Rawekar (2017), WhatsApp is more supportive of the instructional aspect of teaching.

Interestingly, the C2S portrayed the significance of WhatsApp groups in aiding parental involvement. It is through WhatsApp that parents are able to know if there are tasks that they are required to assist their children with:

> ***"They don't use eh what Facebook. They use WhatsApp groups for purposes of, sending us, or parents, activities that need the attention of the parent at home. Each and every grade, has created their own WhatsApp group. But if they have got, eh something, eh perhaps in a particular subject, that is meant for, for all the parents but unfortunately, not all parents can have access to social media" – C2S***

However, during the classroom observations of three Electromagnetic radiation topics of Physical Sciences, I never heard the C2T asking or referring to the uploads or communications in the WhatsApp group. Likewise, it was also determined during the pre-observation interviews from the four participants that neither Twitter nor any other social media were used in the teaching and learning of Physical Sciences.

Therefore, I elevated my inquiry to the use of LMSs in teaching Physical Sciences. I started by asking the C2T if he knew GC, and he indicated his awareness of the LMS. It was then determined that he has never used it with his learners, even though he had confidence of using it:

> ***"No, I'm not using it…. Yah, I am able to use it." – C2T***

The C2T seemed correct since one of the C2Ls knew nothing about this LMS. That was also supported by both the C2P and C2S, who indicated no use of the LMS in school at all, even though the C2S was aware of it:

> ***"No! I have heard of it, but it has not been practiced here at our school." – C2S***

According to Kumar et al. (2020), Google Classroom is a preferred LMS due to its user-friendliness and ease of use. It would have been an advantage if the teacher employed it to support learning of Physical Sciences. Neither Moodle nor Blackboard was practiced at school for teaching Physical Sciences or any other subject. Therefore, I inquired about using Microsoft Teams in the teaching and learning process of Physical Sciences. I asked him during the pre-observation interviews if he knew Microsoft Teams, to which he responded:

> ***"I do know Microsoft Teams." – C2S***

However, he never used it in the teaching and learning of Physical Sciences. During the pre-observation interviews, I also checked about his familiarity with Zoom meetings, which he indicated to be conversant with. This was confirmed during the interviews with the C2P. The C2P went further to indicate that the C2T uses both Zoom and Microsoft Teams during meetings at their circuit and district level:

> ***"Yah normally when they attend meetings, eh not, not for teaching……. Yah it's Microsoft Teams and Zoom they use that, but for meetings not for teaching." – C2P***

That itself may be an advantage during the implementation of blended learning, as videoconferencing has the potential to foster collaboration among learners (Hopper, 2014) and promote social presence (Anastasiades, 2009). Physical Sciences curriculum always encourages active learning (DBE, 2011), which this mode was likely to provide.

I then wanted to understand if the school has a committee dealing specifically with blended learning. The intention was to understand the institutional support of blended learning. The C2T during interviews indicated the absence of such a committee. This was in contrast with what the C2P told me during the interviews:

“No, we are very lucky because we have got one, who specializes in IT. So, he sometimes teaches them, especially those who are willing. He assists them a lot…. It’s just an IT, it’s an IT committee. Consisting of 3 teachers.” – C2P

The C2P further indicated that the committee assists both the teachers and learners. That meant the school had positive institutional support (Tuiloma et al., 2022; Singh, 2003) that was provided to the teachers. However, I never heard C2T referring the learners to the committee for assistance during the classroom observations of his three lessons on the Electromagnetic radiation topic. The C2S mentioned another example of the support being provided as a form of induction for novice teachers:

“Yah there is a committee, Especially the SMT, the School Management Team…those are the people that are responsible for, eh supporting these new especially novice teachers eh other methods of teaching especially these one of creating the WhatsApp group. Is because of the efforts of that committee.” – C2S

The C2P also mentioned the existence of a policy that gives guidance on the use of blended learning/online learning:

“Yah (yes), the policy is there. Without the policy otherwise, it might be misused.” – C2P

But the C2S gave clarity on what the existing policy is all about, which is the issue of bringing or not bringing phones to school:

“No we don’t, we don’t have such a policy. We only have a policy on the use of cell phones. But not on online. We have got a policy that gives direction on how learners should use eh eh wire, cell phones, not online. That one is not existing, it’s not there in our school.” – C2S

5.2.2.2. FINDINGS

5.2.2.2.1 CHALLENGES

a) Power cuts affected the network issue.

The testimony from the participants was mixed, with C2L and C2T indicating poor network connection, whereas the C2P's and C2S indicated a better network and a load-shedding affected network, respectively. The issue of load shedding is dominant in the area in that it puts almost everything to a stop. The Wi-Fi network, which is well-connected and has a good signal, is not spared during power cuts. What was positive to observe was that the Wi-Fi covers a bigger radius, including the classroom area. However, the school did not have an electricity backup, resulting in the Wi-Fi routers becoming dysfunctional during power cuts. Therefore, in the absence of an electricity backup, this electricity instability created a barrier to the effective implementation of the RBLS (Manurung et al., 2020). Research by Babajide et al. (2016) has reported that power outages negatively affect learners' learning, so they can no longer study effectively and engage in discussion forums and tutorials, which are consequently cancelled.

b) Poor institutional support for learners

Even though the school provided teachers with data to use after work as per request, it did not offer learners the same leverage. The school also did not have a programme that accommodated learners without devices. This was a downside to the learning process, as effective institutional support could have prevented impediments to the implementation of the RBLS (Tuiloma et al., 2022).

c) No traces of blended learning implementation and policy

Both the C2P and C2S did not know what blended learning was when I interviewed them. The C2P indicated how he first came across the word when I interviewed him, prompting me to first explain what blended learning is. The C2T, as a result, did not only fail to use blended learning during my lesson observations but indicated to have never used it before during the interviews. This was a disadvantage to the learning process since blended learning holds many benefits. According to Sheerah (2020), blended learning allows learners to be the architects and utilizers of their own knowledge and not just passive spectators in their learning. Other authors report that learners highly recommend blended learning based on their preferences, the depth of technology employed, and the gains thereof (Li et al., 2020).

It therefore did not come as a surprise that despite the C2T and the other participants indicating their knowledge of different LMSs, none indicated the use of such in the school. The LMSs are the drivers of the blended learning platforms, and hence their exposure to the facilitators could have played an important role in implementing blended learning. The C2T had some exposure to GC even though he never implemented it in the teaching of Physical Sciences. Bringing it to the Physical Sciences classroom could have come with benefits as the GC platform amplifies learners' ability to use their knowledge and comprehension effectively (Mohamad et al., 2022).

Both Blackboard and Moodle were never used in the teaching and learning of Physical Sciences. This was a downside to effective blended learning since Moodle carries a lot of advantages which include accessing learning materials, simplified administration, sufficient teaching, favourable learning contexts, affordable learning opportunities, flexible and engaging learning, and a great opportunity to learn through technology (Kizito Bada, 2022). Moreover, Blackboard LMS allows users to access tools such as portfolios, subject contents, "virtual classroom, discussion forum, assignment and test, emails and grader center" (Almekhlafy, 2020, p. 19).

5.2.2.2.2 OPPORTUNITIES

a) Institutional support for teachers

The C2P had indicated that teachers at school are given data to go and use after working hours as per their request. This allowed teachers to download subject relevant resources and continue their work from the comfort of their homes. This denoted good institutional support for teachers (Tuiloma et al., 2022). Fortunately for the C2T, he enjoyed the privilege of the data provided by the school SGB and had a Wi-Fi network at home. This was an advantage to implementing RBLS as the teacher could communicate and share relevant resources with the learners.

b) Availability of devices/computers laboratory

Apart from the laptop and smartphone that the teacher owned, the school had four laptops and 4 PCs in a mini-computer laboratory. Learners were given access to the computer lab, where they would go during study time under the supervision of the teacher, to learn, amongst others, computer skills. This presented an opportunity during the RBLS implementation in that learners could download and upload resources like previous question papers and additional learning materials. This is because computers are the cardinal point of blended learning (Al-Tamimi et al., 2022).

Moreover, learners are, in some instances, allowed to bring devices to school. This had the potential of favouring the implementation of the RBLS as learners who, at the time, would be connected to the Wi-Fi network, and could upload and download different resources such as homework activities. Sophonhiranrak (2021) adds to that by indicating that mobile devices can be used as instruments for learning by assisting learners in uploading homework, having self-reflection on one’s learning process, and sharing views.

c) Social media-assisted learning

With the Facebook application being used by some teachers to aid the teaching and learning process, the C2T was not one of them. However, his use and exposure to the WhatsApp application could not go unnoticed. The C2T created a WhatsApp group for Physical Sciences wherein he communicated with learners, exchanged information, sent work/activities and subject-related resources. This worked to the advantage of the implementation of the RBLS as WhatsApp created a discourse in blended learning which is dialogic and interactive (Qamar et al., 2019).

The WhatsApp group effectively promoted parental involvement in learners' work. The C2P indicated that each grade had its own WhatsApp group where teachers engaged with parents. It was noted that during the lesson observations that I made in the Physical Sciences classroom, there was no indication of any engagement or reference to materials sent on the WhatsApp group. Likewise, the teacher did not apply Facebook in his teaching, despite it being the most preferred social media application for learning among learners (Chang & Leung, 2017). There was also no reported use of Twitter and other social media platforms.

d) Exposure to video conferencing

The C2T is conversant with Microsoft Teams and Zoom meetings even though he has never used them during the teaching and learning of Physical Sciences. The C2T reported to have used the two-videoconferencing software during the circuit and district support meetings. This was confirmed by the C2P, who emphasized that teachers use the software for meetings and not for teaching. VCs are known to remove the physical distance when learning is done remotely since learners can listen and view each other live (Hopper, 2014). It is through VC that group/cooperative learning and interaction among learners are fostered (Hopper, 2014). Therefore, using blended learning, the C2T may choose to have live sessions or synchronized sessions and asynchronous sessions. The asynchronous sessions allow the teacher to post announcements and assignments in their own time while also allowing learners to respond to teachers and other learners in their own convenient time (Hew et al., 2010).

e) Organizational capacity/ institutional support

The C2P had indicated in interviews that an ICT committee is in place made of three teachers. The committee is said to assist other teachers and learners with support on IT-related issues. This provided an opportunity for Organizational capacity, which may have assisted with blended learning logistics (Moskal, 2013). In the process, learners were taught how to use the LMS, how to upload and download documents and engage with their counterparts and teachers in the process.

Table 5. 3 A summary of challenges and opportunities for case 2

CHALLENGES	OPPORTUNITIES
Power cuts affected network issues	Institutional support for teachers
Poor institutional support for learners	Availability of devices/computers laboratory
No traces of blended learning implementation and policy	Social media-assisted learning
	Exposure to video conferencing
	Organizational capacity/ institutional support

5.2.3. CASE 3 – BAFETI-BA-TSELA SECONDARY SCHOOL

5.2.3.1. DATA PRESENTATION AND DISCUSSION

The school had a normal mobile connection. That is according to the C3T:

> ***"No, I don't experience challenges. Because I am able to download, the question papers." – C3T***
>
> ***"Yah. and even download some videos online yah." – C3T***

The only challenge came when they were home, where the network was not reliable. However, the C3Ls indicated during the pre-observation interviews what contributes to the network challenges:

"Oh! the thing, when the electricity is off, as you can see that we are dealing with load shedding right now. So the network connectivity is very bad during load shedding but, at home generally it is good" – C3Ls

Both the C3P and C3S confirmed that. The C3S denoted that:

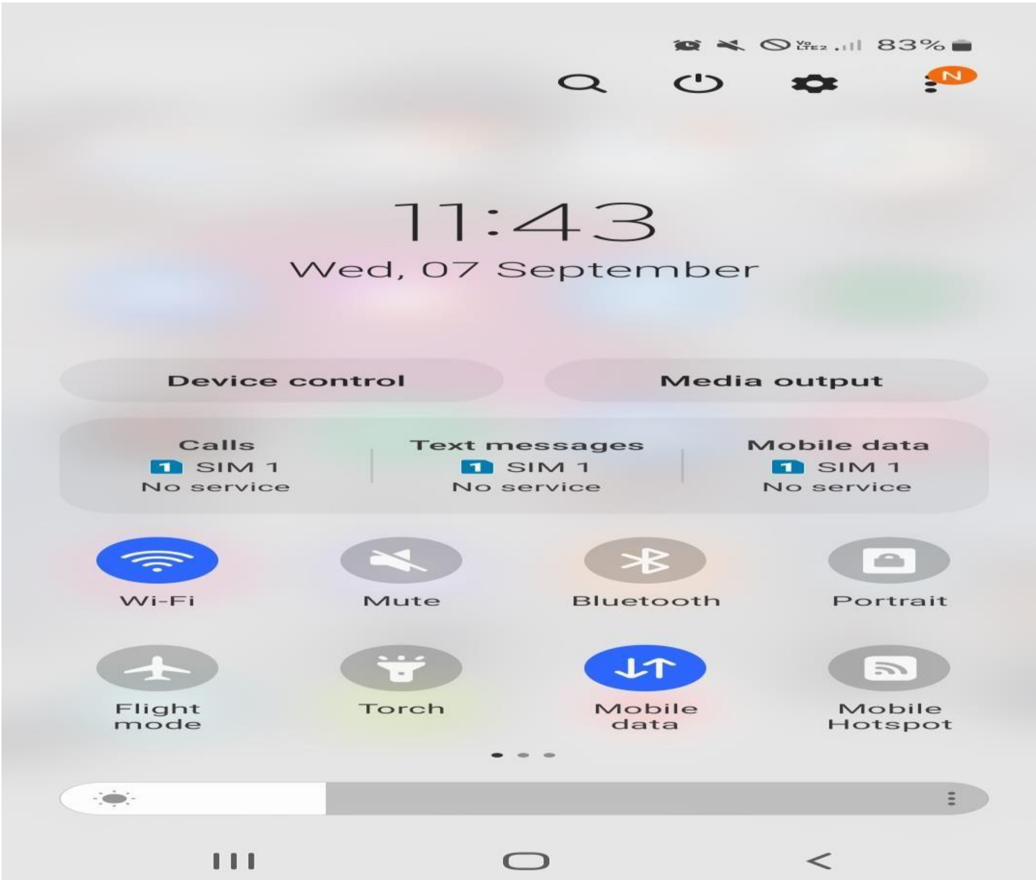
"at home, the network depends entirely on the availability of electricity. The network is giving us problems in the case the electricity is away for, for instance 3 hours" – C3S

That aligned with the C3T`s testimony who, further denoted that:

"isn't it this nowadays there is this load shedding. Yoh cause sometimes yoh electricity will go at 11 and come back at 1 o' clock here at school. And then at home then 3, from 3 up to 5, ah you know. Uhmmm, it's a problem" – C3T

I managed to go around the school vicinity at a time when the electricity was off and can confirm that there was poor mobile network reception as presented in picture J.

Picture J: Mobile network at Case 3 surrounding homes



Load shedding seems to be a common issue in the area of Sekgosese. One cannot disregard its negative impact on effective teaching and learning (Manurung et al., 2020). However, what was positive to note during my interview with the C3P was that the school installed a very reliable Wi-Fi connectivity:

> ***"Eh, the one which we have is a Wi-Fi" – C3P***

That aligned with what the C3S shared with us during the interviews:

> ***"What I know is that we have Wi-Fi that even us as SGB members are connected to" – C3S***

The same sentiments were shared by the C3P, who went further to indicate who else is connected to the Wi-Fi:

> ***“Okay. Those who are using the, the WI-FI eh the teachers, all of them, myself as the head master, our non-teaching staff, together with the SGB members when they go to join meetings, they have access to our WIFI.” – C3P***

Unfortunately, the same privilege was not shared with learners who were not connected to the Wi-Fi. The C3S explained why:

> ***“No. Because we might think they are coming to study only to find that they are here to use Tik-Tok app” – C3S***

Consequently, that may have a negative impact on the advancement of social presence which authenticate learning (Garrison et al., 2000) in the online world (Oh et al., 2018)

However, there was an indication of flexibility from the C3S`s perspective:

> ***“we can connect them if ever there’s a need” – C3S***

The C3P made a similar indication:

> ***“Only when there is have, the same need. Where in, we, we, we, we will have to make use of the laptop of our school to connect them.” – C3P***

I managed to access the Wi-Fi connection during my field observation which seemed to be having a good signal as presented in Pictures J and K.

Picture K: The Wi-Fi router for Case 3 **Picture L: The Wi-Fi for Case 3**

The C3T owned a smartphone, something positive given the advancement of a smartphone in the world of technology and innovation:

> ***"Yeah (yes), I do have eh a phone. The one that I use to download the question paper and other materials, that I use with my learners.***
> ***Yah (Yes)" – C3T***

But that was not the only device the C3T owned and had access to:

> ***"Ah! Mine is laptop and my cell phone. But here at school, we also have access to the projector." – C3T***

I was also very interested in knowing the number of devices the school has, with the implementation of blended learning in mind. So, I asked the C3P about the devices in existence and their total. The C3P indicated the school to be having three laptops and five PCs:

“We have a, we have eh, laptop and computers. Okay. In terms of eh laptops we, have got three. Then eh the computers for the school we have got five.” – C3P

During my field observation, I did note that the school had a wonderful computer laboratory that housed about 10 PCs as presented in picture M.

Picture M: A computer laboratory for Case 3

This created an advantage to the teaching and learning of Physical Sciences since computer-based learning is known to increase the chances of learners’ academic success (Simões et al., 2022).

What was positive to note was that learners were given access to the laboratory. Contrary to what the C3S said in the interviews, she indicated that only the teachers and admins could access the devices at school. However, the C3P said to me during interviews that learners can access the laboratory during study time:

“We, we, we are able to can, let learners make use of them. Are able to get some basics from computer. And lower Grades we will give them more time to learn those basics.” – C3P

I can attest that during my lesson observations where the C3T was teaching the Physical Sciences topic, I did hear him referring his learners to go and do more research in the computer laboratory.

In addition, the school's policies did not permit learners to bring their own devices in the school premises. That was what the C3T shared with me during the preobservation interviews:

> ***"Cell phones are not allowed at all because if a learner is found with a cell phone that's simply going to be taken from the learner." – C3T***

This was in line with what the C3P and C3S said in the interviews. In fact, the C3S went more to indicate the punishment, similar to what was said by the C3T:

> ***"As long we see a phone, the policy says we must confiscate it" – C3T***

I can attest that during my classroom observation of the Physical Sciences, I did not see any learners using a phone for reference or as learning material. Neither did I hear the C3T referring learners to documents or sites on their phones. The use of mobile devices is known to yield positive outcomes on learners' progress in class (Ustun, 2019). Sophonhiranrak (2021) indicates the advantages provided by mobile devices in the learning process, where learners can share resources and their views on the content they are learning. Therefore, not allowing phones during the learning process impedes effective learning.

I went into the space of social media as the LMS. I wanted to understand how the C3T and the learners use social media to support the teaching and learning process of Physical Sciences. I then asked the C3T during the pre-observation interviews if a WhatsApp group exists for Physical Sciences. The C3T indicated the existence of the group chat. In agreement, the C3P, in his interviews, did allude to teachers at the school using WhatsApp to support teaching and learning.

The C3T then further indicated the challenges experienced in using the WhatsApp group:

> ***"Yeah, I do have. But the problem is there are these learners from poor background. Because others they say the following day ma'am I have problem with the data, this and that. But then the group for Physical Sciences I have it. But challenge is other learners, they don't have data because of their background yah." – C3T***

Furthermore, I wanted to understand how the WhatsApp group is used and for what purposes. The C3T indicated that:

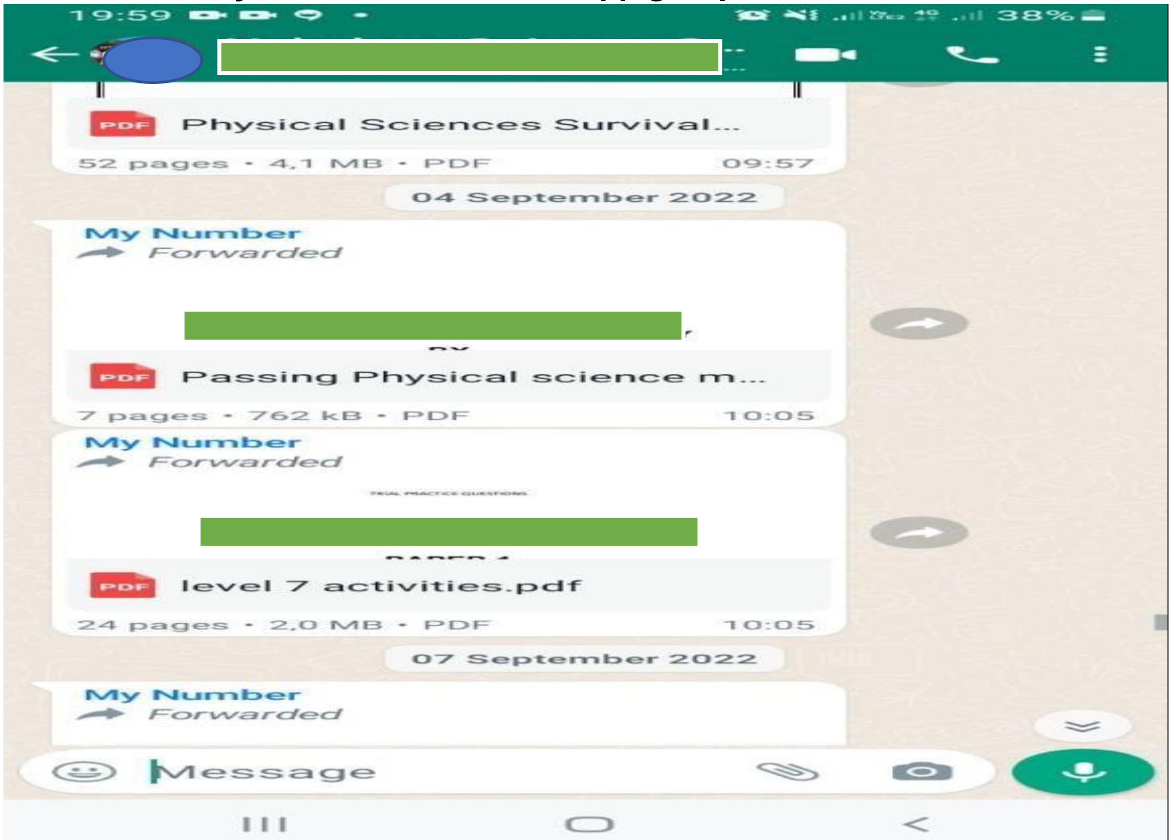
> ***"To inform the learners if they have question they can ask. But, But it's after school hours. Because they are not allowed to access cell phones. Eh after school hours is where they can ask questions if they are experiencing challenges. Its where I will save the videos for, for Physical Sciences the ones that I downloaded for them. But not all of them are able to access those things because of, problem ya data (data issues)." – C3T***

The C3Ls shared the same testimony during the focus group interviews:

> ***"No through WhatsApp we get exercises and memos, that our teachers give to us." – C3Ls***

The teacher managed to send me some screenshots of the Physical Sciences WhatsApp group communications as presented in picture N below.

Picture N: A Physical Sciences WhatsApp group communication



This was good to note since WhatsApp is proven more advantageous to learning as it borders on the instructional, educational, and technical aspects of learning (AlTamimi et al., 2022). However, during the three lesson observations of the teaching and learning of the Electromagnetic radiation of Physical Sciences, I never heard the C3T instructing or referring learners to the WhatsApp group chat announcements or posts. I asked him if he had ever engaged with learners through WhatsApp in between those observed lessons, to which he responded by saying:

> ***"Yah I did. As I was leaving I had to send some activities to do at home yah." – C3T***

However, he could not corroborate the story with WhatsApp screenshots I had later requested.

I then inquired about using Facebook to support the teaching and learning of Physical Sciences. The C3P indicated that not all teachers are using Facebook in their teaching and learning process:

> ***"Eh let me say not all of them. Sometimes, sometimes they do not" – C3P***

The C3P`s story was confirmed when I asked the C3T if he used Facebook in his teaching of Physical Sciences. He responded by indicating he had not used Facebook for some time. What was interesting to note was that learners themselves were already ahead in terms of the use of Facebook, where they were engaging with their peers from different provinces and different countries:

> ***"Uhmmmm (well)! On Facebook there are these specific groups where we have people from different countries…different provinces where we share ehh types of question papers, the work that has been done. We share different things, and different ideas so that we can help each other. So, we use Facebook as creating groups and monitoring each other during Physical Sciences activities." – C3Ls***

This did not come as a surprise as Facebook is more popular among learners (Chang & Leung, 2017). The teacher also did not have a Twitter account. It was for that reason C3Ls were never exposed to it:

> ***"No, we don't use Twitter" – C3L***

However, it was exciting the learn from the C3Ls about an application called Japanese Society for Dialysis Therapy (JSDT) Solutions:

"The only smart App that we use that we are connected to, is the JSDT solutions…. The JSDT solutions. It is an App that provides learners with different subjects and memos." – C3L

Having learners exposed to social media is more advantageous to the learning process as it increases learners' motivation (Akgündüz & Akınoğlu, 2017). I then inquired about the knowledge and the use of the LMS in supporting the teacher and learning of Physical Sciences. It was then discovered during the interviews that the C3T had no knowledge about GC. It was not surprising that all three other participants – the C3Ls, the C3P, and the C3S indicated the non-use of GC to support and manage the teaching and learning of Physical Sciences. The participants were also not aware of Moodle and Blackboard.

I explored their knowledge or use of the video conferencing applications such as Microsoft Teams and Zoom meetings. The C3T indicated his knowledge of Microsoft Teams but indicated he is not using it in Physical Sciences. The same was with his experiences in Zoom Meetings. The C3Ls confirmed that by indicating they are not using it in the learning of Physical Sciences in the current school. However, it was interesting to note that one C3L used Zoom Meetings for learning in her previous school:

"Yes. I used it in the previous school" – C3L

Even though it was used to learn Mathematics:

"Well we used to do…with Mathematics classroom" – C3L

That is positive as VCs encourage collaboration and engagement among learners (Hopper, 2014).

Further, the classes were recorded and not Live:

"It was recorded" – C3L

This meant learners would access the lesson conveniently without worrying about issues such as power cuts.

The C3T claimed to have used blended learning, even though it was not formalized:

> ***"Yeah (yes), I do. But it's not formalized and it's not during the school hours I do that after school hours. Isn't it school learners are not allowed to access their phones here at school." – C3T***

I did hear the C3T referring to learners during the classroom observations to go to the computer laboratory for more research on Electromagnetic radiation. Therefore, I asked him if he made a follow-up, and he indicated that he did not. When I asked about his choice of not making a follow-up, the C3T indicated that the learners gave him verbal and written feedback. I then asked if it was a formal task, and he responded as follows:

> ***"Ah no! Ah, it was not a formal task. It was for enrichment purposes." - C3T***

These occurrences provide an opportunity to formalize blended learning of Physical Sciences in the school. The school enjoyed the existence of an ICT/media committee made up of five members who are teachers. The positive thing is that the participant teacher is part of the committee despite his lack of computer/ICT training. The principal indicated that the committee is responsible for, among others, assisting in the computer laboratory. During my field observation, I managed to talk to some members of this committee who outlined their responsibilities as ranging from assisting learners in searching for information on the internet, applying for bursaries and universities (institutions of higher learning), and providing classroom support, such as setting up a projector for teaching and others. This was indicative of effective institutional support (Singh, 2003) that exists at the school.

Furthermore, the Physical Sciences classes are not overcrowded as C3T indicated that the Physical Sciences classrooms have learners in the following order:

> ***“Grade 10 they are 24, then 11 -17, 12-17.” – C3T***

This aligned with the C3P testimony during the interviews when I asked if the classes had enough spaces:

> ***“In terms of classes we we we have, let me say enough though some of the grades is not. With our FET, its enough because we are having a classroom having +-40 learners. And then, GET (General Education and Training) is the one which is a challenge. Because eh in a class we having more than 50 learners.” – C3P***

Having classes that are not overcrowding reduces the barriers to learning while at the same time fostering social interactions (Tayeg, 2015).

5.2.3.2. FINDINGS

5.2.3.2.1 CHALLENGES

a) Load shedding affected network connection

The C3T indicated that there is a limited challenge that he is experiencing since he was able to download question papers and videos. However, the challenge is that the network signal is poor when they are home. The main challenge was vested in the issue of power cuts which are predominant in the area. During the hours of load shedding, the network connective is at its poorest. The towers become dysfunctional due to the backup batteries that cannot hold up for long, resulting in poor network connectivity. As a result, that may provide an inconvenience to the learning and teaching of Physical Sciences.

The school also had an effective Wi-Fi connectivity and I had the opportunity to have access to its router and antenna during my field observations. The Wi-Fi demonstrated a good signal. However, the router relied on the electricity connection and was rendered dysfunctional during power cuts. Since the school did not have a backup, the school remained disconnected during the load-shedding hours. This presented us with a challenge for the implementation of blended learning in a Physical Sciences classroom (Manurung et al., 2020)

b) No cell phones allowed.

The school's policies do not allow learners to bring cell phones to school. In fact, according to the policies, cell phones will be confiscated from learners if ever they were to be found in their possession. This created a barrier to effective blended learning as mobile devices positively impact learners' achievement, increasing learners' motivation in the process (Ustun, 2019). Likewise, mobile devices can be used as an instrument for learning by assisting learners in uploading homework, sharing views, and self-reflecting (Sophonhiranrak, 2021)

c) No exposure to the LMS

LMS are the main drivers of the blended learning approach and are known to have the ability to increase learners' satisfaction when implemented in the learning process (Padalia & Natsir, 2022). However, it was disappointing to note that none of the participants knew about GC, Moodle, and Blackboard. It was also not evident during the lesson observation of Electromagnetic radiation in a Physical Sciences classroom. This was a disadvantage to the learning process as GC is known to amplify learners' ability to use their knowledge and comprehension effectively (Mohamad et al., 2022). In addition, Blackboard allows learners to learn at their own pace (Ali, 2017), whereas Moodle is known to allow users to access tools such as portfolios, subject contents, “virtual classroom, discussion forum, assignment and test, emails and grader center” (Almekhlafy, 2020, p. 19).

5.2.3.2.2 OPPORTUNITIES

a) Connectivity of learners to the Wi-Fi

The C3P had indicated that only the teaching staff and the SGB are connected to the Wi-Fi network. The C3S had indicated that they did not connect learners with a fear of them using it for non-educational purposes. This created a disadvantage to the effectiveness of the teaching and learning process as learners' attitudes towards learning improve when they learn through online connections (Yapici & Kbayin, 2012). However, the C3P and C3S indicated that there is always a level of flexibility where learners can connect when needed. There was a need during the implementation stage of the RBLS, and this provided an opportunity.

b) Availability of a computer laboratory

Despite the smartphones and laptops that the C3T owns, the school has a computer laboratory that houses about ten computers. C3Ls already have access to the computer laboratory. The C3P indicated that learners get the basics of computer use, with more time given to those in lower grades. During the lesson observations of the Physical Sciences’ topic of Electromagnetic radiation, the C3T did refer C3Ls to the computer laboratory for further research. This was a plus to the implemention of the RBLS in Physical Sciences since computer-based learning is known to increase the chances of learners’ success (Simões et al., 2022). Moreover, AlTamimi et al. (2022) noted computers as the cardinal point of blended learning.
Therefore, blended learning has some, if not most, dependence on computer usage.

c) Social media-aided learning

The C3T had created a Physical Sciences WhatsApp group that he uses with C3Ls. However, the teacher demonstrated that some C3Ls are unable to access it immediately, highlighting the issue of data that C3Ls raised from poor backgrounds. However, the C3T indicated that with those that are able to access WhatsApp, he normally shares things like videos and engages in discussions with C3Ls about content they did not understand. The C3Ls also indicated that the C3T shares things like exercises and memorandum with them.

This is a positive for the effectiveness of the teaching and learning process as WhatsApp has the ability to create a discourse in blended learning which is dialogic and interactive (Qamar et al., 2019). WhatsApp is more advantageous to e-learning as they are more supportive of the instructional, educational, and technical aspects of learning (Rawekar, 2017). Facebook is another social media platform known to support the teaching and learning process. It is one of the most preferred social media platforms among learners (Chang & Leung, 2017). It, therefore, did not come as a surprise that even though the teacher is not using it with his Physical Sciences learners, the learners themselves are more active in it in that they are able to engage with learners from different provinces and countries. The C3Ls indicated that they use the Facebook application for, amongst other things, to share question papers, engage on work that is already covered, and share ideas.

There was no use of Twitter in the teaching and learning of Physical Sciences. However, it was discovered that some C3Ls make use of another smart App called Japanese Society for Dialysis Therapy (JSDT) Solutions. They use the application to access different subjects and resources, such as question papers and memorandums. This exposure to a number of social media platforms increases learners' motivation (Akgündüz & Akınoğlu, 2017).

d) Video-conferencing exposure

Even though the C3T never used VC with Physical Sciences, both the C3T and C3Ls were exposed to the VC software. One C3L indicated how she was exposed to the Zoom Meetings from her previous school, where it was used during the teaching and learning of Mathematics. This exposure created an opportunity for the implementation of the RBLS since VC did not only eliminate the geographic distances between learners and teachers during weekends, holidays, or after hours but fosters group/cooperative learning and can provide C3Ls an opportunity to interact with their peers (Hopper, 2014). As a result, the C3T can choose to use live synchronized sessions or recorded synchronized sessions, which allow learners to access learning at their convenient times (Hew et al., 2010)

Table 5. 4 A summary of challenges and opportunities for Case 3

CHALLENGES	OPPORTUNITIES
Load shedding affected network connection	Connectivity of learners to the Wi-Fi
No cell phones allowed	Availability of a computer laboratory
No exposure to the LMS	Social media-aided learning
	Video-conferencing exposure

5.3. EXTERNAL STAKEHOLDERS

This section focused on data presentation, discussions, and findings from the external stakeholders such as community leaders, network service providers, and the Physical Sciences Senior Education Specialist. I use the pseudonyms that are indicated in Table 5.1 above.

5.3.1. Community leaders (C1CL, C2CL and C3CL)

5.3.1.1. Data presentation and discussion

The community leaders during the interviews gave a picture of the network in their area. CLC2 indicated how the network becomes highly affected during power cuts. However, mobile service providers do not lose network signal the same way.

"Yes Yeah, right. Yes. Okay, right network 2 is not affected by electricity. network provider 2 doesn't trouble for 2 hours. if you move you can find connectivity with network provider 2, but not the case with network 1" – CLC2

This concurred with Jacobs's (2021) observations that backup batteries in the towers can last between 2-4 hours, consequently having the towers heat up and become dysfunctional. The same view was shared by the CLC2:

"it's only the challenges of eh, load shedding and load- reduction." – CLC2

However, the CLC2 highlighted the privilege that some community members enjoy:

"it's only the challenges of eh, load shedding and load- reduction." – CLC2

The CLC3 shared more about the extent of the problem in his area. According to his observation, one has to move around the area to find connectivity:

"Truly speaking, it's a, it's a problem, because when you check from one site to another, you may find that if you connect, well, I'm busy talking with you now, when you shift to another area, the networks to be a problem. And when you move from one area to another, the problem

persists simply because of the connectivity. I think if possible, maybe the network providers like your [network provider 1] or [network provider 2] and they should ever come up with, with a way of refurbishing, they are they are they are what you call they are they are sites where we connect the what you call the cloud.
Okay, actually, it's a problem." – CLC3

Furthermore, the CLC1 indicated the availability of a number of Wi-Fi hotspots found in shops where learners get access:

"but there are other people using Wi-Fi, where some learners, can access that free of charge, especially in shops,…of these foreign nationals…they don't ask. They just, just being around there. They get connected." – CLC1

The CLC3 indicated that he does allow learners to come to his place to access the Wi-Fi network free of charge:

"Especially in my side, I've got the Wi Fi. So, in most cases, young people who need to come to my place, okay, allow them to use my Wi Fi. Without taking any cents to me, okay, just to but you cannot just go around and say come to my place. Whenever they see an important to come and connect problem they do." – CLC1

This presented an opportunity for learning since learning through the Internet improves the learner's attitude (Yapici & Akbayin, 2012). The CLC1 indicated that learners were able to access the municipal sub-office to get a Wi-Fi connection for free. The CLC3 corroborated that:

"Not yet, but when you when you when you go to our sub offices, you do have Wi Fi? Okay, do we have Wi Fi so that our people can just go there

and ask for a password to connect though certain megabytes that you will just give them okay, we can’t just give them

1gig or 2gig or three. or maybe 200megabites just to assist them.” – CLC3

However, the sub-offices are about 12 km away from the school, which can be challenging for learners to access. The CLC1 further indicated that they might look into implementing the Wi-Fi network in the community hall.

The CLC2 gave a testimony about the absence of support they give as a municipality:

“at the moment we do not have anything, but we think we must take that into cognizance as the municipality because it is an important thing for our children.” – CLC2

While on the other hand, the CLC1 indicated the type of support given to the school by municipalities, which evolves around the ‘back to school campaign.’ The CLC2 indicated that their support to schools involves motivating learners and encouraging them to apply for bursaries and places of higher learning.

The CLC1 also indicated that most of his area's schools are under-resourced. That would make technology implementation in schools difficult. He added that they used to award best-performing learners with laptops, but that is no longer the case. The CLC2 indicated that the municipality does not have a programme where they donate devices to schools. This is unfortunate since the use of mobile devices is indicated to give rise to learners’ achievement (Ustun, 2019).

5.3.2. Findings
5.3.2.1. Challenges

a) Power cuts aided network issues

Power cuts are a nightmare for the Sekgosese community as they badly impact network connectivity. This aligned with the testimony that almost all participants gave, who indicated that when there is load shedding, the network ranges from being weak to no network at all. The CLC2 indicated that network providers 1 and 2 do not behave similarly to power cuts since network two can last for at least 2 hours. This is because the backup batteries in the tower last between two to four hours before becoming dysfunctional (Jacobs, 2021). The CLC3 alluded that they resort to moving around different spots hoping to find a better signal.

b) Long walk to the Wi-Fi

There are a number of sites where learners can access Wi-Fi after school. The CLC3 indicated that learners are always allowed to come to his place to access the Wi-Fi whenever they want to do school work or do some research, including applying for places in institutions of higher learning and bursaries. However, the place is a bit far from the school precincts. The CLC1 also indicated that their sub-offices had internet connectivity, where learners could easily access and connect. However, the sub-offices are about 12 km away from the school premises. He also indicated that learners can access Wi-Fi networks from foreign nationals' tuck-shops, which are not password protected. But that is not the case with all spaza shops (tuck shops). A researcher, Chotondo (2022), has already shown that distance has a negative impact on learning, as fewer learners may access those Wi-Fi centers. Consequently, it acted as a barrier during the implementation of the RBLS in a case where learners were required to send or download documents and videos.

c) Minimal support from the Municipality

The CLC1 indicated that the support the municipality gives the school is a ‘back to school campaign’. The CLC2 highlighted going to school for the motivation of learners and some guidance on applying for bursaries and places for learning in institutions of higher learning. However, that is where it ends. The municipality, even though it used to give best-performing learners laptops in the past, according to CLC1’s testimony, it no longer does that. The municipality does not have any programme where they would donate devices to schools. This is a disadvantage to learning as Ustun (2019), content that devices inspire and motivate learners more. Furthermore, they support blended learning in such a way that learners are able to upload homework, share views with others and reflect (Sophonhiranrak, 2021)

5.3.1.2.2 OPPORTUNITIES

There were no opportunities observed from the interviews

Table 5. 5 A summary of challenges and opportunities for the community leaders

Challenges	Opportunities
Power cuts aided network issues	
Long walk to the Wi-Fi	
Minimal support from the Municipality	

5.3.3. Network service providers (MSP1 AND WSPR)

5.3.3.1. Data presentation and discussions

The MSP1 indicated a lot of advancement that they, as the mobile network service provider, are making, especially in reaching out to remote rural areas. He indicated that most areas are still on 2G and struggle to access the 3G, 4G, and 5G broadbands, which are predominantly in urban areas like Cape Town. Further, people may have a challenge accessing the network during peak hours due to congestion.

However, the mobile network becomes too weak or unavailable during power cuts and vandalism:

> ***"Yes, we do. We do experience challenges in Sekgosese. One of the challenges is vandalism. Okay, so basically, they get vandalized. So, we use batteries as a backup. Now we are living at the time of power outages. Our grid is not stable. We don't have enough capacity. [Electricity provider company] is struggling. We've got load shedding. You can name it. load shedding stage two, stage four recently. Yes. Six. Yeah. So, they, they investing a lot. Especial batteries. And those batteries, they don't come cheap. Most of the the base stations, Sekgosese, we've got for a batteries, those lithium batteries, those lithium batteries, each batteries cost about R30,000, including installation. So, think about it, you've got four. So, you've invested about R120,000. So, if those four batteries get stolen, so you lost hundreds. And then you need to put another one, you know, so these days, we've seen the increase on cable theft. So, with these guys are selling the cable because they want copper, maybe they saw the Copper. So, our plea is to the community. If the community they can work with us, when they these people, maybe suspicious people next to the service provider base station, they need to report it. Because when the batteries are stolen, who get affected it is the community" – MSP1***

The same was the case with the WSPR, who indicated that the user should make sure they have a power backup for the routers to continue working even during load shedding:

“Okay. So eh the en, the customer, has to make sure that there is back us,. The power backup for the equipment, ” – MSP1

However, the tower remains working for 24 hours even without electricity. I explored the download speed that network service provider can reach, and this is how the MSP1 responded:

“alright the download speed and it depends on the type of phone you're using, because we have 3 types of things, maybe let me just talk about the latest. The latest, they support almost all the layers, no one can ask what is layers? So you find that you've got your 4g, but that 4g have got multiple layers. I'm not sure if you heard about 4g plus. So, you've got something they call it 4g plus plus. So what is this plus plus means? It means Carrier Aggregation which what you find that your 4g have got different layers. You've got your L900. And red is the frequency Okay, so the smaller the frequency, the longer the distance, the bigger the distance the smaller the distance. So our 4g have got an L 900 and so what that means what your 4g, or 900, you've got 4g, on 1800 and frequency. And you've got 4g, on 21. so you see now you've got about three layers support the 4g. So you find that JB your device, it doesn't support your L900. maybe doesnt Support your L21 that L stands for LTE, so LTE 4g. So if your phone support all these three layers, you can get plus or minus 50 megabits per second. thats your download speed, roughly will get around 20 to 25 megabits per second.” – MSP1

It was important to understand the effectiveness of downloadability as learners were required to upload work and download previous papers and videos, among other things. He went further to explain what causes poor downloads:

“what you find, you find that maybe most of the customers are using a wrong device. Or, your device has been booked in the wrong layer.

So your device or you set your device to be on 2g, get bad speed." – MSP1

The MSP1 also indicated the programme that they provide as a service provider and how it assists learners:

"actually, the service provider is the only thing is provided that provide e-school. So what is e-School the only thing that you need is that service provider SIM card. so when you go with portal. Okay, so when you go to that portal its zero rated, so one, that thing about the syllabus, from grade 1 until grade 12. So you don't need to have airtime to go to that portal even if you don't have airtime. Because it's zero rated. You can just go to the portal and get the information. So, what we've done actually, recently, we partnered with Department of Education whereby we donated about 50 tablets, okay, so a few years ago, before COVID, we even gave the top top student matric student tablet. And remember, we are also training teachers, we've got teachers centre where we train teachers for free. For the same note, like the youth, they something we call it next level. So they can apply for jobs. Those portals it's also zero rated. As an organization we doing a lot on in communities, providing a lot of free or zero rated website. And you will remember even the time we COVID was at the peak. There were a lot of websites that were zero rated from that service provider."

I asked the WSPR which device does the Wi-Fi network works best with. He indicated that all devices are compatible with the network.

5.3.3.2. Findings

5.3.3.2.1 Challenges

a) Power-cuts related network issues

The MSP1 indicated the extent to which power cuts affect the effectiveness of network coverage. He highlighted the issue of vandalism and theft of tower batteries which are quite expensive to replace as the contributor to poor network during load shedding. Jacobs (2021) had already indicated that tower batteries would last 2- 4 hours before the towers become dysfunctional. However, it is very difficult to imagine how towers can continue to operate in the process where batteries are stolen, resulting in poor network connection.

The WSPR had indicated that even though their tower can run for 24 hours, the users would need backup power to keep the routers on. Tech (2018) contended that without power backup, internet connectivity, amongst other services, is rendered ineffective. So even though the three schools have effective Wi-Fi connectivity, backup power should be in place to keep them working even during power cuts.

b) Lower generation (g) coverage in rural areas

The MSP1 indicated that most rural areas are still on lower generation coverage – 2G, while urban areas enjoy advanced generation coverage which is 5G. As a result, rural areas are unable to reach advanced generation coverage, such as 4G and 5G, compromising their ability to download and watch videos effectively. Further, the phone must be able to have multiple layers, at least three. For example, if a phone has 4G, it must also have 4G+ and 4G++ in order for it to have at least a download speed of between 20-25 Mbs. The MSP1 also highlighted the effects of traffic or congestion of the network during peak hours which may have an effect on its signal.

5.3.3.2.1 OPPORTUNITIES

a) E-school as an opportunity

The MSP1 had indicated that they, as a service provider, they have a programme where learners can access a zero-rated portal, meaning you do not need airtime to access it. The portal carries Syllabus from Grade 1 to Grade 12. This allows learners to use the portal to get information that will be crucial for their learning process.

The MSP1 also indicated that as a service provider, they had donated tablets to schools and awarded best-performing learners such devices. According to Ustun (2019), this gesture promotes learners' achievement.

Table 5. 6 A summary of challenges and opportunities from network service providers

CHALLENGES	**OPPORTUNITIES**
Power-cuts related network issues	E-school as an opportunity
Lower generation (g) coverage in rural areas	

5.3.4. Physical Sciences Senior Education Specialist (SES)

5.3.4.1. Data presentation and discussion

The SES confirmed the existence of a circuit WhatsApp group. He indicated that in the WhatsApp group, they share Physical Sciences materials that are also from different areas in the country:

> ***"Uh in terms of the WhatsApp groups, what we usually share, we are sharing the contents or topics, which we may receive from other provinces or other districts in Limpopo, the districts within Gauteng, Eastern Cape, Free state and North-West" – SES***

He also highlighted the use of WhatsApp to discuss test/assessment-related issues:

"uh uh other materials that are related to tests, so that we offer more of assessment to learners. We also taking in consideration the fact that with details to which teachers from other schools, to assess their learners." – SES

This was positive to note as using WhatsApp to share resources with teachers indirectly exposed them to do the same with learners. In addition, Physical Sciences teachers can use the same WhatsApp to create dialog and interactions in the learning and teaching process of Physical Sciences (Qamar et al., 2019). Nevertheless, WhatsApp was their only social message platform in their circuit engagements. There was no testimony about using Twitter, Facebook, and YouTube.

Likewise, the SES highlighted using Microsoft Teams and Zoom Meetings in their meetings. He indicated that they use both platforms to engage in subject-related problems. That matched with the testimony given by most Physical Sciences teachers and principals interviewed. VC platforms positively impacts learning (Hopper, 2014), which was good to note.

Nonetheless, the SES highlighted challenges experienced during meetings:

"The challenge that we have mostly, the challenge of network okay, every time when we're busy with meetings and sharing the other teachers will not be connected or they are connected. They will be dropped. Then we no longer have that educator and that gives us a serious problem to us. That's why we we also rely on the issue of let us into the of the, due to the circumstances of the country. We are failing to do that." – SES

Further, the Department of Education does not provide teachers with data and devices the same way they do with the SESs and other office-based teachers:

> ***"And the other thing is our teachers, they are not provided with data so that they can use for these other things. They are using their, their own for cell phones and data to get them from us. It's a concept which and facilitator, I think the department would start to provide teachers with mobile cell phones with that and so that we can be able to assist them in terms of education." – SES***

This highlights the lack/reluctance of the department to advance ways teachers' facilities teaching and learning in a way that matches the current technological advancements.

I checked with the SES if he has ever encountered teachers who needed assistance with the use of WhatsApp, Microsoft Teams, or Zoom meetings. The SES indicated that the teachers are able to use WhatsApp functionalities as all of them are receiving messages and resources that are sent. However, there are still some who are struggling with the use of VC platforms:

> ***"some of them because of technology, we need to be trained more. They are not used to it and seemingly they're just not helping using the technology, especially due to these teachers who are now at the ages of 50 which we are calling them ama BBT (Born Before Technology). So that is the challenge which we are having." – SES***

He also highlighted that the problem is bigger than it seems in that it has to do with negative attitudes and reluctance, more than anything, towards technology:

> ***"And some of them, even the laptops in the schools where we are there as head of department, they're able to use to use laptops properly and their cell phones. for them to use cell phones properly is when the young ones are near, that's why they always say these young ones are good in technology. its because they have interest but them they have got with***

little interest. That's why they cannot even use this program which is there uh the SA-SAMS." – SES

This issue was observed by Rijal (2023), who indicated that despite teachers' experience, for as long as they were not trained in technology, they do not show any interest in implementing it in class.

The district is not doing much to provide support and training to teachers. However, the teachers themselves are not helping the situation with their disinterest:

"Yeah the the training is not much there, to be fair with you. But schools have got eh the laptops. So as well as somebody's not having that interest, they don't even bother themselves to be involved to use them. Because for the SA-SAMS.. The circuit, we have got the personnel who are dealing with SA-SAMS, even when they take them on board, they're not interested like when they put marks in SA-SAMS, some of the clerks, they have to do the job for them. So even capturing of marks is a problem to them" – SES

Even though the office-based teachers tried to assist, the department only reached out to a few number of teachers for the purpose of giving support:

"like we have indicated in rural schools, they have got Wi-Fi, but they use for personal things. Remember we have got the MST schools, the so-called the former Dinaledi schools. Schools per district, I think per district we have 10 schools. Those are the teachers which are taken on board, to this type of things." – SES However, he thinks much should be done from their side to support the Physical Sciences teachers:

“So, but I think as a department they should during during our leaves or during the this time of the year where we are having maybe over the weekend they should try to conduct those type of things for us so that we implement in schools. But moreover, we can’t implement without resources.” – SES

He further made a comparison between rural schools and urban/semi-urban schools:

“So like I would give you example, I was when I was first appointed at the Gauteng Department of Education as a curriculum advisor and one of the best district in in South Africa which had had, you know, as a person that is Tshwane South, we were inducted when we’re given laptops how to use google forms and these other things and then as I was here before, as a departmental head before I moved to curriculum, I realized that the facilities are there here, in the Gauteng they were there and we were able to make sure that we use we, we use the, the smart board, whereby you can set a test and you put a test there and then learners to be able to come and use that what everything can do.” – SES

The SES also highlighted the issue of thuggery and vandalism, which are the enemies of our education system where schools that were given tablets had them stolen.

5.3.4.2. Findings

5.3.4.2.1 Challenges

a) Network issues as a barrier

The SES indicated the challenges the network brings to the work they do. They do utilize videoconferencing platforms, together with WhatsApp, to hold meetings with teachers. Something that has already been alluded to by C1T, C1P, C2P, and C2T. When used effectively, the use of VC would be beneficial to teachers who would, in the process, sharpen their online usage skills. Consequently, that may motivate them to use it in their teaching and learning of Physical Sciences. That would benefit the learning process as VC platforms are known to increase cooperation and engagement among learners (Hopper, 2014). However, the network issues are an impediment during the Physical Sciences subject support meetings, where most teachers are kicked out of the platforms due to network instability. This may increase the level of disinterest from teachers, especially those who were always reluctant to enter the online teaching and learning space.

b) Poor teacher technology skills

The SES highlighted what he observed from teachers. Most of the teachers he is working with have poor technology skills. Technology skills come in crucial in the online component of blended learning (Tong et al., 2022) and would prove to be a challenge. Some teachers, referred to themselves as BBTs (born-before technology), are very reluctant to use devices such as laptops, wherein they delegate programs such as SA-SAMS to admin clerks at the school. This was noted by Gomba (2019), who reiterated how uncomfortable most teachers are with technology. A disadvantage since using computers increases the learning achievement rate (Simões et al., 2022). Computers and other devices do come in handy during the implementation stage of blended learning, where teachers can upload subject-related resources and communicate with learners. Hence, this indicates dislike does not work to the advantage of the learning process.

c) Poor support from the DBE

The DBE is also not helpful. Despite the reluctance of teachers to use online platforms indicated above, the department is also not doing enough to close this gap. The SES indicated that there is insufficient training whereby few teachers from selected schools are picked for training, leaving many teachers behind. This is also available in the ICT implementation plan from the Limpopo Department of Education (LDE, 2020). Moreover, it was also highlighted by C2P when he indicated that they have an ICT champion at their school. But the success rate of that program cannot be determined as the continuation of that training is left at the hands of the school, without any report back expected.

d) No use of the LMS

Apart from the training mentioned above, the SES has no testimony regarding the training on LMS platforms. This is a downside as LMS are the drivers of blended learning and will play a bigger role in the implementation stage. According to Padalia and Natsir (2022), with its implementation in the learning process, LMS has the ability to increase learners' satisfaction. LMSs such as GC have the ability to amplify learners' ability to use their knowledge and comprehension (Mohamad et al., 2022).

5.3.4.2.2 OPPORTUNITIES

a) Social media-based learning opportunities

According to the SES, most Physical Sciences teachers are well conversant with WhatsApp in that they can receive communication and download subject-related resources. Unsurprisingly, both the C2T and C3T have created a WhatsApp group that they use with their Physical Sciences learners. Even though the C1T had not formed the WhatsApp group, he was already conversant with it. This created a good opportunity to implement the RBLS, as Qamar et al. (2019) report WhatsApp as a promoter of dialogic and interactive discourse in blended learning. In addition, it supports the instructional, educational, and technical aspects of learning (Qamar et al., 2019), which are key in blended learning. Further, since the teachers are already accustomed to receiving resources through the WhatsApp group, they may initiate the same thing with their Physical Sciences learners.

b) Exposure to video conferencing platforms

The SES also indicated using Microsoft Teams and Zoom meetings in their subject support meetings. The VC platforms are known to influence learning in a positive way. Exposing teachers to this platform had the potential to motivate them to use the platform with their learners. This presented a great opportunity for the implementation of blended learning as VC platforms allow learners to interact with their peers (Hopper, 2014), promoting social presence in the process (Oh et al., 2018). The VC platforms also reduce the physical distance between participants (Hopper, 2014), which occurred in online subject support meetings.

Table 5. 7 A summary of challenges and opportunities from the SES

CHALLENGES	**OPPORTUNITIES**
Network issues as a barrier	Social media-based learning opportunities
Poor teacher technology skills	Exposure to video conferencing platforms
Poor support from the DBE	
No use of the LMS	

5.4. CONCLUSION

The chapter outlined the report of the data collected during phase one. The data was presented and discussed simultaneously in paragraphs (narrative) per case. The focus was on the following themes: Challenges and Opportunities in blended learning. The findings from this chapter provided the basis for the designed RBLS.
The next chapter presents the designed RBLS for Physical Sciences.

CHAPTER 6: THE RURAL BLENDED LEARNING STRATEGY (RBLS)

“A vision without a strategy remains an illusion” – Lee Bolman

6.1. INTRODUCTION

The previous chapter presented and discussed data collected during phase one, which answered the following research sub-questions:

i. What were the challenges of Physical Sciences teachers regarding blended teaching and learning in rural schools?
ii. What were the opportunities for Physical Sciences teachers regarding blended teaching and learning in rural schools?

This chapter presents the designed Rural Blended Learning Strategy (RBLS) followed by the role played by the ADDIE model in the designed RBLS. I tapped into the existing challenges and opportunities from phase one data collection; followed by intervention strategies; choices of the Learning Management System (LMS), social media platform, video-conferencing platforms, blended learning model; and the presentation of the RBLS.

6.2. THE ROLE OF THE ANALYSIS, DESIGN, DEVELOPMENT, IMPLEMENTATION, AND EVALUATION (ADDIE) MODEL

The ADDIE model has already been reviewed in the theoretical framework - Setting down the road map chapter (chapter 3), indicating its application in the study. Therefore, I had to touch on its application in this chapter and the chapter preceding it.

In the previous chapter (Chapter 5 - Challenges and opportunities of blended learning in rural schools), the ‘A’ part of the ADDIE model was employed. Findings were generated by analyzing the data from phase one of data collection. The findings were crucial as the prerequisites to the “DD” part of the model, outlined in this chapter's next sections.

Even though the ‘DD’ of the ADDIE model represents design and development, respectively, for this study, I chose to use design to represent both design and development. What was crucial in this regard was the choice of relevant media, appropriate assessment tools, instructional models, resources, devices, the time frame for the implementation, and, more importantly, the relevant LMS (discussed in section 6.4). During the design, it was crucial to consider learners’ diversity of learning.

What followed the design is the ‘I’ and ‘E,’ which are the Implementation and Evaluation, respectively. The two stages were reported in Chapter 7 - The Implementation of The Rural Blended Learning Strategy (RBLS).

6.3. A SUMMARY OF CHALLENGES AND OPPORTUNITIES

Below is a summary of the challenges and opportunities as explained in the previous chapter, of which the RBLS was designed to mitigate these challenges and to harvest from the existing opportunities.

Table 6. 1 A summary of challenges and opportunities

CHALLENGES	OPPORTUNITIES
Load shedding aided network issues	Availability of devices
Lack of institutional support for learners	Flexibility in bringing devices to school
Poor knowledge and lack of exposure to blended learning	Exposure to social media for learning
No traces of blended learning implementation and policy	Organizational capacity/ institutional support

No cell phones allowed	Connectivity of learners to the Wi-Fi
No exposure to the LMS/ No use of the LMS	Video-conferencing exposure
Long walk to the Wi-Fi	E-school as an opportunity
Minimal support from the Municipality	
Lower generation (g) coverage in rural areas Network issues as a barrier	
Poor teacher technology skills	
Poor support from the DBE	

6.4. THE STRATEGY

In this section, I first outlined the steps taken to remedy/mitigate some challenges noted in phase one of data collection. This is followed by my choices on the type of LMS, social media platform, videoconferencing (VC) platform, and the blended learning model. The section is concluded by outlining the plan of action for the implementation of the RBLS, together with a detailed presentation of the strategy.

6.4.1. Intervention strategy

Several things were observed to be challenges and barriers to the effective implementation of a blended learning strategy for Physical Sciences in rural schools.

I presented them and their solutions below:

a) Load shedding/power cuts

The area is predominantly affected by sustained power cuts, which seem common throughout the country. Further, none of our cases had a backup power, rendering the Wi-Fi router and computers useless during blackouts. I then found it crucial to approach the SGBs, to assist or seek assistance from local businesses to provide electric generators and fuel that would keep the Wi-Fi router and computers on, even in the process of load shedding. Research has proven that load shedding can act as a barrier to the effective implementation of blended learning (Manurung et al., 2020)

b) Data issues

Learners and teachers needed to engage through chosen social media, VC, and LMS platforms after school and during weekends. For that to happen effectively, they needed to have data. Hence, I approached the SGBs of the schools and all relevant stakeholders to seek assistance or sponsorship for the provision of data to learners and teachers.

c) LMS issues

During phase one of data collection, it was discovered that even though the participant was exposed to some VC platforms, they never applied them in their teaching. Additionally, the findings from this study showed that most of the teachers are not well acquainted with the functions of the VC platforms, such as the mute and unmute buttons. Hence, I intervened by training teachers and ICT support staff on all functions, including how to open and record videos.

The findings from this study have shown that the participant teachers were either exposed to some LMS or not at all. This was disadvantageous as LMSs act as drivers of blended learning. Therefore, it was prudent that I train these participants' teachers with their ICT committees on GC and its different functions.

d) Device issues

In all our cases, the school's policies do not allow learners to bring along devices to school. However, there is some flexibility where in some instances, learners were allowed to bring devices. This created a good opportunity for implementing RBLS as devices bring some benefits to the learning process (Ustun, 2019). For that reason, the SGBs through the principals were approached to seek permission to allow learners to bring their devices to school for the implementation of the RBLS.

6.4.2. The Design of the RBLS

6.4.2.1. Choice of the LMS

Physical Sciences teachers had little to no knowledge of the LMS, including non-use or non-exposure to the LMSs. I had to rely on their preferences after exposing them to the main three LMSs. Nevertheless, I saw it fit to measure the literature on the LMSs vs. the conditions and opportunities that are in existence within our cases. I used the following table to compare the advantages and disadvantages of each of the main three LMSs and compare or match them with the existing challenges and opportunities:

Table 6. 2 Pros and Cons of the use of different LMSs in blended learning

LMS	Advantages	Disadvantages
Google Classroom	• Free and easy to use (Li, 2020; Zakaria et al., 2020) Easy to create (Beaumont, 2018). • It can be used on more than one device (Li, 2020) • Sync easily with other services such as Google • Drive, which provides storage,	Requires the teacher's supervision at the beginning of its use Cannot format text Posts are displayed automatically Cannot give the learner a grade summary 2018)

	and YouTube for videos (Li, • 2020) • Timesaving • Cloud-based • Has a lot of flexibility. • Provides discussion forums.	
Moodle (Deliwe, 2020)	• Can schedule posts in advance • Interactive engagement and quick feedback • Easy to administer and revise documents • It has a provision for the backup of resources and their recovery • Easy to keep a record of grades and download them in the form of spreadsheets. • Allows teachers to access saved information from their colleagues	• Teachers are unable to examine • learners' innovative and cognitive skills. • Relies on copy and paste in problem-solving

Blackboard (Alokluk, 2018)	• It has the function of a discussion forum • Fosters a learning community among learners • Supports high-order thinking skills	Time wasting and not flexible Costly

a) The Google Classroom (GC)

Despite being one of the most preferred LMS due to its user-friendliness and ease of use, GC carries more advantages than disadvantages, as indicated in Table 6.1 above. One to note, amongst others, is that it is free to use (Li, 2020; Zakaria et al., 2020) and can fit well for schools with limited resources (Zakaria et al., 2020), which in our context are rural schools. Additionally, it is compatible with different devices (Li, 2020), fitting well with this study as schools have a combination of devices (laptops and PCs) while some learners also have smartphones. According to Li (2020, p. 218) GC carries and supports the following features amongst others:

- Assignments/Tasks
- Ratings/measurements
- Communication
- Mobile App
- Privacy

Also, GC allows learners to share resources amongst themselves and their teachers (Beaumont, 2018). Above all, due to its ability to connect to different Google Apps, learners are able to collaborate and work on the same activity using the same document (Beaumont, 2018). Due to its ease of use, GC increases learners' motivation (al Yakin et al., 2022)

b) Moodle

Moodle carries some advantages, as shown in Table 6.1. Among the advantages is that it has quiz templates that teachers can use for formative and summative assessments (Singh & Gokool, 2018). To add to that, it provides room for engagement between the teacher and learners (Deliwe, 2020). However, it carries some disadvantages, including the inability to examine learners' innovation and cognitive skills (Deliwe, 2020) and creating a site for a large group (Singh & Gokool, 2018).

c) Blackboard

Blackboard LMS carries some advantages with it. Amongst them, Blackboard allows a culture of engagement through its platform (Alokluk, 2018). As a result, learners are able to tap into high order thinking (Alokluk, 2018), something which the Moodle platform fails to do (Deliwe, 2020). However, the Blackboard platform also carries some disadvantages as it is perceived to be time exhausting, lacks flexibility, and less economical (Alokluk, 2018).

Likewise, I attempted to download the LMSs to observe their difficulties and advantages. I struggled to download Moodle, which required a multi-step Information Technology (IT) desktop instalment. This was then disregarded as an option as our participant schools do not have well-established IT support staff. Likewise, the Blackboard installation required one to subscribe to different price plans, which may have carried a financial burden on the schools. Nevertheless, GC was easy to download and install. I managed to access it through the Play-Store application for Android and through Google Chrome applications of the desktop.

More so, the GC was free to use.

6.4.2.2. Choice of the social media platform

Social media plays an important role in the learning process. Akgündüz and

Akınoğlu (2017) contend that social media-based learning has a positive effect on academic success and motivation. It was impressive to note that all three cases proved to have a culture of social media usage. Moreover, learners are exposed to multiple social media platforms, including WhatsApp, YouTube, and Facebook.

However, what seems to be commonly used is a WhatsApp platform. The learners and teachers are already exposed to the platform through the class Physical Sciences group and the circuit-based group for Physical Sciences teachers. This exposure borders well for blended learning as WhatsApp can create a discourse in blended learning that is dialogic and interactive (Qamar et al., 2019). On top of that, as part of Google, the YouTube platform could have been used in class. For instance, teachers may instruct learners to play videos by embedding or uploading them on GC.

6.4.2.3. Choice of a blended learning model

Chapter 2, which focused on the existing research in blended learning reviewed many blended learning strategies. In the following section, their relevance to this study, based on the findings from phase one, was discussed:

a) Station rotation blended learning

This is the type of model where learners rotate between different learning stations or groups. In this context, one class may be divided into an online platform group, micro-group discussion, individual assignment group, and others (Staker & Horn, 2012).

b) Lab-rotation blended learning

With lab rotation, learners switch between different locations. For instance, learners may learn about Electromagnetic radiation in a face-to-face Physical Sciences classroom and continue to the computer laboratory to research for practical applications of Electromagnetic radiation or vice-versa.

c) Individual Rotation

Similar to station rotation, this is more individualized timed learning. Each learner will move through different learning stations individually at an allocated time.

d) Flipped Classroom

In this model, learning from a face-to-face classroom is carried home or after school period as homework (Said et al., 2020). Learners may, for example, learn about waves in class or laboratory and continue learning about them at home in the form of homework.

Given the lack of exposure to technology that our cases experienced, it was then decided that it would not yield desired outcomes if we allowed learners to go through different learning stations individually. This disqualifies the individual rotation model. Additionally, the lab and station rotation give desired learning results, given the diversity of learning forms within them. However, they may require more workforce rather than the presence of one teacher. That may not be a problem, given that the schools have ICT committees. Unfortunately, the committees are made up of teaching staff whose availability cannot be guaranteed due to their teaching commitments.

This leaves us with the flipped classroom model. However, given the network challenges in the area and the lack of data for the learners, it might not yield the desired results. That then required us to rely on the school facilities during study time, which happens before and after the normal 7 hours, to flip our classroom. Learners were expected to use the existing computer stations to do their work while others were connected to the Wi-Fi through their cell phones under their teacher's supervision. The learning was allowed to carry home for engagement through WhatsApp as it requires no strong network.

6.4.3. THE RBLS

Table 6. 3 The RBLS plan of action for its implementation

Step	Day/s	Purpose/Action	Responsible person	Stage
1	1-3	Engage with respective principals and SGBs regarding issues such as lack of devices, allowing learners to bring along devices to school, and the provision of backup power as was discovered in phase one	Researcher	Preparation
2	4-6	Interventions – induction of teachers on the use of the LMSs - GC; SM platforms; and VCs - Zoom Meetings, Google Meet, and Microsoft Teams	Researcher	Preparation
3	7-9	The teacher set up the GC site and added learners to the sites. The SM and VC platforms are also created at this stage.	Teacher	Preparation
4	10-17	Observation/Trial stage of the implementation of the RBLS with 1 case.	Teacher and learners	Trial/ implementation
5	18-25	Review/revision (or none) of the strategy	Researcher	Evaluation
6	26-34	Lesson observation/implementation of the RBLS	Researcher/ Teacher	Implementation on
7	35-	Evaluation stage	Researcher	Evaluation

Any strategy requires a proper and carefully planned approach before its implementation. It was, therefore, prudent that meticulous steps are taken as outlined in Table 6.3:

Step 1 – the first step involved engagement with different stakeholders. The intention was to find solutions to address some of the prevalent challenges in our schools. Issues like data provision, backup for electricity, and flexibility in allowing devices in the participant schools.

Step 2 – what was crucial in this instance was to close the available technological gaps from our participant teachers. The Physical Sciences Senior Education Specialist (SES) had indicated how some Physical Sciences teachers struggle with login in and other functions of the VC platforms. Further, it was also discovered that none of the teachers knew the use of the different LMSs. Moreover, they did not know what blended learning was. It was ultimately necessary that I provide some form of induction on the use of the VC platforms and LMSs. The training was also open to ICT committees of the school.

Step 3 – the teachers were then allowed to set up the LMS, SM, and VC sites for the learners. In the process, they were expected to add and communicate with the learners.

Step 4- This was the trial stage where I wanted to observe how the teachers use the sites in relation to what they currently teach in class. These served as a pilot stage for the implementation of the RBLS. The teacher (one case) was required to use the flipped classroom approach where he would teach with GC, SM, and VC platforms of his choice in the online platform before/after teaching in the face-to-face mode. As a result, he used a flipped classroom approach for a minimum of 3 lessons in a randomized manner.

Step 5 – the trial stage of the implementation of the RBLS was reviewed, given the data collected. The decision had to be made whether to revise the strategy or keep it the way it was.

Step 6 – this was the main event. The implementation of the RBLS would be repeated as in step 4 above, depending on whether there was a need to review/revise the strategy in step 5 above.

Step 7 – this stage allowed me to evaluate if the RBLS shaped the teaching and learning of Physical Sciences. In the process, findings were made after extensive data analysis.

The RBLS is outlined in Figure 6.1 below:

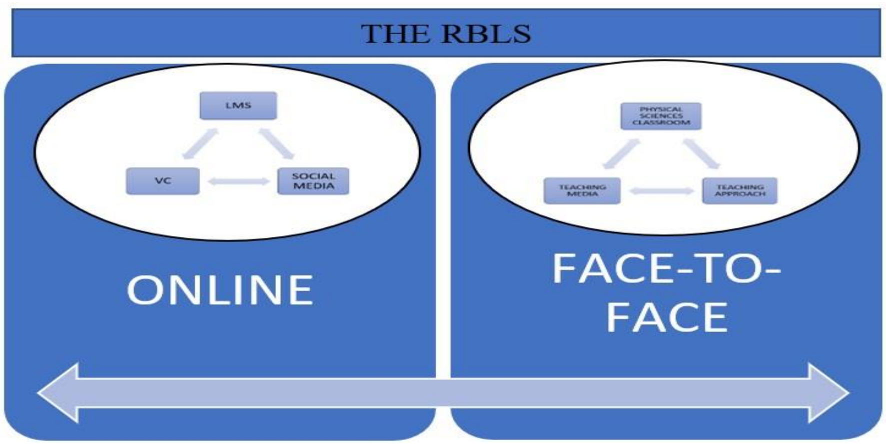


Figure 6. 1 The Rural Blended Learning Strategy (RBLS)

The RBLS indicated that learning is not a one-way approach but takes place through multiple engagements and forms. Hence, it assumes a triangular shape, with each point representing different media/platforms and approaches. The back-and-forth engagement is denoted by a double arrow in between, indicating that this movement is not a fixed route, but there should be a level of flexibility. The framework comprises two modes of learning - the online and the face-to-face components, which come one after the other.

The face-to-face classroom was preceded by the online component, where learners were given an online quiz as class preparation. In the face-to-face Physical Sciences classroom, the teacher resumed the lesson by giving feedback on the online quiz/class preparation activity, addressing prior knowledge. According to (Simsar & Davidson, 2020), prior knowledge, amongst others, has a prolonged effect on learners’ self-efficacy. Likewise, the visitation of prior knowledge would influence learners’ engagement positively (Dong et al., 2020). The teacher would then gave instructions, outline the learning outcomes and what should be happening in class for that particular day. The teacher then facilitates the lesson in a way that encourages collaborative learning, which the Physical Sciences curriculum supports in always leading to active learning (DBE, 2011).

The teacher should be able to conduct his teaching in such a way that he connects theory and practice (Yang & Lu, 2023). The type of instructional strategies and explanatory frameworks are key (Nkanyani & Mudau, 2019; Mudau, 2016). Moreover, the approach should be in a way that avoids authoritative discourse and encourages dialogic discourse (Mudau & Netshivumbe, 2022; Nkanyani & Mudau, 2019).

The learning process would then be assessed through a class activity, with feedback being ultimately given. According to Wilson (2018), classroom assessment positively impacts the learning process. The teacher then consolidates the lesson and give instruction about the online lesson, which would follow the face-to-face lesson. The learners would respond by following the lesson objectives, working together, and engaging with their peers and teacher. They would then do classroom activities and receive feedback from their teacher.

The learning process will then continue into the online classroom component, which would occur after normal school hours. When learners open the GC LMS, they will find an instruction the teacher gave in the form of a text or a Microsoft Teams/Zoom recorded asynchronous video. In the process, the learners and the teacher would engage through the SM platform and GC through the class comment section. Learners would use that opportunity to discuss, engage and ask questions for clarity. The advantage of this function is that the participants do not have to respond immediately but may respond at their convenience, given the persistent issue of load shedding and network connectivity.

Furthermore, the environment should provide room for the development of Self Directed Learning (SDL), social constructivism, and learner-centered/active learning to align with 21st-century skills and to address the emergence of the 4IR (van der Westhuizen & Golightly, 2019). The learners will use the platform to do home or pre-classroom activities through Google Docs or online quizzes in Google Forms. The good thing about quizzes is that they give immediate feedback. The teacher would give feedback for the tasks online or in the following class. Consequently, the teacher may also upload additional resources such as notes, YouTube videos/links, previous question papers, worksheets, e-books, articles, laboratory rules, and others, which may support learners.

6.5. CONCLUSION

This chapter presented the designed RBLS shaped by the data collected during phase one. The next chapter presents and discusses phase two of the study which focused on the implementation of the designed RBLS.

CHAPTER 7: THE IMPLEMENTATION OF THE RURAL BLENDED LEARNING STRATEGY (RBLS)

“Strategy without process is little more than a wish list.” – Robert Filek

7.1. INTRODUCTION

The previous chapter presented the RBLS and how it was designed, followed by motivations for the choices of the Learning Management System (LMS), social media (SM) platforms, and Video Conferencing (VC) platforms. It was concluded by outlining designed RBLS. This chapter presented the implementation of the designed RBLS. The intention was to understand:

i. How did the RBLS shaped the teaching and learning of Physical Sciences in rural schools?

In this section, data collected during phase two of the implementation of the designed RBLS was presented and discussed for each case before findings were made.

7.2. CASE 1 – MAKWALENI – A – THABA SECONDARY SCHOOL

7.2.1. Data Presentation and Discussions

As per the intervention strategies in Chapter 6 – The Rural Blended Learning Strategy (RBLS), I approached the C1P on two things: the provision of backup power and the learners' flexibility in bringing phones to school. However, the power backup never materialized. Likewise, I inducted the C1T with his Educator Assistants (EAs) on the RBLS. The emphasis was on online platforms such as Google Classroom (GC) and SM platforms such as WhatsApp, Twitter, and Facebook – which the C1T had to choose from any combination of the three. The intention was to show the C1T how to add C1Ls to the platforms and how to teach Physical Sciences with the designed RBLS.

Moreover, the C1T was inducted on the VC platforms such as Microsoft Teams and Zoom Meetings, where I took him and his EAs through different functions of the platforms. More importantly, I took him through on how to schedule and record sessions through the VC platforms and how to upload the recorded videos in the SM and GC platforms. In a way, the teacher was expected to be flexible while simultaneously diversifying online platforms.

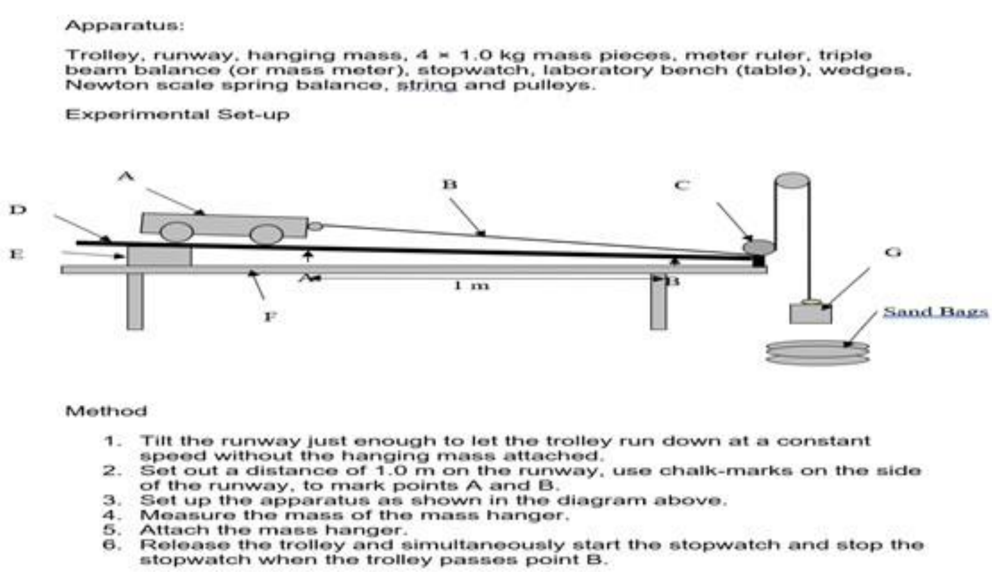
Consequently, a minimum of three lesson observations were made. The observations were made on both the online and face-to-face platforms. The first lesson was on the mass vs. acceleration experiment, whereas the second and third lessons were common test feedback on the topics – Electrostatics and Vectors in two dimensions, respectively.

7.2.1.1. Face-to-face platform

a) Prior knowledge/link to online class

The C1T started the first lesson, which was the mass vs. acceleration experiment as presented in picture A by reading laboratory rules. Something that would be expected in a laboratory environment.

Picture A: Showing an experimental setup and instructions of the force vs. acceleration Grade 11 practical:


Apparatus:

Trolley, runway, hanging mass, 4 × 1.0 kg mass pieces, meter ruler, triple beam balance (or mass meter), stopwatch, laboratory bench (table), wedges, Newton scale spring balance, string and pulleys.

Experimental Set-up

Method

1. Tilt the runway just enough to let the trolley run down at a constant speed without the hanging mass attached.
2. Set out a distance of 1.0 m on the runway, use chalk-marks on the side of the runway, to mark points A and B.
3. Set up the apparatus as shown in the diagram above.
4. Measure the mass of the mass hanger.
5. Attach the mass hanger.
6. Release the trolley and simultaneously start the stopwatch and stop the stopwatch when the trolley passes point B.

He consequently took learners through the experiment. He took them through different apparatus they would use as presented in picture B. However, he had not linked learners to any previous knowledge nor made mention of any of the online platforms. This was a downside of implementing the RBLS, as Simsar and Davidson (2020) highlighted how prior knowledge, amongst others, has a prolonged effect on learners' self-efficacy. Regarding the second and third lessons, the C2T only reminded learners that the topic was already covered and that it should be treated as revision. He had never referred learners to any work or additional resources on the online platform/s, except after the third lesson, where he referred learners to the task he uploaded to WhatsApp and told them that they should send it back using the same platform. Likewise, the C1T failed use blended learning in his teaching of Physical Sciences in this regard (Jeffrey et al., 2014).

Picture B: C1T demonstrating the acceleration vs. mass experiment apparatus.

b) Teaching approach

The C1T used the learner-centered method in the experiment lesson. For example, after doing the experiment with some learners while others were observing as presented in picture C, he resorted to grouping those learners, allowing them to do the experiment in their groups under his supervision as presented in picture D. This was a good choice since teacher-centeredness is one of the expected approaches in blended learning (Cunningham, 2021).

Picture C: the C1T taking C1Ls through the experiment while some perform the experiment.

Picture D: C2Ls doing the experiment in their groups

He indicated that he wanted to save time, and since one learner could not do all the required steps of the experiment due to its complexity:

> *"**Yes, normally with practical's we, we, we need to group them. Maybe because of time also? Because of time. And also, a practical, self does not need. If a single person, a single learner, cannot. Because you need to handle this and that one liner need to handle stopwatch, another learner need to, to handle the trolley, another learner need to balance this and that another learner need to make sure the place is clean is OK. So, a single learner it will be difficult for him or her to carry. The experiment is good for learners sometimes to, to good." – C1T***

Nonetheless, that approach got learners excited and more engaged. One learner felt that working as a group improved their teamwork ability:

> **"*And the issue of grouping. Grouping. Yeah, yeah. Grouping helped us to give ourselves some space because we are meaning our classroom. So, working as a group also builds team building skills." - C1L1***

Another learner felt that the opportunity allowed those who were struggling, to learn from those who were doing better:

> ***"Yeah, because there are some other learners who are slow. So say grouped us like he knows the, you know, they can do this better than others. So he grouped us like. Then those who can do better than others, they have to teach the low-minded others like, ne ba tsea ba ba go kgona kgona, ba mo magareng le ba ba very low b aba hlakantsha (the teacher who take the top learners, mix them with the moderate and low performing learners)" – C1L2***

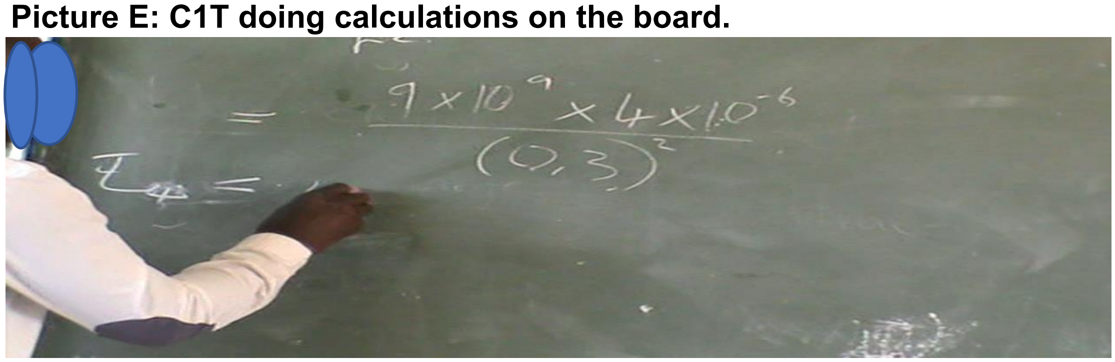
It can be noted from the above statement that the teacher diversified his practical groups to elicit different skills. Additionally, under his supervision, he ensured that all group members participated fully. For example, he asked learners to exchange roles in one of the groups. In the process, those performing the experiment would swap roles with those who were recording the results. He indicated that he wanted to empower female learners who seemed aloof and lacking confidence:

> ***“Let's talk about the. Issue of gender the males and females. When it comes to practical’s, most of the time, the females want to be at the back. You want to be at the back. They don't want to do, They don't want to. They want to be involved in a practical activity. Yes, they can do a recording and this and that. But when it comes to a handling of operators, they don't want to be there. So there's still that fear of there's that fear. Maybe to say no these things. It's for, It's for boys, it's for girls. You see, so we need to beat this fear. To say no, this is for everyone. This is for everyone, even if it was a group.” – C1T***

That approach was more learner-centered and would support the aims of the Physical Sciences curriculum (DBE, 2011). Likewise, it supported social constructivism as learners constructed knowledge through their engagements with their peers and teacher (Ardiansyah & Ujihanti, 2018; Kola, 2017). Interestingly, the C1T had noted the lack of confidence from his female colleagues during subject support meetings. According to the C1T, the female colleagues sat at the back while other male teachers performed the experiments.

Nevertheless, his approach in the second and third lessons was dominantly teacher centered. For example, he was doing calculations on the board while at the same time asking for responses from learners as presented in picture E.

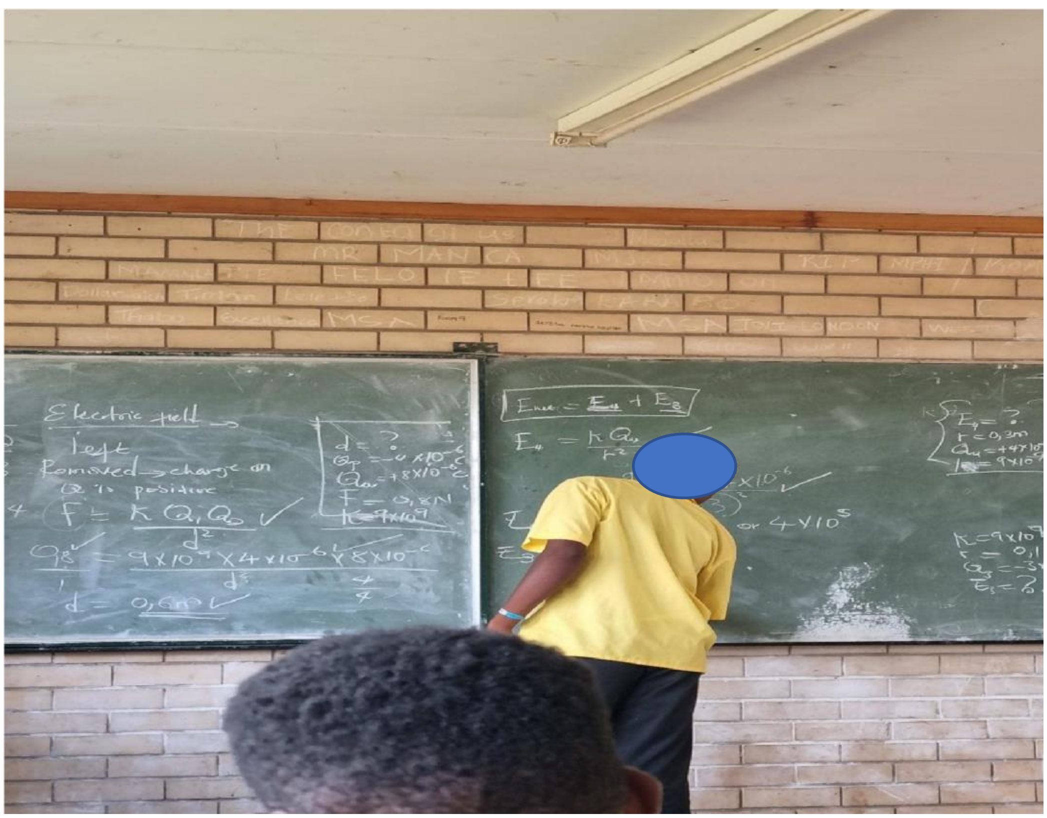
Picture E: C1T doing calculations on the board.



He could have asked learners who did well in such questions to come and show others how they did it. However, he did that once as presented in picture F and never repeated it. He indicated that he had the issue of time in mind:

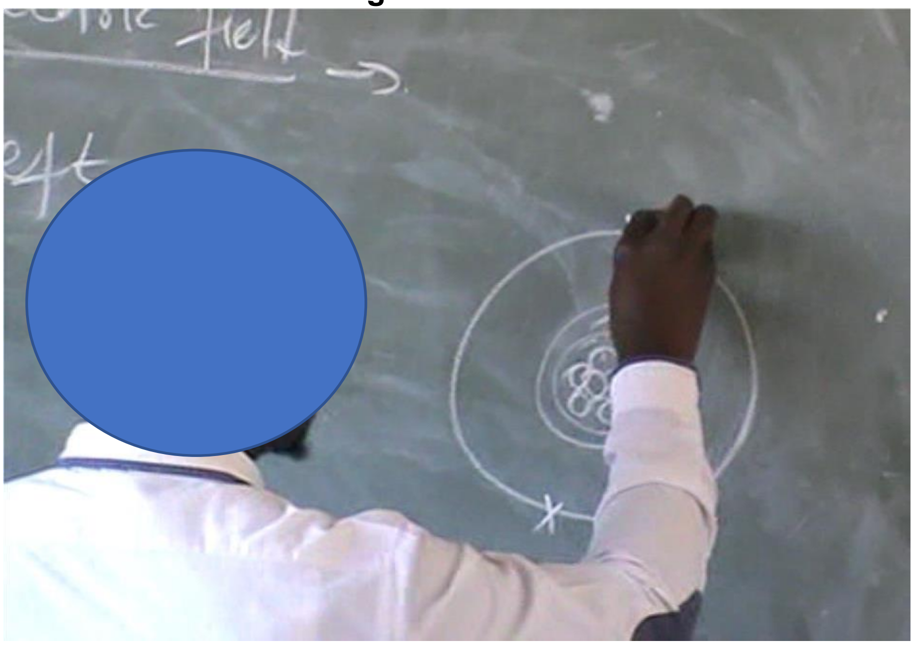
> ***"The time that we are having. Contact time with learners, remember. The lesson is a one hour less normally is a One-hour lesson. And sometimes we have to to to to chase time. We need to make sure that, at least by the end of the of the lesson, then we have covered this and that. Remember, there is a curriculum that we need to cover, so I realise, or maybe if I give more time, more learners to come in front and show their method, then it may consume a lot of times." – C1T***

Picture F: The C1L solving a problem in front of a Physical Sciences class



Nevertheless, he and some learners had some engagements, even though he was not consistent. He did not provide C1Ls an opportunity during their engagement with him to elaborate more. As a result, he was unable to provide sufficient room for social constructivism (Ardiansyah & Ujihanti, 2018). Likewise, he used demonstration frameworks (Mudau, 2016) to emphasize his teaching of the content. For example, when explaining the concept of charges in Electrostatics, he used the atomic structure to explain how charges are formed and which sub-atomic particles are involved as presented in picture G.

Picture G: The C1T using demonstration framework



b). Practical/Experiment

The C1T did not do any practical demonstration or engage learners in hands-on activities in lessons 2 and 3. It was only in lesson 1, which was practical in nature, that an experiment was done. He indicated that since lessons 2 and 3 were feedback from the common test, he did not see a need because he had the issue of saving time in mind. Also, one of the feedback lessons was on gravitational forces, which was covered in experiment 1:

> ***"And again remember of one of the of the feedbacks that they've given them is based on newtons laws and the practical is newtons is newtons laws. So you see you can you can relate the truth. So they they get what***

they understanding. What what do you mean about the gravitational force? What do you mean about acceleration? The tool that we're talking about, the pulley. Why is it important to to have a pulley? What is the function of the pulley? the string that we are always always talking about to say? Hmm hmm. Frictionless pulley or the the mass of the pulleys to what what? Which way do they use in? Is it a mass-less you say this we can ignore the mess of the of the of the string. It's like that. Even the trolley. We find that this letter, they're not aware or when you. Talk about the trailer, talking about talking about, yes. So that demonstration here. Hmm, I think it did you it is worked a lot. They helped them a lot. They even even also checking the angle. Of the, what you call this the the runway. Say when you talk about the angle of incline, we're talking about something like this. the yes. This inclined we find that letters were not aware about client or what. When you talk about inclined angle of incline not talking about the bench, maybe they're not away or no. We're just talking about a simple table. I went so the gravitational force. Things like that. You may find that these learners were not aware." – C1T

However, it would have been expected that the teacher forms a link between the theory and practice by referring learners to that practice. That approach could have not only led to learners' increase in fascination about the topic under study but it could have also created an efficient environment for learning (Yang & Lu, 2023).

c) Assessment

The only visible assessment was during the first lesson – the experiment, which required learners to submit a report at their conclusion. He did not assess the learners in the other two lessons. He indicated that he used the lessons as an opportunity to show learners where they went wrong and how they should be able to go through answering questions to avoid losing easy marks. However, the C1T could have given learners an assessment as extra work to do when they are free, but he did not do that. It was also important to check if his feedback was well received, given the fact that learners are still going to write the same content during the upcoming mid-year exams. This influenced the learning process negatively (Wilson, 2018).

7.2.1.2. Online platform

a) Use of the LMS platform

The C1T had not created a GC platform during the first lesson observation. He only created it prior to the second lesson. Still, he was the only participant in the platform, with no learner added as presented in picture G. He indicated that the challenge emanated from the fact that he did not have a personal laptop but a staff laptop which most of the teaching staff relied on:

> ***"Okay. With the Google Classroom platform. I had some challenges myself. I'm not in a position of a laptop. Since we are competing for the laptop in school, so I don't have a personal laptop right now. It was stolen." – C1T***

Yet, Li et al. (2020) indicated how compatible GC is with a variety of devices. As such, the C1T could have used other devices, such as his smartphone. However, it appeared that it was the usage of GC that he struggled with, despite the training I provided to him prior to the implementation of the designed RBLS:

> ***It's it's difficult for me to, to, to use for example for a Google Classroom, yes. But I have created account using my cell phone.***
> ***But it's not that easy…..Using the Google account for a first, for the very first time in your life. So I try to make some practice. At least, I can learn to use it, but it was not easy for me…..So maybe I also need some sort of a, a workshop on using a Google account more workshop only***

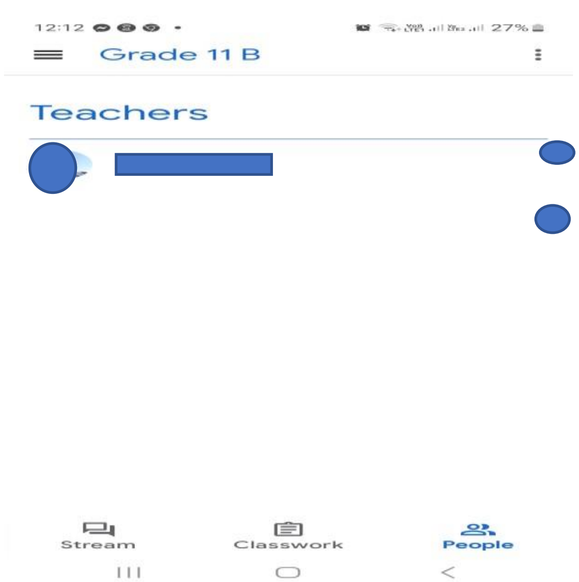
using a Google account so that when I use it that I, use it effectively." – C1T

Likewise, the C1T attempted to use the GC platform to communicate with his learners as presented in picture H. That was positive since engaging learners through the GC platform increases their motivation as it would have provided a room for more advanced engagements (Makena et al., 2022; Ali, 2017). However, his attempt to use the GC platform did not bear any fruits as no learner was added. The C1T proceeded by uploading a task to the platform as presented in picture I. Nonetheless, no learner was there to do and submit the task as C1T indicated that he did not have a laptop to manage his smooth usage of the GC platform.

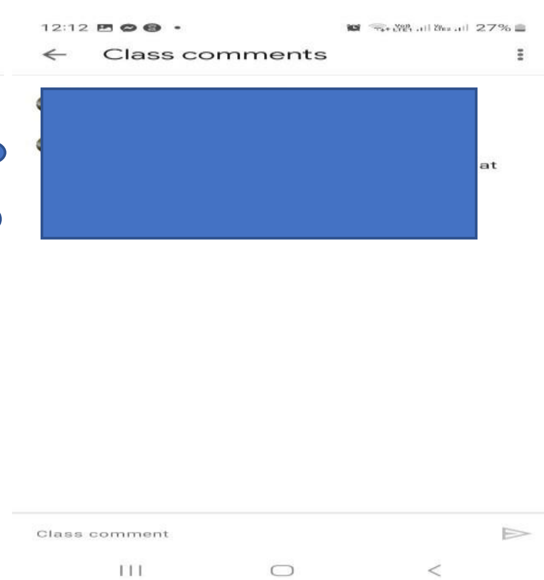
Furthermore, learners did not respond or engage with the teacher since they were never told about the platform. The only thing the C1T did was to ask for emails, and it ended there:

"No, no, no. He did not say anything." – C1Ls

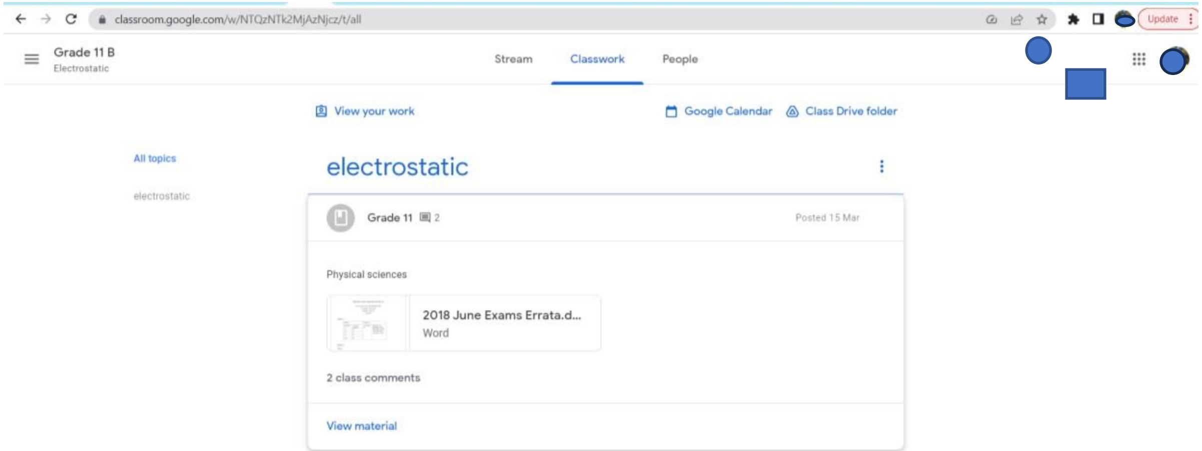
Picture H: Case 2 GC participant page



Picture I: Case 2 GC Stream tab



Picture J: Case 1 GC Classwork tab – desktop version



b) Use of the SM platform

The C1T utilized the SM platform to aid his teaching. By the first lesson, he had added 14 learners to the WhatsApp group. He even made announcements, such as when he reminded a learner to submit the task as presented in picture K. The C1T also used the platform to report marks to the C1Ls as presented in picture L. Likewise, one C1L used the platform to engage the teacher in activities he had promised to give them in the face-to-face classroom.

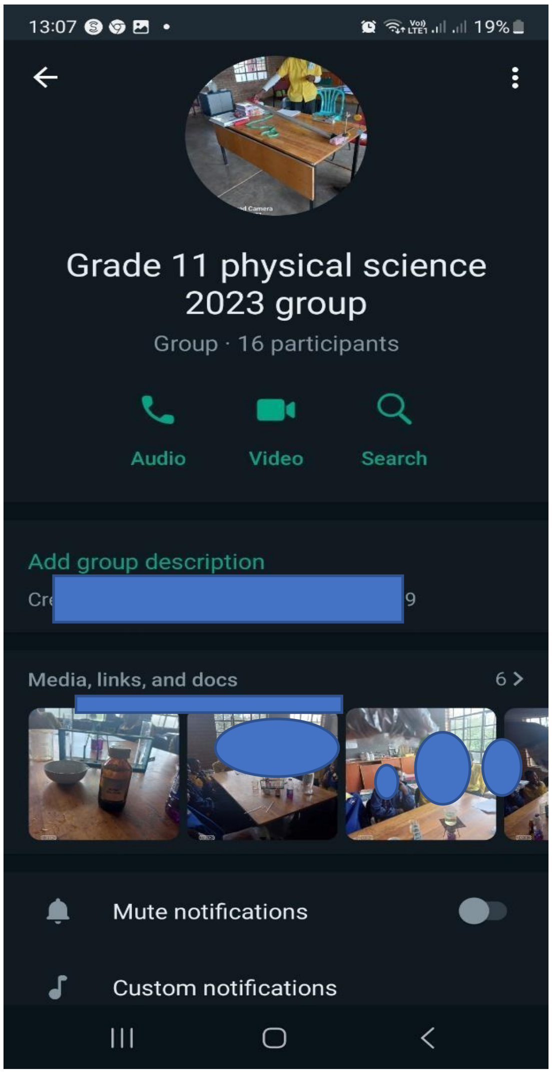
He proceeded and asked the C1T to share resources in order to gradually introduce the C1Ls to term 2 work. However, the C1T shared a picture of Grade 8 learners doing the practical. He said he wanted to promote the practical work in science:

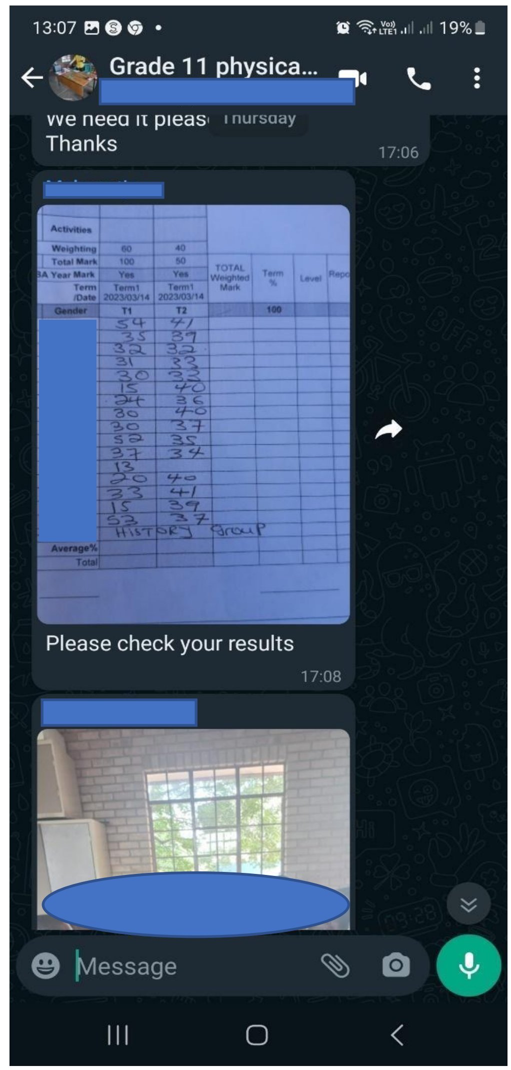
> ***"It was not all about what I was doing class. It's all about trying to promote. Physical Sciences, also a small a small number. Small number of learners were doing Physical Sciences, so I'm promoting that and also they must they must feel comfortable, right? Or no, this thing of maybe WhatsApp it's not for, it's not for them or other other learners, see are involved, and remember that those pictures, that is, is the natural sciences has a great 8 learners and I'm not teaching that natural sciences." - C1T***

Even though that was for a good course, it had nothing to do with what he was teaching in class. Therefore, the C1T failed to use the WhatsApp platform effectively to teach Physical Sciences. Research has already indicated how SM has won the hearts of learners, increasing their excitement and teaching-learning experience (Cilliers, 2021).

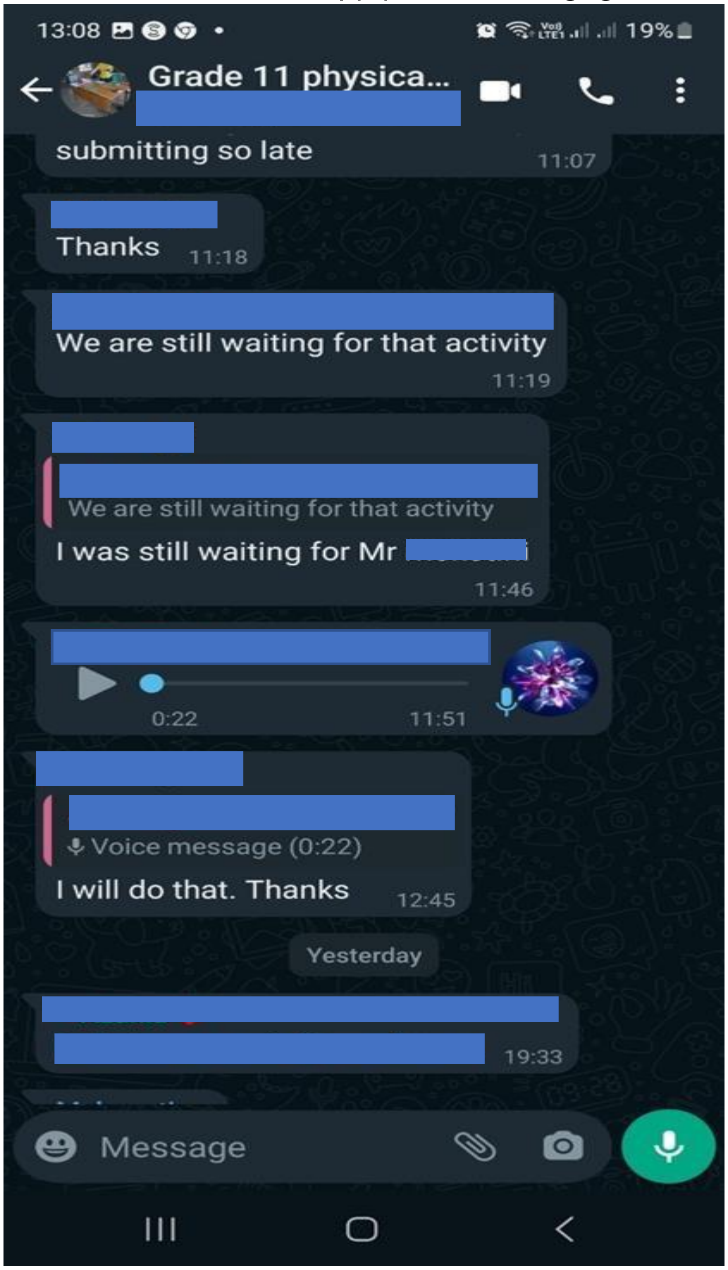
Picture K: C1T WhatsApp participants' page platform

Picture L: C1T WhatsApp communication with learners





Picture M: C1T WhatsApp platform - engagement of the C1L with the C1T



The C1T also used the WhatsApp platform to report marks to the learners as presented in picture L.

c) Use of the VC platform/s

The C1T had not used VC platforms to record and schedule sessions. He indicated that he had attempted it but failed:

"I tried it. I tried it. It's not easy for me. I try it all and especially when I'm at home like that, but I could not get it right. I could not get it right. Yes, I tried, and I still want to try it." – C1T

He also repeated the issue of not having a laptop as another factor that led to the failure:

"I was not sure of where to where to start. Even the problem with the laptop because of I cannot take it from school and bring it here to home. Yeah." – C1T

This was a loss to the learning process as Ulfah Safitri & Asrining Tyas (2022) found learners in their study to have positively accepted the use of VC platforms.

7.2.2. FINDINGS

a) Minimal learner-centeredness

The Physical Sciences curriculum encourages teachers to utilize learner-centered approaches (DBE, 2011). In fact, as per its principle, the curriculum promotes "active and critical methods to learning" and discourages the "route, uncritical learning greatly" (p. 4). Even though the C1T tried at instances to advance learner centeredness in a lesson, for example, by promoting group work during the experiment and asking a learner to come and show his peers how to calculate the problem. The C1L did not engage with his peers or his teacher during that time. Social constructivists believe learning is effective when learners engage with their peers and teacher (Ardiansyah & Ujihanti, 2018).

Nonetheless, there was no evidence of such engagements, at least in a sufficient manner. The C1T could have amplified what he did in the first lesson which was the mass vs acceleration experiment, which was more learner centered. In the lesson, he allowed learners to be highly engaged and hands-on. He even empowered female learners who seemed aloof and lacking confidence by asking them to swap their roles of recording values, with male learners who were performing the experiment. That was very commendable but could not be repeated in the second and third lessons. Further, learner-centered lessons align with the aims of the Physical Sciences Curriculum (DBE, 2011) and blended learning (Tabo et al., 2022; Sheerah, 2020).

b) Poor Institutional support

The C1T was disadvantaged by ineffective institutional support, despite the issue of theft, which was alarming and led to some of the challenges to the implementation of the RBLS. However, having an individual laptop that would allow him to do work without rushing, knowing that another colleague might come and demand the laptop, would have helped a good course. Tuiloma et al. (2022) have already indicated how effective institutional support can prevent impediments to the implementation of the RBLS.

c) No Flipping of the classroom

The C1T failed to link to the online platform in the face-to-face lessons. The C1T could have achieved that by mentioning or referencing what learners have learned or what he could have uploaded or placed on the online platforms. Likewise, he did not mention whatever was learned online from what was taught in class. He could have given instructions through the online platform and the more engaged learning in the classroom (Maher et al., 2015) but did not do that. Consequently, apart from the assessments, the online and face-to-face platforms were treated in isolation, resulting in the failure to blend (Jeffrey et al., 2014) the teaching and learning of Physical Sciences.

d) LMS use challenges

The C1T had created the LMS as a GC platform. But that was after the second lesson. It appears that many teachers are using the same laptop that he relies on and, therefore, could not create it in time. When the induction was provided to him as part of the intervention strategy, the C1T was taken through both the desktop and smartphone versions of GC since GC is compatible with several devices (Li, 2020) and should have switched to using his smartphone. In addition, the C1T had indicated his access to the Wi-Fi during phase 1 of data collection, which he could have used with the smartphone in the comfort of his home to create the GC.

Nonetheless, it was established that the C1T failed to add learners to the GC platform mainly due to his poor computer skills. Although he managed to get learners' emails, he never added them to the GC platform. Instead, he went on to send in announcements and assessments, which were in vain, as no learner was added to the platform. Consequently, the C1T failed to use the GC LMS to aid his teaching and deprived learners of learning through the platform, which is known to increase their motivation (al Yakin et al., 2022) due to its ease of use (Kumar et al., 2020; al Yakin et al., 2022)

e) Insufficient use SM platform

Although the C1T had used the SM platform to make announcements or notices to learners, for example, when he wanted a particular learner to submit work, he never used the platform to teach Physical Sciences. For example, he could have shared the practical worksheet with learners in advance or used the platform to engage learners on what he had already or was about to teach. In that way, he could have successfully flipped the classroom (Maher et al., 2015), but he did not. One C1L tried to engage the C1T, asking him to introduce the term two work, even if it is just a definition, but the C1T did not do that despite him promising the learner. He deprived C1Ls of an effective learning environment as Akgündüz and Akınoğlu (2017) contend that SM-based learning has a positive effect on academic success and motivation.

In addition, he used the WhatsApp platform to promote practical work by sharing grade 8 learners doing the practical. Even though it was commendable, it was irrelevant to what the C1T was teaching in class. He could have used the opportunity for instructional purposes (Gon & Rawekar, 2017) in explaining what is expected from the mass vs acceleration experiment to the C1Ls, prior to the experiment. He could have also shared YouTube links to videos of a similar experiment to give learners a picture of what could be expected from the practical or to communicate laboratory rules per the designed RBLS's expectations.

f) Failure to use VC platforms

Despite the induction I provided to C1T on the use of VC platforms such as Microsoft Teams and Zoom Meetings, he failed to use the platforms. He indicated during the interviews how much he tried and failed even after the induction. He also cited the issue of lacking a laptop as another factor. This deprived learner of an opportunity to receive effective teaching and learning. Anastasiades (2009) indicated how VC platforms promote social presence. The C1T could have used the platforms to record asynchronized sessions, which he could have uploaded to WhatsApp and/or GC. According to Hew and Knapczyk (2007) asynchronized sessions are reported to develop learners' critical thinking as well as problem-solving skills. Additionally, he could have scheduled live sessions through the platforms.

7.3. CASE 2 – MATHOKO SECONDARY SCHOOL

7.3.1. DATA PRESENTATION AND DISCUSSIONS

Before the implementation of the RBLS in class, interventions were made as indicated in chapter 6 of the Rural Blended Learning Strategy (RBLS). The RBLS included engaging the principal in allowing learners to bring along cell phones to school for the duration of the implementation. The principal acceded to the request but needed to consult with the School Governing Body (SGB). This was a great boost as the Case 2 teacher (C2T) was able to use the cell phones to add some of the learners to the GC platform. Likewise, the C2P was engaged in the provision of electricity power backup, which never materialized. The classroom observation involved observing the face-to-face and online context for at least three lessons.

7.3.1.1. Face-to-face platform

a) Prior knowledge/link to online class

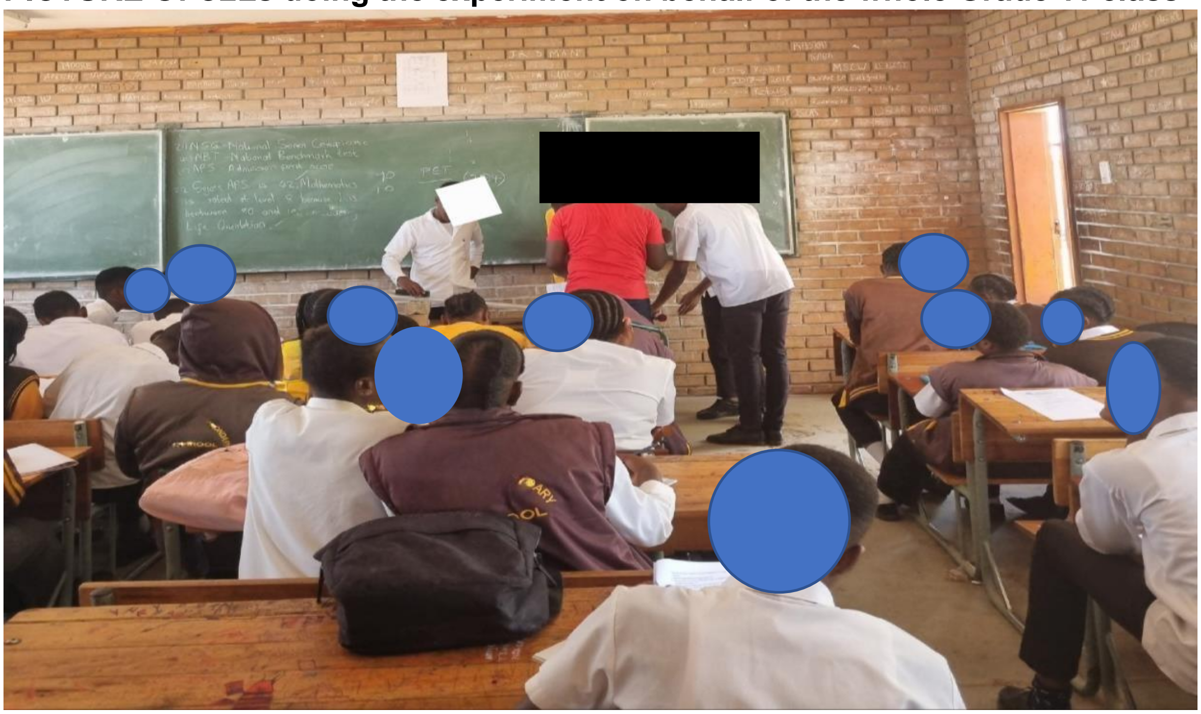
The C2T started the first lesson, which was the relationship between force and acceleration experiment as presented in picture K, by taking learners through what is expected from them in the experiment. However, he never linked the experiment to any prior knowledge or theory that pertains to the experiment they were going to perform. He then redeemed himself in the second lesson, where he taught about circuit diagrams. He started the lesson by visiting prior knowledge from the Grade 10 work of series and parallel circuits. According to Simsar and Davidson (2020), prior knowledge has long effect on learners` self-efficacy. The C2T also visited prior knowledge to a lesser extent when he was teaching the topic – Power. He asked learners “what is energy?” to which learners responded by saying, "energy is the ability to do work.” He then told them that what they stated was learnt in grade 7.

Likewise, he failed to mention the online platforms or refer to them in the first two lessons. He referred learners to GC platform after the third lesson, when he had already concluded the lesson. He failed to connect the online platform with the faceto-face platform, hence there was no blended learning of Physical Sciences (Jeffrey et al., 2014). What was exciting to observe in one lesson is that the C2T clarified a learner's misconception about the GC. The learner thought GC consumes a lot of data and felt WhatsApp was better, for which the C2T corrected by indicating that the GC consumes less data similar or less compared to WhatsApp. However, it was established in the focus group interviews that some C2Ls used WhatsApp ticket data and not the data meant for general use.

b) Teaching approach

The C2T used teacher-centered methods for most of the lessons. For example, in both lessons 2 and 3, he spent a lot of time writing on the board and speaking simultaneously while learners were busy writing down notes. Also, in the first lesson which was the experiment, he picked four learners to come and do the experiment while the rest of the class was taking down reading as presented in picture O. In the process, a total of four C2Ls did the experiment while the rest of the class were recording the results. Science is a doing subject as per the requirement of the Physical Sciences curriculum (DBE, 2011). Likewise, teacher-centered methods did not yield active learning in class, which is one of the expectations of the Physical Sciences curriculum (DBE, 2011)

PICTURE O: C2Ls doing the experiment on behalf of the whole Grade 11 class



The C2T consequently deprived C2Ls of an opportunity to be engaged hands-on with the content. He indicated time as an issue that led to his choice:

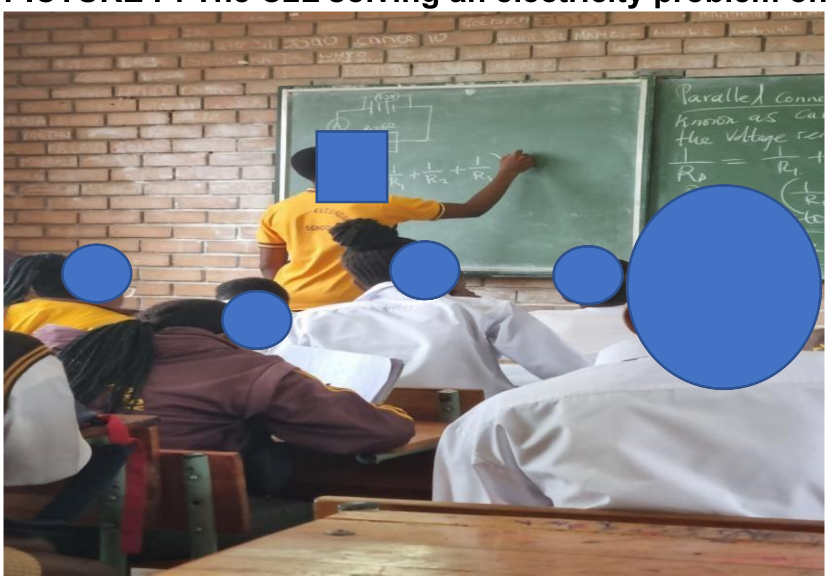
> ***"The reason why, why I did that was because of time again because learners were still busy writing. They are common tests. OK, so of which I couldn't take much time with them. I wanted them to also prepare for the common test, which they were busy, writing so hence I opted to call for learners to demonstrate to the rest just to save time." – C2T***

Likewise, in the dominant part of his lessons, he kept on writing on the board while the C2Ls were reciting answers either in small numbers or as a whole class. He continued by doing the calculations for C2Ls for the most part of the lessons, except at one instant as presented in picture P. The C2T indicated that he wanted to check if his C2Ls understood what he taught:

> ***"Yes, I did. I did that there. There is one learner which I called, to, to come and solve one of the the, the problems. Yeah, I gave to them. Yeah. Yeah, so wanting to check if they really understand. What I was busy. Showing them or the approach on the questions." – C2T***

However, he was inconsistent as that approach was not evident in the other lessons. He indicated time as a factor and that he tried to address that by giving learners work in the WhatsApp and GC platform.

PICTURE P: The C2L solving an electricity problem on the board



Regarding the teaching media, the teacher deprived C2Ls to learn with object they see. Rather than naming electric components, the teacher could have brought some if not all the electric components to class for the purpose of showing learners during his teaching of electric circuits. Even though he tried to use the wall plug socket as an example of a resistor, he could have brought some resistors to class.

c) Practical/Experiment

Except for the first lesson which was an experiment, the C2T never did any practical demonstration in the second and third lessons. That may have created an impediment to active learning, which is one of the aims of the Physical Sciences curriculum.

d) Assessment

The C2T only assessed the learners in lesson 1 which was an experiment where learners were subsequently required to write a practical report. He never assessed learners in lessons 2 and 3. He said he realized that the content for lesson 2 did not carry much which could be assessed and then decided to assess both the content for lesson 2 and 3 at once:

> ***"Yeah, the, the the thing is what has transpired is, you know, when I check, you know, the the electric circuit. So for the, second lesson, it was not having some of the things whereby the the, the problems which I normally share with them you know caters both lessons. The reason why I did not give them a problem. During the first lesson was that I. Wanted to, to also introduce the other part so that when I give them the problem it will be you know catering both first and I mean second and third. yeah." - C2T***

But still, that did not occur in class. This was a downside of his approach as according to Wilson (2018), classroom assessment positively impacts the learning process.

7.3.1.2. Online platform

a) Use of the LMS platform

The C2T created the GC platform before implementing the RBLS. He consequently managed to add the C2Ls through the class code and through the email invitations, which learners created by themselves under his guidance. During the first observation, he managed to add 13 out of 43 learners. He ended up with 32 learners during the conclusion of my observations. However, about 11 learners had not joined the GC platform. The C2T indicated the issue of parental resistance as a factor:

> ***"What I've discovered is that some of the learners, their parents are resistant. They don't want to buy them cell phones. They are saying they are too playful when they are with their cell phones. The ones which I couldn't manage to add was because of not having a cell phone". – C2T***

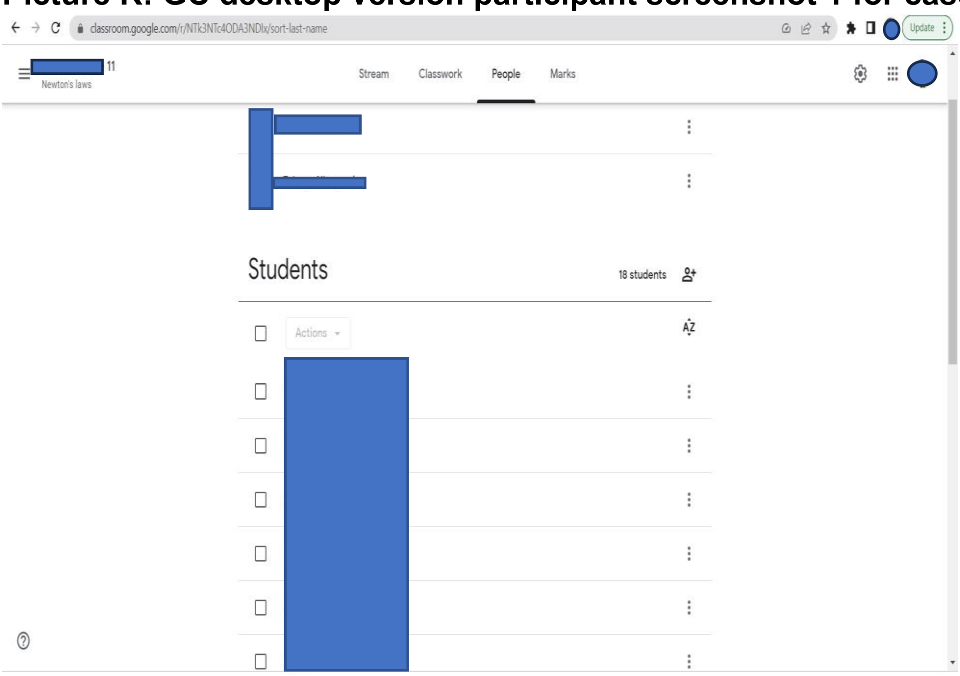
The C2Ls themselves indicated to have experienced a lot of challenges when joining the GC platform. For example, one C2L indicated that the challenges are mostly due to the fact that the platform is alien to them:

> ***"It's a new thing. To us so. Looking in or. Connecting to it was pretty. It was pretty difficult in terms of. The steps we we should follow to get connected, so we are." – C2L***

He consequently managed to communicate with his C2Ls through the GC platform when he wanted the C2Ls who were already added, to send a message to those who were yet to be added as presented in picture L. That communication was fruitful as the number of C2Ls increased to 18 by the day I made my first classroom observations as presented in picture R.

Picture Q: The GC/stream cell phone version screenshot of case 2

Picture R: GC desktop version participant screenshot 1 for case 2



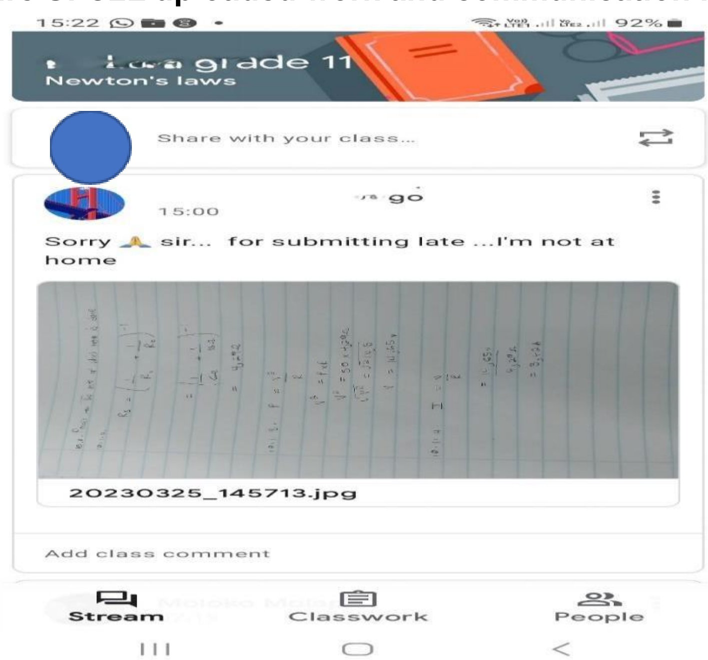
Additionally, he used the GC LMS to engage C2Ls on a subject-related matter or even to refer to the face-to-face content as presented in picture S. For example, just after the third lesson, he uploaded an assessment that required learners on the stream of the GC and indicated to them to send him feedback as presented in picture T. At the same time, he assigned 30 learners of his class the same work on the Classwork tab of the GC as presented in picture T. However, only one of the C2Ls did submit their work on the GC. When I asked the C2Ls why they did not send that, one C2L explained that the challenge faced had to do with their inability to use the platform:

> ***"Yes, I experienced a few [challenges]… Especially when we're supposed to give feedbacks on the activities that we were given, I explained a challenge there because I did not know how to." -C1L***

Nonetheless, the C2L consequently managed to use other methods to send work to the C2T:

> ***"So instead, I just sent the e-mail directly to Mr [C2T] because I did not know how to send the feedback via the Google." - C2L***

Picture S: C2L uploaded work and communication in GC platform



Interestingly, one C2L found the GC to be improving her self-directed learning (SDL):

> ***"I like the fact that we can learn from our comfort zones. We can be at home. Some people don't like social interactions like myself. So learning through Google Classroom has given me a. From where I can learn freely link to wonder if what what people are thinking, what people are doing is just to me and my work. I feel isolated and I feel like I can do best when I'm isolated from other people." – C2L1***

On the same note, another C2L shared with me how the GC platform had motivated him to be more engaged in his studies:

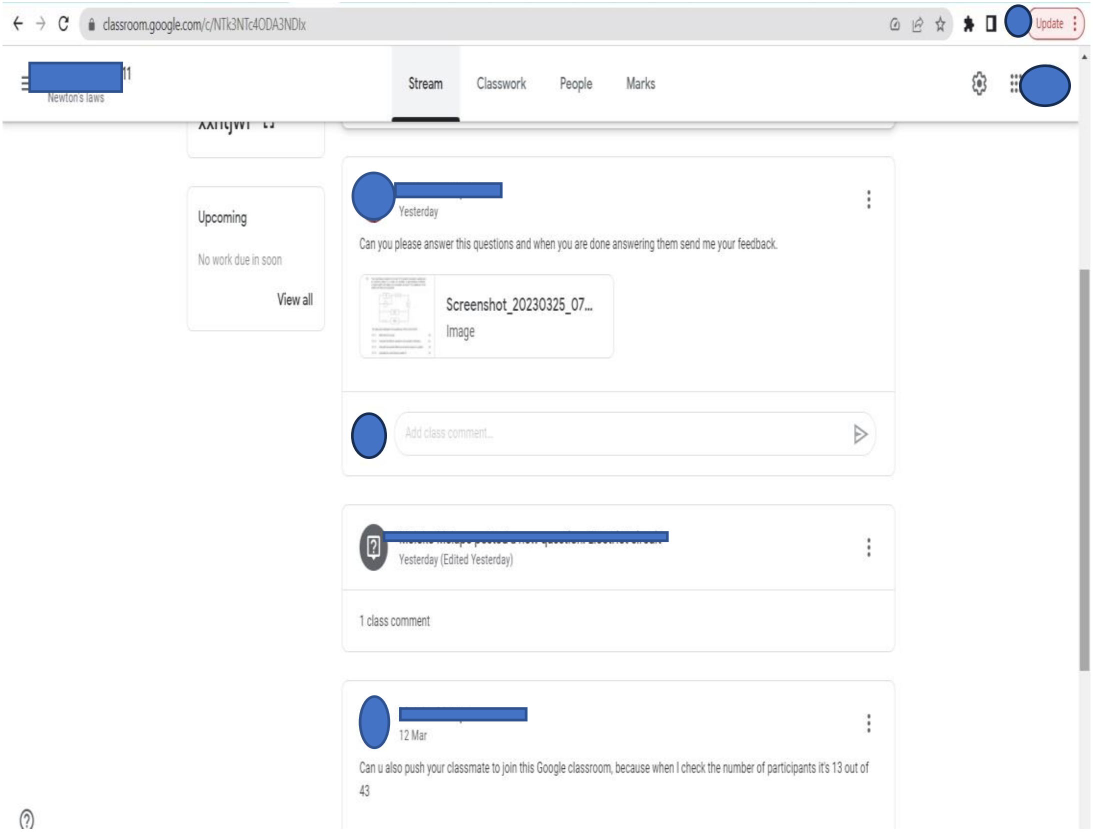
> ***"Now I know how to invest in my studies to be my academics better. So yeah, Google Classroom is giving me the opportunity." – C2L2***

van der Westhuizen and Golightly (2019) contended how blended learning platforms yield SDL, promote 21st century skills, and align with the 4IR. In addition, they proposed that this may lead to development of social constructivism, and learner-centered active learning.

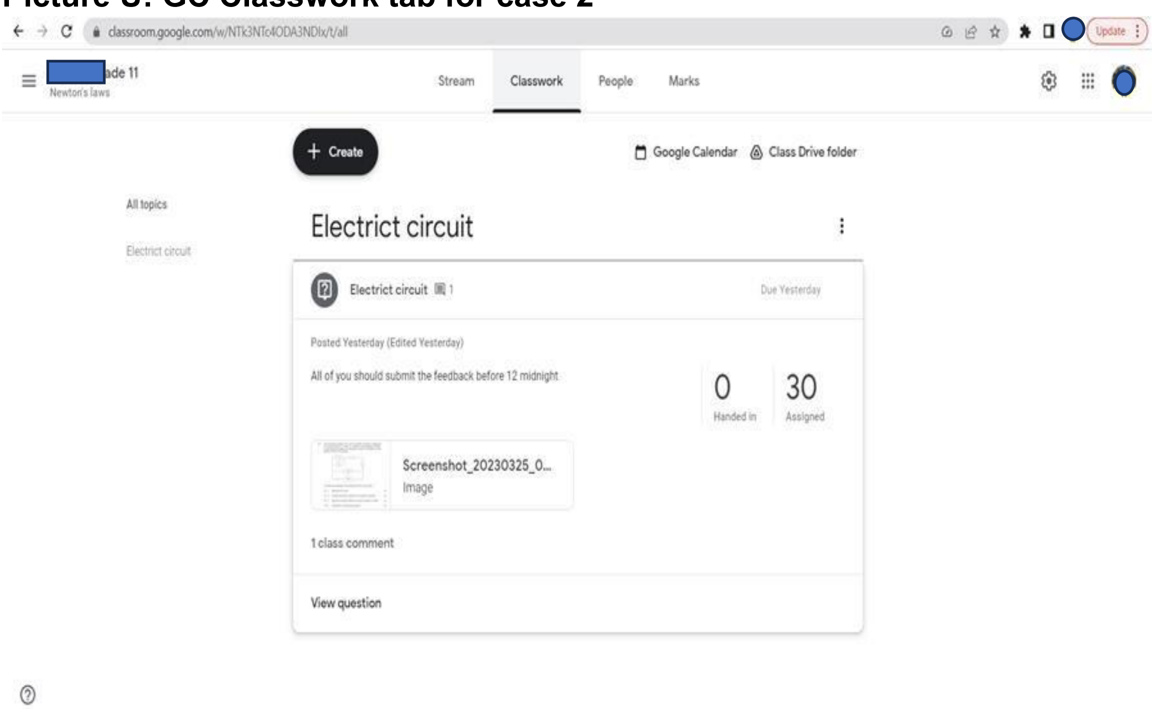
Likewise, the C2T had not used the Marks tab for the GC as presented in picture V. He could have used to give the C2Ls a report back of their progress to their performance in a digital manner (Sukmawati & Nensia, 2019). He said he felt that since learners responded to the task on WhatsApp and not GC, he should use the WhatsApp platform to report back:

> ***"Uhmm!. I couldn't give them their, their marks via Google Classroom, but I gave them via WhatsApp because they responded in WhatsApp than classroom for the so." - C2T***

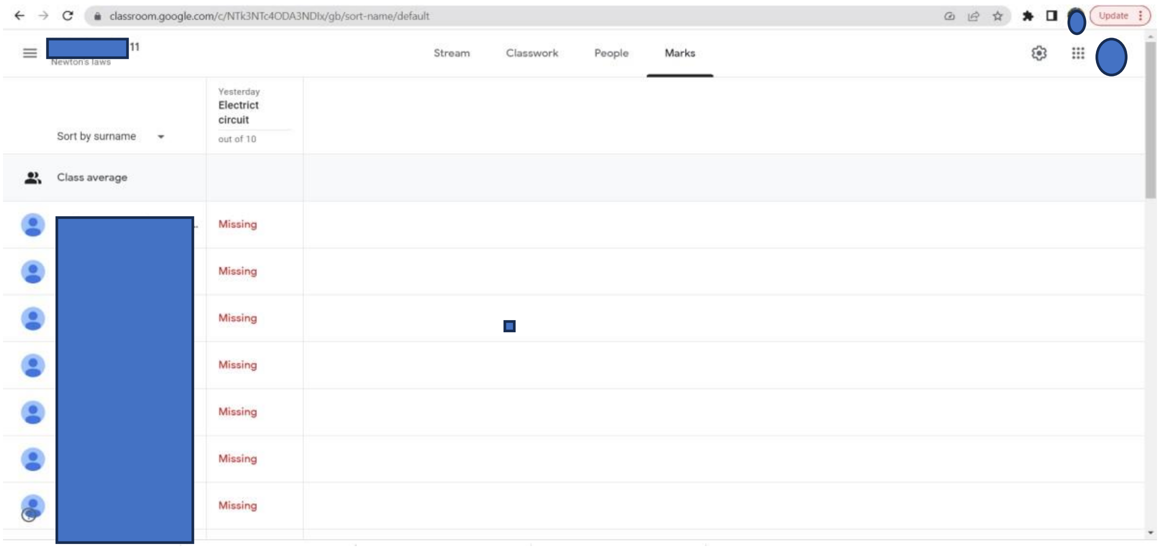
Picture T: GC stream desktop version for case 2



Picture U: GC Classwork tab for case 2



Picture V: GC Marks tab for case 2



The C2T had not uploaded any learning support material such as notes, videos, pictures, and previous question papers as per the RBLS. He could have used the platform to share, for example, the practical worksheet on the GC platform prior to the experiment's performance. He indicated workload as the reason for not following that route:

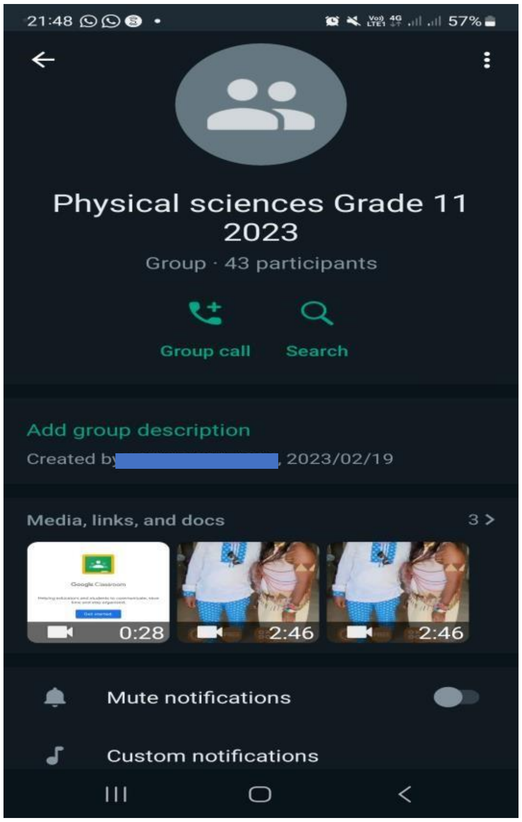
> ***"No, I couldn't manage to share those via WhatsApp or Google Classroom due to the workload." – C2T***

Likewise, he had not referenced the face-to-face platform in the GC platform.

b) Use of the SM platform/s

It was also refreshing to note that the C2T used social media to aid his teaching of Physical Sciences. The C2T had created a WhatsApp group that he used with his Grade 11 Physical Sciences learners. By the time of the first observation, he had added 40 learners in total, with a total of 3 teachers, resulting in 43 members as presented in picture W. In the last face-to-face observation, the number of learners had increased to 42.

Picture W: The WhatsApp Physical Sciences group participants page for case 2



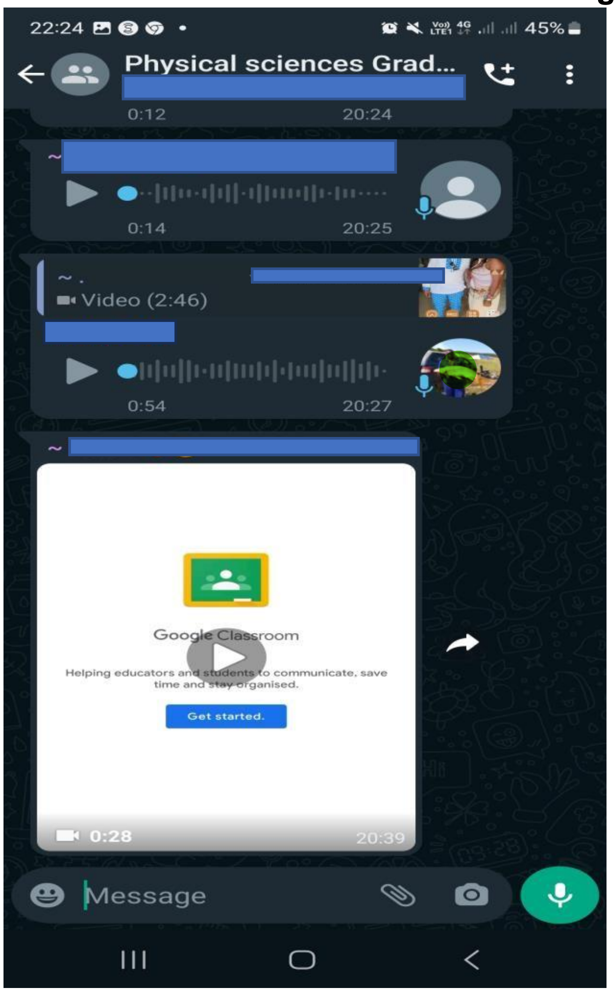
Picture X: A WhatsApp group chat page for case 2 with uploaded video and voice notes.

It was also interesting to note that the teacher uploaded a video on the platform explaining to the learners how to download, install and join the GC platform as presented in picture X. He even used a WhatsApp voice note to amplify his message. It can also be noted from picture F that after sending the voice note, he added two more learners to the WhatsApp group. One learner also had a challenge in joining the GC platform. However, through the engagement with the C2T, she sent a recorded video showing where she faced the challenge as presented in Picture Y. The learner could use the online application to engage and raise their concern with the teacher. I asked the C2T if he was able to assist that learner, and he responded by saying:

> ***"OK. So and I managed because I ended up, you know, sending sending, you know, inviting her via the e-mail. So I I got the the email from. That***

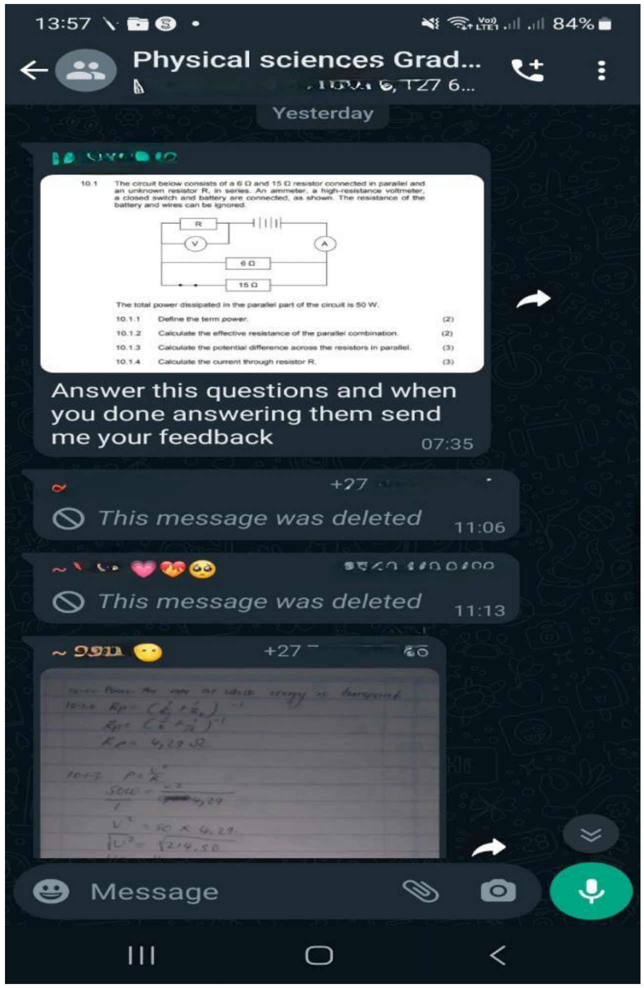
screenshot. She sent to me so, so. So I ended up inviting her. And she was able to respond, to respond. So, it came to a success because I now have her on my Google Classroom." – C2T

PICTURE Z: A screenshot of a video engagement between the C2T and C2L



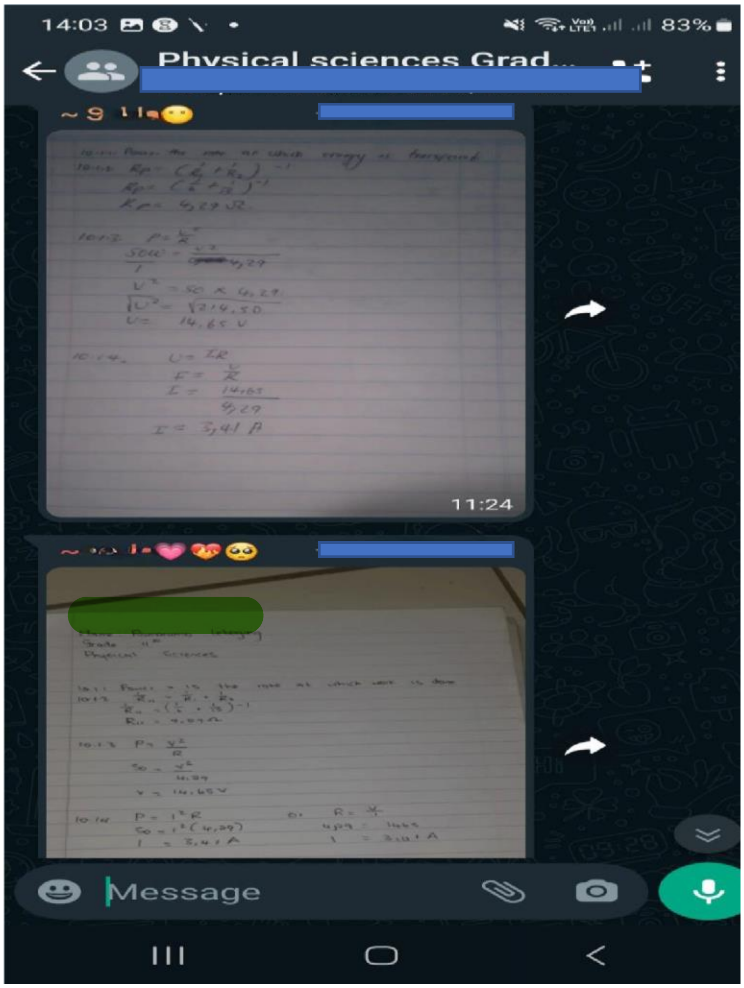
The teacher also used the WhatsApp platform to assess learners as presented in Picture AA.

Picture AA: The assigned work in the WhatsApp platform of case 2



He sent the same assessment as the one he assigned in the GC platform. He indicated that he did this to accommodate some learners who were failing to join the GC platform. Nonetheless, he only did that in the third lesson, and not the first two lessons. Interestingly, unlike other platforms, learners responded positively by submitting their tasks on the WhatsApp platform as presented in picture BB. To be specific, 21 learners did submit the task.

Picture BB: The C2Ls submitted work on WhatsApp:

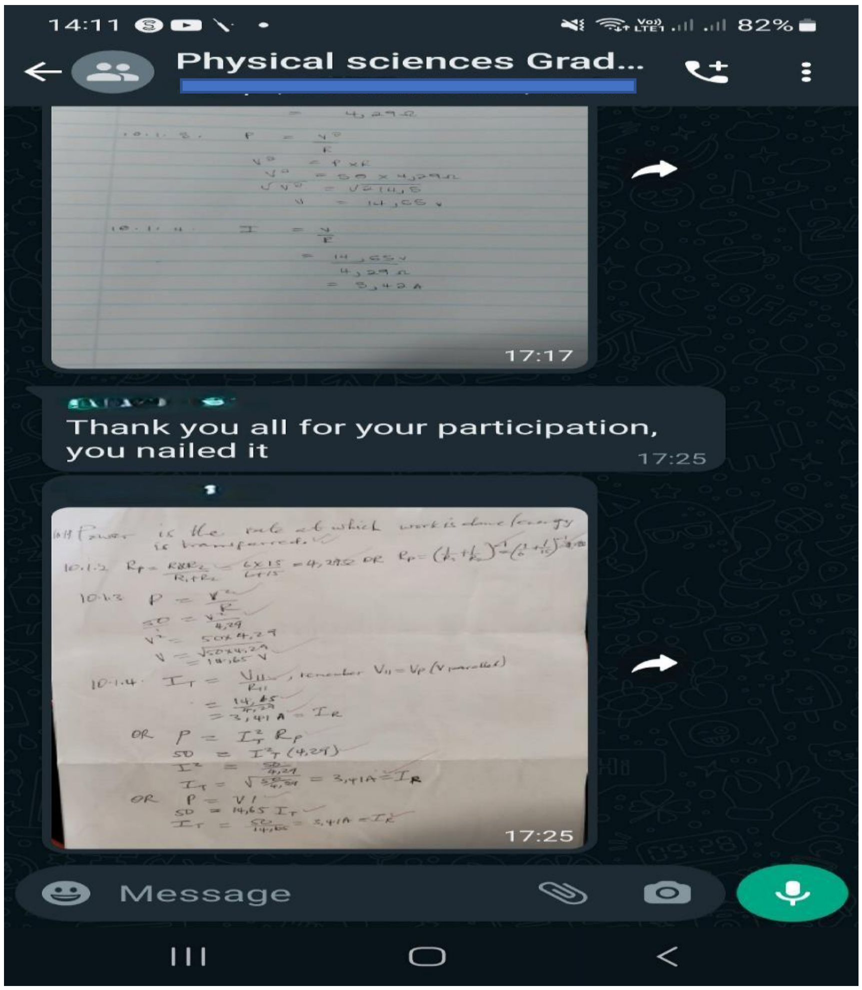


I asked the C2Ls why they chose WhatsApp over the GC platform and they indicated that most of them are using WhatsApp ticket that caters only to WhatsApp and no other Applications:

> ***"What she's referring to (referring to the other learner) is the fact that there's a specific bit of WhatsApp and there's general data for every app. So, the one that she had was for WhatsApp. Therefore, she could not logging into the Google Classroom." – C2L*** Ultimately, the teacher gave them feedback by sending them back the memorandum/marking guideline and briefly commenting on their performance as presented in picture CC. The teacher did not mark the task and gave the following reason for that choice:

"In fact, in fact, the feedback which they gave to me, all of them answered the problems correctly. Then I have to also. You know, paste solutions, yes, yes, because I also added some of the methods which they did not use. For those. Other than that, there are other ways which you can still solve these problems." – C2T

Picture CC: The C2T feedback on WhatsApp



This implied that the C2T used the WhatsApp platform to assess and give C2L feedback.

c) Use of the VC platform/s

Even though the C2T had used videos to explain instructions to the learners on the SM platform, he had not used any of the VC platforms to that. However, he utilized the screen recorder application in his smartphone to record the GC joining demonstration as presented in picture Z above. He had not used the MS Teams, Zoom, or Google Meet platforms. He indicated that he is doing that for a group of learners from different schools that he teaches after school for enrichment purposes and has never done that with the learners from his school of employment. He gave the following reasons for that:

> ***"No, it has never crossed my mind because. You know at my workstation normally learn us the challenges which they normally have. They always complain about data, you know, some complains about not having phones. Yeah, that's the reason why I was having challenges. But the ones which I, normally see, during the extra lessons. They do have phones and their parents also support them when when it comes to, you know, buying data for them, yeah." – C2T***

The C2T, therefore, deprived the C2Ls of an opportunity to be taught through the VC platforms, allowing them to interact with their peers (Hopper, 2014), and promoting social presence in the process (Oh et al., 2018).

7.3.2. FINDINGS

a) Failure to link online and face-to-face platforms

The C2T failed to form a link between the online and face-to-face platforms. He had not made mention of any online platforms in the face-to-face platforms and vice versa. The RBLS expected him to begin the face-to-face lesson as a continuation of the online lessons and/or complete the face-to-face lesson as a pre-requisite to the online lesson. Likewise, the RBLS expected the C1T to revisit prior knowledge and deal with misconceptions, which he dealt with in the last two lessons. Nonetheless, he failed to outline lesson objectives and give instructions.

b) Teacher-centered Approach to learning Physical Sciences

Contrary to what the Physical Sciences curriculum expects (DBE, 2011), the C2T chose to use the teacher-centered method. For example, in the performance of the experiment, the C2T chose to use a few C2Ls to do the experiment while the rest of the class recorded the experiment seated. Science is a doing subject. However, the C1T deprived the C1Ls of an opportunity to learn hands-on. Learner-centeredness bolds well with blended learning (Tabo et al., 2022; Sheerah, 2020). Further, the approach did not give room for engagement between the C1T and C1Ls and between the C1Ls themselves. That provided a barrier to social constructivism in the classroom (Ardiansyah & Ujihanti, 2018). Consequently, learners had no room for cooperative learning (Marzouki et al., 2017).

Likewise, the teacher failed to contextualize learning. For example, in the Electric circuit lesson, the C2T could have brought electrical components such as resistors, batteries, and cells. In the same lesson, the C2T was explaining the difference between a battery and a cell which could have been easily explained with cells in the C2T's hands. In addition, when solving problems, the C2T chose to do the calculations on the board while the C2Ls recited answers. He only allowed a C2L once to come to the board and do it on behalf of others, but that move was not consistent. That approach was teacher-centered, contrary to what blended learning is embedded in (Tabo et al., 2022; Sheerah, 2020). The C2T cited time as an issue. Further, the C2T failed to test the learning progress with an assessment in the face-to-face class. Failure to have classroom assessments had a negative impact on the learning process (Wilson, 2018). He only assessed learners through the homework on the online platform.

c) Good usage of GC LMS/ GC led Self-directed learning

The C2T found using the GC as simple. For example, not only did he create the platform, but he also managed to add 30 of the 43 C2Ls. Some of the C2Ls themselves did not find joining the platform easily. C2Ls indicated the issue of data vs data tickets as an issue. The C2T highlighted the lack of parental involvement bordered on initiating the GC platform. However, some C2Ls indicated how GC allowed them to learn at their own pace and motivated them to work independently (al Yakin et al., 2022). GC influenced their self-directed learning (van der Westhuizen et al., 2022).

The C2T also managed to use the GC effectively to support his teaching of Physical Sciences by taking advantage of some of its tabs, like the Classwork tab and the Stream (Li, 2020). For example, he uploaded an assessment under the classwork tab in the third lesson and asked the C2Ls to submit. He also duplicated the assignment under the stream as an announcement. However, only one C2L responded. One of the C2Ls who did not submit highlighted how she struggled to submit work on the GC platform, as a result she ended up sending her work through an email.

Likewise, the C2T could not report back or give feedback to learners through the platform. He failed to report back on their progress to their performance in a digital manner (Sukmawati & Nensia, 2019). Nonetheless, he indicated that he gave them a report on WhatsApp. More so, the C2T could not upload any learning support materials such as notes, pictures, videos, and links that could have helped the C2Ls understand the content better.

d) Use of the SM platform

The C2T used the WhatsApp platform to teach Physical Sciences effectively. For example, he uploaded work that C2Ls had to respond to, the same work he had uploaded in the GC platform. However, in this platform, most learners responded and returned the written work. It was not surprising since Gon and Rawekar (2017) found WhatsApp to be an effective instrument for facilitating an activity for learning. Likewise, the C2T gave them feedback by sharing the memorandum and indicated to them that all ‘nailed it.’ Nonetheless, the C2T did not use the platform to give them instructions or send additional resources and videos. He minimally engaged them on subject-related matters.

e) VC skills unused

The C2T had plenty of video creation skills. For example, when creating the GC platform, he used a screen recorder application on his phone to show C2Ls how to join the GC. He also assisted one C2L struggling to join using the screen recorder application. Likewise, during the interview, he indicated how he uses Microsoft

Teams and Zoom meetings VC platforms to create lessons for the learners he assists after school hours as a private tutor. Nonetheless, he never demonstrated those skills in his Grade 11 classroom at his school of employment. He could have used the platforms to record asynchronized sessions or instructions, which are known to develop learners' critical thinking and problem-solving skills (Hew & Knapczyk, 2007), or to schedule live sessions, but did not. VC platforms are known to promote social presence in the process (Oh et al., 2018), and as such, the C2T deprived the C2L of that.

7.4. CASE 3 – BAFETI-BA-TSELA SECONDARY SCHOOL

7.4.1. Data Presentation and Discussions

As per the designed Rural Blended Learning Strategy (RBLS) in chapter 6, I engaged the C3P about the provision of electricity power backup and the flexibility of learners' bringing phones to school. On my arrival, it was exciting to note that the electricity power backup in the form of a generator was already in place as presented in Picture DD, compared to when I came to the school for Phase one data collection. This was a sign of an effective institutional support which had the potential of preventing impediments to the implementation of the RBLS (Tuiloma et al., 2022). The C3P also did not see a problem with learners bringing phones to school provided they are supervised by the C3L. However, the issue of cell phones was not evident during my classroom observations. Literature has already indicated how mobile devices influence learning positively (Ustun, 2019).

Moreover, as I indicated in the previous chapter, I inducted the teacher on using LMS, SM, and VC platforms in blended learning before my observations. However, the observations did not start as I anticipated. There were issues with the Athletics programme, District common test programme, and teacher union meetings that impeded the start of the implementation of the RBLS.

Picture DD : Case 3 electric generator

7.4.1.1. Face-to-face Platform

a) Prior knowledge/link to online class

The C3T positively initiated the lesson as he engaged C3L on their prior knowledge of Newton`s third law and gravitational acceleration. He did the same in the second lesson and third, where he began by leading the corrections of the work he gave to learners in the previous lesson and initiated the corrections to the homework that he gave the previous day in the third lesson. He then started a new chapter on Electrostatics, revisiting prior knowledge of what they learned in the previous grade. That was positive to note since prior knowledge is known to influence learners' engagement positively (Dong et al., 2020).

However, never in any instance of the three lessons did the C3T refer to the online platform of blended learning, be it the LMS, SM, or VC. Even though he made use of copies of the previous question paper in the assessment, he never referred them to any uploads or additional resources on the online platform. Even when he gave them homework in the second lesson, he made no mention of any assessment on the online platform/s.

He indicated during the post-observation interviews that he had not created any online platform at that time:

> ***"Oh yeah. When it comes to that I encountered some problems so I, didn't manage to create online platform for learners. So that's why I didn't mention it." – C3T***

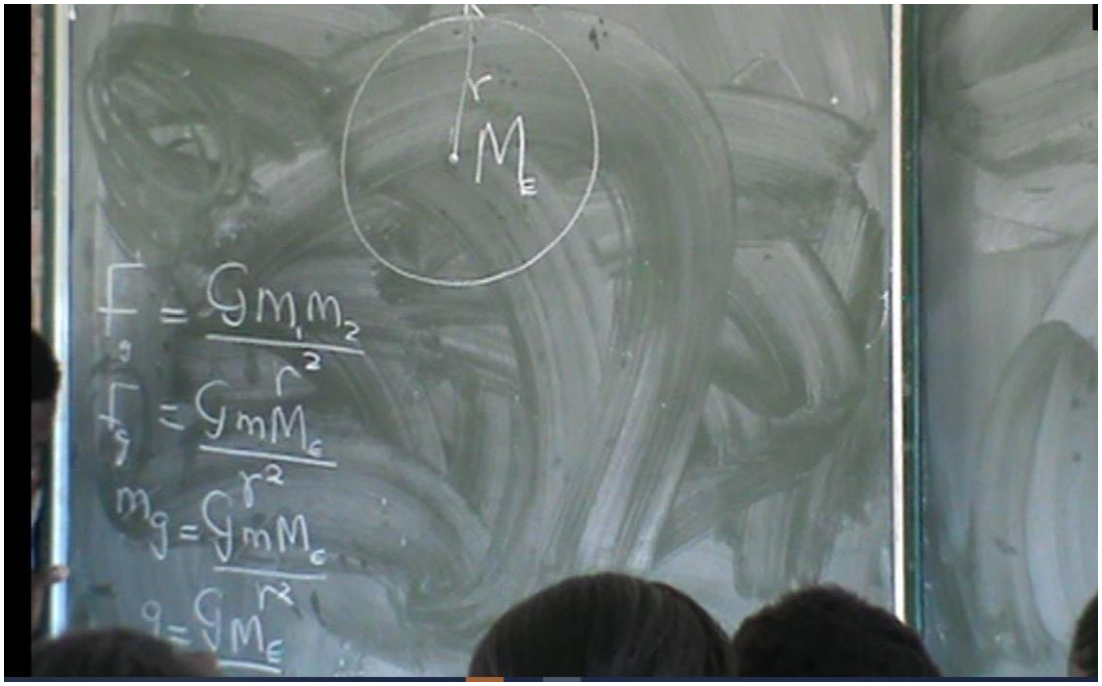
However, the online platforms were created during the other two lessons. Despite their presence, the C3T still chose not to refer C3Ls to them.

b) Teaching approach

The C3T employed the demonstration and explanatory frameworks (Mudau, 2016), where he drew diagrams to demonstrate the center of gravity between two bodies and used formulae to prove the value of gravity and its calculation using Newton's law of gravitation as presented in picture EE. However, his teaching was more teacher-centered, contrary to what blended learning is based upon (Horn & Staker, 2014). Likewise, he spent a lot of time showing learners how to do such calculations, but not in any instance has he asked them to come and demonstrate their understanding by doing calculations themselves. He instead chose to involve them when he wanted values from calculations. He gave the following reasons for his choice:

> ***"So, for me to manage my time since, I am slow in teaching, so I just ask learners what to write on the chalkboard, so they will respond when some, some learners respond, the others will be learning at the same time. That's why I use that method. I just write the question. If it's time to calculate, I ask which formula should I use, then they will give me formula while I'm busy writing on the chalkboard and they will respond that way." - C3T***

PICTURE EE: C3T using demonstration and explanatory framework during his teaching.



He continued with the teacher-centered method in his two other lessons. For example, in the second lesson, he resorted to using the recitation method when he was doing corrections with learners. In the process, the C3T was writting on the board while learners were mentioning the values of the calculations they were doing in a recitation manner. The C3T did not make use of practical demonstration during his teaching. In the third lesson, he sang the same song. Teacher-centered methods are not only discouraged by the Physical Sciences curriculum (DBE, 2011) but are in contrast with the principles of blended learning (Sheerah, 2020).

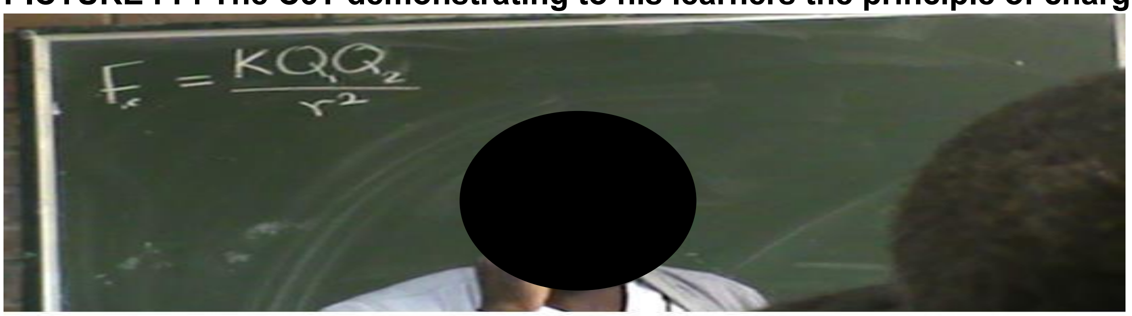
He was dominating the learning process during the assessment and feedback. He spent a lot of time writing to learners what he asked them to go and write at home. He later gave them work, which he did for them on the board. He deprived learners of an opportunity to demonstrate their understanding of the topic taught and his opportunity to assess if learning had been attained. Wilson (2018) indicated how classroom assessment positively influences learning.

There was an instance where the teacher demonstrated the generation of charges in electrostatics using the rubbing of a ruler as presented in Picture FF, but never asked them to do it practically from where they were sitting. I could not help but notice one learner holding a ruler in hand, ready to do what the teacher was doing, only for the teacher to explain what they should expect before moving to the next section. The teacher deprived learners of an opportunity for hands-on learning, an element of active learning, which is one of the aims of Physical Sciences (DBE, 2011). In his defence, the teacher indicated that he was visiting prior knowledge, hence the speed he was moving with:

> ***"Uh Yeah, I did, but it's just that I noticed that they've learned that in previous years, so I was just giving them or taping inside the prior knowledge that I was just reminding them how electrostatic works". – C3T***

Furthermore, throughout the lesson, there was no reference to any online platform/s.

PICTURE FF: The C3T demonstrating to his learners the principle of charges



He continued the teacher-centered methods in the third lesson, where he taught Electrostatics. He reminded C3L what they had learned from the previous grade, revisiting their prior knowledge. He used Newton 's law of Gravitation to introduce the formula of Coulomb's law. However, his teaching was more authoritative and involved fewer learners in the learning process (Netshivumbe & Mudau, 2022; Nkanyani & Mudau, 2019). He kept talking, describing, and feeding learners with information but never allowed them to engage with him or their peers. There was no opportunity for social constructivism to unfold (Ardiansyah & Ujihanti, 2018). Regarding the teaching media, the teacher employed only chalk, a duster, a ruler, and copies of question papers.

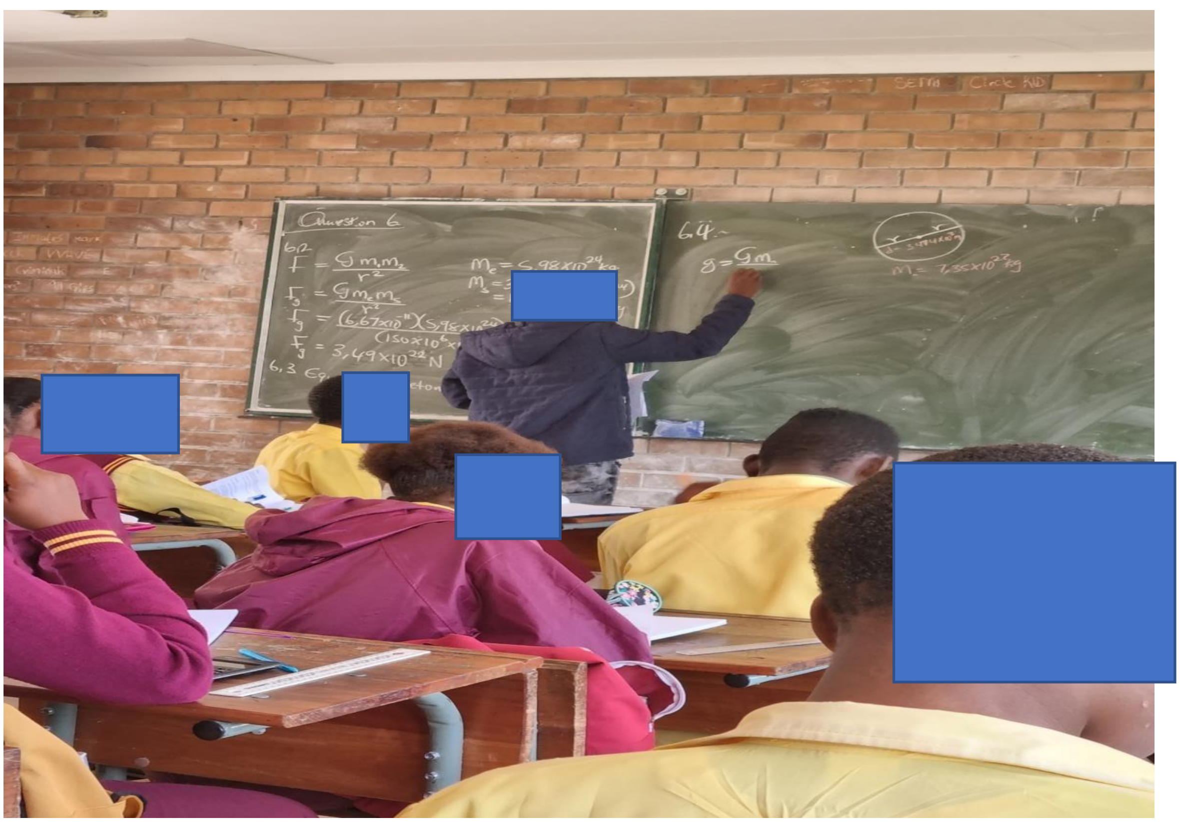
c) Practical/experiment

Despite Physical Sciences being a doing subject (DBE, 2011), the C3T never employed practical demonstrations for any of the topics. Further, the C3T never referred learners to the LMS, SM, or VC for any video or resource explaining or demonstrating gravity and its law.

d) Assessment

The C3T concluded the face-to-face lesson by giving learners a home activity from one of the questions in the previous question paper that was shared with learners. There was never a reference for any task in the LMS, SM, or VC. As such, the C3T treated both the online and face-to-face platforms as two different entities. It evident how the assessment impacts the learning process effectively (Wilson, 2018), and as such, this was a downside.

Picture GG: C3T doing calculations of Newton`s law of gravitation on the board:



7.4.1.2 Online platform

a) Use of LMS

There was an existence of the LMS in the form of GC created. Even though it took the C3T almost two weeks to create, he cited the issue of time management as the barrier to its creation:

"So uh uh eish, the first one it might be the time management because I remember my working hours, Uh they are limited. So, and one more thing uh my learners, they don't have a Google account. Yeah, that may that that caused me to delay the progress that that's why I didn't have enough time." – C3T

In addition, it was noted that the platform had only the C3T and one learner added to it as presented in picture FF, despite the C3T indicating to have added 11 out of 39 learners to the platform. He claimed that learners gave him invalid emails when he was adding them to the GC platform:

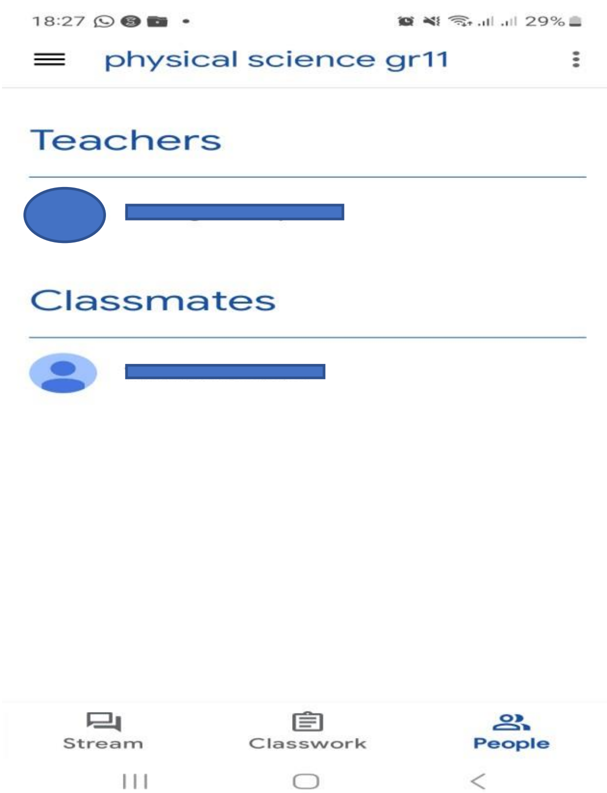
"*Yes, yes. I thought the emails I've got before, they were 11 and they were working. Only to find out that it's only one email which is working. The others, they just use their head to create any email without registering the email. They didn't create an email, they just gave me the emails. I thought maybe they are working. You know, the only email which was working is one. So, it means I had one learner out of 39, imagine. So, I thought maybe I'm somewhere far to be done with the that Google uh classroom then, that, that caused me that, that that delays me because now when I have to go back and restart again." – C3T*

The C3Ls themselves admitted to having given the teacher non-existing emails:

"I think because we made the emails ourselves, not knowing like the exact information to." – C3L1

"Or maybe we can call it this at email.com without creating it? Is that what what happened?" – C3L2

Picture HH: A screenshot of GC in the first lesson of the C3T (Mobile version)



The C3T had not assessed learners as presented in picture II, nor had he made any announcements on the GC platform as presented in picture JJ below. Consequently, the C3T failed to provide room for learners to engage on the platform (Li, 2020). In addition, there were no resources uploaded to support his teaching. According to Beaumont (2018), GC allows learners to share resources with their teachers. The C3T also did not use any simulation or experiments to supplement his teaching. There was also no indication or reference to the face-to-face lesson in the GC platform.

Consequently, the C3T never used the LMS to teach Physical Sciences. There were no changes regarding the online platforms for a minimum of three observations. The

GC LMS remained the same, where only one C3L was added. No announcement was made as presented in picture JJ below, nor was any assessment created. The C3T had not uploaded any resource or video, nor did he embed any supporting material to the LMS. Further, there was no reference to face-to-face classes in the LMS. Likewise, he failed to use blended learning for teaching Physical Sciences (Jeffrey et al., 2014).

Picture II: C3T GC assignment tab for case 3 (mobile version)

b) Use of SM platform/s

The C3T had neither created any SM platform to supplement his teaching of Physical Sciences. He indicated to be using SM only for his personal use:

> ***"Ah no,no (laughing). No, I don't use social media to communicate with learners, I just use it for my personal reasons." – C3T***

SM is known to positively impact the learning process as it promotes learner centeredness (Chang & Leung, 2017), and as such, this choice from the C3T disadvantaged learners. Consequently, for the lesson observed, the C3T failed to implement blended learning (Thorne, 2003) in his teaching of Physical Sciences.

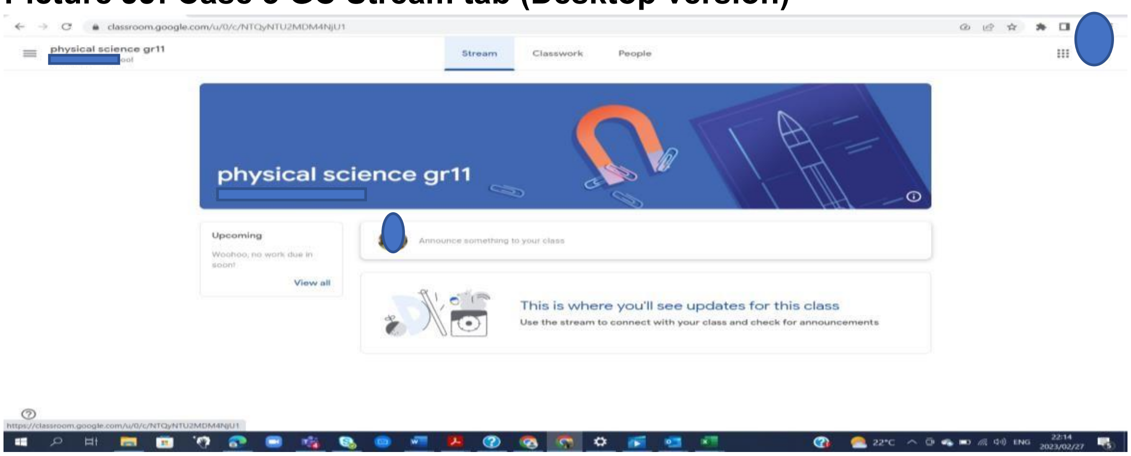
c) Use of VC platform/s

Even though I provided induction to the C3T on the use of VC platforms, he never attempted at all to use any of the VC platforms:

> ***"Ah, ah. I never tried that." – C3T***

So, the VC platforms were not used for the three lessons observed, hence no blended learning. Authors Ulfah Safitri and Asrining Tyas (2022) have already indicated how learners highly accept the VC platforms in their learning and, therefore, it is no-use disadvantaged the C3Ls' learning achievement.

Picture JJ: Case 3 GC Stream tab (Desktop version)



7.4.2. Findings

a) Teacher-centered methods

The approach used by the teacher was not effective for the learning of Physical Sciences. He mainly relied on teacher-centered methods that yielded rote learning and passive thinking among learners, which contradicts what blended learning seeks to achieve (Sheerah, 2020). The C3T also did not allow learners to engage during the learning process, whether through his teaching or assessment. Learners had to rely on the C3T to solve problems for them on the board while they were reciting the answers from their calculators. The C3T never asked them to come to the board to write, failing to involve learners in their learning process. This contradicts the Physical Sciences curriculum, which encourages active learning (DBE, 2011). Consequently, there was no room for social constructivism during the Physical Sciences teaching and learning process (Ardiansyah & Ujihanti, 2018; Kola, 2017). In addition, the C3T appeared to be using an authoritative approach instead of the dialogic approach of discourse (Nkanyani & Mudau, 2019; Netshivumbe & Mudau, 2022), as he was dictating how the learning process should unfold.

b) LMS creation and usage issues

The C3T seems to struggle in the creation of the GC site. It took him about two weeks after the induction to create the LMS. He cited the time management issue as his impediment to the site's creation. Kastner (2020) has already indicated teachers' need to learn technological logistics before implementing blended learning, and if time is an issue, then its implementation may become difficult. It is also concerning to note that with the resources such as a well-equipped computer laboratory, reliable WI-FI connectivity, and backup electricity, the teacher still struggled to use that to his advantage. The teacher disregarded the institutional support (Tuiloma et al., 2022).

Likewise, he failed to use the GC LMS to aid his teaching and learning. According to Mohamad et al. (2022), most learners believed that employing GC as an LMS can amplify their ability to use their knowledge and comprehension effectively. Furthermore, GC could have permitted C3T to share different resources with his C3Ls (Li, 2020). The C3Ls could, in the process, share resources amongst themselves. Things like online books, pictures, worksheets, previous question papers, YouTube or recorded videos, could have supported his teaching and learning process. The C3T could not even assess learners through the platform despite GC providing different types of assessment, such as multiple choice and long questions. Therefore, the C3T deprived his learners of an opportunity to be assessed in a diversified manner.

The C3T also failed to use the stream tab to make announcements. Using the stream tab would have allowed him to engage with his learners while allowing his learners to engage amongst themselves. He would have allowed social constructivism to prevail in his class (Ardiansyah & Ujihanti, 2018; Kola, 2017). Tarnopolsky (2012), argues that the teacher should facilitate learning in a way that caters to social interactions, both in the class and outside.

c) No use of SM platform/s

The C3T did not create the SM platform to aid his teaching of Physical Sciences. He indicated that he uses SM only for his personal use. This deprived learner of an opportunity to learn in a manner that they prefer, which is meaningful. Akgündüz and Akınoğlu (2017) indicate in their study that SM-based learning has a positive effect on academic success and motivation. On the other hand, Chang and Leung (2017) stated the role of SM on learner engagement, promoting learner centeredness in the learning process. The teacher could have used SM to support his teaching, where he could have made announcements, sent them resources and videos, or even assessed them.

d) No VC platform used

The C3T was inducted on the use of VC platforms such as Google Meet, Microsoft Teams, and Zoom Meetings. He was even shown how to record a lesson, to use different keys and tabs when teaching, and to schedule classes using these platforms. Despite my interventions, the teacher never created nor used VC platforms in his teaching of Physical Sciences. Again, he denied learners an opportunity to experience diversity in learning. He could have used the platforms to offer learners live synchronized sessions as a continuation of the face-to-face lessons (Li, 2020), implementing the RBLS. He could have alternatively recorded the lesson using either Zoom meetings or Microsoft Teams and offered his learners the asynchronous mode of learning, which learners could access at their convenience (Hew et al., 2010). More than that, VCs are known to foster group/cooperative learning and allow learners to interact with their peers (Hopper, 2014), which was not prevalent in this case.

e) No blended learning was implemented.

The C3T failed to use blended learning to teach Physical Sciences (Jeffrey et al., 2014) despite the induction given to him before the implementation. Additionally, with a computer laboratory and Wi-Fi availability, the C3T did not use the resources to implement the RBLS. The C3T never referred to the online platform/s when he was in the face-to-face class and vice-versa. Therefore, he failed to flip the classroom (Boubih et al., 2020) and to use blended learning, as both the online and face-to-face platforms were treated as separate learning platforms which are in isolation from one another. Blended learning requires teachers to amalgamate online and face-to-face platforms (Thorne, 2003). The C3T only facilitated the face-to-face part of blended learning and never attempted to facilitate the online platform/s. More so, to flip the classroom, the C3T was required to facilitate in such a way that work from the face-to-face class is carried over as homework to the online platform/s. Equally so, home exercises are carried to classroom exercises (Boubih et al., 2020), which was not the case in this instance.

7.5. CONCLUSION

This chapter presented the implementation of the RBLS. The intention was to understand how the RBLS shaped the teaching and learning of Physical Sciences in rural schools. The next chapter summarizes findings by answering research questions and making contributions, limitations, and recommendations for the study.

CHAPTER 8: THE FINISH LINE

"Now this is not the end. It is not even the beginning of the end. But it is perhaps the end of the beginning" – Wiston Churchill

8.1. INTRODUCTION

The previous chapter presented and discussed the implementation of the designed Rural Blended Learning Strategy (RBLS) in Physical Sciences. The intention was to understand how the RBLS shaped the teaching and learning of Physical Sciences in rural schools. This chapter presented a summary of findings by answering the research questions, main contributions, limitations, and recommendations.

8.2. RESEARCH QUESTIONS

This study answered the following research questions:

i. What were the challenges of Physical Sciences teachers regarding blended teaching and learning in rural schools?
ii. What were the opportunities for Physical Sciences teachers regarding blended teaching and learning in rural schools?
iii. How did the designed RBLS shaped the teaching and learning of Physical Sciences in rural schools?

The following section represents answers to the research questions:

8.2.1. **What were the challenges of Physical Sciences teachers regarding blended teaching and learning in rural schools?**

Before designing the RBLS, I needed to check all the parameters that may create a barrier to implementing the strategy. I, therefore, went to seek such answers from the teachers, learners, principals, School Governing Body (SGB) representatives, and external stakeholders such as community leaders, mobile network service providers, Wi-Fi network service providers, and the Physical Sciences Senior

Education Specialist (SES). I also made field and classroom observations for triangulation.

CASE 1 – MAKWALENI A THABA SECONDARY SCHOOL

The school experienced a lot of challenges such as poor network connectivity. The persistent power cuts in the form of load-shedding compounded this problem. In addition to that, despite the school having a reliable Wi-Fi network, it becomes useless during load-shedding. Likewise, the Wi-Fi becomes futile with the school not having a power-back up.

Also, the school did not have good institutional support. Even though the C1T had access to a staff laptop at school, he did not have one assigned to him. In addition, no devices were reserved for the C1Ls, and there was no programme from the school to assist learners without devices.

Likewise, such as C1P, C1L, C1S, and the C1T did not know about blended learning. Furthermore, the C1T never received any training in blended learning. It was also interesting to note that only the C1P had some knowledge about Learning Management systems (LMSs). For example, it was established during the interviews that C1P was aware of Google Classroom (GC) and Moodle, even though she never interacted with them.

CASE 2 – MATHOKO SECONDARY SCHOOL

Mathoko Secondary school was not spared from power-cuts issues that are persistent throughout the country. That has a bearing on the network connectivity, either the mobile or Wi-Fi networks. Also, the absence of a power-back-up did not help as Wi-Fi routers would have continued to operate. Moreover, even though the school offered their teachers free data, under request, the same leverage was not given to the C2Ls. The C2Ls did not enjoy the same institutional support that their C2Ts enjoyed.

Additionally, no devices were reserved for C2Ls to use to support the teaching and learning process. As a result, C2Ls without devices were deprived of blended learning opportunities. Even though the C2T knew about blended learning, it was not the same as the C2P and the C2S. The C2P was hearing the word for the first time, while C2T knew a bit about the LMSs in that he managed to identify GC. Nonetheless, he never applied it to implement blended learning during my phase one lesson observations.

CASE 3 – BAFETI BA TSELA SECONDARY SCHOOL

Bafeti ba Tsela secondary school experienced load-shedding, worsening the connectivity issue. However, the situation was better from the C3T 's view in that he could download different learning support materials. What worked in favour of the school is that post my phase one observation, the school managed to purchase an electricity backup generator, which provided much assistance to the sustainability of the Wi-Fi network, even during the stages of power cuts/load shedding. However, the challenge persists when C1Ls are home, where most households are poor and do not have any alternative for network connectivity. As a result, they suffered from poor to no network connectivity since the mobile network towers' backup batteries can withstand only a certain period during load shedding. Moreover, the school's policies did not permit learners to bring cell phones to school. The absence of cell phones was noted during my phase one classroom observations.

Furthermore, it was noted that all the participants such as the C3P, C3S, C3Ls, and the C3T did not have any knowledge about the LMSs. As a result, it was no surprise that none of the LMSs were employed during my phase one classroom observations.

EXTERNAL STAKEHOLDERS

It was also prudent to look at challenges from the external stakeholders' point of view. The external stakeholders amplified what was gathered from the teachers, principals, SGB representatives, and learners. For example, the community leader highlighted the issue of power cuts/load shedding network issues for CLC2. The CLC2 indicated that the stability of the mobile network does not last for more than 2 hours. This was substantiated by the WSPR.

According to the SES, most Physical Sciences teachers have poor technology skills. Consequently, they end up delegating those duties to schools' administrative clerks. The SES also indicated how the education department fails to fill in that gap of training teachers since they only do that with a few teachers from selected schools. The same sentiments were initially shared by the C2P, who indicated their school had the ICT champion. Nonetheless, it was only one teacher from a pool of teachers in the school. Likewise, the SES had never provided blended learning-related training to Physical Sciences teachers.

8.2.2. What were the opportunities for Physical Sciences teachers regarding blended teaching and learning in rural schools?

In this section, I was guided by the fact that there ought to be opportunities whenever there are challenges. Similar to answering the first research question, the principals, SGB representatives, Physical Sciences learners, and their teachers were interviewed. On the same note, external stakeholders such as community leaders, MSP1, WSPR, and the SES were also interviewed. I also made classroom and field observations.

CASE 1 – MAKWALENI A THABA SECONDARY SCHOOL

The school had several devices (8 laptops) belonging to different departments. That in itself created an excellent opportunity for the implementation of the RBLS. Likewise, even though the school's policies do not allow learners to bring their devices to school, there was a level of flexibility in bringing them to school under the supervision of C1T. Moreover, it was discovered that the C1T did not create any social media (SM) group to teach Physical Sciences. Nonetheless, a WhatsApp group was used for teaching Physical Sciences by the other Physical Sciences teacher with her learners. That allowed the C1T to create a WhatsApp group with his Physical Sciences learners.

The C1Ls were exposed to YouTube for educational purposes. Moreover, even though the C1T never used videoconferencing (VC) platforms such as Microsoft

Teams and Zoom Meetings, he had exposure to it. The SES had already indicated that he sometimes uses the platforms to hold support meetings with the Physical Sciences teachers.

CASE 2 – MATHOKO SECONDARY SCHOOL

There was proper institutional support for teachers in the school. For example, the C2P had shared with me how they, as the SGB, buy data for teachers under request. The data was used for things like downloading question papers. Also, the C2T has a Wi-Fi network at home, which makes working online in the comfort of their homes simple. The school also had four laptops and four personal computers (PCs), which were placed in a mini-computer laboratory. There was flexibility in allowing learners to bring devices to school under the C2T's supervision. That created a perfect opportunity for the implementation of the RBLS. More so, the C2T had created a WhatsApp group for his Physical Sciences class. He was able to send activities and subject-related materials to the group and communicate with learners.

Just like the C1T, the C2T was exposed to VC platforms used during online support meetings, even though he had never used them for teaching Physical Sciences. Mathoko Secondary School also had a three-teacher ICT group that assisted learners with ICT-related matters. Hence, the school enjoyed good organizational support.

CASE 3 – BAFETI BA TSELA SECONDARY SCHOOL

The C3P and C3S had indicated that even though only the SGB and teaching staff were connected to the Wi-Fi, there is a level of flexibility wherein learners, under the arrangement, may be connected to the Wi-Fi. The school's computer laboratory housed ten effectively working computers connected to Wi-Fi. C3Ls had access to the computer laboratory, and there was an instance in phase one lesson observations that the C3T referred them to the computer laboratory for further research. This provided an opportunity for the implementation of the RBLS. In addition, there was a Physical Sciences WhatsApp group that the C3T used with his

C3Ls. The C3T used the group chat to share videos, activities, memorandums, and discussion forums with the CL3s.

Although, the C3T did not use the VC platforms during my classroom observations, his exposure to the VC platforms during circuit/district-based support meetings provided opportunities for the implementation of the RBLS.

EXTERNAL STAKEHOLDERS

The MSP1 highlighted the opportunities their service provider provides to schools. For example, they had an E-school portal that learners could access at no fee. The portal carries Syllabus from Grade 1 to Grade 12. Moreover, the service provider has been providing tablets to schools. This presented an opportunity for the implementation of the RBLS as the SES indicated how well-conversant the Physical Sciences teachers are with the SM platforms. He used WhatsApp to communicate with them and he did not experience any challenges with teachers. As indicated by the Physical Sciences teachers above, it was the SES who exposed them to the VC platforms.

8.2.3. How did the designed RBLS shaped the teaching and learning of Physical Sciences in rural schools?

The Physical Sciences teachers and their learners were interviewed through semi structured and focus group interviews to answer this question. However, that was preceded by the teaching of Physical Sciences with the RBLS, where a minimum of three lessons were observed. This section presented answers per case.

CASE 1 – MAKWALENI A THABA SECONDARY SCHOOL

The C1T used a more teacher-centered approach during the face-to-face class. For example, he applied group work during the experiment lesson, where learners seemed more engaged and worked cooperatively. However, that was not visible in the second and third lessons. He approached the second and third lessons in an authoritative way where most of the time, learners were watching him doing calculations for them. At the same time, they were seated and reciting answers. That did not work in favour of the RBLS, as blended learning is known to support leaner centeredness. More so, the C1T was more disadvantaged in the online component of the RBLS. Unlike during phase one of data collection, the C1T was found to be sharing the same laptop with his other colleagues. That created a challenge for him in the implementation of the RBLS. Also, the C1T had LMS creation challenges. For example, he created the GC LMS after the second lesson. Even though he did not have an individual laptop, he could have used a smartphone since GC is compatible with different devices.

Given that C1T had Wi-Fi connectivity at home, the challenges could have only been from his side. Nevertheless, he still managed to send his C1Ls communication and assessment. But that was in vain, as he failed to add learners to the GC platform. In addition to that, the C1T had a WhatsApp group created. However, he did not use it sufficiently. For example, he only used it to make announcements or when he wanted to send a message to a particular learner. Nonetheless, he did not send videos or additional support materials with it. He sent pictures of Grade 8 learners doing experiments. Even though that was commendable, it was irrelevant to what he taught during the face-to-face class.

Consequently, he did not use the SM platform to teach Physical Sciences. Moreover, despite being exposed to the VC platforms during circuit meetings and having been inducted by me on the online platforms, the C1T opted not to use the VC platforms to teach Physical Sciences. He indicated that he still needed more training than he had already received.

More so, the C1T failed to apply the flipped classroom method. The RBLS expected him to treat the face-to-face and the online platforms as one class. Meaning what was done in the face-to-face classroom should have been carried over to the online platforms and vice-versa. Although he tried uploading the assessment to the GC platform, it was in vain, as no learner was added. Moreover, he did not mention the face-to-face class on the online platform and vice-versa. As a result, he failed to form a link between the online and face-to-face classes and treated them as isolated platforms.

CASE 2 – MATHOKO SECONDARY SCHOOL

The C2T failed to create a link between an online and face-to-face platform. He did not link what learners learned from the face-to-face platform to the online platform and vice-versa. He did not apply the RBLS as it was outlined and failed to use the flipped classroom method. Despite being exposed to and trained by me on the use of VCs to teach Physical Sciences, he never did that. He did use a screen recorder to create a video where he was communicating with learners, guiding them on how to join the GC platform. Nonetheless, he never used that skill to teach Physical Sciences. He could have used the screen recorder to explain certain concepts of Physical Sciences and give learners feedback on the common test and other things that were learned in the face-to-face classroom.

The C2T made use of the SM platform to teach Physical Sciences. Through the WhatsApp group, he managed to upload the work that learners were supposed to do. What was interesting to note is that most C2Ls were able to respond and that the C2T subsequently provided feedback. Nonetheless, he did not use the SM platform sufficiently. He could have used the platform also to upload content-related videos and subject-related resources to support his teaching. It was interesting to note that the C2T managed to create the GC platform successfully and added the majority of his C2Ls to the platform of which C2Ls were more comfortable with the GC LMS. In addition to that, the GC promoted the C2Ls' Self-directed learning (SDL). Nonetheless, some indicated their frustration regarding the lack of data as most of them are using WhatsApp data tickets, which is specifically made for the access of WhatsApp and no other platform.

The C3T approached his face-to-face class in a teacher-centered way. For example, he did the experiment with a few C2Ls while the rest of the class recorded values. He deprived the C2Ls of an opportunity to be hands-on with science. He did not bring along electrical components during the electricity lesson, failing to contextualize the learning of science. He did not allow learners, except for once, to solve scientific problems on the board. Instead, he chose to do it for them while they recited answers from where they were seated. In the process, the C2T deprived C2Ls of an opportunity to learn in a socially constructive manner.

CASE 3 – BAFETI BA TSELA SECONDARY SCHOOL

The C3T used the teacher-centered method in the face-to-face Physical Sciences class. He relied on rote learning and was, most of the time, using the authoritative discourse. Not only did he deprive the C3L of being hands-on, but he also did not provide room for social constructivism, which is a proper ingredient for implementing the RBLS. Despite having a well-furnished computer laboratory, backup electricity, effective Wi-Fi connectivity, and a laptop, the C3T only managed to create the GC platform and added one learner. He failed to assess nor communicate with the C3Ls through the GC platform. He also failed to socially engage learners through the platform. Likewise, he could have uploaded videos, online books, pictures, and other support material to the GC platform but did not. This was evident that the C3T failed to teach Physical Sciences with the GC platform.

The C3T did not create any SM platform to teach Physical Sciences due to personal reasons. As a result, he failed to assess, upload resources, and engage learners using the SM platform. Moreover, the C3T failed to use the VC platforms to teach Physical Sciences despite being trained or being exposed to the platforms through the circuit/district support meetings. Additionally, the C3T did not follow the prescription of the RBLS. He never said anything about online platforms in the faceto-face classroom. Hence, he failed to use RBLS to teach Physical Sciences.

8.3. MAIN CONTRIBUTIONS

Although several studies on blended learning were conducted, this study designed and implemented the Rural Blended Learning Strategy (RBLS) for Physical Sciences. Phase one of this study has not only revealed the challenges and opportunities of blended learning in rural schools in the context of Physical Sciences but has provided an educational platform for the principals, School Governing Bodies, community leaders, Senior Education Specialists, network service providers, Physical Sciences teachers, and learners. For example, it was discovered that the above-mentioned participants had little to no knowledge about blended learning. Likewise, some schools managed to purchase an electricity backup generator post phase one data collection, something they may not have thought about before. Furthermore, this study provoked the School Governing Bodies to be flexible in allowing learners to bring along smartphones and other devices to school, which was something they did not do before.

More so, before the implementation of the RBLS, shown in Figure 8.1 below, the following interventions were made:

- Engaging the principals on the flexibility of allowing learners to bring along smartphones and other devices.
- Engaging the principals on the issue of organizing electricity backup power.
- Training and inducting teachers on creating, adding learners, and using the RBLS to teach Physical Sciences.

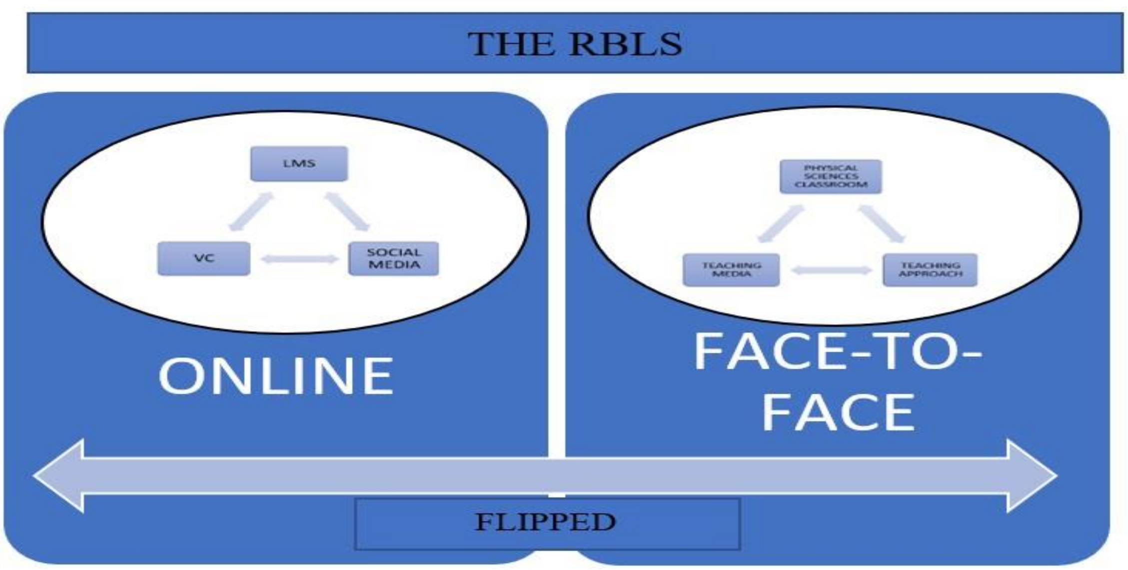


Figure 8. 1 The Rural Blended Learning Strategy (RBLS)

Further to that, the RBLS gave teachers an opportunity to use blended learning to teach Physical Sciences. Even though no teacher was perfect in implementing the

RBLS, the strategy holds opportunities for future prospects. With time seemingly being a factor, the prolonged implementation may yield better results. The teachers may use the RBLS to complete what they could not complete in a face-to-face classroom. Likewise, learners may be able to engage their teachers even after school hours, improving learning and achievement. Furthermore, learners would get more support; for example, instead of them relying only on what the teacher said in class, they may receive additional resources such as videos, e-books, pictures, and worksheets that may support their learning process in the comfort of their homes. This may work in favor of learners who prefer working alone as it promotes Self Directed Learning while at the same time yielding social constructive learning through engagement in both the face-to-face class and the online platforms. More so, learners may be assessed in a diversified manner and receive continuous and constructive feedback.

8.4. LIMITATIONS

The study was undertaken in the Sekgosese East 2 circuit under the Mopani East district and cannot be generalized to a wider population. The findings of this study were key in the designed RBLS, which may be applied to other rural schools. Furthermore, the study only involved three cases, including the external stakeholders. Nonetheless, it can be undertaken under a larger scope.

8.5. RECOMMENDATIONS

- The cases did not have any devices, such as laptops and tablets, reserved for learners. In addition, only one case had a computer laboratory with personal computers connected to Wi-Fi and easily accessible to learners under the supervision of their teachers. It is therefore recommended that School Governing Bodies should prioritize the purchase of computers and relevant furniture. The Department of Basic Education should also provide schools with sufficient classes and computer laboratories.

- It was discovered that the Wi-Fi routers become dysfunctional during power cuts but can work well through a backup generator. However, only one school managed to purchase the backup generator. It is recommended that School Governing Bodies invest funds in purchasing generators or any other electricity backup appliances.
- The teachers seemed to struggle with the time available during the creation of the Google Classroom Learning Management System and the addition of learners, even with the existence of the Information and Communications Technology committee. It is recommended that the Department of Basic Education should employ more Educator Assistants with Information Technology skills that can assist teachers during the creation of Learning Management Systems.
- Most participants were alarmed by the word “blended learning” as they heard it for the first time. It is recommended that the Department of Basic Education should provide information to teachers and all stakeholders on what blended learning is and how it can be implemented in class.
- During the implementation of the RBLS, learners indicated to have struggled with Google Classroom as it requires them to use normal data while they can only afford WhatsApp ticket data. It is recommended that the Department of Basic Education should engage network service providers to make Learning Management Systems and Videoconferencing platforms zero-rated for learners.
- Most teachers seemed to be struggling with the Learning Management Systems, while none used Videoconferencing platforms, despite the training I provided. The Senior Education Specialists should be empowered to provide more training to teachers on the use of Learning Management Systems, Social Media, and Videoconferencing platforms to teach Physical Sciences. The universities should also provide community engagement for the implementation of the RBLS. Further, the Department of Basic Education

should provide Information and Technology related training to all their teachers instead of a few that have already had training.

- None of the schools under study had a blended learning policy. It is recommended that the School Governing Bodies from rural schools formulate policies that would assist their schools in the implementation of the RBLS.
- It is also recommended that the SGBs should also strengthen their institutional support by providing teachers with relevant devices and data and developing a program where they accommodate learners without devices.

8.6. CONCLUSION

This chapter presented a summary of findings from the designed and implemented RBLS for Physical Sciences. The main contributions and limitations of the study were also made. The chapter concluded with the recommendations.

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APPENDICES

APPENDIX 1: PROOF OF REGISTRATION

UNISA university of south africa

1944

NKANYANI T E MR
[redacted]

STUDENT NUMBER : 44616732

ENQUIRIES TEL : 0861670411
FAX : (012)429-4150
eMAIL : mandd@unisa.ac.za

2023-03-15

Dear Student

I hereby confirm that you have been registered for the current academic year as follows:

Proposed Qualification: PHD (EDUCATION) (90019)

CODE	PAPER	S NAME OF STUDY UNIT	NQF crdts	LANG.	PROVISIONAL EXAM.DATE	EXAMINATION CENTRE(PLACE)
Study units registered without formal exams:						
TFNSE01		PhD - Education (Natural Science Education)	**	E		
@ TFNSE01		PhD - Education (Natural Science Education)	**	E		

@ Exam transferred from previous academic year

You are referred to the "MyRegistration" brochure regarding fees that are forfeited on cancellation of any study units.

\# Your attention is drawn to University rules and regulations (www.unisa.ac.za/register).
Please note the new requirements for reregistration and the number of credits per year which state that students registered for the first time from 2013, must complete 36 NQF credits in the first year of study, and thereafter must complete 48 NQF credits per year.
Students registered for the MBA, MBL and DBL degrees must visit the SBL's ESOnLine for study material and other important information.
Readmission rules for Honours: Note that in terms of the Unisa Admission Policy academic activity must be demonstrated to the satisfaction of the University during each year of study. If you fail to meet this requirement in the first year of study, you will be admitted to another year of study. After a second year of not demonstrating academic activity to the satisfaction of the University, you will not be re-admitted, except with the express approval of the Executive Dean of the College in which you are registered. Note too, that this study programme must be completed within three years. Non-compliance will result in your academic exclusion, and you will therefore not be allowed to re-register for a qualification at the same level on the National Qualifications Framework in the same College for a period of five years after such exclusion, after which you will have to re-apply for admission to any such qualification.
Readmission rules for M&D: Note that in terms of the Unisa Admission Policy, a candidate must complete a Master's qualification within three years. Under exceptional circumstances and on recommendation of the Executive Dean, a candidate may be allowed an extra (fourth) year to complete the qualification. For a Doctoral degree, a candidate must complete the study programme within six years. Under exceptional circumstances, and on recommendation by the Executive Dean, a candidate may be allowed an extra (seventh) year to complete the qualification.

BALANCE ON STUDY ACCOUNT: 0.00

Yours faithfully,

Prof M S Mothata
Registrar

0108 O 00 0

UNIVERSITEIT VAN SUID-AFRIKA
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APPENDIX 2: UNISA ETHICS CERTIFICATE

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2022/02/09

Ref: **2022/03/09/44616732/14/AM**
Name: Mr TE Nkanyani
Student No.: 44616732

Dear Mr TE Nkanyani

Decision: Ethics Approval from 2022/03/09 to 2027/03/09

Researcher(s): Name: Mr TE Nkanyani
E-mail address: lefabotse@gmail.com
Telephone: 076 401 3824

Supervisor(s): Name: Prof A.V Mudau
E-mail address: mudauav@unisa.ac.za
Telephone: 012 429 6353

Name: Ms L Sikhosana
E-mail address: esikhol@unisa.ac.za
Telephone: 012 429 6353

Title of research:

DESIGN AND IMPLEMENTATION OF A BLENDED LEARNING STRATEGY FOR PHYSICAL SCIENCES TEACHERS IN RURAL SCHOOLS

Qualification: PhD Natural Science Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2022/03/09 to 2027/03/09.

*The **low risk** application was reviewed by the Ethics Review Committee on 2022/03/09 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.

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2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2027/03/09.** Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2022/03/09/44616732/14/AM** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Prof AT Motlhabane
CHAIRPERSON: CEDU RERC
motlhat@unisa.ac.za

Prof Mpine Makoe
ACTING EXECUTIVE DEAN
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APPENDIX 3: LIMPOPO DEPARTMENT OF EDUCATION APPROVAL CERTIFICATE

CONFIDENTIAL

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE PREMIER

TO: DR MC MAKOLA

FROM: DR T MABILA

CHAIRPERSON: LIMPOPO PROVINCIAL RESEARCH ETHICS COMMITTEE (LPREC)

ONLINE REVIEW DATE: 19th – 30th MAY 2022

SUBJECT: DESIGNING AND IMPLEMENTING A STRATEGY FOR BLENDED TEACHING AND LEARNING FOR PHYSICAL SCIENCE TEACHERS IN RURAL SCHOOLS.

RESEARCHERS: NKANYANI ET

Dear Colleague

The above researcher's research proposal served at the Limpopo Provincial Research Ethics Committee (LPREC). The ethics committee is satisfied with the ethical soundness of the proposed study.

Decision: The revised research proposal is granted approval and ethical clearance.

Regards

Chairperson: Dr T Mabila

Secretariat: Ms J Mokobi

Date: 03/06/2022

APPENDIX 4: LETTERS TO SCHOOLS

LETTER TO THE PRINCIPAL

UNISA university of south africa

Request for permission to conduct research at ………………. Secondary school

Title of the title of your research: The design and implementation of a blended learning strategy for Physical Sciences teachers at rural schools.

Date: 31 March 2022

Name of the person to who you address the request: ……………

Department of the person: Limpopo Department of Education

Contact details of the person : …………………

Dear school principal

I, Tebogo Nkanyani am doing research under supervision of Prof Awelani V Mudau, a professor in the Department of science and technology education and Dr Lettah Sikhosana, towards a PhD degree at the University of South Africa. We have funding from UNISA M&D Bursary for among others, formatting, editing and printing. We are inviting you to participate in a study entitled: The design and implementation of a blended learning strategy for Physical Sciences teachers at rural schools.

The aim of the study is to determine the nature and impact of the developed strategy on blended learning of Physical Sciences teachers in rural schools

Your school has been selected because it is located in Sekgosese East II of Mopani East district, which is predominantly rural.

The study will entail two phases in the following manner:

Phase I: semi-structured interviews (telephonic) and observations with the participant, and

Phase II: 3 lesson observations in the participant`s class.

The benefits of this study are that participants may not only assist the researcher in answering the research question but also be better equipped for an effective blended learning environment in their teaching.

This study carries no potential risk to participants, learners or anyone in the school.

There will be no reimbursement or any incentives for participation in the research. Feedback procedure will entail sharing copies of both the findings and the thesis as a whole with the participants.

Yours sincerely

Mr T.E Nkanyani

Unisa PhD candidate

LETTER TO THE SCHOOL GOVERNING BODY

Request for permission to conduct research at ………… school

Title of the title of your research: The design and implementation of a blended learning strategy for Physical Sciences teachers at rural schools.

Date: 21 January 2022

Name of the person to who you address the request: ……………. (SGB chairperson)

Department of the person: Limpopo Department of Education

Contact details of the person: ……………………

Dear SGB chairperson

I, Tebogo Nkanyani am doing research under supervision of Prof Awelani V. Mudau, a professor in the Department of science and technology education and Dr Lettah Sikhosana, towards a PhD degree at the University of South Africa. We have funding from UNISA M&D Bursary for among others, formatting, editing and printing. We are inviting you to participate in a study entitled: The design and implementation of a blended learning strategy for Physical Sciences teachers at rural schools.

The aim of the study is to determine the nature and impact of the developed strategy on blended learning of Physical Sciences teachers in rural schools

Your school has been selected because it is located in Sekgosese East II of Mopani East district, which is predominantly rural.

The study will entail two phases in the following manner:

Phase I: semi-structured interviews (telephonic) and observations with the participant, and

Phase II: 3 lesson observations in the participant`s class.

The benefits of this study are that participants may not only assist the researcher in answering the research question but also be better equipped for an effective blended learning environment in their teaching.

This study carries no potential risk to participants, learners or anyone in the school.

There will be no reimbursement or any incentives for participation in the research. Feedback procedure will entail sharing copies of both the findings and the thesis as a whole with the participants.

Yours sincerely

Mr T.E Nkanyani

Unisa PhD candidate

LETTER FOR CONSENT/ASSENT

Date 31/03/2022

Title: The design and implementation of a blended learning strategy for Physical Sciences teachers at rural schools.

DEAR PROSPECTIVE PARTICIPANT

My name is Tebogo Nkanyani and I am doing research under the supervision of Prof Awelani Mudau, a Prof in the Department of Science and Technology Education, and Dr Lettah Sikhosana, towards a PhD at the University of South Africa. We have funding from Unisa M & D bursary fund for among others, formatting, editing and printing. We are inviting you to participate in a study entitled: The design and implementation of a blended learning strategy for Physical Sciences teachers at rural schools.

WHAT IS THE PURPOSE OF THE STUDY?

This study is expected to collect important information that could assist in designing the blended learning strategies to mitigate challenges/weaknesses and/or strengthen opportunities that exist in Physical Sciences classes in rural schools.

WHY AM I BEING INVITED TO PARTICIPATE?

You are invited because you are a Physical Sciences teachers belonging to a secondary school in the Sekgosese area of Mopani East district, which is regarded as rural. I obtained your contact details from the secretary of the Sekgosese East I circuit Physical Science group. You are chosen together with 5 other participants

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

The study involves telephonic semi-structured interviews which will be audio-taped and classroom observations which will be video-taped. You will be asked questions on your qualifications, connectivity (both electricity and network), availability of devices, institutional support among others. The interviews may take between 1-2 hours whereas observations may take duration of 1 hour per lesson.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent (adult)/ assent (participant younger than 18 years old) form. You are free to withdraw at any time and without giving a reason.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

The benefits of this study are that participants may not only assist the researcher in answering the research question but also be better equipped for an effective blended learning environment in their teaching.

ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

This study carries no potential risk to participants, learners or anyone in the school.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

Your name will not be recorded anywhere and no one will be able to connect you to the answers you give (*this measure refers to anonymity)*. Your answers will be given a code number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings *(this measure refers to confidentiality).*

Your answers may be reviewed by people responsible for making sure that research is done properly, including the transcriber, external coder, and members of the Research Ethics Review Committee. Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

Further, your anonymous data may be used for other purposes, such as a research report, journal articles and/or conference proceedings. *A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report).*

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet in my office for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. The hard copies will be shredded and/or electronic copies will be permanently deleted from the hard drive of the computer through the use of a relevant software program.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

As I will be visiting you at your workplace, you will not have to use your money for transport or any other logistics. As such, there will not be any payments or incentives for participating in this study.

HAS THE STUDY RECEIVED ETHICS APPROVAL

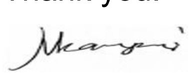
This study has received written approval from the Research Ethics Review Committee of the College of Education (CEDU*),* Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Tebogo Nkanyani on 446161732@mylife.unisa.ac.za. The findings are accessible for 3 months. Should you have concerns about the way in which the research has been conducted, you may contact Prof Awelani Mudau on 012 429 6353, mudauav@unisa.ac.za

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.



(insert signature)

TEBOGO NKANYANI
(type your name)

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, __________________ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and lessons

I have received a signed copy of the informed consent agreement.

____

Participant Name & Surname (please print)

____________________________ ____________________________________

Participant Signature Date

APPENDIX 5: LETTER TO THE CIRCUIT MANAGER

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT …………SECONDARY SCHOOL

Title of the title of your research: **The design and implementation of a blended learning strategy for Physical Sciences teachers at rural schools.**

Date: 31 March 2022
Name of the person to who you address the request: Mr …………
Department of the person: Limpopo Department of Education
Contact details of the person: ………………………..

Dear circuit manager
I, Tebogo Nkanyani am doing research under supervision of Prof Awelani V Mudau, a professor in the Department of science and technology education and Dr Lettah Sikhosana, towards a PhD degree at the University of South Africa. We have funding from UNISA M&D Bursary, the NWU study assistance, and the NWU UCDP Emerging researcher funding for among others, formatting, editing and printing. We are inviting you to participate in a study entitled: The design and implementation of a blended learning strategy for Physical Sciences teachers at rural schools.
The aim of the study is to determine the nature and impact of the developed strategy on blended learning of Physical Sciences teachers in rural schools
Three schools from your circuit, Sekgosese East II circuit have been selected because they belong to the Mopani East district, which is predominantly rural.
The study will entail two phases in the following manner:
Phase I: semi-structured interviews (telephonic) and observations with the participant, and
Phase II: 3 lesson observations in the participant`s class.

The benefits of this study are that participants may not only assist the researcher in answering the research question but also be better equipped for an effective blended learning environment in their teaching.

This study carries no potential risk to participants, learners or anyone in the school.

There will be no reimbursement or any incentives for participation in the research. Feedback procedure will entail sharing copies of both the findings and the thesis as a whole with the participants.

Yours sincerely

Mr T.E Nkanyani

Unisa PhD candidate

APPENDIX 6: CONSENT FORMS

MAKWALENI-A-THABA SECONDARY SCHOOL LEARNER

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, [redacted] (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and lessons

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print) [redacted]

Participant's position and Name of institution [redacted] High School Cleane

____________________ 04 /07 /2022

Participant Signature Date

Researcher's Name & Surname (please print) Tebogo Nkanyani

Nkanyani 04/07/2022

Researcher's signature Date

MATHOKO SENDARY SCHOOL TEACHER CONSENT FORM

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, ______________________________ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and lessons

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print) ______________________________

Participant's position and Name of institution EDUCATOR ______________

______________ 04/07/2022

Participant Signature Date

Researcher's Name & Surname (please print) Tebogo Nkanyani

______________ 04/07/2022

Researcher's signature Date

MATHOKO SECONDARY SCHOOL GOVERNING BODY CONSENT/ASSENT FORM

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, [redacted]_____________(participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and lessons

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print) [redacted]

Participant's position and Name of institution SGB CHAIRPERSON [redacted] Sec School

____________________ 04/07/2022

Participant Signature Date

Researcher's Name & Surname (please print) Tebogo Nkanyani

____________________ 04/07/2022

Researcher's signature Date

DEPARTMENT OF EDUCATION
LIMPOPO PROVINCE

MAKWALENI-A-THABA SECONDARY SCHOOL PRINCIPAL'S CONSENT FORM

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, ______________________________(participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and lessons

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print) ______________________

Participant's position and Name of institution PRINCIPAL ______________

______________________ 04/07/2022

Participant Signature Date

Researcher's Name & Surname (please print) Tebogo Nkanyani

______________________ 04/07/2022

Researcher's signature Date

SECONDARY
DEPARTMENT OF EDUCATION
2022 -07- 04
SEKGOSESE EAST 1

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, [redacted] (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and lessons

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print) [redacted]

Participant's position and Name of institution SES MOPANI WEST

Participant Signature

25 /10/ 2022

Date

Researcher's Name & Surname (please print) Tebogo Nkanyani

Researcher's signature

04/07/2022

Date

COMMUNITY LEADER CONSENT/ASSENT FORM

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, [illegible] (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and lessons

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print) ____________________

Participant's position and Name of institution ward Committee ( )

____________________ 04/07/2022.

Participant Signature Date

Researcher's Name & Surname (please print) Tebogo Nkanyani

____________________ 04/07/2022

Researcher's signature Date

MOBILE NETWORK PROVIDER CONSENT FORM

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, [illegible]__________________________________(participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and lessons

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print) ______________________________

Participant's position and Name of institution __Operations Manager________________________

________________________ ____04/07/2022____________________

Participant Signature Date

Researcher's Name & Surname (please print) Tebogo Nkanyani

________________________ 04/07/2022

Researcher's signature Date

APPENDIX 7: INTERVIEW PROTOCOL (PHASE 1)

Teacher

Good day Sir/madam

Thank you for availing yourself for this study. Please note I will be using the tape recorder to record our conversation as I indicated in the invitation letter.

1. Please share with me your experience with regard to network connectivity at school, and at home.
2. Does your school use Wi-Fi router, or mobile data? Do they buy data or do you use your own data?
3. What type of phone do you own? Do you use it in Physical Sciences? What are the other devices that you have?
4. Do you allow learners to bring their devices like phones to class? If yes………do you allow them for certain events or do you allow them to bring devices along anytime?
5. Do you have devices at school reserved for leaners? Which devices are those? Do learners carry those devices home? How do you assist learners without devices?

Do you have computers for learners and or do you have a computer lab?

6. Do you know/use WhatsApp?

(If yes) Do you have a WhatsApp group for your Physical Sciences group? Which grade? What do use the WhatsApp group for? How frequent do you use it? Is there any challenges you face with it?

7. Do you know/use Facebook?

(If yes) Do you have a Facebook group for your Physical Sciences group? Which grade? What do use the Facebook group for? How frequent do you use it? Is there any challenges you face with it?

8. Do you know/use Twitter?

(If yes) Do you have a Facebook group for your Physical Sciences group? Which grade? What do use the Facebook group for? How frequent do you use it? Is there any challenges you face with it?

9. Is there any social media platform apart from the ones mentioned above yo use in your subject?
10. Are you aware of Google classroom? (If Yes) Do you use it in Physical Sciences? (If yes) What do use it for? How frequent do you use it? Is there any challenges you face with it?

(if No) Do you use it for any other subject than Physical Sciences What do you use it for?

11. Do you know/use Microsoft teams?

(If yes) Do you have a Microsoft Teams for your Physical Sciences group? Which grade? What do use the Microsoft Teams for? How frequent do you use it? Is there any challenges you face with it?

12. Do you know/use Zoom meetings?

(If yes) Do you have a Zoom meetings for your Physical Sciences group? Which grade? What do use the Zoom meetings for? How frequent do you use it? Is there any challenges you face with it?

13. Is there any other Learning Management System (LMS) that you use? (apart from or if not mentioned above)
14. What is the average number of learners in your classes or per class?
15. Did you attend any blended learning and teaching training?
16. Do you use blended learning your teaching?

(If yes) which method(s) do you employ? How frequent do you blend your teaching? Or is it used for specific topics?

17. How do you give instructions in the blended learning platform?
18. What is your general perception about blended teaching and learning?
19. What type of support do you receive in blended learning from your school? Form your school management team (SMT) or school governing body (SGB)?
20. Do you have a blended learning committee at school?

(if Yes) How many members?

21. Do you have any policy whether whole-school or subject based, that guides on online or/and blended learning?
22.

Principal

Thank you for availing yourself for this study. Please note I will be using the tape recorder to record our conversation as I indicated in the invitation letter.

1. Please share with me your experience with regard to network connectivity at school, and at home (bring in the issue of electricity if not mentioned).
2. Does your school use Wi-Fi router, or mobile data? Do they buy data or do you use your own data?
3. Who pays for data at school? Does everyone pay for their data or does your school pay for data? Do you have data for all at school? E.g any rooters or data plans available? Is it available for everyone or only a few? Are learners connected or restricted or connected by request? What is the radius of connectivity?
4. Do you have devices like laptops, tablets, smartphones at school? What type of devices? How many does the school have?

How many of those devices at school are reserved for leaners? Which devices are those? Do learners carry those devices home?

5. Do you allow learners to bring their devices to school? If yes………do you allow them for certain events or do you allow them to bring devices along anytime?

How do you assist learners without devices?

6. Do majority of your teacher own smartphones, laptops, tablets or any other gadgets?
7. Do you have reliable electricity at school and at surrounding houses? Do learners have reliable electricity?
8. Do your classes have enough space? How many learners do you have in one class as an average in FET phase?
9. Do you know blended learning? Do your school use it? Which methods do you use? How frequent is it used?
10. Do your teachers use Facebook in their lessons?

Do your teachers use WhatsApp in their teaching?

Do your teachers use Twitter in their teaching?
Do your teachers use Zoom in their teaching?

Do your teachers use Teams in their teaching?

11. Do your teachers use Google classroom or Moodle as a learning Management System of blended learning? Which subjects is it used for?
12. Do you offer any blended learning and teaching training to staff?
13. What type of support do you give in blended learning to your staff? As the school management team (SMT) or school governing body (SGB)?
14. Do you have any policy whether whole-school or subject based, that guides on online or/and blended learning?
15. Do you have school blended learning support staff/committee at school?

(If yes) How many? How do they assist learners and teachers?

SGB REPRESENTATIVE

Good day Sir/madam

Thank you for availing yourself for this study. Please note I will be using the tape recorder to record our conversation as I indicated in the invitation letter.

1. Please start by indicating your experience as the SGB member (this is to check how long has the incumbent been involved in the development of the school
2. Please share with me your experience with regard to network connectivity at school, and at home. (bring in the issue of electricity if not mentioned).
3. Who pays for data? Does everyone pay for their data or do you as the SGB pay for data? Do you have data for all at school? E.g any rooters or data plans available? Is it available for everyone or only a few? Are learners connected or restricted or connected by request? What is the radius of connectivity?
4. Do you have devices at school? Devices like laptops, computers, tablets,smartphones How many does the school have?

How many of those devices at school reserved for leaners? Which devices are those? Do learners carry those devices home?

5. Do your policies allow learners to bring their devices to school?

If yes………do you allow them for certain events or do you allow them to bring devices along anytime?

How do you assist learners without smartphones, laptops, tablets or computers?

6. Do majority of your teacher own smartphones, laptops, tablets or any other gadgets?

What role do you as the SGB play in empowering teachers with the provision of these devices?

7. Do your classes have enough space? How many learners do you have in one class as an average?
8. Do you know blended learning?

(if yes) Do your school use it? Which methods do you use? How frequent is it used?

9. Do your teachers use Facebook in their lessons?

Do your teachers use WhatsApp in their teaching?

Do your teachers use Twitter in their teaching?

Do your children use any of those when they do their homework at home?

10. Do your teachers use Google classroom or Moodle as a Learning Management System of blended learning? Which subjects is it used for?
11. Do you offer any blended learning and teaching training to staff?
12. What type of support do you give in blended learning to your staff? As the school governing body (SGB)?
13. Do you have any policy whether whole-school or subject based, that guides on blended learning?
14. Do you have school blended learning support staff/committee at school?

(If yes) How many? How do they assist learners and teachers?

LEARNERS (FOCUS GROUP)

Good day learners. Thank you for availing yourself for this study. Please note I will be using the tape recorder to record our conversation as I indicated in the invitation letter.

1. How is network connectivity at school?
2. How is network connectivity at home? Which network provider is more reliable? Do you have moments where it is reliable? How do you address the connectivity problems if ever you do? (bring in the issue of electricity if not mentioned).
3. Do you have community-based network?
4. How many of you own smart devices and what type?
5. Do they borrow you devices like phones, tablets, laptops at school?

(If yes), how often do use them? Do you take them home? Do they allow you to bring devices to school?

6. How often do you buy data? Daily, weekly, monthly etc?
7. Do you know YouTube or any platform for educational purposes?
8. How do receive and submit tasks/Assignments?
9. Which textbooks do you use? Is it physical textbooks or eBooks/online articles?
10. How does your teacher give you instruction?
11. Do You know Facebook? Do you have it? Do your Physical Sciences teachers use it in the Subject? (If yes) What does he use it for?
12. Do You know WhatsApp? Do you have it? Do your Physical Sciences teachers use it in the Subject? (If yes) What does he use it for?
13. Do You know Twitter? Do you have it? Do your Physical Sciences teachers use it in the Subject? (If yes) What does he use it for?
14. Do you use YouTube? Do your Physical Sciences teacher use it in his/her teaching?
15. Do you know Google classroom or Moodle or Blackboard?

(If yes) where do you know it from?

16. Do you know Microsoft Teams? Commonly known as Teams?

(If yes) where do you know it from? Do you use it in Physical Sciences?

17. Do you know Zoom meetings? Popularly known as Zoom?

(If yes) what do you normally use it for?

WI-FI NETWORK PROVIDER

Good day Sir/Maam

Thank you very much for affording us this opportunity to do research interviews with you. Please note I will be using the tape recorder to record our conversation as I indicated in the invitation letter.

- Can you briefly share with us your coverage, how far do you cover communities? Are you also covering schools, sekgosese?
- What radius do your rooters cover?
- What download speeds do you offer with your rooters?
- How realible are your towers? Is network always available?
- What type of connections do you offer? Is it only wireless?
- Do you have situations wherein you offer free or discounted services to schools?
- Do you donate devices to schools or learners?
- How does electricity affect your rooters?
- Which devices do your rooters work well with? Is it phones, gadgets, laptops or pcs?
- Anything you want to add?

MOBILE NETWORK PROVIDER

Good day Sir/Maam

Thank you very much for affording us this opportunity to do research interviews with you. Please note I will be using the tape recorder to record our conversation as I indicated in the invitation letter.

e) Can you briefly share with us your coverage, how far do you cover communities? Are you also covering schools, sekgosese?
f) What radius do your towers cover? How effective are they in the Sekgosese area? What challenges do you face regarding the towers?
g) Do you have certain periods where they are reliable and periods where they are not?
h) What download speeds do you offer with your rooters?
i) What type of connections do you offer? Do you offer only mobile network or also fibre or LAN? Do you have them in Sekgosese?
j) Do you have situations wherein you offer free or discounted services to schools?
k) Do you donate devices to schools or learners?
l) Which devices do your network work well with? Is it phones, gadgets, laptops or pcs?
m) Anything you want to add?

APPENDIX 8: INTERVIEW PROTOCOL (PHASE 2 POST-OBSERVATION)

MATHOKO SECONDARY SCHOOL

2. Before the experiment, have you considered sharing the worksheet with leaners on any learning platform? Any reason for **Not?**
3. Have you considered creating a video to explain how the experiment is should be taking place?
4. What was in mind when you asked 4 learners while the rest of the class was recording values? Have you considered grouping your learners in doing the experiment?
5. In the practical, you used the recitation method when you were asking for learners to identify apparatus. Have you considered looking for individual responses, where learners could just easily raise their hands in anticipation of your recognition.
6. I noted that you managed to create the Google Classroom platform and added learners, but noted that you could not add all 43. You managed to add 29. What could have been the reason for not attaining 100% addition?
7. I noted that you used the Google Classroom to instruct learners who were already added to encourage others to join. Did you experience success?
8. Have you considered engaging learners in the Google Classroom platform on issues that were covered in the face-to-face class?
9. I also noted your use of WhatsApp to communicate with your learners. Did you find it effective
10. Apart from assessment, you had not uploaded any material that could have connected learners to the face-to-face content. Things like additional notes, videos, pictures etc? What could have been the reason?
11. Did you use any other social media platform, apart from WhatsApp?
12. There was a learner who sent an inquiry about her challenges in joining the Google Classroom platform and you subsequently asked her to send a video screenshot

for the problem. What was the purpose of the video screenshot? Did you manage to assist the learner?

13. Have you ever used the Video-conferencing platforms like Microsoft Teams,Zoom Meetings or any other Video-conferencing platforms to hold online classes?

Did you use any of those mentioned?

BAFETI BA TSELA SECONDARY SCHOOL

2. During you face-to-face teaching, you never made mention of the online platforms. What was could have led to that?
3. It took you almost two weeks to create the site after the induction. What could have caused that delay?
4. In the third lesson, you demonstrated to learners the principles of Electrostatics through rubbing you hair with the ruler, you then later explained what would happen if the put the ruler next to papers. Have you considered allowing learners to experience it themselves since it was not visible in class?
5. How did you involve learners to the content you were teaching in class?
6. Initially you had indicated to have 11 out 39 emails from learners which you were going to use to add learners to the GC site. However, during my observations I noted you only have added 1 learner. Did you experience any challenges? What are those challenges?
7. Did you consider using the GC platform to assess or announce/engage with learners?
8. Did you use social media to aid your teaching? If Not, what was the reason/
9. Did you use VC platforms in your teaching of Science? If not, what could have been the reason?
10. Did you use upload anything to the Learning Management System?
11. Did you upload anything to Social Media?

INTERVIEW TRANSCRIPTS

CASE 1: MAKWALENI A THABA SECONDARY SCHOOL
"Ehmmm (well), I can say it is poor because of load shedding. When there is eh load shedding. There's no network"- C1T ***"Eh network is Wi-Fi, of [Wi-Fi network provider] which is reliable, then unless if we have rain or strong winds, but majority or most of the time we rely on it." – C1P*** ***"We are connected to Wi-Fi which is password protected. Then we are able to search thing online" – C1L*** ***"We have to look at the code of conduct, when it is eh, amended we will need to bring all stakeholders involved." – C1S***
CASE 2: MATHOKO SECONDARY SCHOOL
"Yah (Yes) at home I've got Wi-Fi connectivity, plus mobile connectivity. Even at work." – C2T ***"No, we normally buy as per, per request. If the teacher wants to download something we buy data for that one." - C2P*** ***"Yah Yah! Obviously given the fourth industrial revolution and these things of robotics, and coding….Teachers as, as a phase and subject groups, have got their own, eh eh eh laptops…….Yah! But others have got their own personal, laptops. We ensure that each and every department, has got their own laptop for, purposes of eh teaching and learning." -C2S***

"certain events, they sometimes do allow us to come with our mobile devices." - CSLs
CASE 3: BAFETI BA TSELA SECONDARY SCHOOL
"*Yes, yes. I thought the emails I've got before, they were 11 and they were working. Only to find out that it's only one email which is working. The others, they just use their head to create any email without registering the email. They didn't create an email, they just gave me the emails. I thought maybe they are working. You know, the only email which was working is one. So, it means I had one learner out of 39, imagine. So, I thought maybe I'm somewhere far to be done with the that Google uh classroom then, that, that caused me that, that that delays me because now when I have to go back and restart again." – C3T*   ***"I think because we made the emails ourselves, not knowing like the exact information to." – C3L1***   ***"Or maybe we can call it this at email.com without creating it? Is that what what happened?" – C3L2***   ***"we can connect them if ever there's a need" – C3S***   ***"We have a, we have eh, laptop and computers. Okay. In terms of eh laptops we, have got three. Then eh the computers for the school we have got five." – C3P***
EXTERNAL STAKEHOLDERS

“Not yet, but when you when you when you go to our sub offices, you do have Wi Fi? Okay, do we have Wi Fi so that our people can just go there and ask for a password to connect though certain megabytes that you will just give them okay, we can’t just give them 1gig or 2gig or three. or maybe 200megabites just to assist them.” – CLC3

“alright the download speed and it depends on the type of phone you're using, because we have 3 types of things, maybe let me just talk about the latest. The

latest, they support almost all the layers, no one can ask what is layers? So you find that you've got your 4g, but that 4g have got multiple layers. I'm not sure if you heard about 4g plus. So, you've got something they call it 4g plus plus. So what is this plus plus means? It means Carrier Aggregation which what you find that your 4g have got different layers. You've got your L900. And red is the frequency Okay, so the smaller the frequency, the longer the distance, the bigger the distance the smaller the distance. So our 4g have got an L 900 and so what that means what your 4g, or 900, you've got 4g, on 1800 and frequency. And you've got 4g, on 21. so you see now you've got about three layers support the 4g. So you find that JB your device, it doesn't support your L900. maybe doesnt Support your L21 that L stands for LTE, so LTE 4g. So if your phone support all these three layers, you can get plus or minus 50 megabits per second. thats your download speed, roughly will get around 20 to 25 megabits per second.” – MSP1

“Uh in terms of the WhatsApp groups, what we usually share, we are sharing the contents or topics, which we may receive from other provinces or other districts in Limpopo, the districts within Gauteng, Eastern Cape, Free state and North-West” – SES

APPENDIX 9: OBSERVATION PROTOCOL (PHASE 1)

OBSERVATION PROTOCOL CASE 1: MAKWALENI-A-THABA SECONDARY SCHOOL

Checklist criteria	**Yes**	**No**	**Additional information**
1.Does the teacher have device/s			
2.If yes in 1 above, does s/he own the device			The device belongs to the departmental head
3.Indicate the type/types of devices			Laptop
4. Does the school have network connectivity?			
5. Indicate the type of connectivity device observed			WIFI Routers
Is there electricity connection			
Indicate type of devices the teacher uses			Laptop and projector
Any devices reserved for leaners			Computers reserved for learners are no longer working. There are about 6 laptops that can be borrowed from the departmental heads
If yes, how many?			6 that can be borrowed from departmental heads
Write information about class space			The grade 10 class is spacious and has only 24 learners
Any available lesson plans indicating any blended learning method used			

Write information about practical types used (facetoface or simulated or blended)			Face to face
Any evidence of communication through social media			WhatsApp group
Evidence of LMS similar blackboard, efundi, myunisa			
Any available online/blended learning policy			

MATHOKO SECONDARY SCHOOL

Checklist criteria	Yes	No	Additional information
1.Does the teacher have device/s			
2.If yes in 1 above, does s/he own the device			
3.Indicate the type/types of devices			laptop
4. Does the school have network connectivity?			
5. Indicate the type of connectivity device observed			Routers
6. Is there electricity connection			
7. Indicate type of devices the teacher uses			Laptop and projector
8. Any devices reserved for leaners			Reserved for both learner and teachers
If yes, how many?			3
Write information about class space			Can accommodate 56 learners
Any available lesson plans indicating any blended learning method used			
Write information about practical types used (facetoface or simulated or blended)			Face to face
Any evidence of communication through social media			

Evidence of LMS similar blackboard, efundi, myunisa			
Any available online/blended learning policy			

BAFETI BA TSELA SECONDARY SCHOOL

Checklist criteria	**Yes**	**No**	**Additional information**
1.Does the teacher have device/s			
2.If yes in 1 above, does s/he own the device			
3.Indicate the type/types of devices			**Laptops and cell phone**
4. Does the school have network connectivity?			
5. Indicate the type of connectivity device observed			**Routers**
6. Is there electricity connection			
7. Indicate type of devices the teacher uses			**Projectors**
8. Any devices reserved for leaners			
9. If yes, how many?			**8 computers**
10. Write information about class space			**Large enough**
11. Any available lesson plans indicating any blended learning method used			

12. Write information about practical types used (facetoface or simulated or blended)			**facetoface**
13. Any evidence of communication through social media			**WhatsApp**
14. Evidence of LMS similar blackboard, efundi, myunisa			
15. Any available online/blended learning policy			

APPENDIX 10: OBSERVATION PROTOCOL PHASE 2

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CASE …………..   DATE………………….

LESSON NO…………   TIME………………..

FACE-TO-FACE	1. TEACHING SCIENCE FACE TO FACE	YES/NO	COMMENTS
	a. CONNECTION TO PRIOR KNOWLEDGE/GIVING INSTRUCTIONS/LESSON OBJECTIVES – Does the teacher link the lesson to prior knowledge? Does the teacher give instructions in the lesson? Is the instruction verbal or written? Does the teacher outline lesson objectives?		
	b. LINK TO THE ONLINE SESSIONS/PLATFORM – is there a link between the face-toface and the online platforms?		

	c. TEACHING – What teaching method/s does the teacher employ? Are the method learnercentred or teacher centred?		
	d. TEACHING MEDIA/RESOURCES – What resources/teaching media does the teacher use? How effective/relevant are they to the teaching of Physical Sciences?		
	e. PRACTICAL – Does the teacher facilitate practical work or does he demonstrate the concepts with experiments?		
	f. ASSESSMENT – What assessment method do the teacher use? Does the teacher give feedback/how does the teacher give feedback? Is the any reference to the online platform?		

ONLINE	2. TEACHING PHYSICAL SCIENCES ONLINE		
	a. USE OF LMS	YES/NO	COMMENTS

	i. CREATION OF LMS - can the teacher create an LMS on his own.		
	ii. ADDING PARTICIPANTS- can the teacher add participants to the LMS through their emails or class code?		

	iii. ANNOUCEMENTS AND DISCUSSIONS – is the teacher able to announce on the platform any message or information he/she wants to convey to learners? Can the teacher initiate discussions on the platform. How do learners engage with the teacher?		
	iv. ASSESSMENT – can the teacher assess learners on the platform? Does he use multiple type of assessments or just a single type of assessment? Is the teacher able to give constructive feedback to his/her learners?		

	2.1.5. UPLOAD OF RESOURCES/VIDEOS/LESSONS – Is the teacher able to upload different notes, internet sources, e-books, previous question papers etc on the platform? Is the teacher able embed or upload YouTube videos or any other educational videos. Is the teacher able to upload recorded lessons on the platform?		
	i. SIMULATION OF EXPERIMENTS – does the teacher use platforms to embed simulation of practical's?		
	ii. LINK TO THE FACE TO FACE CLASS – Is there a link/references to the face to face class on the LMS		

	b. USE OF SOCIAL MEDIA		
	1.1.1. CREATION/EXISTENCE OF SOCIAL MEDIA GROUP/NUMBER OF PLATFORMS – can the teacher create a social media group/groups?		
	1.1.2. DISCUSSIONS AND ANNOUNCEMENTS – is the social media groups active? Is the teacher making announcements on the platform/platforms? Is there any form of discussions and engagements?		

	1.1.3. UPLOAD OF RESOURCES/VIDEOS – does the teacher upload different resources such as subject related documents, e-books, previous question papers, videos, recorded lessons etc.		
	1.1.4. SCHEDULING OF CLASSES – does the teacher use social media to schedule classes		
	1.1.5. ASSESSMENT – Does the teacher use social media to assess learners and in also giving feedback		
	1.1.6. LINK TO THE FACE TO FACE CLASS – Is there a link/references to the face to face class on the social media platforms		
	1.2. USE OF VC PLATFORMS		
	1.2.1. EXISTENCE/NUMBER OF PLATFORMS - Does the teacher use one or more VC platforms?		
	1.2.2. SCHEDULING OF MEETINGS/CLASSES - Is the teacher able to schedule classes in through the VC platform/s.		
	1.2.3. LIVE/RECORDED SESSIONS – What mode of classes does the teacher facilitate? Is it recorded/asynchronous or live/synchronous?		

	2.1.6. USE OF KEYS/TABS DURING TEACHING – does the teacher use different keys and functions in VC platforms. Functions such as the chat boxes, annotation keys, pointers etc		
	2.1.7. LENGTH OF THE SESSIONS – how long are the sessions? Is the time sufficient?		
	2.1.8. USE OF VIDEOS FOR PRACTICALS – Does the teacher use the VC platform to demonstrate practical's.		
	2.1.9. LINK TO THE FACE TO FACE CLASS – Is there a link/references to the face to face class during the online lessons		

APPENDIX 11: DETAILED ANALYSIS SYSTEM

PHASE ONE

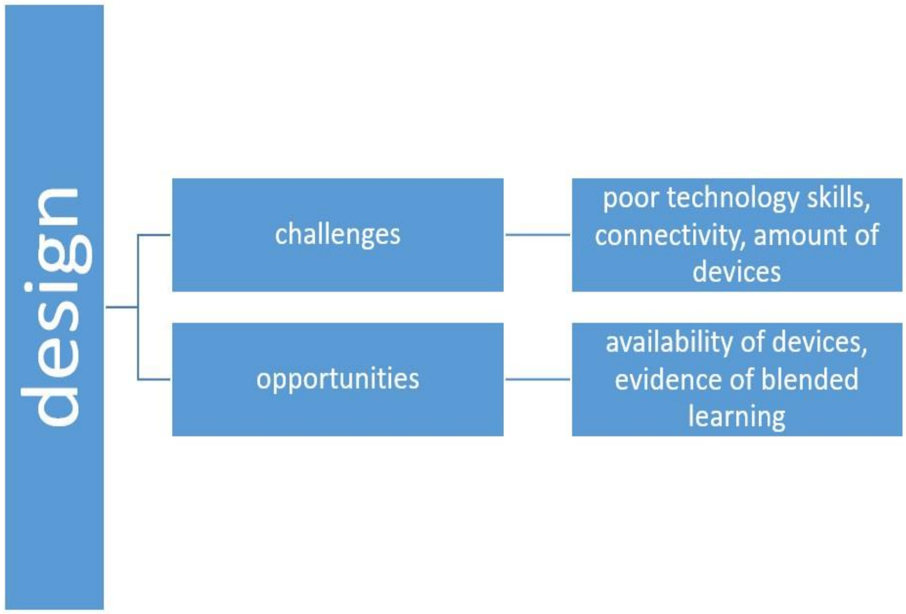
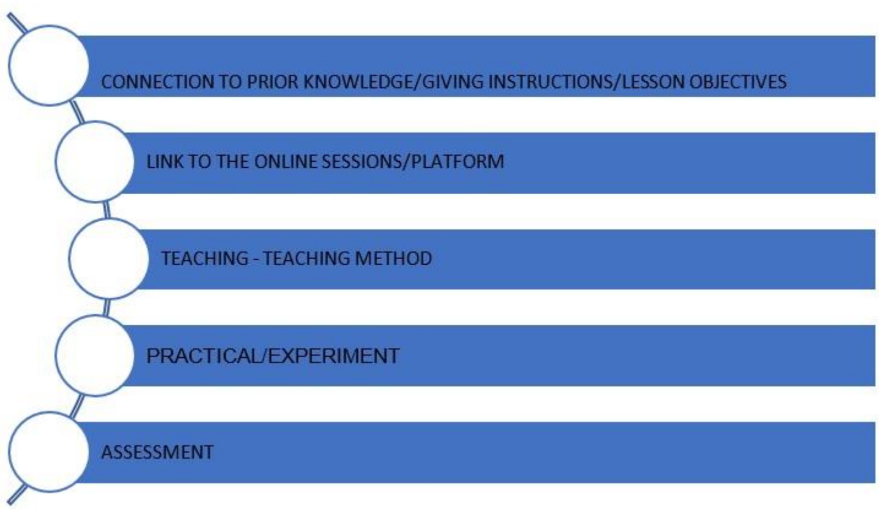


Fig 4.3 The Detailed Analysis System (DAS) for phase 1

PHASE TWO

DAS PHASE 2 BLENDED LEARNING

1. FACE-TO-FACE SESSION



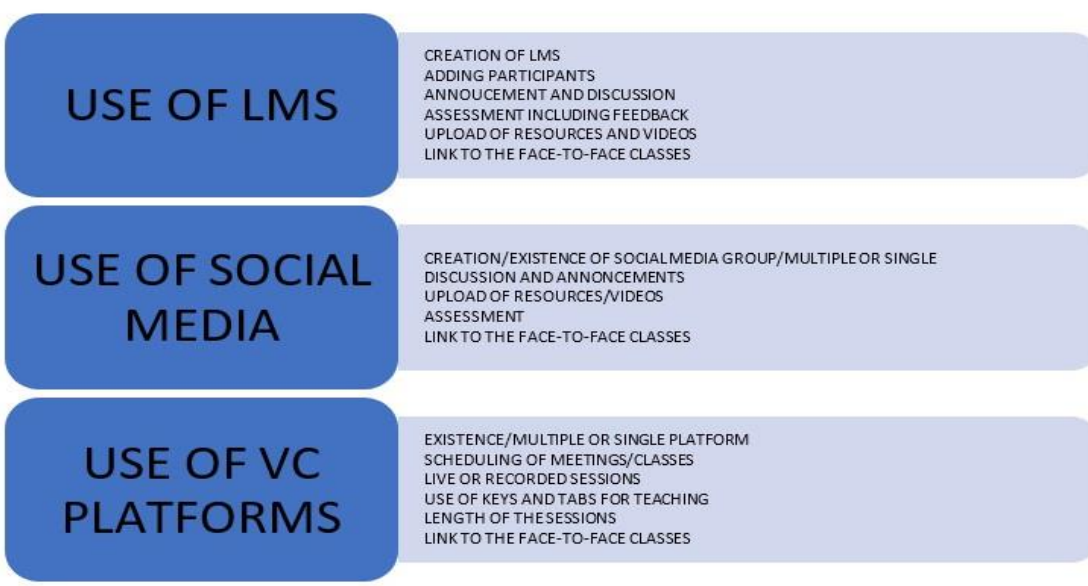
a. CONNECTION TO PRIOR KNOWLEDGE/GIVING INSTRUCTIONS/LESSON OBJECTIVES – Does the teacher link the lesson to prior knowledge? Does the teacher give instructions in the lesson? Is the instruction verbal or written? Does the teacher outline lesson objectives?
b. LINK TO THE ONLINE SESSIONS/PLATFORM – is there a link between the face-to-face and the online platforms?
c. TEACHING – What teaching method/s does the teacher employ? Are the method learner-centred or teacher centred?
d. PRACTICAL – Does the teacher facilitate practical work or does he demonstrate the concepts with experiments?
e. ASSESSMENT – What assessment method do the teacher use? Does the teacher give feedback/how does the teacher give feedback? Is the any reference to the online platform?

What is key in all the dimensions is if there is some connection between the face to face with the online platform.

2. ONLINE

P

LATFORM



3. USE OF LMS
    a. CREATION OF LMS - The intention here is to check if the teacher, even after induction can create an LMS on his own.
    b. ADDING PARTICIPANTS- What is key here is can the teacher add participants to the LMS through their emails or class code
    c. ANNOUCEMENTS AND DISCUSSIONS – is the teacher able to announce on the platform any message or information he/she wants to convey to learners? Can the teacher initiate discussions on the platform? How do learners engage with the teacher?
    d. ASSESSMENT – can the teacher assess learners on the platform? Does he use multiple type of assessments or just a single type of assessment? Is the teacher able to give constructive feedback to his/her learners?
    e. UPLOAD OF RESOURCES/VIDEOS/LESSONS – Is the teacher able to upload different notes, internet sources, e-books, previous question papers etc on the platform? Is the teacher able embed or upload YouTube videos or any other educational videos? Is the teacher able to upload recorded lessons on the platform?
    f. SIMULATION OF EXPERIMENTS – does the teacher use platforms to embed simulation of practical's?

4. USE OF SOCIAL MEDIA
    a. CREATION/EXISTENCE OF SOCIAL MEDIA GROUP/NUMBER OF PLATFORMS – can the teacher create a social media group/groups?
    b. DISCUSSIONS AND ANNOUNCEMENTS – is the social media groups active? Is the teacher making announcements on the platform/platforms? Is there any form of discussions and engagements?
    c. UPLOAD OF RESOURCES/VIDEOS – does the teacher upload different resources such as subject related documents, e-books, previous question papers, videos, recorded lessons etc.
    d. SCHEDULING OF CLASSES – does the teacher use social media to schedule classes

e. ASSESSMENT – Does the teacher use social media to assess learners and in also giving feedback

5. USE OF VC PLATFORMS

5.1 EXISTENCE/NUMBER OF PLATFORMS - Does the teacher use one or more VC platforms?

5.2 SCHEDULING OF MEETINGS/CLASSES - Is the teacher able to schedule classes in through the VC platform/s.

5.3 LIVE/RECORDED SESSIONS – What mode of classes does the teacher facilitate? Is it recorded/asynchronous or live/synchronous?

5.4 USE OF KEYS/TABS DURING TEACHING – does the teacher use different keys and functions in VC platforms. Functions such as the chat boxes, annotation keys, pointers etc

5.5 LENGTH OF THE SESSIONS – how long are the sessions? Is the time sufficient?

5.6 USE OF VIDEOS FOR PRACTICALS – Does the teacher use the VC platform to demonstrate practical's.

APPENDIX 12: DIARY ENTRIES

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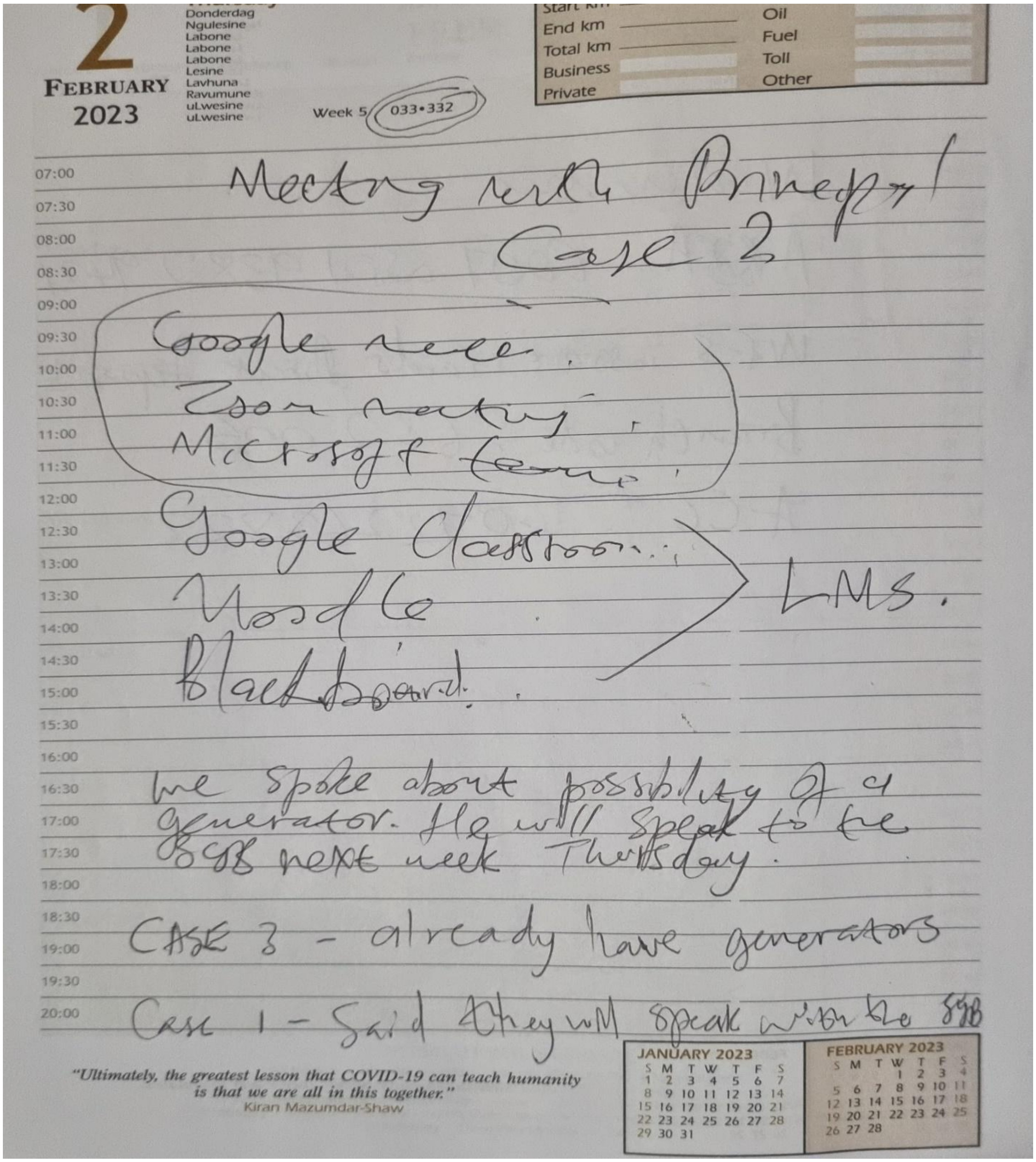
MEETING WITH THE PRINCIPALS DURING THE INTERVENTION



2 FEBRUARY 2023

Donderdag
Ngulesine
Labone
Labone
Labone
Lesine
Lavhuna
Ravumune
uLwesine
uLwesine

Week 5 033•332

Start km
End km
Total km
Business
Private
Oil
Fuel
Toll
Other

Meeting with Principal
Case 2

Google meet.
Zoom meeting,
Microsoft teams,

Google Classroom
Moodle
Blackboard
LMS.

We spoke about possibility of a generator. He will speak to the SGB next week Thursday.

CASE 3 – already have generators

Case 1 – Said they will speak with the SGB

"Ultimately, the greatest lesson that COVID-19 can teach humanity is that we are all in this together."
Kiran Mazumdar-Shaw

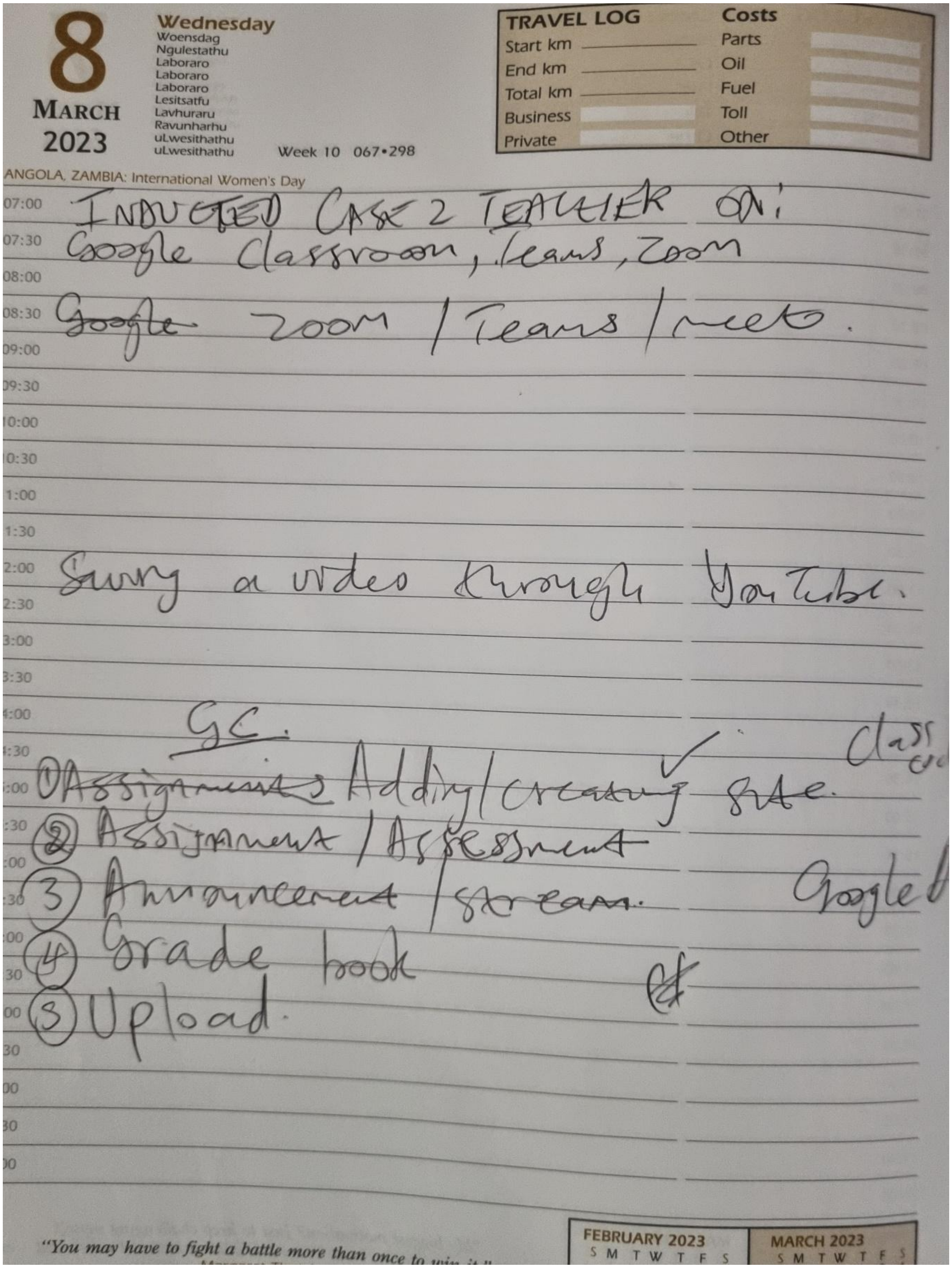
JANUARY 2023

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

FEBRUARY 2023

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

INDUCTING A CASE 2 TEACHER ON THE RBLS



CASE 1 LESSON OBSERVATION FIELD NOTES PHASE 2

13:12

CASE 1 LESSON 2 22/03/23 feedback on Common test

He started by giving learners their scripts/answer sheets from the common test.

The topic he focused on is electrostatics.

He started with question 4.1. and he indicated that the content is the same as the one he had already covered.

He indicated where they got it wrong, which is converting between nC, μC, MC.

He asked learners to define electric field (good) (He involved learners in their learning rather than just defining it for them)

Used demonstration framework in his teaching. together with calculations.

Learners were involved in their learning where they were able to identify an error which was initially made by the teacher.

Used the atom structure and its particles to explain the movement of charge (electrons)

He was doing calculations on the board while asking learners for the answers (sometimes) [Why not ask those he knows they got it right to come to the board and do it.

[There was less engagement between the teacher and learners.]

[when he asks learners questions, he does not ask them to elaborate more]

CASE 2 OBSERVATION FIELD NOTES PHASE 2

WEIGHT EXPERIMENT
use of pulleys.

The relationship between applied force and acceleration

CASE 2 LESSON 1 13 March 2023

The teacher took the learners through what is expected from them in the experiment. He also indicated that they will have to come and measure the mass of the hanger with the mass balance.
He asked 3 students to come and ~~demonstrate~~ perform the experiment.
He asked learners to identify the apparatus (He used recitation method to ask questions)

The teacher invited learners to come and observe marks on the apparatus.
[The teacher was supposed to ask learners to come to the front. However majority of learners remained seated. Learners were far from action.]
Took learners through the relationship of the variables

The four ~~students~~ learners were involved in the experiment and telling other learners results. The learners concluded the experiment with the guidance of the teacher. They have redo the experiment.

He took them through how to do calculations.

He even taught them how to plot a graph. He also demonstrated the relationship between gradient of the graph and formulae. The gradient is $\frac{1}{m}$ and then mass will be the inverse

Concluded by telling them to submit the report in the morning. [No reference

CASE 3 OBSERVATION FIELD NOTES PHASE 2

CASE 3 24/02/23

OBSERVATION Lesson 1 - Newton's of gravit acceleration

Formula Sheet

Handed over pamphlets – Exam Sheets /

Started reminding learners on what they have already studied.

Used Demonstration frameworks - drawing and formulas

~~Helped~~ Showed them to prove the value of gravity through calculations

Gave them questions.

The lesson was teacher centred since learners were not given a chance to calculate or answer the questions themselves. ~~The only thing learners did was give the~~

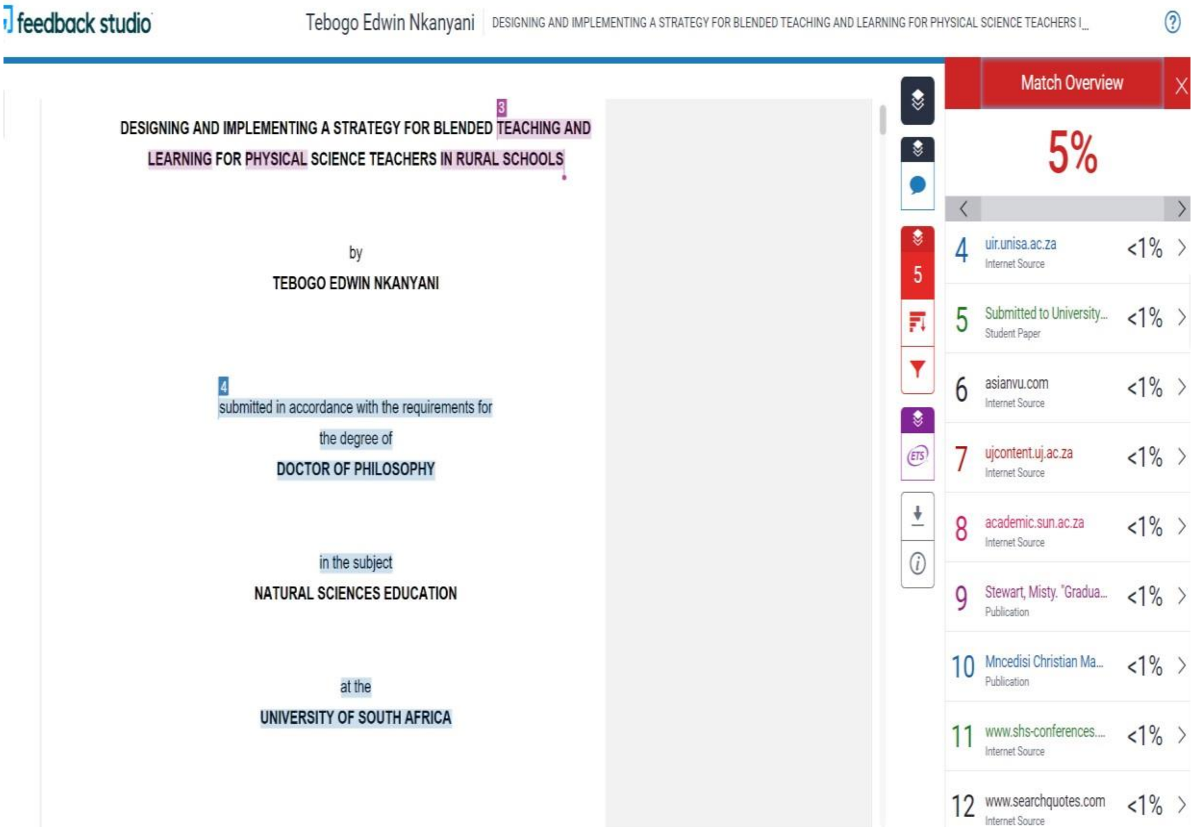
* The teacher could grouped learners and allow them to solve the problem through their engagements.

The only thing that the ~~teacher~~ learners gave was answers after calculating on behalf of the teacher.

~~He gave question 6 as Classwork/Homework~~

Treated question 6

APPENDIX 13: TURNITIN REPORT



APPENDIX 14: LANGUAGE EDITOR'S LETTER

Academic consultancy
"Perfection is our DNA"

309 Aardal flats
219 Stead avenue
academicconsultancy3@gmail.com
04 June 2023

To whom it may concern

This letter is to confirm that I, Keegan Bruce Schmidt, freelance copy editor, have edited and proofread the dissertation entitled "Designing and Implementing A Strategy for Blended Teaching and Learning for Physical Science Teachers in Rural Schools" by **Tebogo Edwin Nkanyani** for Grammar and spelling.

I have not changed any of the ideas presented in this paper; only the grammar and spelling have been altered for the | purposes of clarity. This is to confirm that I have edited the document to a level I deem satisfactory.

Should you have any questions feel free to contact us

Keegan Schmidt
Qualifications:

- BIS (University of Pretoria)
- BIS Hons (University of Pretoria)