

Multiple Technologies in Rural Contexts: Lessons from School Environments in Eastern Cape Province

Mogege Mosimege, Lisa Wiebesiek, Matthews Makgamatha,
Maglin Moodley, Lolita Winnaar



Education and Skills Development Programme



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ACKNOWLEDGEMENTS

The Monitoring, Evaluation, Reflection and Learning (MERL) Research Project on the Technology for Rural Education and Development (Tech4RED) is a massive initiative that involves a number of stakeholders. The MERL Team would like to acknowledge the following stakeholders and the officials involved in the initiative, and who played important roles in the introduction of multiple technological interventions in the Cofimvaba Education District:

- Department of Science and Technology
- Department of Basic Education
- Department of Rural Development and Land Reform
- The Eastern Cape Department of Education
- The Cofimvaba Education District
- Intsika Yethu Local Municipality
- Working Group Coordinators and Members.

The project required numerous visits to schools in the Cofimvaba Education District for the purpose of collecting data. The team is therefore appreciative of the following officials and community members in the Nciba and Mabelentombi Circuits: School principals, teachers, learners, and members of the School Governing Bodies that agreed to participate in the interviews, focus group discussions, individual discussions and other forms of data collection that the MERL Team used throughout the process.

The MERL Team would like to thank the following colleagues and former colleagues at the HSRC who were part of the MERL process since its inception in 2011: Dr Logan Govender, Ms Thandokazi Maseti, Prof Thenjiwe Meyiwa, Dr Nosisi Feza, Mr Gcobani Mkwela, Ms Tebello Letsekha, Prof Oladele Arowolo, Dr Nolutho Diko, and Ms Lisa Wiebesiek.

Working with the learners in the Eastern Cape Province required someone who could help the MERL Team with the isiXhosa language for purposes of data collection and appropriate understanding, and in some cases translation from isiXhosa into English. The MERL appreciates the contributions of Dr Thembinkosi Twalo and Ms Hilda Watani in this regard. Dr Twalo assisted with some of the data collection, specifically the classroom observations and focus group discussions.

The MERL Team appreciates the support and arrangements related to the project provided by Ms Matselane Maja, Ms Elmi de Koning and Ms Erika Masser, the administration team in the Pretoria Office of the Education and Skills Development Programme. It would have been impossible to fulfil this task without their support.

The contribution of Dr Glenda Kruss, Dr George Frempong and the Executive Director of the Education and Skills Development Programme, Dr Vijay Reddy, in reviewing the final report and making valuable comments, is greatly appreciated. Dr Reddy has not only provided the review of the final report, but has been central to the MERL activities and even led the team when some of the members left the HSRC.

At the time of the finalisation of the report, the MERL Team comprised the following members: Prof Mogege Mosi-mege, Mr Matthews Makgamatha, Mr Maglin Moodley, and Ms Lolita Winnaar.

March 2016

LIST OF TERMS AND ACRONYMS

AAP	Anglo-American Platinum
ACE	Advanced Certificate in Education
ANC	African National Congress
App	Application
ARC	Agricultural Research Council
Backwards Mapping	Part of the first step in the development of a Theory of Change, this process entails clearly articulating the ultimate goal of an initiative, programme or project and working through the outcomes, outputs, and action strategies in that order.
CAPS	Curriculum Assessment Policy Statement
Caregiver	The parent or guardian of a minor child
CHCW	Community Health Care Worker
Cofimvaba	A rural area in the Eastern Cape Province. Also an education district of the Eastern Cape Department of Education.
Comparison group	The Mabelentombi Circuit. Referred to as the comparison group for the discussion of the Learner Performance study as it was used as a point of comparison with the Nciba Circuit.
CSIR	Council for Scientific and Industrial Research
DBE	Department of Basic Education
DCU	Data Capturing Unit – the unit within the HSRC responsible for capturing quantitative data into data sets to be used for analysis.
District Official	An employee of the Cofimvaba District Education Office
DoE	Department of Education
DoH	Department of Health
DRDLR	Department of Rural Development and Land Reform
DSD	Department of Social Development
DST	Department of Science and Technology
ECDoE	Eastern Cape Department of Education
e-Education	electronic-Education
eHealth	electronic-Health
EMIS	Education Management Information Systems
ESD	Education and Skills Development – a research unit in the HSRC. The unit responsible for the Monitoring, Evaluation, Reflection and Learning of the Tech4RED initiative
ESKOM	The South African Public Electricity Provider
FGD	Focus Group Discussion

Foundation Phase	Grades R-3
Intermediate Phase	Grades 4-6
Senior Phase	Grades 7-9
FET Phase	Grades 10-12
HoD	Head of Department
HSRC	Human Sciences Research Council
ICT(s)	Information and Communication Technology(ies)
ICT4RED	Information and Communication Technology for Rural Education and Development – one of the Tech4RED working groups.
Intervention group	The Nciba Circuit. Referred to as the intervention group for the discussion of the Learner Performance study as it is the circuit in which the Tech4RED interventions are being implemented, and to differentiate it from the Mabelentombi Circuit.
ISDN	Integrated Service Digital Network
IYLM	Intsika Yethu Local Municipality – Cofimvaba falls within the boundaries of this Local Municipality.
JSS	Junior Secondary School
SSS	Senior Secondary School
SPS	Senior Primary School
JPS	Junior Primary School
Learner Performance	A measurement of learner achievement based on the results of testing and/or assessments. In the case of the MERL Learner Performance study, a measurement of learner achievement based on a mathematics assessment.
Mabelentombi	The Mabelentombi Circuit – the circuit within the Cofimvaba Education District – in which the MERL team
MBS	MERL Buddy System
MBTMB	Mabelentombi
MERL	Monitoring, Evaluation, Reflection and Learning
MERL Buddy	A member of the MERL team assigned to a working group to monitor that working group's activities and intervention.
NALA	National Assessment of Learners' Achievement
Nciba	The Nciba Circuit – the circuit within the Cofimvaba Education District – in which the Tech4RED is being implemented.
NDP	National Development Plan
NHI	National Health Insurance
NMMU	Nelson Mandela Metropolitan University
NSNP	National School Nutrition Programme
PISA	Programme for International Student Assessment

Project Co-ordination Team	A team within the DST responsible for the running and co-ordination of the Cofimvaba Technology for Rural Education and Development (Tech4RED) project
QLP	Quality Learning Project
R & D	Research and Development
Sasol Nzalo	The Sasol Nzalo Foundation
School Nurses	Nurses focused on providing healthcare and screening to learners in schools.
SGB	School Governing Body
SHIPP	Futures Group Sexual HIV Prevention Programme
SPSS	A software package for statistical analysis
Tech4RED	Technology for Rural Education and Development
ToC	Theory of Change
ToR	Terms of Reference
TIMSS	Trends in International Mathematics and Science Study
T-Test	A statistical test that assesses whether the means of two groups are statistically different from each other.
UFH	University of Fort Hare
UNDESA	The United Nations Department of Economic and Social Affairs
UNICEF	The United Nations Children's Fund
VUT	Vaal University of Technology
WG	Working Group
WGC	Working Group Convenor
WRC	Water Research Commission

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EXECUTIVE SUMMARY

This report documents the monitoring, evaluation, reflections and learnings of the Technology for Rural Education and Development (Tech4RED) initiative spearheaded by the Department of Science and Technology (DST) in the Nciba Circuit in Cofimvaba, Eastern Cape. The DST initiated this distinctive and innovative intervention in 26 schools in the Nciba Circuit to enrich the teaching and learning of mathematics, science and technology in this rural environment. Conducted in partnership with the Department of Basic Education (DBE), the Eastern Cape Department of Education and the Department of Rural Development and Land Reform, and operating within a policy context the initiative was intended to contribute to the improvement of teaching and learning, and change in material conditions, in the schools through interventions in six focus areas. These areas are: Information and Communication Technology, Nutrition, Science, Health, Sanitation, and Energy.

In the early stages of the conception of the Tech4RED initiative, the Human Sciences Research Council (HSRC) was appointed by the DST to conduct the Monitoring and Evaluation (M&E) of the Tech4RED project. Noting that the learnings and feedback from those involved in the intervention are instrumental sources of data in a comprehensive and accurate evaluation, the M&E framework was developed for the Tech4Red. This framework was designed to go beyond the traditional M&E processes of many studies similar in nature. To this end, the framework design included the processes of Reflection and Learning (R&L), to ensure that the Tech4RED was responsive during the project cycle. This led to the development of a Monitoring, Evaluation, Reflection and Learning (MERL) framework.

In order to respond to the MERL research questions, provide a portfolio of evidence to inform and influence the implementation of the Tech4RED, and address policy aspects related to rural education, the MERL Working Group made use of numerous research and data collection methods – both quantitative and qualitative. These data collection methods included the following activities: a contextual baseline study of all of the schools in the Nciba Circuit; reflection workshops; an intentional design workshop; a baseline learner achievement assessment; follow-up learner achievement assessments; and qualitative interviews and focus group discussions with learners, teachers, school principals, members of School Governing Bodies, Working Group Convenors, and officials of the Eastern Cape Department of Education.

This report presents the key findings, and recommendations of the MERL Working Group for the Tech4RED following rigorous fieldwork between 2013 and 2015 and intense engagement with relevant stakeholders. Specifically, this report focuses on the issues which need to be considered when (a) introducing context-appropriate multiple interventions in rural contexts; (b) assessing the impact of technology and developing evidence-based strategies for technology integration that contributes to teaching and learning gains. Also provided in this report are specific recommendations for further research and replication of the initiative in similar contexts.

The first part of the findings relates to theory and gaps in the literature on technology for educational development. The review of the existing literature and knowledge in technology for educational development identifies a number of critical research gaps in which the initiative can make significant contributions. These are as follows:

1. The available empirical literature focuses largely on cognitive outcomes rather than taking an holistic approach and understanding, which would also focus on the cognitive and social outcomes of implementing technology for educational development.
2. The literature on technology interventions for educational development focuses largely on equipment such as the use of computers, tablets, e-readers and computers in the classroom.
3. Much of the available knowledge is grounded in theoretical reasoning with highly fragmented empirical data to substantiate the theory.
4. Limited amounts of the academic research available has been turned into readily available policy knowledge.

The second part of the findings relate to the material conditions in and around schools, including access to services like health and electricity, which can contribute in substantial ways to the teaching and learning environment based on the six Tech4RED interventions. The related Working Groups and the interventions are described briefly below:

1. The Information & Communication Technology for Rural Education Development (ICT4RED) Working Group targeted teachers, learners, and officials from the Cofimvaba Education District. Teachers were introduced to tablets and taught how to use them. They were also trained to use the tablets as teaching and learning tools in the classroom using particular pedagogic strategies.
2. The Nutrition Working Group aimed to pilot an intervention that would provide a comprehensive approach to supplementing existing school nutrition programmes. Their model included five components which are: School-based community gardens, learner awareness through nutrition education, nutri-breakfast drink, modifying school kitchen facilities, and training of food handlers.
3. The Sanitation Working Group considered appropriate toilet technologies and selected a South African-designed, low pour-flush technology, to test and finally implement in five schools in the Nciba Circuit.
4. The eHealth Working Group aimed to demonstrate that eHealth, through the use of mobile devices with specific mobile applications, would improve access to school healthcare and health education, based on the needs of the schools in the Nciba Circuit.
5. The Energy Working Group embarked upon designing and implementing an intervention to facilitate access to sufficient, regular and reliable supply of electricity to schools. In addition to this initial task, the scope of the Energy Working Group's intervention expanded to include meeting the energy needs created by other working group interventions, such as the ICT4RED Working Group (e.g. charging stations, running servers) and the Nutrition Working Group (e.g. food preparation).
6. The Science Centre Working Group planned their intervention in two parts. The first was the mobile science laboratory to provide support to learners and teachers in the Nciba Circuit. The second was the establishment of the science centre in the Cofimvaba District.

The findings on the material conditions at the beginning of the MERL process in May 2013 can be summarised as:

- ICTs – Eight (8) schools reported access to and availability of computers, one (1) had access to tablets;
- Health – Twenty-two (22) schools indicated that there was a medical facility (government clinic) in the vicinity of the school;
- Water and Sanitation – Eighteen (18) schools reported a regular supply of water while twenty one (21) schools reported having pit toilets; and
- Nutrition – All twenty-six (26) schools reported having a feeding scheme
- Access to and Sources of Electricity – Twenty-four (24) schools reported having access to electricity.

The introduction of the Tech4RED interventions resulted in the following changes in material conditions in the period between March 2014 and October 2015:

- There was a significant increase in the number of schools which had access to internet and use thereof;
- In respect of the ICT component training, the intervention schools showed an increase in the number of schools that indicated teachers attended ICT training as compared to a decline in the comparison groups;
- The number of separate toilet facilities between male and female learners and between learners and teachers increased significantly in both cases; and
- Considering access to electricity among the intervention schools, it is noted that from March 2014 to October 2015, there was an increase of four schools with access to electricity in the experimental group as compared to the number of schools in the comparison circuit.

With respect to performance in mathematics, the following results were noted from both the experimental circuit (Nciba) and comparison circuit (Mabelentombi) in the period March 2014 to October 2015:

- In Grade 5 the Nciba circuit showed an improvement of 21 per cent whereas the Mabelentombi circuit showed an improvement of 19 per cent; and

- In Grade 8 the Nciba circuit showed an improvement of 24 per cent whereas the Mabelentombi circuit showed an improvement of 16 per cent.

From these results it can be concluded that even though there was some improvement in the mathematics performance in the Nciba circuit, these changes cannot strictly be attributed to the Tech4RED interventions as similar improvements were observed in the Mabelentombi circuit where there were no interventions.

Rurality is a central factor in rural education and rural education development. At present the norms and standards governing school infrastructure do not adequately meet the needs of schools in rural communities, which are faced with unique multiple challenges. This emerged from the examination of material conditions in the Cofimvaba Education District. Cognisance of the environment (which is rural and deprived) necessitates that a budget be set aside to maintain, sustain and upgrade the technologies introduced.

Also necessary is the continued professional development of teachers which has, so far, been well received by the teachers in the intervention circuit. The data collected by the MERL showed that teachers attended professional development workshops covering the following: mathematics content, mathematics pedagogy/instruction, the mathematics curriculum, integrating ICTs into mathematics teaching and learning, improving learners' critical thinking and problem solving skills, mathematics assessment, as well as general aspects related to the Curriculum Assessment Policy Statement (CAPS).

Intervention designed to achieve meaningful gains require a clearly articulated theory of change which guides their introduction and integration. Although a theory of change existed at the beginning of the Tech4RED project, it emerged in the course of the MERL process that it was not documented for the benefit of all the stakeholders, and was also neither clearly and explicitly integrated into the initiative as a whole, nor its related implementation. This is deduced from the manner in which the Tech4RED was implemented, with each working group selecting schools following different criteria, making it difficult to identify outcomes related to the multiple interventions aspect of the TECH4Red. Following the MERL process, a Theory of Change was developed and later refined, based on the work that had been undertaken by the Tech4RED Project. The authors of this report believe that the revised TOC can be used as a basis for further work in Tech4RED and for the expansion of similar interventions in South Africa.

As the project owner, the DST supported by the HSRC, should initiate round table discussions and dialogues to discuss the policy implications of the Tech4RED. The DST should continue to engage with the Department of Education regarding some of the policy related findings to use as evidence in championing the need to revise policies, norms and standards in rural contexts. Engagement with the DBE should also address the revision of budgets and securing funds to ensure the technologies are upgraded and expanded. Given that the Tech4RED includes a focus on informing and influencing policy, developing an outcome statement would benefit the initiative in future by making policy considerations central to the design and implementation of each working group intervention.

The most important future research considerations relate to the continued research into the impact of the Tech4RED in the Nciba Circuit as well as the possible roll-out to other Education Districts in the Eastern Cape Department of Education. The authors of the report therefore recommend further implementation and introduction of the six interventions to other schools where these have not yet been introduced, and the monitoring of all interventions over a longer period of time.

The Tech4RED has, to date, been a successful pre-pilot project in that it has produced numerous lessons, particularly for the possible next phase of implementation and replication in similar contexts. The Tech4RED can be seen as bringing marginalised bodies of knowledge to the forefront through an innovative initiative which harnesses valuable technologies to address the persistent challenges facing rural education. It can also be seen as an innovative way to contribute to the improvement of teaching and learning in mathematics and science, especially in rural contexts.

CHAPTER 1 INTRODUCTION

The Cofimvaba Technology for Rural Education and Development (Tech4RED) project is an innovative and complex intervention spearheaded by the Department of Science and Technology (DST) in partnership with the Department of Basic Education (DBE), the Eastern Cape Department of Education (ECDoE) and the Department of Rural Development and Land Reform (DRDLR). The Tech4RED was implemented in the Nciba Circuit of the Cofimvaba Education District in the Eastern Cape with the aim of creating

... an opportunity to examine whether and how the introduction of new technologies, as well as technologies that have been tested in other contexts, will contribute to improvements to the quality of teaching and learning in a rural context. Set to be piloted in the Nciba Schools Circuit during 2013, this Project will serve as a 'testing ground' of different ways in which a range of technology intensive interventions could enhance the teaching and learning of maths, science and technology. (DST Project Status Report 1 – 2012 & Report 2 – 2013)

Instead of taking a traditional approach to educational and development interventions (which tends to focus on the classroom), the DST used its comparative edge with the Tech4RED to conceptualise an innovative initiative which entailed introducing multiple technological interventions in and around the classroom and the school in a rural context. Co-ordinated by the DST, six themed working groups (WGs), each led by a working group convenor (WGC), were established to develop and implement interventions in the Nciba Circuit¹. The WGs that comprise the Tech4RED include Information & Communication Technology for Rural Education Development (ICT4RED), eHealth, Sanitation, Science Centre, Nutrition, and Energy. In line with the objective of using knowledge, evidence and learning to inform and influence how science and technology may be used to achieve inclusive development, the DST approached the HSRC to function as a 'sounding board' for the Tech4RED. To this end, drawing on a number of theories, approaches, and methodologies, the HSRC research team developed a Monitoring, Evaluation, Reflection and Learning (MERL) framework for the Tech4RED.

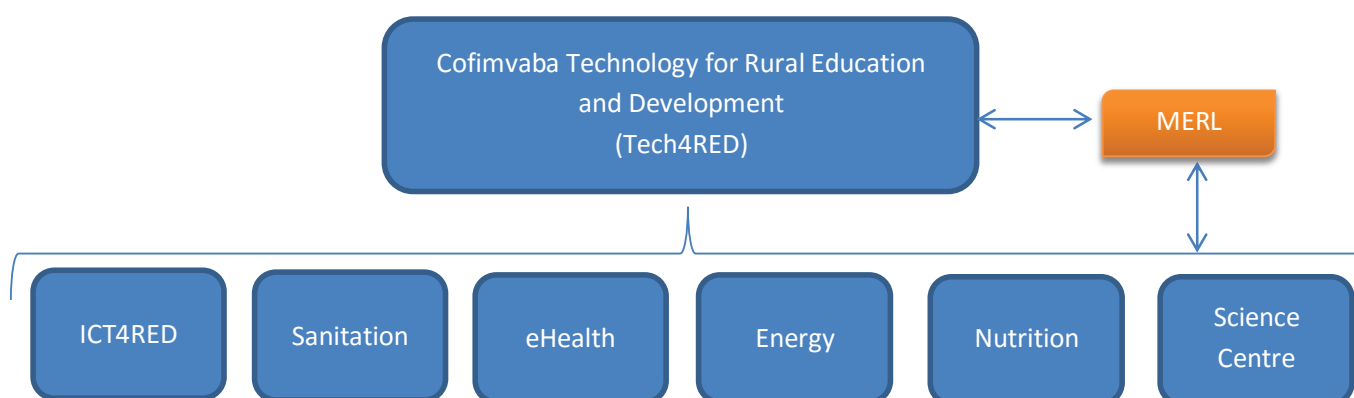


Figure 1 The Structure of the Tech4RED

The MERL framework and processes were guided by the following key research questions:

1. How was each of the technological innovations chosen, introduced, implemented and embedded in a rural environment?
2. How were the multiple interventions chosen, introduced, implemented and embedded in a rural environment?

¹ There have been a number of iterations of the Tech4RED since 2011. The evolution of the initiative is documented in the *Monitoring Report on the Historical Documenting of the Tech4RED*.

3. What has been the impact of the individual and multiple interventions at the level of individuals (teachers and learners), school, and district?²
4. What were the mechanisms for the lessons from the pilot site to be implemented at a national level: communication and dissemination processes; influencing key actors; financial costing and infrastructure (including human resources)?³

Guided by these research questions, the MERL Research Team undertook a number of research activities, generating both qualitative and quantitative data. These research activities included a survey of the material conditions in schools in the Nciba Circuit (May 2013), the historical documenting of the Tech4RED, the learner performance study in the Nciba (intervention) Circuit and the Mabelentombi (comparison) Circuit (May 2014), monitoring interviews and Focus Group Discussions (FGDs) (July 2014), and a learner performance study (October 2014). The data collection activities that were conducted in July 2014 and October 2014 were repeated in October 2015. Research (monitoring) reports have been written based on these research activities. Drawing on these research reports, this consolidated report comprises the findings, analysis and recommendations of the MERL WG for the Tech4RED as at 31 December 2015.

Building on the portfolio of evidence from the intervention, the report documents a Theory of Change (ToC) for the Tech4RED. The MERL acknowledges that whilst this ToC existed from the conceptualisation of the Tech4RED project, it was not documented. Documenting the ToC will guide the design and implementation of the initiative in the future. The ToC developed for the Tech4RED can also serve as the basis for the design and implementation of similar initiatives for rural education development that use multiple interventions to improve the quality of teaching and learning in a rural school context.

The rest of this chapter is divided into three sections. First, a brief background to the Tech4RED is provided; secondly, the ToC for the Tech4RED and the MER is considered; and finally, we outline the structure of the report.

1.1 Background

In 1995, the Department of Education (DoE) released the *White Paper on Education and Training*, which committed government to provide all South African learners with quality education by supporting interventions that address learners' competencies. Despite, however, the support for and intentions behind the 'redress agenda', education implementation since 1995 has faced numerous challenges. In some areas, particularly rural and under-resourced areas in former homelands, these challenges are exacerbated by: extreme poverty; a significant backlog in basic services and infrastructure; and various forms of 'distance', including geographical, ideological, emotional, linguistic, and epistemological distance (Thomson, 2009). This situation extends beyond the former homelands to other rural areas of South Africa.

In response to the persistent challenges facing the education system, particularly to education in rural areas, and in the spirit of co-operation with other government departments towards making a contribution to the development of education in South Africa, the DST, via the Tech4RED, is leveraging its comparative edge to contribute to, and support, the basic education sphere. The Tech4RED interventions operate in three broad areas, namely: teaching and learning, material conditions, and human conditions (Interview with Nonhlanhla Mkhize, 27 August 2013). Each of the interventions makes a contribution to all of these three areas, to a greater or lesser extent.

The Tech4RED project operates within a policy context and is intended to inform and influence that context. The MERL team has identified six core policies and programmes that frame the policy context in which the Tech4RED is located. The six core policies are:

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- 2 In the MERL proposal this research question read: "What has been the impact of the individual and multiple interventions at the level of individuals (teachers & learners), school, district, and community?" We have excluded the word 'community' here, as the Tech4RED and therefore the MERL study focuses on the school rather than the community.
 - 3 In the MERL proposal this research question read: "What are the mechanisms for the lessons from the pilot site to be implemented at a national level..."

- The National Development Plan,
- The Department of Education White Paper on e-Education,
- The National School Nutrition Programme,
- The National e-Health strategy 2012-2016,
- Schooling 2025, and
- The Regulations Relating to Minimum Uniform Norms and Standards for Public School Infrastructure.

The policy context in which the Tech4RED operates, and which it informs and influences, is discussed in detail in Chapter 2 of this report.

It is critical to consider the rural context in which the Tech4RED is being implemented. While acknowledging the importance of the challenges faced by the education sector in South Africa broadly, it is critical to recognise the rural education sector as disproportionately affected by the inequalities and challenges that are the legacy of the Apartheid government's policies. Nkambule, Balfour, Pillay & Moletsane (2011: 342) argue that "[i]n South Africa it is well known that since the end of apartheid in 1994 rural development and rural education have remained on the margins of progress made in improving people's lives. This is despite the governments' attempts at addressing the complexities of rurality and rural education." Many of the inequalities and challenges encountered in a rural education context of multiple deprivation (Balfour, Mitchell & Moletsane, 2008) are unique and require innovative solutions. More than just a sterile setting for testing the effects that multiple, technology-led interventions have in a rural school circuit, the context of Cofimvaba becomes a key factor in the Tech4RED.⁵

The Tech4RED initiative is shaped by Innovation for Inclusive Development as a framework. The Organisation for Economic Co-operation and Development (OECD) defines inclusive innovation projects as "initiatives that directly serve the welfare of lower-income and excluded groups. Inclusive innovations often modify existing technologies, products or services to better meet the needs of those groups" (2015: 5). Defined in this way, the Tech4RED is clearly positioned as an innovation for inclusive development project. In addition to developing and/or testing new technologies, the Tech4RED used existing technologies in innovative ways. Like many other rural education circuits – by virtue of its historical and current disadvantages in terms of resources, infrastructure, and distance from urban centres, education and social centres – the Nciba Schools community can be thought of as an excluded group.

1.2 The Institutional Context

The initiative that was to become the Tech4RED was first conceptualised and championed by then Deputy Minister of Science and Technology, Derek Hanekom. At the time that implementation of the Tech4RED was taking place across programmes within the DST, the initiative was placed, by then Deputy Minister Hanekom, under the leadership of Programme 5. Prior to the 2014–2015 Annual Performance Plan (DST 2014), Programme 5 was called 'Socio-Economic Partnerships'. The 2014–2015 Annual Performance Plan (ibid. 2014) referred to this programme as 'Socio-Economic Innovation Partnerships'. This change in name indicated the overt inclusion of a focus on innovation in this programme.

In addition to the change in the name of the programme, in this same document (DST 2014) there were changes in the name of the sub-programme previously referred to as 'Science and Technology for Social Impact' to 'Innovation for Inclusive Development'.

Prior to the name-change in the 2014–2015 Annual Performance Plan, the sub-programme 'Science and Technology for Social Impact' had been described as follows:

4 While there is no single, universally preferred definition of the term 'rural' that serves all purposes, in this context it is used to refer to a geographic area that is located outside a city or town (Wiebesiek, et al. 2013).

5 We must caution against any assumption of homogeneity of rural areas. As Helge (1986: 2) (in Nkambule, Balfour, Pillay & Moletsane (2011: 342)) notes, "the diversity of rural schools and their unique needs support the imperative need for quality rural education research."

In the 2012–2013 Annual Report:

The sub-programme leads and supports knowledge generation in human and social dynamics in development, and promotes technology transfer for poverty reduction to support the creation of sustainable job and wealth opportunities and to contribute to creating sustainable human settlements in areas of deprivation. It focuses on mature technologies that do not yet have widespread application, but are seen as having the potential to achieve government's broad development objectives. It does this by building partnerships with other government departments focusing on research, technology demonstration and technology transfer (DST 2013: 47).

As a sub-programme within Programme 5, Innovation for Inclusive Development

...supports the experimentation of S&T-based innovations for tackling poverty including the creation of sustainable job and wealth opportunities, building sustainable human settlements, and enhancing the delivery of basic services. The sub-programme focuses on mature technologies that do not yet have widespread application, but are seen as having the potential to achieve government's broad development objectives. The focus is on supporting the widespread adoption and use of promising S&T-based innovation by supporting the generation of practical knowledge and insights, producing suitable policy evidence, introducing decision-support tools, and building capacity (DST 2014: 90).

The inclusion of 'development' in the name of the sub-programme is significant in that it speaks to the development imperative of the Tech4RED. Further, the revisions to the description of the sub-programme reveal that the Tech4RED, as it evolved over the period 2011–2014, has informed and influenced – and has been informed and influenced by – the institutional context of the DST. By virtue of it being a government department, the DST is not only an institutional context for the Tech4RED, but also a policy context. This bidirectional relationship between the initiative and the context(s) in which it is located (as described here) has already generated changes within the DST.

Further evidence of the emergence of the focus on innovation and development within Programme 5 can be seen in changes to its strategic objectives in annual reports and the annual performance plan. In the 2012–2013 Annual Report (DST 2013: 47), strategic objective 1 of Programme 5 was: "Through knowledge, evidence and learning, to inform and influence technology choices and the way alternative technologies can be used to transform rural and social economic development, government planning and service delivery and the building of sustainable human settlements." In the 2014–2015 Annual Performance Plan (DST 2014), strategic objective 1 of Programme 5 changed to "through knowledge, evidence and learning, to inform and influence how science and technology can be used to achieve inclusive development" (DST 2014: 89). This revised strategic objective has somewhat more scope than the previous formulation. The Tech4RED is closely aligned to strategic objective 1 as it appears in the 2014–2015 Annual Performance Plan (ibid. 2014).

There are two particularly important phrases in this objective, namely 'inform and influence' and 'inclusive development'. We draw attention to these phrases here, quoted from the DST's Annual Performance Plan 2014–15, for two reasons. The first is to clarify the conceptual context in which the Tech4RED intervention was designed and implemented; and the second is to establish a working definition for these phrases informing our analysis, and as they are used throughout this report.

The phrase 'inform and influence' is interpreted as follows by Programme 5⁶:

'Inform and influence' – one of the responsibilities of the DST is to facilitate the use of new approaches to address a range of social challenges by using good science or deploying promising technologies that are available but may not be used for a range of reasons. However, DST does not have the mandate or responsibility for supporting adoption of promising technology (for example, alternative building technologies). This is normally done by government departments with service delivery responsibilities (for example, providing water and energy services or building houses in a new way). The approach used by a service delivery departments [sic], whether through direct procurement or through some policy instrument (such as a subsidy, a

6 A similar definition appeared as a footnote to strategic objective 1 in the 2012--2013 Annual Report (DST 2013: 47).

regulation, or by issuing standards), have a significant impact on what technologies are used. The role of the DST is to invest in projects and processes that can generate the kind of appropriate knowledge and evidence and to package the knowledge and evidence in ways that support decision making by government, communities, and other role-players. In many instances, knowledge and evidence will need to be shared through structured learning opportunities such as conferences, workshops and decision support systems (DST 2014: 89).

As described above, the conceptualisation, design and implementation of the Tech4RED took place within, and was framed by, the evolving institutional context of the DST as a government department, specifically Programme 5. Further, the initiative seems to have contributed to revisions in the focus and description of Programme 5, particularly the sub-programme now known as Innovation for Inclusive Development. It was required that the Tech4RED remain aligned to the mandate and strategic objectives which structure the institutional context in which it operates. The relationship described in this section can be graphically represented in Figure 2.

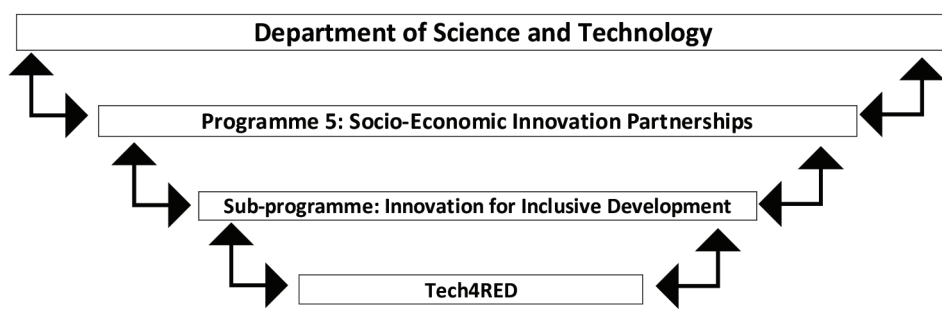


Figure 2 The Institutional Context of the Tech4RED

1.3 The Implementation Context

While acknowledging the importance of the challenges faced by the education sector in South Africa broadly, it is critical to recognise that the rural⁷ education sector is disproportionately affected by the inequalities and challenges that are the legacy of the Apartheid government’s policies. Nkambule, Balfour, Pillay & Moletsane (2011: 342) argue that “[i]n South Africa it is well known that since the end of apartheid in 1994 rural development and rural education have remained on the margins of progress made in improving people’s lives. This is despite the governments’ attempts at addressing the complexities of rurality and rural education.” Many of the inequalities and challenges encountered in a rural education context of multiple deprivation (Balfour, Mitchell & Moletsane, 2008) are unique and require innovative solutions.

In order to avoid becoming another example of a research study that is “...conducted in a rural context without any intention of investigating rural issues or rural education issues, or explaining how rurality influences education in these rural contexts” (Nkambule, Balfour, Pillay & Moletsane 2011: 341-342), we argue that a close examination of the context in which the Tech4RED was implemented is crucial. More than merely a sterile setting for testing the effects that multiple, technology-led interventions have in a rural school circuit, the context of Cofimvaba becomes a key factor in the Tech4RED.⁸

The Nciba Circuit forms part of the Cofimvaba Education District. Cofimvaba is one of two main towns within the Intsika Yethu Local Municipality (IYLM) of the Chris Hani District Municipality (CHDM) of the Eastern Cape. The Eastern Cape Province in general, and the Cofimvaba area in particular, is predominantly rural and is character-

7 We are not aware of the definition of the term used at the conception of the Tech4RED. We therefore use the following: While there is no single, universally preferred definition of the term rural that serves all purposes, in this context it is used to refer to a geographic area that is located outside a city or town (Wiebesiek, et al. 2013).

8 We must caution against any assumption of homogeneity of rural areas. As Helge (1986: 2) (in Nkambule, Balfour, Pillay & Moletsane (2011: 342)) notes, “the diversity of rural schools and their unique needs support the imperative need for quality rural education research”.

ised by high levels of poverty and unemployment. The CHDM reported that 52.95 per cent of the district lived in poverty⁹. In the IYLM, adult unemployment is recorded at 46.6 per cent, and youth unemployment at 56.4 per cent. These figures exclude discouraged work-seekers who have given up looking for work¹⁰. A 2006 survey estimated unemployment in the area at 87.1 per cent (Intsika Yethu Local Municipality, 2011).

The communities around the schools in the Nciba Circuit are characterised by poverty. Families and communities engage in small-scale subsistence farming. It is difficult to describe the Nciba Circuit in general terms, as there is much variation in the circumstances of each school in terms of resources and needs. The schools in the circuit are under-resourced, to varying degrees, in terms of infrastructure, services, and materials. Further, in the context of Cofimvaba, some schools may seem to be relatively well-resourced. Of the twenty-six schools in the Nciba Circuit, there is one quintile 3 school, and four quintile 2 schools. The remaining twenty-one schools in the circuit are quintile 1 schools. All of the schools in the Nciba Circuit are accessed by dirt roads. Dusty in the dry summer months, these roads can become muddy and inaccessible during extended periods of wet weather. Many learners walk long distances to and from school every day¹¹. While some of the schools have been (re)built in recent years from brick, others still use rondavels, mud structures, and containers as school buildings. Prior to the Tech4RED, all of the schools used pit latrines. In many of the schools, food for the school feeding scheme is cooked outside over fires, or in classrooms that are used for learning and teaching. None of the schools have dedicated sports facilities. Only five schools in the circuit have a library. In this context, innovative approaches to addressing the development needs of the area, particularly in schools, are required.

The material conditions of the schools in the Nciba Circuit prior to the introduction of the Tech4RED are discussed in detail in Chapter 6 of this report. Moletsane, Juan, Prinsloo & Reddy (2015: 4) note that “rural communities are also dynamic, and have resilience and agency to respond to the various challenges that face them”. The Nciba Circuit was selected as the pilot site for the Tech4RED not only because it was a rural and under-resourced circuit in the Eastern Cape, with significant service-delivery challenges, but, importantly, it was identified as having the drive to achieve.¹²

1.4 A Theory of Change Approach to the Planning and Evaluation of the Tech4RED

The MERL research team acknowledges that while an implicit ToC existed from the conceptualisation of the TECH4RED project, it was not made explicit. Making the initial ToC for the Tech4RED explicit, as well as the ways in which that ToC has been adapted in response to learnings from the implementation of the Tech4RED, is an important tool for reflection and learning to guide the design and implementation of the initiative in the future. This revised ToC can serve as an initial ToC for similar initiatives for rural education development that use multiple interventions to improve the quality of teaching and learning in a rural school context.

A ToC approach to planning, monitoring and evaluating a programme or project has an underlying philosophy of “commitment to generating community engagement, capacity-building and ownership, and to evaluation as a means of developing programmes” (Blamey and Mackenzie 2000: 447). A fundamental feature of the ToC approach is the importance of the context of both the intervention and the evaluation thereof. Further, the ToC approach allows a project or initiative to remain flexible and responsive to the reflections and learnings generated during implementation. The synergies between the ToC approach, Innovation for Inclusive Development, and the aim of the Tech4RED, makes it well-suited to the task of planning, monitoring, evaluating, reflecting and learning. It is, therefore, important to document the implicit ToC underpinning the Tech4RED in the early stages of its conception, and the ways in which that ToC has evolved during the implementation of the Tech4RED. In this report, we draw on findings, reflections and learning arising out of MERL processes to revise the ToC for the Tech4RED such that it can be used as a basis for the project planning and evaluation of similar initiatives. Connell and Klem (2000) recommend adopting and adapting an initial or existing ToC for education reform.

9 <http://www.chrishanidm.gov.za/about-us>

10 http://www.statssa.gov.za/?page_id=993&id=intsika-yethu-municipality

11 Participants in interviews have reported distances of up to 10 km (Interview with school principal, May 2013).

12 Minutes of meeting between DST, CSIR, DBE & ECDoE, August 2011.

In Figure 3, a ToC for the early stages of the Tech4RED is presented graphically. Please note that the figure is simplified. The green arrows represent decision-making pathways. The arrows illustrate that the ToC for the Tech4RED was developed using backwards mapping, i.e. the process began with deciding upon – and clearly articulating – the goal of the initiative, then the outcomes that would need to be achieved in order for this goal to be reached, the

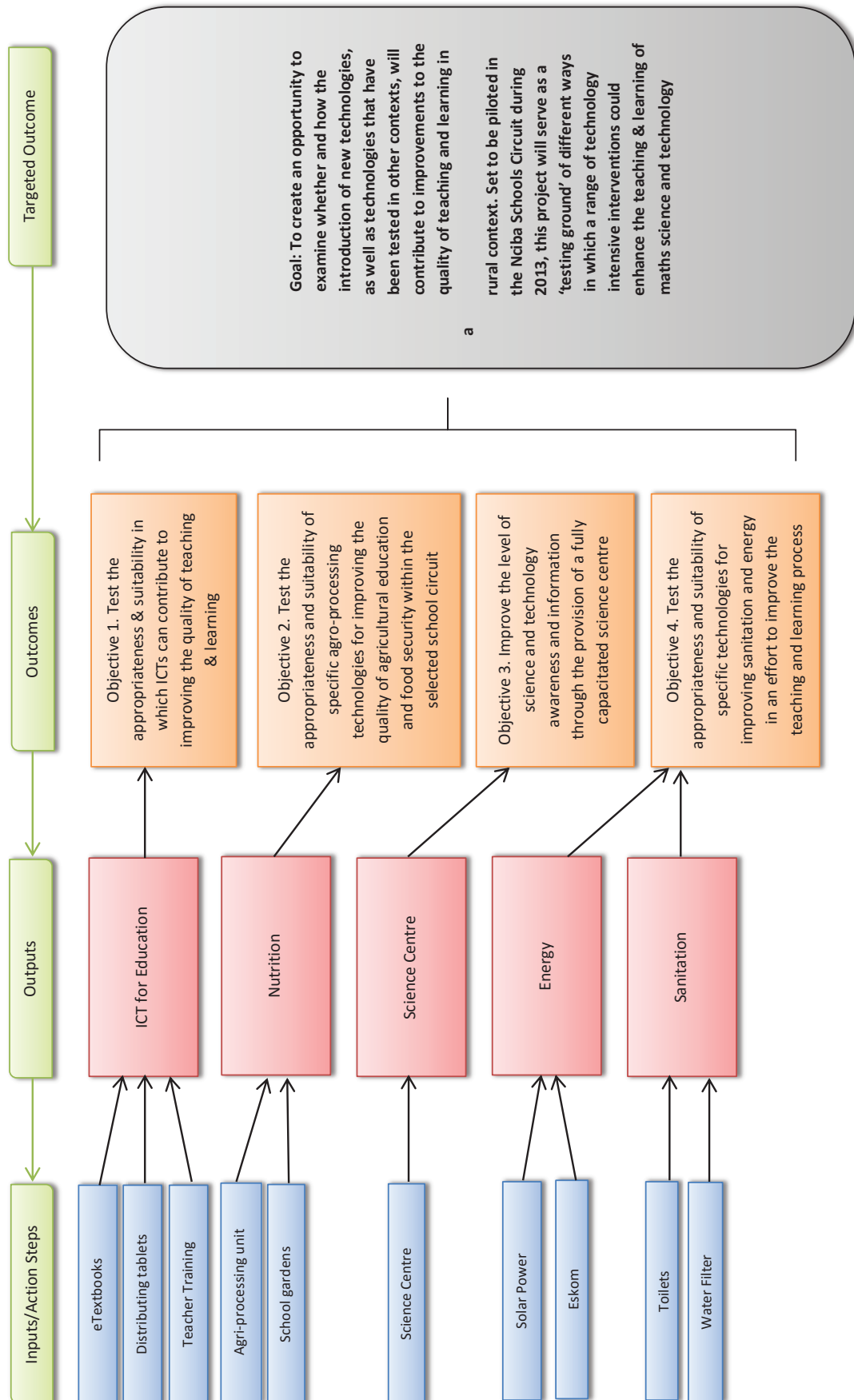


Figure 3 Graphic Representation of Initial, Implicit, Theory of Change for the Tech4RED

outputs and action steps. The black arrows represent pathways of change. The goal and objectives, as articulated in Figure 3, have been adapted from the aim of the Tech4RED as articulated in the *DST Project Status Reports 1 & 2* (11 November 2012; 11 March 2013), and the *2013/14 Tech4RED Project Risk Profile* circulated in November 2013.

Four objectives were identified in order to reach the Tech4RED goal of creating an opportunity to examine whether, and how, the introduction of new technologies, as well as technologies that have been tested in other contexts, would contribute to improvements to the quality of teaching and learning in a rural context. Each objective was seen as contributing to the overall goal of the Tech4RED. For example, the first objective related to information and communication technologies (ICTs) as a form of technology that could be used to improve teaching and learning by addressing a specific problem or challenge faced by a rural school, such as access to information. The problem of a shortage or lack of up-to-date textbooks, for example, might be alleviated by providing an e-Reader on which textbooks could be loaded. A similar process was followed for each of the objectives. It will be made clear in the chapters that follow, that while the goal of the Tech4RED remained largely unchanged, the other components of the ToC were revised and adapted to suit the implementation context, in response to specific community needs, and in response to challenges faced by each of the WGs. In summary, the ToC for the Tech4RED in its initial stages can be described as follows: to improve the quality of teaching and learning in a rural context, various different technologies can be used to intervene in the rural school context in innovative ways, not just in the classroom, but in the school environment and in terms of learner well-being.

In the following section, an overview of the structure of the report is provided to summarise the document and guide readers through each chapter.

1.5 Structure of the Report

Chapter 2 of the report is a brief overview of the policy context in which the Tech4RED is located, and which it intends to inform and influences to illustrate synergies between the Tech4RED and the policy context. Further, the chapter draws attention to certain gaps in the policy around rural education development that the Tech4RED is well positioned to address.

In Chapter 3, the literature on technology for educational development is reviewed. This review covers aspects such as technology implementation, technology integration, technology enabled social innovation and technology and gains in educational outcomes.

The methodology and research design of the MERL are discussed in Chapter 4. Informed by the MERL framework and responsive to the research context of the Tech4RED, the MERL research approach has been flexible and responsive while collecting and analysing high quality data on the Tech4RED. The chapter provides insights into how data was generated to answer the MERL research questions.

In Chapter 5 a descriptive summary of each of the six working group interventions comprising the Tech4RED is provided.

Drawing on data extracted from questionnaires completed by school principals, teachers and learners, Chapter 6 provides a profile of the Cofimvaba School Community. This chapter establishes that the Nciba Circuit in which the Tech4RED was being implemented (the 'intervention circuit') and the Mabelentombi Circuit (the circuit chosen to serve as the 'comparison circuit'), are similar enough in terms of these profiles to be comparable.

In Chapter 7 the findings of a survey of the material conditions of schools are presented to establish what, if anything, changed in material conditions in the Nciba Circuit between May 2013 and October 2015. These changes were compared with those in the material conditions of schools in the Mabelentombi Circuit so that the impact of the Tech4RED on the material conditions of schools in the intervention circuit could be established.

Using qualitative data generated by interviews and focus group discussions with members of the Cofimvaba Schools Community, Chapter 8 offers reflections on the Tech4RED from the perspectives of the intended beneficiaries of the initiative. The chapter reveals that the Tech4RED interventions are targeted correctly.

Chapter 9 presents the findings of the MERL Learner Performance Study. It shows how learner performance differs in the two circuits and reveals how the Tech4RED has affected learner performance in the Nciba Circuit between March 2014 and October 2015.

In Chapter 10 the report is concluded with a discussion of learnings and recommendations that have emerged from the MERL study. The chapter also includes a revised ToC for the Tech4RED based on what was learnt from the MERL study. This ToC can be used as a starting point for discussions about the ToC for the next phase of the Tech4RED.

CHAPTER 2 A REVIEW OF THE POLICY CONTEXT

2.1 Introduction

One of the key objectives of the Tech4RED is to use the evidence generated from the project to inform and influence policy related to rural education and development. The Tech4RED initiative is informed by a number of government policies, which set the basis and guidelines for the scope of work and the implementation plans of each WG, and which it also seeks to inform and influence through evidence. In this chapter, a review of these key policies is presented in order to clearly establish what the policy context of the Tech4RED is and how the Tech4RED fits into that context; and to identify gaps in the policy that the Tech4RED can address.

2.2 Medium Term Strategic Framework and National Development Plan

The Tech4RED policy context is informed by the twelve key outcomes that collectively address the main strategic development priorities of the South African government, as developed within the Medium Term Strategic Framework 2010–2014 (DPME, 2010). “Improved quality of basic education” is the first of the twelve key outcomes. The Tech4RED is also aligned with the National Development Plan (NDP). According to the NDP (National Planning Commission: 2011), improving education is critical, particularly in rural contexts where inequalities persist. Due to the impact that the quality of a schooling system has on further education, basic education, training and innovation have been identified as central to the long-term development of the country. Therefore, foundation skills are essential components of a good education system. For most black learners in South Africa, the poor quality of education remains a challenge and government seeks interventions to address this challenge. As outlined in the NDP (ibid., 2011), improving education requires management and support from all interested parties. The NDP calls for programmes that support the holistic development of learners and that are responsive to the needs of children, families and communities.

2.3 Schooling 2025

Schooling 2025 is a long-term plan developed by the DBE and introduced in 2010 for the purpose of monitoring progress against a set of measurable indicators covering all aspects of basic education. These indicators include:

- Enrolments and retention of learners
- Teachers
- Infrastructure
- School funding
- Learner well-being and school safety
- Mass literacy
- Educational quality.

With respect to learners, this long-term plan aims to “have learners who attend school every day and are on time because they want to come to school, the school is accessible and because they know if they miss school when they should not, some action is taken. Part of the reason why learners want to come to school is that they get to meet friends in an environment where everyone is respected, they will have a good meal, they know they can depend on their teachers for advice and guidance, and they are able to participate in sporting and cultural activities organized at the school after school hours” (DBE, 2015). The long-term plan directly and indirectly affects the Tech4RED initiative and all the established WGs to a greater or lesser extent, with this influence extending beyond the scope of the Tech4RED project. The impact of the Tech4Red initiative in Cofimvaba in the Eastern Cape should be seen in the context of Schooling 2025.

2.4 The Department of Education White Paper on e-Education

The White Paper on e-Education was developed by the DoE in 2004. It provides the guidelines for the introduction of ICTs in schools in order to create new ways for students and teachers to engage in information selection, gathering, sorting and analysis. Central to the development of this white paper was the DoE's belief that "ICTs create access to learning opportunities, redress inequalities, improve the quality of learning and teaching, and deliver lifelong learning" (DoE, 2004:16). The DoE also recognises that ICTs encourage a teaching and learning milieu which acknowledge that people operate differently, have distinct learning styles and culturally diverse perspectives (ibid, 2004). This recognition is important in the context of the Tech4RED initiative as it is based in a rural setting in the Eastern Cape in which cultural aspects are prominent and impact on the teaching and learning activities.

The White Paper on e-Education also highlights the importance of equity in the provision of ICTs in schools. In this respect it states: "The principle of equity should inform our approach and provide an alternative basis for supplying access to information and the allocation of resources. Equal access and equal competence must be the objective of our education system" (DoE, 2004: 22). It is, therefore, important that in any intervention that relates to provision of ICTs, the principle of equity should be kept in mind. In line with this principle, the MERL framework should also consider the extent to which equity issues were taken into account in the provision of the tablets, connectivity, mobikits, and so on.

The white paper remains silent on rural education and the specific needs of, and challenges faced by, this sector; and fails to address the digital divide within South Africa which is split by urban/rural location as well as the resources available to schools.

2.5 The National e-Health Strategy

The Department of Health (DoH) developed the eHealth Strategy which was adopted by government in July 2012. It is important to note that it was adopted after the start of the Tech4RED Project in 2011, and would therefore have impacted on the nature and scope of work of the eHealth WG after the initial planning. According to the eHealth strategy, ICTs play a vital role in enabling effective health care service delivery and overall performance of the health system (DoH, 2012).

The strategy sees eHealth as "an investment in ICT in health and healthcare that enables changes and improvements in clinical and working practices in order to secure benefits that exceed the costs over time" (DOH, 2012: 21). It identifies 10 strategic priorities that must be addressed in order to leverage eHealth and to strengthen healthcare transformation in South Africa. The following priorities are important and should be considered in the Tech4RED intervention:

- Stakeholder Engagement – In order for e-Health to succeed, there needs to be collaboration with all stakeholders affected by e-Health, including m-Health and Telemedicine;
- Standards and Interoperability – This deals with national standards for procurement of software and hardware, software accreditation, etc.;
- Investment, Affordability and Sustainability – Before embarking upon any e-Health project, financing must be procured and sustainability protected;
- Benefits Realisation – Stakeholders need to benefit from promises made and interventions embarked upon;
- Applications and Tools to support Healthcare Delivery – The range of digital applications and tools with the potential to support and improve healthcare delivery.

2.6 The National School Nutrition Program

The DoH introduced the National School Nutrition Programme (NSNP) (DoH: 1994) which was later transferred to the DBE in 2004 specifically to enhance learning capacity through the provision of nutritious meals to learners. It began as a Primary School Nutrition Programme (PSNP) and after an extensive review it was expanded to include secondary schools – in 2009 – and renamed the NSNP. The NSNP was "conceptualised as a shared component of

general education and health development, based on a conceptual framework for understanding how health and nutrition factors influence school achievement” (Gauteng Department of Education, 2004: 2).

The PSNP was established with the following objectives:

- (i) To contribute to the improvement of the quality of education by enhancing primary school learners’ active learning capacity as well as their school attendance and punctuality through the temporary alleviation of hunger;
- (ii) To improve knowledge about nutrition, perceptions, attitudes and eating patterns amongst primary school learners, their parents and teachers through education as part of the general education curriculum or through other primary school education feeding initiatives;
- (iii) To enhance broader development initiatives, particularly in the areas of small business development, economic empowerment and combatting poverty.

The same objectives were retained when this program was expanded to secondary schools as the NSNP.

The NSNP is an important programme, particularly in areas like Cofimvaba which has high levels of poverty and food insecurity. The work of the Tech4RED, specifically the Nutrition WG, has the potential to enhance and/or improve the programme so that learners most in need are provided with sufficient, cost-effective nutrition to support their physical and cognitive development, and their educational attainment.

2.7 Regulations Relating to Minimum Uniform Norms and Standards for Public School Infrastructure

The Regulations Relating to the Minimum Uniform Norms and Standards for Public School Infrastructure (henceforth referred to as ‘The Regulations’), were published by the DBE in the *Government Gazette* on 29 November 2013 in terms of the South African Schools Act, 1996. The Regulations were published after the start of the Tech4RED in 2011. The Regulations prescribe and delimit norms and standards for public school infrastructure in terms of electricity, water, sanitation, library or media centre facilities, laboratories for science, technology and life sciences, sport and recreational facilities, electronic connectivity at schools, perimeter security and school safety, and design considerations for all education areas. The regulations call for the availability of classrooms, electricity, water, sanitation, electronic connectivity and perimeter security to be prioritised (DBE, 2013: 8). The regulations further state that “[i]n implementing these regulations every reasonable possible avenue must be explored and alternatives considered to give effect to the norms and standards contained in these regulations” (DBE, 2013: 8). The Regulations provide an important policy framework for the work undertaken by the Tech4RED via the WG interventions.

In Table 1, we provide an overview of the regulations relating to the Tech4RED interventions.

Table 1 Overview of the Regulations Relating to the Minimum Norms and Standards for Public School Infrastructure

Intervention	Norms & Standards, 2013	Other Policy
ICT4RED	In terms of section 16 of the document: (1) All schools have some form of wired or wireless connectivity for purposes of communication, which must be maintained in good working order. (2) The following communication facilities must be provided: (a) telephone facilities; (b) fax facilities; (c) internet facilities; and (d) an intercom or public address system.	White Paper on e-Education (2004); Schooling 2025
eHealth		National eHealth Strategy, 2012-2016
Nutrition		National Schools Nutrition Programme; schooling 2025

Sanitation	In terms of section 12 of the document: (1) All schools must have a sufficient number of sanitation facilities, as contained in Annexure G, that are easily accessible to all learners and educators, provide privacy and security, promote health and hygiene standards, comply with all relevant laws and are maintained in good working order. (2) The choice of an appropriate sanitation technology must be based on a assessment conducted on the most suitable sanitation technology for each particular school. (3) Sanitation facilities could include one or more of the following: (a) waterborne sanitation; (b) small bore sewer reticulation; (c) septic or conservancy tank systems; (d) ventilated improved pit (VIP) latrines; or (e) composting toilets. (4) Plain pit or bucket latrines are not allowed at schools.	Schooling 2025
Energy	In terms of section 10 of the document: (1) All schools must have some form of power supply which complies with all relevant laws. (2) The choice of an appropriate power supply must be sufficient to serve the power requirements of each particular school and must be based on the most appropriate source of power supply available for that particular school. (3) Sources of power supply could include one or more of the following: (a) grid electrical reticulation; (b) generators; (c) solar powered energy; or (d) wind powered energy sources.	Schooling 2025
Science Centre	In terms of section 14 of the document: (1) All schools that offer science subjects must have a laboratory and the necessary apparatus and consumables in accordance with the specific curriculum needs of a particular school to make it possible to conduct experiments and scientific investigations. (2) The apparatus and consumables contemplated in sub-regulation (1) may be housed in a laboratory, a mobile laboratory, a classroom or a safe container, as determined by the school. (3) The apparatus and consumables contemplated in sub-regulation (1) must be stored in a lockable facility in accordance with safety standards provided for in all relevant laws. (4) A laboratory for science, technology and life sciences may, where practicable, be combined in one room. (5) A laboratory must be maintained in good working order.	
Libraries	In terms of section 13 of The Regulations: (1) All schools must have a school library or a media centre and a minimum, adequate and suitable school library collection. (2) The core school library collection must be regularly replenished according to the requirements of a particular school and administered using one or more of the following: (a) a mobile library; (b) a cluster library; (c) a classroom library; (d) a centralised school library; (e) a school community library.	
Review of Regulations	(1) The Department of Basic Education must periodically review the norms and standards contained in these regulations in order to ensure that those norms and standards remain current and serve the needs of the teaching and learning process. (2) (a) An education department may within the parameters set by these regulations, adapt the norms and standards to best suit schools within the province concerned. (b) Any adaption contemplated in paragraph (a) may not lead to a diminution of the minimum norms and standards contained in these regulations.	

The Regulations acknowledge that “strides have been taken to provide relevant, effect, responsive, inclusive and sustainable teaching and learning school infrastructure to address the systematic inequalities experienced by all learners”. In recognition of the continued “uneven development with regard to the provision of basic school infrastructure to all public schools” which is a result of “the painful legacy of apartheid”, The Regulations were, however, developed with a specific redress agenda in mind. The document reaffirms the responsibility of the Government to continue to “provide basic school infrastructure to all public schools, particularly those that were previously

disadvantaged”. Although not explicitly stated as such, The Regulations allude to a ‘Joined-up Government’ (see, for example, Pillay, Tomlinson & Du Toit, 2006; and Kraak, Lauder, Brown & Ashton, 2006) approach to addressing uneven development in teaching and learning infrastructure in South African Schools. The joined-up approach means that while the DBE is the lead department with a responsibility for schooling, it must work with other government departments in a co-ordinated and responsive way to address education challenges in South Africa. The Tech4RED is positioned to make invaluable contributions within the framework of The Regulations, as well as to The Regulations themselves. Provision is made for this contribution to The Regulations in Regulation (4), sub-regulation (5), where it is stated:

- (a) The implementation of the norms and standards contained in these regulations is, where applicable, subject to the resources and co-operation of other government agencies and entities responsible for infrastructure in general and the making available of such infrastructure.
- (b) The Department of Basic Education must, as far as practicable, facilitate and co-ordinate the responsibilities of the government agencies and entities contemplated in paragraph (a).

(DBE, 2013: 8)

In addition to an alignment between the Tech4RED and the redress agenda of The Regulations in terms of a focus on providing relevant, effective, responsive, inclusive and sustainable teaching and learning school infrastructure to previously disadvantaged schools in particular, The Regulations speak directly to five of the six WG interventions comprising the Tech4RED. While The Regulations stipulate what infrastructure must be available, and the specifications of such infrastructure, in some instances the document is silent on how to comply with these norms and standards. The lessons learned from the WG interventions are of particular value in demonstrating ways in which to comply with The Regulations that are relevant, effective, responsive, inclusive and sustainable in a rural school context.

While The Regulations do make various distinctions between types of schools, these distinctions are not made by specifically taking rurality into account. They fail, therefore, to acknowledge and address the specific needs of and challenges faced by education in the rural environments.

2.8 Concluding Remarks

This policy context is important to bear in mind as the findings from the Tech4RED are intended to inform and influence policy – both revisions to existing policy as well as new policy. While policy documents clearly articulate what should be in place or what should be achieved, they do not adequately show how to go about accomplishing that which is set out in policy. The Tech4RED, with its clear intention to inform and influence policy, is uniquely and perfectly positioned to provide important examples of how to achieve policy aims and goals in relation to rural education and development. In particular, the Tech4RED can make a strong case for the need for specific policy-making for rural education development.

CHAPTER 3 TECHNOLOGY FOR EDUCATIONAL DEVELOPMENT: A REVIEW OF THE LITERATURE

3.1 Introduction

Technology enthusiasts have long heralded the power of technology to transform education, with the rapid growth of ICTs resulting in a high level of interest in the use of modern technology to improve the education status of some of the world's underprivileged people (Winthrop & Smith, 2012). In part, the aspiration to incorporate technology in the school environment can be attributed to the view that technology has the ability to inspire teachers and learners, encourage perseverance on challenging tasks and contextualise the learning environment (Gee, 2008; Hartnell-Young, 2009; Looi, 2009; Specht, 2010; Specht, Howell, & Young, 2007). It is also argued that the inclusion of technology in the school environment has the capability to offer “anywhere, anytime”, creative and collaborative construction of knowledge (Chen & Kinshuk, 2008; Evans & Johri, 2008; Norris & Soloway, 2008).

Much of the literature on technology for educational advancement has a limited conception of technology, with a focus on the use of technology as a tool for improving the delivery of instruction in the classroom. This limited conception has, in part, to do with two competing views on the definition of technology. The first view, advocated by fundamentalists, describes technology as the methodical application of science to everyday problems (Braudel, in Seels & Richey, 2004: 7). According to this view, technology for educational development is about the technical application of tools, machines, and communication systems such as multimedia and computerised instruction.

The second – and contemporary – view is that technology is the application of knowledge to be built from one generation to the next and, as such, includes tools, processes, applications, skills, and organisation (Seels & Richey, 2004: 6). Understood this way, technology for educational development would encompass the application of the principles of science in order to solve problems associated with teaching and learning.

Attempting to provide what he terms a “socio-technical” definition of technology, Rooney (2012) turns to ancient Greece, noting that the etymology of the word technology suggests that it has long had a socio-technical meaning. The Greek root of technology, *techné*, means belonging to the arts, crafts or skill, and is also related to strategies. Therefore, to the ancients, technology was more than ‘gadgets’, it was also (perhaps more importantly) to do with abilities, know-how, and the art of doing things, knowledge, actions and gadgets.

In defining and classifying technologies it is also important to avoid the tendency of separating technology and society. Explanations like these argue that technology is dehumanising because society is not seen as technological and technology is not seen as social (Rooney, 2012). The understanding of technologies for educational development needs to be based on a broad interpretation of what constitutes technology. Such an understanding would deal with a wide set of interconnecting and heterogeneous possibilities, thus avoiding not only teleological analysis, but also the temptation to look only for cause-effect relationships when evaluating the usefulness of technology.

As noted in an earlier section, the authors of this report adopt a social sciences definition of technology for educational development. This includes a view of technology as interrelated with social issues and as a tool or technique which enhances capability. Educational technology is, in this sense, not confined to computers and mobile phones, but has a broader application of scientific knowledge that advances teaching and learning and also the wellbeing and dignity of individuals, leading to their improved learning.

The Tech4RED proposes a unique framework which goes beyond the classroom and cognitive gains, and deals in a nuanced way with the complexity and uses of technology for educational development, with implications for both the cognitive, and overall wellbeing and dignity, of those in the school community. This is the view and understanding of technology adopted in both the Tech4Red and MERL framework where technology is taken to mean both physical products and ideas or intellectual devices. Understood this way machines, which are the result of a certain technology, only represent a small part of technology.

This review of literature covers both national and international experiences with an attempt to identify some of the global best practices and lessons learnt in implementing technological interventions to improve teaching and learning, wellbeing and dignity. Given the lack of literature on the implementation of multiple technologies in a single context, the learning gains are reviewed for each of the technologies implemented as part of the Tech4RED.

3.2 Technology Implementation

Even with the extraordinary growth of access to technology, its use remains uneven, particularly in the global South. There are important enabling and constraining conditions that vary in different contexts and which assist in determining the degree to which technology can be leveraged to help improve educational outcomes (Buttenheim et al., 2011: 6). These conditions are often interconnected and can help explain why technology for educational development is put to better use in certain contexts.

For instance, in the provinces of Delhi and Karnataka in India, the presence of conditions such as resilient political will in developing and executing information technology (IT) policies, vigorous ICT infrastructure and human technical capability, have aided the development of technology towards useful ends. By contrast, in Malawi, while several conditions are in place such as high-level political will and sound policies, the lack of resources, dependence on external donors and poor infrastructure are proving to be difficult barriers to surmount (Winthrop & Smith 2012). While some similarities can be drawn between the contexts in India, Malawi and South Africa, the value of these examples is that they emphasise the need for strong political will to be supported by sufficient resources and the necessary infrastructure to enable initiatives like the Tech4RED to be successful.

While the physical and economic conditions – such as basic infrastructure and the availability of financing for technology projects – are important, research indicates that it is often the willingness and capacity of key actors and personnel that prove to be equally, if not more, significant in enabling effective use of technology. In any given context, understanding the enabling conditions is an important ingredient for being able to select where and how technology could be useful for improving people’s lives. Winthrop and Smith (2012) list the following as some of the most important technology implementation enablers:

1. Access to electricity
2. Connectivity
3. Human resource capacity
4. Political will and management
5. Financial resources.

3.3 Technology Integration

It is sometimes difficult to describe how technology can impact learning because the term ‘technology integration’ is a broad umbrella that covers varied tools and practices; and there are many ways technology can become an integral part of the learning process (Dexter, 2012). But how we define technology integration can also depend on the kinds of technology available, how much access one has to technology, and who is using the technology. For instance, in a classroom with only an interactive whiteboard and one computer, learning is likely to remain teacher-centric, and integration will revolve around teacher needs, not necessarily student needs (ibid).

Reigeluth and Joseph (2002), note that in the school context technology integration focuses on “how to use technology to support the way teaching is currently done in the schools”. The underlying logic of this definition is that the most effective use of technology in education requires fundamental changes in the way teaching and learning takes place in schools. Educational technologists (Ertmer, 1999, 2005; Su, 2009) emphasise the effectiveness of technology in education over efficiency.

Educational technology does not possess inherent instructional value: a teacher designs into the instruction any value that technology adds to the teaching and learning processes. In the classroom context, seamless technology integration is when students are not only using technology daily, but have access to a variety of tools that match the task at hand and provide them with the opportunity to build a deeper understanding of content. In the school wide context, seamless integration is when teachers have convenient and flexible access to, and technical support for, appropriate educational technologies in order for them to utilise them in their classrooms (Robertson, et al. 2010: 34).

3.3.1 Social Impact of Technology Integration

In much of the literature on the social implications of technology, the focus is often on conventional technologies, particularly information communication technologies. Technology has affected humans in a number of different

ways and has become “a basis for future social behaviour” (McGrath, 2012: 10). The submersion of new technologies into society has led to major social change which has meant that individuals have had to adapt in many ways.

Vankatesh and Vitalari (cited in McGrath, 2012) define social change as “the process by which alteration occurs in the structure and function of a social system”. Church et al. (2010: 280) argue that some of the major societal changes have been due to the introduction of media technologies. These have resulted in human interaction being mediated, if not governed, by the situation or the portability of certain devices.

Another major impact of new media technologies is the digital divide. Selwyn (2004) argued that the understanding of the digital divide, based simply on the technological disparities between the rich and the poor, is too simplistic and suggests that with the right political will, these disparities can be addressed and closed. He challenges the definition of the digital divide, arguing that it is an unhelpful notion that suggests binary positions of access or no access to technology (you either have or you do not have) that cannot be reconciled. In his view, these are popular and political conceptualisations that simplify the digital divide (also Zheng and Walsham, 2008) and lack the “sociological sophistication” (Selwyn, 2004 citing Webster, 1995) to accommodate various positions.

New media technologies have created new prospects for individuals by enhancing different patterns of social interaction, access to information, and allocation of time. Access to technology, such as personal computers and laptops, has made certain boundaries more permeable than ever (Mesch, 2006: 124).

3.4 Technology Enabled Social Innovation

Social innovations are social in both their ends and their means. Specifically, social innovation can be defined as new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations. They are innovations that are not only good for society, but enhance society’s ability to act (BEPA, 2011).

A social innovation system refers to institutional arrangements designed to produce a steady flow of social innovations, to address multifaceted problems from several perspectives. Such an institutional arrangement would make use of a variety of means and resources over a period time and at different levels of scale, so as to transform problems and their contexts into new ways of understanding, new approaches, and potentially result in the emergence of new systems (Huddart, 2012: 9).

Technology is rapidly being deployed to advance social innovation that creates lasting change. The ultimate success of any technological innovation will be in the ability to engage larger numbers and greater diversity among participants, and their ability to translate new insights into on-the-ground change in their communities. In order for technologies to achieve these changes, an organizational network mind-set is critical (Tapscott, 2012: 38).

In an era where governments and communities face several challenges in many parts of the world, new and effective ways are needed to address complex social issues. While continuous innovation is commonly understood to be a source of growth, technology made possible social innovation systems which were designed to replace maladaptive institutions and obsolete policy frameworks with novel and disruptive means for improving outcomes on a number of issues (Huddart, 2012: 5).

According to Westley and Antadze (2009), technology driven social innovations involve institutional and social system change, contribute to overall social resilience, and demand a complex interaction between agency, intent and emergent opportunity. Social innovation is an initiative, product or process that changes basic routines, resource and authority flows or beliefs of any social system.

Recent advances in technology-enabled platforms for scaling new ideas, point to an approaching horizon where institutions and citizens can play an increasingly active and informed role in shaping desirable and sustainable futures. Such work can move forward more quickly when those involved invest in active collaboration around solving complex social and environmental challenges (Huddart, 2012: 15). In order to properly explore how technology can contribute to social change, we need to understand the cultural and organisational trends that strongly influence technology decisions.

3.5 Technology and Gains in Educational Outcomes

The increased use of conventional technology in education has engendered substantial innovation and debate over benefits and disadvantages. One omnipresent tension is between the observation that investments in education technology produce a high payoff in student learning and the competing observation that resources are squandered. For Chapman and Selwood (2004: 28), this debate is driven, in part, by a difference of opinion over whether certain cultures are more responsive to technology than others. Adopting this view suggests that the values, philosophies and principles held by technology users has an impact on the degree to which technology is generalisable across countries and cultures.

Technology and gains in educational outcomes are not inevitable partners (Johnson, 2002; Resnick, 2002). Providing access does not ensure that technology will effectively enhance teaching and learning, and result in improved achievement; nor does providing access imply that all teachers and students will make optimal use of the technology. Noeth and Volkov (2004) point out that the introduction of technologies in an educational context may mean very little without clear objectives and goals for its use, structures for its application, trained and skilled deliverers, and clearly envisioned plans for evaluating its effectiveness.

The Benton Foundation Communications Policy Program (2002) suggests that five factors must be in place for technologies in and out of the classroom to support real gains in educational outcomes:

- Leadership around technology use, anchored in solid educational objectives;
- Sustained and intensive professional development that takes place in the service of the core vision, not simply around technology;
- Adequate technology resources in the schools;
- Recognition that real change and lasting results take time; and
- Evaluation that enables school leaders and teachers to determine whether they are realising their goals and to help them adjust their practice to better meet those goals.

3.5.1 Information Communication Technologies

ICT can be understood as an updating of the conventional information technology to incorporate the rapid convergence of technologies such as computers, telecommunications and broadcasting technologies, as well as stressing the communicative and networking capacity of the modern-day information technologies (Selwyn, 2004: 346). In this sense, ICT is seen and used as an umbrella term for a variety of technologies and technological applications. This definition is in line with the conception underpinning many of the e-strategy goals to health, education and nutrition, which set the framework for improved quality of education in schools.

The view that ICT can help improve learner achievement can be traced back at least to the fifties, and builds on some of the original findings of Skinner (1954, 1957), who claimed that new technologies in schools had the potential to make teaching and learning more efficient. In recent years, and in line with the widespread view that new technologies accounted for the majority of the productivity resurgence in the nineties (Jorgensen and Stiroh, 2000) there has been resurgence in the use of ICT in the classroom (Michin, McNally, & Silva, 2011: 1).

A review by Kirkpatrick and Cuban (2008) suggests that evidence for the effectiveness of ICT in schools is both limited and mixed. Most importantly, results are commonly inferred from a simple correlation between ICT and learner achievement, which casts serious doubt on the validity of results. Beginning with a study conducted by Angrist and Lavy (2002), there has been a small number of economic studies that address this issue and apply more rigorous methods of analysis: none of them, with the exception of Banerjee, Carlin and Gelfand (2004) (on schools in Indian urban slums), shows evidence of a positive causal relationship between the introduction of ICTs and learner performance.

Significantly, the authors cast serious doubt on the methodological approach of existing studies. Evidence for the English experience is reported in Becta (2002) and Ofsted (2001), and points to a positive link between high standards across the curriculum and ICT use in schools. As for most of the studies reviewed by Kirkpatrick and Cuban (2008), results are, however, generally inferred from a simple positive correlation between ICT and pupil performance.

In a report commissioned by the Software and Information Industry Association, Silvin-Kachala and Bialo (2000) summarized educational technology research from the late 1980s through 2000. They concluded that technology is making a significant positive impact on education. In addition to numerous other findings, they listed the following key findings:

- Learning gains were visible when students developed multimedia presentations on social studies topics
- The introduction of ICTs has significant positive effects on student attitudes toward learning and on student self-concept
- Students trained in collaborative learning on computers in small groups had higher achievement, higher self-esteem, and better attitudes toward learning, and these results were especially pronounced for low ability and female students.

However the use of computer and teaching software may well be correlated with other inputs to education, which are unobserved or imperfectly measured and that contemporaneously affect performance and technology. This gives rise to serious concern about the validity of the findings. In fact, this problem is well illustrated in a study by Fuchs and Woessman (2004), which uses international data from the Programme for International Student Assessment (PISA). Fuchs and Woessman (*ibid.*) show that while the simple bivariate correlation between the availability of computers at school and school performance is strongly and significantly positive, this becomes small and insignificant when other school characteristics are taken into account. School characteristics would here include class size, expenditure per learner, availability of instructional material and instruction time. This suggests that establishing whether computers have a causal impact requires experimental or quasi-experimental evidence, where a 'treatment' and 'control' group can be properly defined (Michin, McNally, & Silva, 2006: 3-4).

3.5.2 Health and Nutrition

Relationships between child health, nutrition and education outcomes are multifaceted due to numerous diverse associations that are of potential interest. These include the production function from academic skills, standard demand functions, and conditional demand functions (Glewwe, 1994: 3602). Glewwe (*ibid.*) argues that while it is difficult, credibly estimating the relationship between child health and education is not impossible. The two notable and fundamental problems are the following:

- (1) It is impossible to obtain data on all variables that belong in the equations of interest, which raises serious problems of omitted variable bias; and
- (2) The variables on which one does have data often contain errors in measurement, which can lead to problems of attenuation bias.

The problems noted are not easy to fix, despite much richer data and the use of more precise estimation methods. Moreover, differences in data – in terms of both the health and education measure employed – complicate comparison of the magnitude of estimated health effects across studies (Glewwe, 1994: 3608). Despite the difficulties noted above, studies using cross sectional data, panel data or data from randomised evaluations have, however, found sizeable and statistically significant positive impact of child health on educational outcomes.

Several of the earliest studies by nutritionists and public health researchers paid attention to the influences of specific nutrients which were lacking in children's diets. Studies in India and Indonesia by Soemantri, Pollitt, and Kim (1989), Soewondo, Husaini, and Pollitt (1989), and Seshadri and Gopaldas (1989), identified large and statistically noteworthy impacts on cognitive development and school performance of iron supplementation among children who were anaemic.

Other studies paid attention to parasitic infections, particularly those located in the intestines. In South Africa, Kvalsig, Cooppan, and Connolly (1991) examined whipworms and other parasites and found that drug treatments had some effect on cognitive and education outcomes, while some impacts were not statistically significant. Nokes et al. (1992) assessed treatment for whipworms in Jamaica and determined that some cognitive functions were enhanced by the drug treatment, but others, particularly those related to academic performance in schools, appeared not to have changed substantially.

Other studies focused on general food supplementation to supply calories and protein. The most well-known of these is the study by the Institute of Nutrition of Central America and Panama (INCAP) (Pollitt et al., 1993; Martorell, Habicht and Rivera, 1995) initiated in four Guatemalan villages in 1969. Two of these villages were randomly selected to receive porridge (*atole*) high in calories and protein, while the other two villages received a drink (*fresco*) with less calories and no protein.

These projects are arguably among the most convincing research to date, showing long-term effects of childhood health and nutrition on later education and on life outcomes more broadly. It is important to note, however, that these studies are also subject to some criticisms. Many of these studies have relatively small sample sizes, such as 210 children in the South African study and 103 in the Jamaican study.

Previous empirical work has found mixed evidence for the impact of school feeding (see Kristjansson et al., 2007; Adelman et al., 2008; Bundy et al., 2009). Adelman et al., (2008) point out that relatively few of the studies in the literature measuring enrolment impacts use a randomised design, perhaps reflecting the popularity of the intervention and the political obstacles to randomisation (Buttenheim et al., 2011: 6).

Research on school feeding programmes in 342 Catholic schools in South Africa, conducted in 2004 by the Catholic Institute of Education (CIE), revealed that feeding programmes improve learner attendance as well as the performance of disadvantaged learners. A report released by KPMG in May 2008 on the School Nutrition Programme, revealed that school feeding programmes enhance learning and strengthen nutrition education for the school community.

3.5.3 Water, Sanitation and Health

Issues associated with water and sanitation impact on children's right to education in many ways. In an atmosphere of poor access to water and sanitation in the school environment, children are unable to fulfil their education potential. United Nations Children's Fund (UNICEF) data dating back to 2003, reported that over 400 million school-aged children per year are infected with intestinal worms, which, research indicates, sap their learning abilities. This situation has not improved over the years, and in 2005 diarrhoeal diseases, intestinal worms and other debilitating parasites still affected an appalling number of learners. About 40 per cent of an estimated 578 million school-age children were reported to be infested with worms, while 88 million children under 15 years of age with schistosomiasis (UNICEF, 2005: 5). Such diseases tend to affect children, especially between the ages of 5 and 14, which is a period of extreme physical and intellectual development. These diseases have a negative effect on growth, nutritional status, physical activities, cognisance, concentration and school performance.

Schools partially determine children's health and well-being by providing a healthy or unhealthy environment. Although water and sanitation facilities in schools are gradually being recognised as important for promoting good hygiene conduct and children's well-being, numerous schools have exceptionally poor facilities. Conditions vary from inappropriate and inadequate sanitary facilities, to the outright lack of latrines and safe water for drinking and hygiene, which can contribute to absenteeism and the high drop-out rates of girls (UNICEF, 2003).

Water is intimately linked with education and gender equality. Girls who have to spend time gathering water for the family tend not to be in school. And where schools have sanitation, attendance is higher, especially for girls. Water is connected to health, since millions of children get sick and die every year from water-borne diseases and for lack of basic sanitation and hygiene (Kofi Annan, 2004).

School water, sanitation and education hygiene make a notable difference – it is well understood that improvements to sanitation and hygiene behaviours combined with safe water supply can significantly prevent diarrhoeal diseases, including cholera, dysentery and other infections (Bellamy, 2005: 10). While not enough has been done in the past to combine the benefits of these efforts by strategically integrating them, there is evidence to suggest that broader integration with sectors such as education has led to some synergies (Bellamy, 2005; UNICEF, 2005).

3.5.4 Energy

In a recent documentary titled *Black Out*, award-winning filmmaker, Eva Weber, captures the sometimes overlooked importance of energy to education. In the opening scene, hundreds of children in Guinea's capital Conakry are too busy studying underneath the international airport's parking lot lights to notice the sound of airplanes landing, honking taxis

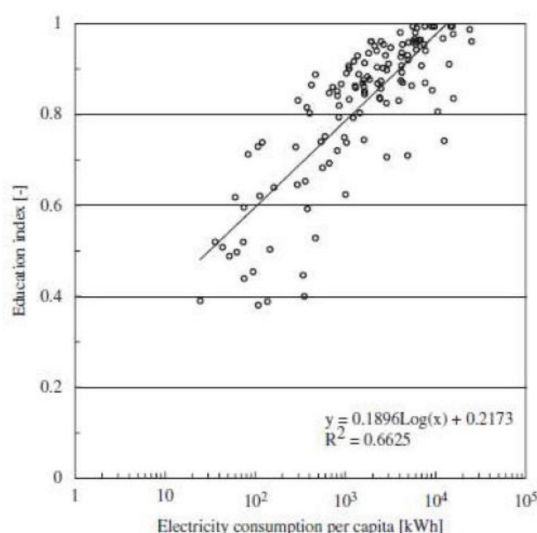
and rumbling buses. These learners, none of whom have electricity at home or at school, meet in illuminated public areas every night to revise their school work (Goodwin, 2013). In South Africa, each year almost 80 000 young children accidentally consume kerosene (spilled from lamps) to the point where they have to be admitted to the hospital and, even with treatment, more than 60 per cent develop chemically induced pneumonia (Mills, 2012).

While energy poverty is becoming increasingly prominent as a development issue, there remains an enormous gap in addressing this often overlooked, but nevertheless serious, challenge. In December 2014 the United Nations estimated that around 1.4 billion people in the world have no access to electricity, while a billion more only have access to unreliable electricity networks. Results from a study conducted by the Citizens for Renewable Energies and Sustainability (CURES) in 2009, reported that two million households in South Africa relied on candles for lighting. In 2013, Statistics South Africa reported that 1.45 million, or 11 per cent, of South African households did not have access to electricity in 2012.

As teaching and learning typically occurs during the day, the importance of lighting as a constraint to education in the developing areas is constantly forgotten. We concentrate mainly on pedagogy and little on access to energy. Focusing on energy is essential, as there are several studies which report a clear correlation between access to energy and academic success. Valerio (2014) reported on a study, conducted in 2011, in a school in the south-east of Sudan whose pupils averaged a pass rate of less than 50 per cent. This pass rate was propelled to 100 per cent following the introduction of solar-powered generators. With the availability of light after dark, students were able to study safely at night. In the same year, a school in Tanzania also recorded a similar boost in grades, as well as learner attendance, after the school became energised (Valerio, 2014).

Reporting on a study that sought to examine the access to electricity and socio-economic impacts in rural areas of developing countries (Diniz et al. 2006: 2528) state that electricity “[a]llows the access of lower-income people to lighting, communication, as well as a variety of educational delivery opportunities ... A major impact [of electrification] has been reducing illiteracy and improving the quality of education”.

Figure 4 demonstrates a strong correlation (above 66 %) with electricity consumption per capita and higher scores on the education index – a proxy for the mean years of schooling a student receives – across 120 countries. The inverse is also true: schools without electricity tend to perform more poorly than electrified counterparts (UNDESA, 2014).



Source: Kanagawa & Nakata (2008: np).

Figure 4 Relationship Between Electricity Consumption and Education Index in 210 countries

The lack of access to energy not only limits a child’s ability to study after dark. Electrification can help rural schools attract teachers, allowing them to prepare their lessons better. Electricity also enables the use of ICT’s in education, as well as access to the Internet. At home, access to electricity means improved cooking facilities, which free up time for educational activities that would traditionally be spent collecting wood (UNDESA, 2010: 8). Besides enabling teachers – for example, to continue classes and print test papers at their own schools – the ultimate goal of energising a school is to make learning enjoyable for students (Valerio, 2014).

3.6 Evaluating the Effectiveness of Technology for Educational Development

There seems to be universal agreement that a major criterion of conventional technological implementation in the schools revolves around whether such applications actually do improve teaching and learning and increase student achievement (Rockman, 2000). There are, however, a number of complexities and challenges of reliably in evaluating the effectiveness of technology (Noeth & Volkov, 2004: viii).

It is a daunting task to separate the effects of technology from the effects of other factors that have an influence on teaching and learning. Noeth and Volkov (*ibid*) suggest that results and conclusions must be considered in the context of the interdependent set of variables in which the use of technology is embedded. These resources can include access, teacher preparation and experience, student background, curriculum content, instructional methods, and additional educational resources.

While evaluation of the effectiveness of technology for educational development is multifaceted, technology as a primary educational tool should be held accountable to the promise of enhancing teaching, learning, and achievement (Dede, 2002). No matter how refined, sophisticated, or vigorous a particular technology is, it is only useful in educational settings if it advances educational practices and outcomes. The evidence in the literature on technology interventions in schools suggests that technology, in general, has demonstrated positive but limited results on improving the educational achievement of students.

Stories abound of unsuccessful technology interventions in education. There are numerous reasons for this. Some of the failures arise because decision-makers and implementers fail to follow the general rule of determining whether the use of the technology can be expected to add value (Winthrop & Smith, 2012: 30). Other failures occur because those implementing the technology do not take full account of the enabling conditions needed for successful interventions. Better understanding of the main shortcomings of technology in education is an important first step in assessing what strategies, if any, are needed to enable technology to effectively advance educational outcomes and processes (*ibid*).

Winthrop and Smith (2012: 29) propose a rule of thumb that can be applied across the board of interventions in education, to assess whether technology adds value. It requires understanding the relevant outcomes and the direct and indirect costs when:

1. no technology is used;
2. only technology is used; and
3. a blend of technology and traditional approaches is used.

If outcomes are the same or greater when no technology is used than when a blend of technology and traditional instructional practices is used, then it is often better not to use the technology.

The World Bank uses the Information for Development Programme (InfoDev), to assess the impact of Technology in three areas:

1. student outcomes, such as higher achievement in school subjects or the learning of entirely new skills needed for a developing economy;
2. teacher and classroom outcomes, such as development of teachers' technology skills and of their knowledge of new pedagogical approaches, as well as improved attitudes toward teaching; and
3. other outcomes such as increased innovativeness in schools and increased access to adult education and literacy for community members (Winthrop & Smith, 2012: 28).

Noeth and Volkov (2004) offer three recommendations that can be included as part of all technology planning and evaluation. These recommendations are intended to serve as benchmarks for addressing some of the major challenges of assessing the application of technology. They are particularly useful in the evaluation and planning of a project like the Tech4RED which not only aims to assess the outcomes of technology implementation, but also developing evidence-based strategies for technology integration.

1. Relevant stakeholders should reach consensus on the purpose and intended outcomes of the planned technology implementation.

The use and impact of technology in a school setting can be far-reaching. There are many stakeholders who will influence, and be influenced by, technological implementation in schools. It is, therefore, critical to include representatives of all groups who might potentially be affected, both in the short- and the long-term, by the technology applications. The purposes and expected outcomes should be discussed and be part of the conceptualisation and creation of the technology implementation.

2. Every technology plan should include an evaluation component, and multiple evaluation methods should be considered, specified, and employed to access agreed-upon outcomes.

Technology implementations should include a major focus on evaluation activities and outcomes – bearing in mind that technological applications are only one element of a complete educational process. The discussion and design of the evaluation component should begin when technology programmes are conceptualised, and continue throughout and beyond programme implementation.

3. Teachers and administrators should receive adequate, tailored, and continuing education about how to best integrate technology into their schools and should be evaluated on their proficiency in doing so.

McNabb, Hawkes and Rouk (1999) note that, in evaluating the effectiveness of technology interventions, it should be kept in mind that standardised test scores offer limited formative information with which to drive the development of a school's technology program. Most schools are looking for additional methods of collecting useful data for this purpose. Standardised test scores have become the accepted measure with which policy-makers and the public gauge the benefits of educational investments, but educators and evaluation researchers argue that they say little about how to improve technology's effectiveness in schools. For this, information is needed from formative evaluation. Formative evaluation tells what technology applications work, under what conditions, and with which students.

Setting our sights higher and using improved metrics to measure progress, are vital to successful innovation. But our metric for whether students succeed should not simply be whether they learn the mathematics that mathematicians think is important, the science that scientists feel is vital, and so on. Becoming a productive worker and citizen involves much more than having an adequate background in the field of knowledge. Integrating these concepts and skills, and being a lifelong learner with the self-worth, discipline, and motivation to apply this knowledge, is of paramount importance – yet this is not captured by discipline-based standards alone (Dede, 2010: 11).

3.7 Conclusion: Technology in the Classroom and Beyond

The potential of technology to transform and yield positive educational outcomes has been outlined in a number of research studies over the years. These studies typically focus on conventional instructional technologies and their cognitive outcomes. The result is that the potential of non-instructional and out-of-the-classroom based technologies are often overlooked, as are other outcomes such as enhancing learner wellbeing, sense of self-worth and motivation. Much of this has to do with the conception of technology as contained in the literature on technology for educational development, where technology is associated with machinery, computers, devices and factories.

The authors of this report argue for a broader understanding of technology, particularly for educational development, which is about the application of knowledge and takes into account skills, actions and gadgets to advance education. This broader understanding of technology is also at the core of the Tech4RED project itself, which brings in technologies to address a variety of problems in the school environment. These include access to water, sanitation, energy and resources for science education.

The introduction of technology in the school environment offers both teachers and learners the opportunity to re-examine old challenges with innovative tools. Instead of viewing technology as a skill set that students need to acquire – as is often the case, with an emphasis on information communication technologies – it should be viewed as a tool to transform curricula, enhance wellbeing, restore human dignity and to provide students with favourable learning environments suitable to their unique contexts.

CHAPTER 4 METHODOLOGY AND RESEARCH DESIGN

4.1 Introduction

In order to monitor and evaluate the Tech4RED, the research team developed an innovative, fit-for-purpose MERL framework. The inclusion of the reflection and learning processes in particular was intended to ensure that the MERL framework went beyond the traditional, before-and-after approaches to monitoring and evaluation, so that feedback to the Tech4RED throughout the project cycle would allow the initiative to be responsive to successes and challenges. (For a detailed discussion of the MERL framework, please refer to the MERL Conceptual Framework document.)

4.2 Research Purpose

The MERL framework for the Tech4RED project aimed to:

- systematically assess the relevance, success, and number of completed interventions as well as on-going performance of the interventions;
- respond to specific questions arising out of intervention process(es) to guide decision-makers and/or programme managers;
- provide information on whether underlying theories and assumptions used in programme development were valid, and to determine whether such theories worked and the reasons for their success or failure; and
- chart the way forward from 'lessons learned' and 'recommendations'.

The MERL research team was guided by the following key research questions to map out and frame the monitoring and evaluation processes:

1. How was each of the technological innovations chosen, introduced, implemented and embedded in a rural environment?
2. How were the multiple interventions chosen, introduced, implemented and embedded in a rural environment?
3. What has been the impact of the individual and multiple interventions at the level of individuals (teachers and learners); school and district?
4. What were the lessons learned from the pilot site to be implemented at a national level (communication and dissemination processes, influencing key actors; financial costing and infrastructure (including human resources)?

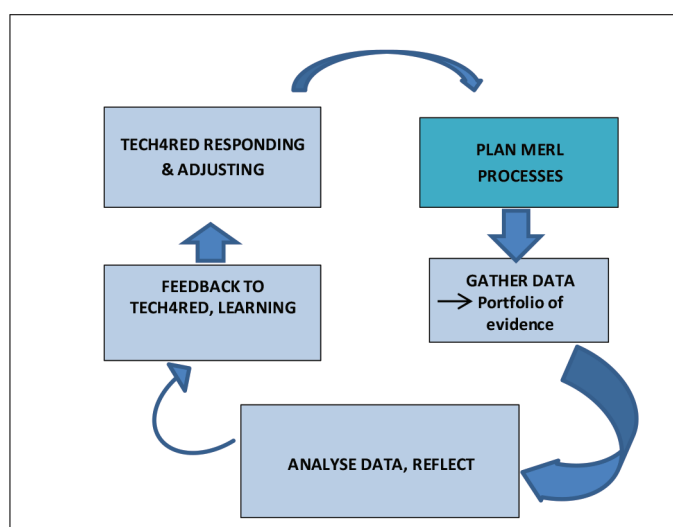


Figure 5 Cofimvaba MERL Learning Loop

Critical to the MERL framework, particularly to the reflection and learning processes, is the MERL learning loop, illustrated in Figure 5.

As Figure 5 shows, the MERL learning loop is an on-going and repetitive process. In other words, planning, information gathering and analysis (reflection), learning and adaptation, feature in all stages of the Tech4RED initiative and the MERL project. As data was gathered and analysed by the research team, it was fed back to WGs and the Tech4RED via formal reporting structures, verbal and written reports presented at task team meetings, a number of workshops, and separate engagements with each WG. An attempt was made to establish a MERL/Working Groups Forum during which findings, reflections and learnings could be shared with and among WGs. This structure, however, did not work as well as initially envisaged and poor resulted in its ultimate abandonment. In place of the MERL/Working Groups Forum, a MERL Buddy System was subsequently proposed. This system paired each member of the research team with one or more WGs so that they could participate in WG meetings and activities. This structure enjoyed more success with some WGs than with others.

4.3 Design and Methodology

In order to answer the research questions, and to provide a portfolio of evidence to inform and influence the implementation of the Tech4RED – as well as policy related to rural education – the MERL study adopted a mixed methods research design (Tashakkori & Teddlie, 2010). This design made use of quantitative and qualitative research methods for data collection purposes. The portfolio of evidence generated through the MERL research activities was intended to reduce the impact of confirmation bias on evaluation of the Tech4RED initiative:

[W]hen development professionals engage with projects and other development problems, they bring with them disciplinary, cultural, and ideological priors, leaving them susceptible to confirmation bias. Confirmation bias refers to the selective gathering of (or the giving of undue weight to) information in order to support a previously held belief (Nickerson 1998) and to the neglect (or discounting) of information that does not support those previously held beliefs.

(World Development Bank 2015: 182)

The portfolio of evidence generated by the MERL team over a period of three years, was strengthened by the involvement of different stakeholders, using different methodologies, in the collection of data, . The MERL study was aimed at ensuring the development of a comprehensive and nuanced picture of the Tech4RED. It was to do so by capturing the ‘voices’ of the intended beneficiaries of the Tech4RED initiative through qualitative research approaches, and by integrating these voices into the quantitative research component. The MERL project was structured to be responsive and adaptable to the dynamic research environment in which the Tech4RED was being implemented. As learnings and reflections emerged from the implementation of the various Tech4RED interventions, and as the Tech4RED itself evolved, the MERL framework was revised, new structures were established, and additional or revised data collection procedures were developed.

4.4 Research Activities

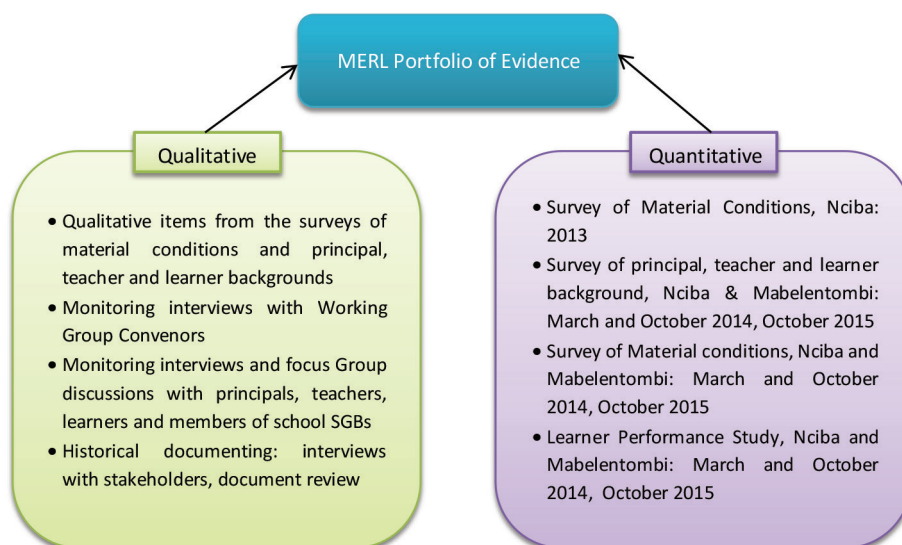


Figure 6 The MERL Portfolio of Evidence

In order to build up a portfolio of evidence on the processes, outcomes and impact of the Tech4RED for this report, the MERL undertook a number of research activities¹³ (see Figure 6).

Each research activity is discussed briefly below. The outputs of each activity discussed below can be found in Appendix A.

4.4.1 Survey of Material Conditions, Nciba: May, 2013

The data collection activities were carried out by the MERL team in May 2013.

Data Collection

The purpose of collecting data on the material conditions of schools in the Nciba Circuit in May 2013 was to establish what the conditions were in the schools in this circuit prior to the Tech4RED working group interventions being implemented. At the time of data collection, in May 2013, most Tech4RED activities were still at the planning phase with the exception of the ICT4RED WG which had begun implementation of a pre-pilot intervention in one school, after the scoping and design project conducted by the CSIR between November 2011 and April 2012.

Participants

Participants included school principals or their representatives in the form of either the Heads of Departments (HoDs) or chairpersons of the School Governing Bodies (SGBs) in the 26 schools in the Nciba Circuit.

Instrument(s)

A comprehensive questionnaire, comprising both qualitative and quantitative items, was compiled by the MERL team. The questionnaire was divided into six sections, each focusing on a theme of interest to Tech4RED at the time. The sections were as follows:

- ICT in education;
- Nutrition and Agri-teaching;
- Water and Sanitation;
- Health;
- Energy; and
- Infrastructure.

The items in the questionnaire sought to establish general information about these themes given that there was little information available about the interventions planned by the WGs at the time. The questionnaire items were developed based on the information pertaining to the Tech4RED that was then at the disposal of the MERL team.

Data Collection

Data collection took place between 19 and 23 May 2013. Data was collected by administering a questionnaire to each of the 26 schools in the Nciba circuit. Questionnaires were completed by school principals or an individual, such as a HoD, appointed by the principal to do so. Questionnaires were completed for each of the schools in the Nciba circuit.

The MERL team was able to conduct site visits to 15 schools in the circuit. During these site visits, the team monitored the administration of the questionnaire and obtained first-hand information about the school context. The selection of schools for site visits was based on geographical location, and an attempt to visit a representative number of schools. Two teams of MERL researchers, each consisting of two persons and accompanied by a district official, visited the schools.

¹³ Ethical clearance was obtained from the HSRC Research Ethics Committee for all data collection. All ethical protocols were followed in conducting each research activity.

The MERL team also convened a meeting with the school principals of all of the schools in the Nciba Circuit. This meeting was attended by the Nciba Circuit manager. During the meeting, the MERL team introduced themselves, explained the MERL study, and the purpose of the questionnaire. The MERL team was also able to meet the principals of the 11 schools that they were unable to visit.

Output(s)

A report was written by the MERL Team (September 2013) titled: *MERL for the Tech4RED – Report on Contextual Baseline Data Collection – Nciba Circuit*. Further, observations from field notes as well as informal interviews with school principals or their representatives, were presented as preliminary feedback at a task team meeting shortly after the MERL team's return from the field.

4.4.2 Historical Documenting of the Tech4RED, July – November 2013

Twenty-six historical documenting interviews were conducted by the MERL team between July and November 2013. These interviews were with representatives from the DST, the Cofimvaba Education District, the Human Sciences Research Council (HSRC), the Centre for Scientific and Industrial Research (CSIR), and the intended beneficiaries of the Tech4RED (i.e. school principals and representatives from SGBs).

Instrument(s)

The historical documenting process involved in-depth interviews with stakeholders, and a review of various documents related to the Tech4RED – For example, minutes of task team meetings up to November 2013, concept papers, status reports, and proposals. Semi-structured interview schedules were developed for each 'category' of stakeholder.

Data Collection

Interviews and the document review were conducted by members of the MERL team. The interviews were semi-structured and were conducted in person or over the telephone where possible. These interviews were audio recorded and transcribed. Where an in-person or telephone interview was not possible, participants were requested to respond to the interview questions via e-mail. A total of 26 interviews were conducted. While the MERL team was able to secure interviews with the majority of the intended participants, it was not easy for the team to obtain responses from senior individuals from the DST team due to the busy schedules of some of the intended participants. Their input would have been extremely beneficial to this process.

Output(s)

A draft historical documenting of the Tech4RED project was written and submitted to the DST in September 2014.

4.4.3 Monitoring Interviews with Working Group Convenors, June – July 2014

Qualitative interviews were conducted with WGCs for the purpose of monitoring progress in their work and activities, reflecting on and drawing out learnings from the implementation process up to that time. The data collected through these interviews was used to inform the discussions in the interviews with teachers, principals and SGB members, as well as the FGDs with learners that took place in July 2014.

Instruments

A semi-structured interview schedule was developed to guide the discussion during the interviews. A PowerPoint presentation was prepared and used to facilitate discussion of WG progress in relation to the vision, mission and outcome statements developed at the intentional design workshop.

Data collection

Interviews were conducted by MERL team members and WGCs/members. Interviews were audio recorded for later transcription and analysis.

Output(s)

The data generated in these interviews has informed the analysis and write up of this report.

4.4.4 Monitoring Interviews and FGDs with teachers, principals, members of SGBs, and learners from six schools in the Nciba Circuit, July 2014 – August 2014

FGDs were held with learners in six schools in the Nciba Circuit. The FGDs took place in the same schools as the monitoring interviews with principals, teachers and representatives from the SGB. A maximum of six learners took part in each FGD. FGDs were held with learners from grades 4, 7 and 9.

Instruments

A semi-structured generic FGD schedule was developed for learners in Grade 4. A semi-structured, generic focus group discussion guide was developed for use in FGDs with learners in grades 7 and 9 who participated in a combined FGD. An advantage of this instrument was that it could be modified to specifically suit each WG through probing, and the use of particular examples. The interview focussed on the learners' general experiences, attitudes and opinions of the Tech4RED and the Tech4RED interventions in their schools.

Selection of Participants

The six schools in which data was collected were selected based on the same criteria as those listed for the monitoring interviews discussed above. FGDs were carried out with learners in Grades 4, 7 and 9. These grades had been selected as they were the ones in which the learner performance survey was administered in March 2014 (as being representative of the school). Learners were purposively selected for participation in FGDs based on the following criteria:

- a learner in the relevant school, in the relevant grade;
- at least one learner from each class in the grade to a maximum of 6 learners;
- three participants were female and three were male;
- teachers were consulted regarding the selection of learners who were more outspoken and likely to participate.

If the learner and/or her/his parent or legal guardian chose not to participate, another learner was selected and invited to participate.

Data Collection

Data collection took place between 21 July and 01 August 2014. The FGDs were facilitated by a member of the MERL team. Grade 4 FGDs were conducted in isiXhosa, and Grade 7 and 9 FGDs were conducted in a combination of isiXhosa and English. Each member of the MERL team was trained on how to most effectively use the generic instruments (interview schedules).

A maximum of two FGDs, with a maximum of 6 learners in each, was held at each school, depending on which grades were represented. The first FGD was held only for Grade 4 learners, with Grade 7 and 9 learners participating in a separate joint FGD. The FGDs with Grade 4 learners were conducted in isiXhosa. The FGDs with Grade 7 and 9 learners were conducted in isiXhosa and/or English, depending on the preferences of the participants.

All the interviews were audio-recorded to be transcribed later in preparation for analysis and reporting.

Output(s)

The data generated in the FGDs informed the analysis and write up of this report.

4.4.5 Survey of Principal, Teacher and Learner Background, Nciba and Mabelentombi: March and October 2014

The Nciba Circuit was pre-selected as the 'testing ground' for the Tech4RED. This circuit is therefore referred to as the intervention circuit. For the purposes of the survey components of the MERL research and the Learner

Performance Study, the Mabelentombi Circuit was selected to serve as a comparison, and is therefore referred to as the comparison circuit.¹⁴

The survey was administered through three questionnaires – a separate questionnaire was developed for principals, teachers and learners – in March and in October 2014. The purpose of the surveys was to establish a profile of the main intended beneficiaries of the Tech4RED interventions. The survey was administered for a third time in October 2015. It was administered in 24 schools in the Nciba Circuit and 21 schools in the Mabelentombi Circuit.

A school questionnaire was completed by the school principal or a person designated by her/him in schools in both circuits. A maximum of two mathematics teachers per school completed a teacher questionnaire. Learners from Grades 7 and 9 in participating schools in both circuits completed learner questionnaires. Learners were chosen from these grades to complete the questionnaires as the Learner Performance study (discussed in 3.3.7 below), which was being conducted at the same time, targeting Grades 4, 7 and 9. Learners in Grade 4 were not asked to complete a learner questionnaire due to its length and the complexity of the items.

4.4.6 Survey of Material Conditions, Nciba and Mabelentombi: March and October 2014

The survey was administered using a questionnaire completed by the school principal or a designated individual, in 24 schools in the Nciba Circuit, and 21 schools in the Mabelentombi Circuit in March and October 2014. The purpose of this survey was to track any changes in the material conditions of schools in the Nciba and Mabelentombi Circuits and compare any differences between the two circuits. The survey was administered for a third time in October 2015.

4.4.7 Learner Performance Study, Nciba and Mabelentombi: March and October 2014, October 2015

The MERL team conducted a study of learner performance in the Nciba and Mabelentombi Circuits at three times, the first two in March and October 2014. Mathematics tests were developed and administered to learners in Grades 4, 7, and 9 in both circuits. The purpose of the Learner Performance study was to establish patterns of learner performance in both circuits and compare the differences between the two. The Learner Performance study was conducted for a third time in October 2015.

4.4.8 Interviews of Eastern Cape Department of Education Officials: December 2015

The MERL team conducted interviews of the senior officials of the ECDoE. The officials interviewed included the Cofimvaba District Director, The Circuit Managers of Nciba and Mabelentombi Circuits, the officials responsible for ICT at both the Cofimvaba Education District and at the Provincial Office, and other senior officials in the Provincial Office who had been involved in decisions related to Tech4RED. The purpose of the interviews was to determine their knowledge and involvement in the Tech4RED as well as to determine their views about the project, including those regarding the lessons learnt from the project and the future thereof.

4.5 Concluding Remarks

This chapter provides a brief overview of the research activities undertaken by the MERL research team. The data generated by these activities are presented and discussed in the chapters that follow. The portfolio of evidence for the Tech4RED was comprised of a number of rich sources of data which allow for a nuanced and holistic understanding of the Tech4RED to be developed, and which form the foundation for the findings presented in this report and the recommendations arising therefrom.

CHAPTER 5 INNOVATIVE INTERVENTIONS FOR INCLUSIVE DEVELOPMENT

5.1 Introduction

Each WG intervention comprising the Tech4RED had its own goal and objectives. In achieving its objectives and thus its goal, an intervention contributed to the achievement of the objectives and goal of the Tech4RED as a whole. The structure of the Tech4RED is represented graphically in Figure 7. This structure is also mirrored in the ToC diagram on page 17 in Chapter 1 (Figure 1).

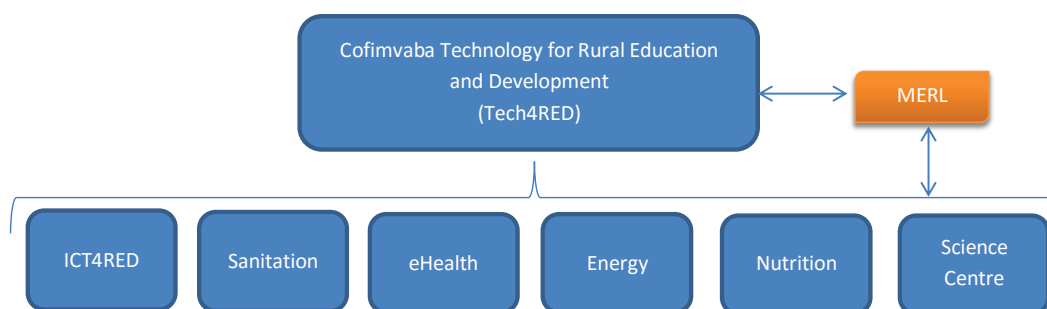


Figure 7 The Tech4RED and the Working Groups

Also illustrated in Figure 7, is the position of the MERL in relation to the Tech4RED and the WGs of which it is comprised. It was critical for the MERL to maintain a certain amount of independence as the evaluator of the initiative, while simultaneously engaging in the bidirectional exchange of knowledge with the Tech4RED and the WGs through the processes of reflection and learning via the MERL Learning Loop.

In this chapter, we present an overview of each intervention.

5.2 Information and Communication Technology for Rural Education Development (ICT4RED) Working Group

Working Group Convenor	Merryl Ford (Meraka Institute, CSIR)
Partners	DST, DRDLR, Meraka Institute, Cofimvaba District Office CoZa Cares Foundation (Content) SchoolNet SA (Teacher Professional Development) AfroFusion (Communication) Hive Holdings (Technology infrastructure design, operations management) Tipp Focus (Change Management) NMMU Govan Mbeki Mathematics Development Unit (Content) Fort Hare, Up, NMMU, UFS, UNISA (Research)
Stakeholders	DBE, ECDoE, Nciba Schools Community
Policy Context	ICT RDI Roadmap (DST, 2013) White Paper on e-Education (DBE, 2004) ECDoE's strategic and performance plans DRDLR's Programme of Action National Programme of Action (Outcomes 1 and 6) National Development Plan The DBE has developed an eEducation Plan that sets out a strategy for the next 5 years. Integrated Strategic Planning Framework for Teacher Education and Development in South Africa. This was developed jointly by the Departments of Basic Education and Higher Education and Training.

Reach	All schools in the Nciba Circuit.
Service Delivery Challenge	A lack of access to teaching and learning materials, a lack of appropriate ICTs, as well as a lack of skills required to integrate the use of ICTs into a classroom for teaching and learning.

The ICT4RED intervention was implemented in phases. Phase 0 involved conducting desktop research to inform Phase 1, which was a pilot of the intervention, at one school in the Nciba Circuit. Incorporating learnings from Phase 1, Phase 2 involved expanding the intervention to a further 11 schools in the circuit. Again, incorporating learning from the previous phase into the model, the Phase 3 of the intervention expanded into the remaining 14 schools in the circuit.

In Phase 1 (2012/13), the intervention was piloted in one Senior Secondary school with which the CSIR had established a relationship through the DST-funded Technology for Rural Innovation and Education Development (Tech4RED) project (Van Rensburg 2011; 2015). In Phase 2 (2013/14), the intervention was rolled out to a further 11 schools. In Phase 3 (2014/15), the intervention was implemented at the remaining 14 schools in the circuit. By 31 March 2015 (ICT4RED Project Status Report), the ICT4RED intervention had reached all of the schools in the Nciba Circuit. The ICT4RED WG reflected on the learnings from each phase, and used them to refine the implementation model for the next phase. In this way, the ICT4RED aligned the methodology used with the experimental/reflection and learning nature of the Tech4RED by testing approaches, and actively using the processes of reflection and learning to adjust their implementation. Further, ICT4RED used the findings from Phase 1 of implementation to approach the DRDLR for funding to support the implementation of Phases 2 and 3.

Broadly, the ICT4RED WG intervention targeted teachers, learners, and officials from the Cofimvaba Education District. Teachers were introduced to and taught how to use tablets. They were also trained to use the tablets as teaching and learning tools in the classroom employing particular pedagogic strategies. The ICT4RED WG developed an innovative digital badge system for their successful ‘Earn as You Learn’ methodology, which required teachers to earn their tablets and various tablet accessories. The WG further motivated the teachers with incentives such as providing digital projectors to schools on successful completion of training modules, opportunities to earn of badges, and use of the tablets, teaching strategies and approaches on which they had been trained. Once the teachers had successfully completed all of the training modules and earned their tablets and other equipment, schools were provided with mobi-kits¹⁵ – a set of 15 tablets for the use of learners.

There were a number of components to the ICT4RED intervention that played a largely ‘behind the scenes’ role in its implementation. These included: Programme Management, Project Management, School ICT Architecture, Monitoring and Evaluation, Modelling, Network, Content, Community Engagement, Change Management, Stakeholder Management, Communication, Teacher Professional Development, Operational Management, and Evidence-based Policy. Each component had a so-called ‘champion’. The ICT intervention incorporated eLearning, the provision of teaching and learning materials, teacher professional development, and the development of the curriculum into its model.

The ICT4RED WG developed a 12-component implementation framework that could be adapted for use in other contexts. The framework assumed that implementation would take place from a zero-base, but it could be implemented using only those components relevant to the context. The framework paid particular attention to certain ‘enablers’ that had to be in place in order for the intervention to be successful. These enablers included community engagement and change management. The ICT4RED WG argued that without these critical, enabling components, the investment in technology would be wasteful because it would not be successfully integrated into the teaching and learning environment.

The ICT4RED intervention addressed both the lack of access to ICTs, and the necessary skills to use ICTs effectively in the teaching and learning environment, but it also has the potential to address the critical lack of access to traditional teaching and learning materials, such as textbooks. Further, this intervention provided both teachers and learners with the opportunity to develop twenty-first century skills that would enable them to participate more fully in an increasingly technology-centred world.

15 With the exception of the phase 1 school where a one-tablet-per-learner approach was tested with learners from grades 10-12.

5.3 Nutrition

Working Group Convenor	Busisiwe Ntuli (DST)
Description of Intervention	Nutritional Breakfast Drink School-based Community Gardens Kitchens Training of food handlers Nutrition education
Partners	CSIR (Project Management, R&D), UFH (R&D, Production and Distribution), VUT (Impact Study), Agricultural Research Council (ARC) (School Gardens) Public-Private Partners: Tiger Brand Foundation, Nestle
Stakeholders	DST, DPW, DBE, ECDoE, School community in Nciba (learners, staff, parents)
Policy Context	National School Nutrition Programme
Reach	5 schools in the Nciba Circuit (Arthur Mfebe SSS, St Marks JSS, Gando JSS, Bangilizwe JSS, Siyabalala SS)
Service Delivery Challenge	A lack of sufficient and appropriate nutrition for learners in the Nciba Circuit. Hungry and poorly-nourished learners negatively impacts on the quality of teaching and learning.

The Nutrition WG aimed to pilot an intervention that would provide a comprehensive approach to supplementing existing school nutrition programmes. Their model included five components, which are discussed below.

Component 1: School-based community gardens

The Nutrition WG partnered with the Agricultural Research Council (ARC) for this component of the intervention. This entailed establishing or improving vegetable gardens in the 5 schools targeted for the intervention in the Nciba circuit. Tended by parents, learners, volunteers from the community, or supported by workers from the Extended Public Works Programme (EPWP) these gardens were planted with vegetables that were chosen for their nutritional value as well as the suitability of the soil and climate for their growth. The produce from the school gardens was intended to supplement the school feeding scheme, as well as provide a source of income for the school from selling excess produce to the community. The gardens were also intended to educate learners on agriculture and science.

Component 2: Learner awareness through nutrition education

A short, animated film on the importance of good nutrition and food hygiene was developed by the Nutrition WG with learners as their target audience. In addition, a board game was developed and distributed to schools as an educational tool.

Component 3: Nutri-breakfast drink

The Nutrition WG developed and piloted a pre-prepared breakfast drink formula, which was refined by increasing the levels of zinc and iron. For this component of the study, the Nutrition WG partnered with the University of Fort Hare (UFH) (R&D, production and distribution), and the Vaal University of Technology (VUT) (impact study). A second impact study was conducted in December 2015 after uninterrupted supply of the breakfast drink to the five pilot schools between July and December 2015.

Component 4: Modifying school kitchen facilities

Findings from the schools' prospectus, developed by the CSIR during the design and scoping phase of the initiative, indicated that a number of schools in the circuit did not have adequate, or in some cases any, cooking facilities for the preparation of learner meals for the school feeding programme, and subsequently the preparation of the breakfast drink. A number of schools were preparing food over open fires outside school buildings, and there were cases of food for learners being prepared and served out of classrooms in which teaching and learning was taking place. In response to these findings, the Nutrition WG planned to upgrade suitable kitchens for the sufficient and hygienic preparation and serving of learner meals in four of the schools in which the intervention was piloted. On completion of the kitchens in April 2015, they were handed over to the DBE for maintenance.

Component 5: Training of Food Handlers

Learner meals were being prepared by untrained community volunteers, including parents, in difficult and unhygienic (for example, no hand-washing facilities available) conditions. In response to this situation, the Nutrition WG recruited and trained food-handlers – who were paid small stipends – to prepare and serve learner meals. Food handlers were trained on food safety, hygiene, and preparation. In April 2015 a training course on hygiene, storage, food, safety, and food preparation was run which targeted meal servers, school nutrition co-ordinators, nutrition teachers, and district co-ordinators.

5.4 Sanitation

Working Group Convenor	Henry Roman (DST)
Partners	Water Research Commission, Maluti Consulting Engineers
Stakeholders	DST, CSIR, DBE, ECDoE, Nciba School Community
Policy Context	DBE norms and standards
Reach	Arthur Mfebe SSS, St Marks JSS, Zamuxolo JSS, Mvuzo JSS, Mbudlu JSS
Service Delivery Challenge	A lack of safe and hygienic toilets in the schools in the Nciba Circuit some of which did not have toilets or did not have working toilets before the intervention began.

After careful consideration of which toilet technologies were appropriate for testing in schools in the Nciba Circuit, the Sanitation WG selected a South African-designed, low, pour-flush technology, to test in three schools in the Nciba Circuit. The necessary time spent on selecting the technology to be tested resulted in the implementation of this intervention being delayed until the fourth quarter of 2014. This delay, however, ensured that the technology selected was context-appropriate in terms of the functioning of the technology, as well as acceptability to the Nciba School Community. The design of the toilet as well as the structure housing the toilet were modified to better suit the environment. The modifications made to the design of the toilet and its structure resulted in the design being more cost-effective per unit than the VIP latrines that are the current standard in the district.

There were plans during earlier phases of the Tech4RED for the Sanitation WG to develop an intervention to investigate ways in which water could be filtered to make it safer for drinking and cooking. The focus, however, shifted away from water, given the urgent need to improve the conditions of the toilets in the schools in the circuit, particularly as a result of the attention that this issue received during the Parliamentary Portfolio Committee meeting in July 2014.

The outcomes of this intervention in terms of the functioning of the technologies in the context of Nciba schools, and the acceptability of the technologies to users, remains to be seen. The Sanitation WG is currently monitoring the use of the toilets in the three schools in which they have been installed. Unspent funds are to be directed to the expansion of the intervention to two further schools in the circuit.

5.5 eHealth

Working Group Convenor	Glaudina Loots (DST)
Partners	University of Pretoria
Stakeholders	DoH, DBE, ECDoE, District Office, Nciba Schools Community, NMMU
Policy Context	National eHealth Strategy; School Health Policy
Reach	This intervention was more community-based and did not target particular schools as such.
Service Delivery Challenge	A lack of easily accessible, efficient, preventative medicine, and access to services

The eHealth intervention is described by the eHealth WG as follows:

It is the aim of this project to demonstrate the use of eHealth to improve School Healthcare. The primary objective of this project is: To make use of mobile devices with specific mobile applications to improve access to school healthcare and health education based on the needs of the schools in the Nciba Circuit.

The eHealth intervention, as it has been implemented thus far, can be divided into five broad components.

Component 1: Developing health profiles for learners in Nciba

This component of the eHealth intervention involved developing an integrated electronic platform where the results of learner health screening could be uploaded to a database to create learner health profiles, which would include follow up and referral, and could be accessed remotely on smartphones or tablets. This system was intended to replace the paper-based system. In an attempt to build on an existing system already in use, the eHealth WG considered adapting the EMIS system. The EMIS system, however, proved to be inappropriate for this, and a new app – the School Health App – was developed. The School Health Policy was digitised through the School Health App. The learners' health profiles were comprised of results from screening apps developed under component 2 of the eHealth WG intervention.

Component 2: Adapting or developing health screening apps

The eHealth WG group ensured that apps were developed or adapted for learner health screening that met the requirements of the school health policy, including a hearing app developed by the University of Pretoria. The apps were loaded onto tablets and mobile phones to be tested in five clinics in Cofimvaba. Learners could be screened for the following using the apps: oral health, hearing, vision, speech, nutritional assessment, food and hunger, anthropometric measurements, physical assessment of gross and fine motor skills, immunisation, mental health, TB, HIV, Asthma, and diabetes. The eHealth WG demonstrated the screening apps and School Health app to the National Department of Education and the National Department of Health. Out of the interactions with the DoH in particular, a number of new opportunities may be identified, specifically: linking to the HPV vaccination campaign piloted by the DoH; the possibility of creating a central database for use by the DoH and the DBE; and the feasibility of scaling-up for implementation at other National Health Insurance (NHI) pilot sites.

The eHealth WG was able to secure additional funding through the Futures Group Sexual HIV Prevention Programme (SHIPP)¹⁶ to continue its work for a further three years.

Component 3: Training of school nurses and health care workers on use of apps

School nurses were particularly targeted for training on the use of the tablet and mobile phone devices, as well as on the use of the apps for screening learners. This has enabled them to screen more learners per day than they were previously able to do using the manual, paper-based system.

Community Health Care Workers (CHCWs) at one clinic, as well as their supervisor, were also trained on the use of the tablets and mobile phones, as well the apps, for the purposes of monitoring and managing themselves and their programmes.

Component 4: Health education

The eHealth WG developed educational material to be displayed in five Clinics in Nciba. To this end, educational content and materials were loaded onto USB drives, which were inserted into television sets that had been installed on the walls of the waiting rooms of the clinics. In this way up-to-date and appropriate health-related information was made available to patients waiting to be attended to.

Further, this working group engaged with the DBE, ECDoE, and the district with regards to what health-related information should be covered in Life Orientation lessons in schools.

16 http://futuresgroup.com/projects/Sexual_HIV_Prevention_Program_SHIPP_South_Africa

Component 5: Health communication

The eHealth WG established a so-called virtual collaboration environment using a chat room facility for school nurses so that they could share information with each other. The development and roll-out of an app for learners to use in communicating with school nurses or counsellors, provides learners with the opportunity to privately seek information or advice from health care professionals.

5.6 Energy

Working Group Convenor	Somila Xosa (DST)
Partners	Eskom, Intsika Yethu Municipality, Nciba circuit schools, Anglo-American Platinum, Clean Energy Investments, Air Products
Stakeholders	ECDoE, Nciba circuit school community, Cofimvaba District Office, DST
Reach	Zenzile JSS, Mtimbini SPS, Arthur Mfebe SS, St Marks JSS, Mvuzo JSS
Service Delivery Challenge	A lack of sufficient, regular and reliable supply of electricity to schools in the Nciba circuit

The Energy WG was tasked with designing and implementing an intervention to facilitate access to sufficient, regular and reliable supply of electricity to schools. In addition to this initial task, the scope of the Energy WG's intervention came to include meeting the energy needs created by other working group interventions, such as the ICT4RED WG (e.g. charging stations, running servers) and the Nutrition WG (e.g. food preparation).

The work of the Energy WG began with an energy audit of the schools in the Nciba circuit to determine their energy needs, as well as to gain a sense of the context in order to suggest appropriate and sustainable technology solutions to energy-related challenges. The Energy WG intervention involved the testing of two technologies: hydrogen fuel cell technology, and solar power.

Component 1: Hydrogen fuel cell technology

For this component of the intervention, the Energy WG partnered with Anglo-American Platinum (AAP), Clean Energy Solutions, and Air Products. The hydrogen fuel cells would provide back-up and/or primary power to three schools in the Nciba circuit. Clean Energy Solutions designed the fuel cell power systems that were installed at the schools. It was also commissioned to operate and maintain the fuel cells for the three-year duration of the project, after which the DST would take ownership of the technology. Using practical demonstration kits provided by AAP, learners had the opportunity to observe the fuel cell technology in action. Education sessions were facilitated by Dr Ron Beyers from the Nelson Mandela Metropolitan University (NMMU). An important aspect of this work was ensuring compliance with new safety standards for the use of hydrogen fuel cells. This intervention was launched by the Minister of Science and Technology, Naledi Pandor, on 12 June 2015.

Component 2: Solar energy

Solar energy were tested at two schools in the Nciba circuit by a team from the Centre for Energy Research at NMMU. Scheduled for completion by the end of July 2015, these systems were ready in time for the launch of the hydrogen fuel cell technology on 12 June 2015.

5.7 Science Centre

Working Group Convenor	Rufus Wesi (Sasol Nzalo)/Isaac Ramovha (DST)
Partners	Sasol Nzalo, Cofimvaba District Office, Cofimvaba Schools Community, Instika Yethu Municipality
Stakeholders	DST, DBE, ECDoE
Policy Context	Youth into Science Strategy
Reach	This working group intervention is more community-based and does not target particular schools.

Service Delivery Challenge	A lack of laboratories, science equipment and skilled teachers in schools in the Nciba circuit compromise the quality of science teaching and learning.
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This was an intervention in two phases. The first was the provision of a mobile science laboratory to support learners and teachers in the Nciba Circuit. The second was the science centre project, which was still in the planning stage at the time of writing.

5.7.1 Mobile science laboratory

One fully equipped mobile science laboratory was commissioned and was launched on 9 April 2014.

Component 1: Mobile science laboratory delivery

During this stage of the intervention the vehicle for the mobile science laboratory was first procured. The interior was then modified, the necessary equipment and materials resourced. The mobile science laboratory was fully equipped, and safety features fitted.

Component 2: Training

Seventy-five maths and science teachers (FET-qualified) from the Nciba Circuit were trained on the activities that would be undertaken at their schools using the mobile science laboratory. This included training on the use of all equipment and conducting experiments. The WGC from Sasol Nzalo explained that this training was important to “prepare them [the teachers] for this facility so that when it comes to their schools, when they host it in their premises they know what it is about, they know what it is going to be doing so teachers as well are going to be in a position to support the activities that will be happening in their classrooms”.

Component 3: Running the mobile science laboratory

Two individuals were nominated by the Cofimvaba District Office to participate in, and ultimately take over, the running and management of the mobile science lab. It was intended that they would run the mobile science lab, facilitate sessions with learners and conduct experiments. They were trained over three days. They spent the first day of training with another mobile science lab project run by Sasol Nzalo, going over relevant content and each experiment, learning how to facilitate a session and conduct an experiment in a school environment. On the second day of training, the facilitators went out to schools with the science lab and learned how to run the mobile science lab day-to-day from making plans with schools. Training took place over three days.

The mobile science laboratory intervention was intended to support both teachers and learners. Learners would be supported in two ways: first, through the mobile laboratory visits to schools, giving the learner opportunities to do experiments and participate in related activities; and secondly, through a learner support programme which targeted gifted learners, regularly bringing them together at a centralised location for extra instruction in mathematics and science. The intervention would engage teachers in two ways. The first mode of support for teachers was in the form of bi-annual teacher workshops during which they were given the opportunity to refresh their knowledge and skills. The second mode of support for teachers was the regular supportive visits to their schools, helping them to improve their teaching style and methods and so enhance their teaching of science.

Since the launch of the mobile science laboratory in April 2014, the DST appointed two interns, through the National Youth Service (NYS), to man the mobile laboratory which visited FET phase schools between 12 and 15 times per month during the school term.

5.7.2 Science Centre

The CSIR was appointed Project Manager of this aspect of the Science Centre intervention. It was in charge of the architectural design of the Science Centre, as well as its eco-building. A Project Steering Committee and a Project Committee were established. The Intsika Yethu Local Municipality was to provide the site for the science centre, and was considering, at the time of the writing of this report, providing a larger site than originally allocated. The implementation schedule developed by the Science Centre WG projected that construction of the Science Centre

was to begin in October 2015 and conclude in March 2016. It would provide valuable insights if the impact of this intervention could be followed up after completion in March 2016.

5.8 Concluding Remarks

The interventions comprising the Tech4RED have used innovative technologies and approaches to address multiple needs and challenges faced by the Cofimvaba Schools Community. The findings with regards to the outcomes of each of the WG interventions that have been documented to date, are promising. It is important to note, however, that at the time of the last MERL data collection reported on here (October 2015), a number of working group interventions had not yet 'been on the ground' long enough to gain traction in the Nciba Schools Community. Therefore, a full description of these interventions that does justice to each of them and the Tech4RED as a whole, requires more time for implementation and further research and analysis. Of particular interest, is the role played by the introduction of multiple interventions into a rural school circuit. The extent to which WGs collaborated or co-ordinated with each other in the design and implementation of each intervention, is an important indicator. The extent of the collaboration and coordination between the WGs has not, however, been explored further by the MERL Research team.

CHAPTER 6 THE COFIMVABA SCHOOL COMMUNITY: PRINCIPALS, TEACHERS AND LEARNERS IN NCIBA AND MABELENTOMBI

6.1 Introduction

This chapter of the report is divided into five sections. Each section (with the exception of this one and the concluding remarks) is dedicated to developing a descriptive profile of the principals, teachers and learners in both the Nciba and Mabelentombi Circuits, and to establish that the two circuits are similar in these respects. The data is compared across the two circuits. The data presented in this chapter was generated by the survey of principal, teacher and learner backgrounds, discussed under 3.3.5 in Chapter 3. Data was collected at three points in time – March 2014, October 2014 and finally, in October 2015. The process of data collection took place in both circuits.

6.2 School Principals in the Intervention and Comparison Circuits

In both the Nciba and Mabelentombi circuits there were more male than female principals. The majority of the principals fall in the age range of 46-55 years. This pattern remained constant during the three periods of data collection.

As expected, there were no striking differences with regards to Sex and Age categories between March 2014 and October 2015 in both Nciba and Mabelentombi schools (Table 2). The small variations in numbers may be attributed to retirement, resignations, and/or promotions within the principal group.

Table 2 Principal Profile by Sex and Age

		Nciba Schools			Mabelentombi Schools		
		March 2014	October 2014	October 2015	March 2014	October 2014	October 2015
Sex	Male	15	13	14	15	14	11
	Female	9	9	7	6	7	7
Age	36 – 45 years	7	4	4	2	5	3
	46 – 55 years	13	15	12	15	12	12
	56 – older	4	3	5	4	4	3

With regards to the educational qualification of the principals from schools in both circuits, Table 3 reflects the highest qualification of the responding principals. The findings show that between the periods of March 2014 and October 2014, there was a high number of principals from the Nciba Circuit who reported having an Advanced Certificate in Education (ACE), but in October 2015 there was a noticeable drop in the number of principals who held the ACE certification. This drop in numbers was also evident with regards to the Master’s in Education degree. This marked decrease in numbers in the ACE and Master’s degree between the last two date points was accompanied by a marked increase in numbers in other qualifications. The increase was noted in principals that held Diplomas, Bachelor and Honours degrees. The reasons for the sudden fluctuations in the number of respondents could not be accurately pinpointed, however, there could be a number of contextual factors that contributed to this outcome. These could include retirement, promotions, rationalisation of schools or human movement, or incorrect statement of qualifications. In the Mabelentombi circuit, the findings show that more principals had a Diploma in Education qualification with very few holding an ACE qualification. The number of principals with a Bachelor in Education was also higher in Mabelentombi.

The number of principals with the ACE qualification¹⁷ in Nciba was promising as this qualification focuses on developing school leaders; however the number of principals with the ACE qualification in the Mabelentombi circuit was fairly low.

Table 3 Principal Profile by Highest Educational Qualification

		Nciba Schools			Mabelentombi Schools		
		March 2014	October 2014	October 2015	March 2014	October 2014	October 2015
Academic qualification	Diploma in education	3	2	10	6	7	12
	Advanced Certificate in Education (ACE)	9	8	4	3	1	4
	Bachelor of Education	3	5	14	5	8	4
	Honours Degree in Education or PGCE	1	0	4	0	0	6
	Master's in Education	8	7	0	6	4	0

6.3 Mathematics Teachers in the Intervention and Comparison Circuits

In both the Nciba and Mabelentombi circuits there were more female than male teachers. The majority of teachers were 40 years or older, which implied that the teachers were experienced (Table 4). This pattern remained constant over the three time points. With retirement on the horizon for some, an older staff complement could also lead to problems. It is, therefore, important that younger teachers be recruited into schools in these circuits.

Table 4 Mathematics Teacher Profile by Sex and Age

		Nciba Schools			Mabelentombi Schools		
		March 2014	October 2014	October 2015	March 2014	October 2014	October 2015
Sex	Male	7	7	10	4	2	8
	Female	15	15	24	17	20	19
Age	25– 39 years	3	5	3	6	6	5
	40 – 49 years	13	13	20	13	10	18
	Older than 50	7	5	11	3	6	4

6.3.1 Academic qualification of mathematics teachers

Table 5 reflects the highest educational qualification of mathematics teachers in both circuits over the three dates. In the Nciba and Mabelentombi Circuits, most mathematics teachers either had a Diploma in Education or had attained an undergraduate degree. In both circuits, there were a number of mathematics teachers with an Honours

17 According to The Report of the Standards Generating Body for Educators in Schooling (10 October 2001):

“The ACE is a flexible Level 6 qualification aimed at providing educators with an opportunity of updating, enriching and supplementing their existing knowledge in a particular area of specialisation or of changing their area of specialisation. The former might become necessary due to new developments in an area of study while the latter may be a response to changing national needs or a need for a change in career path. Access to the ACE is open to candidates who are already in possession of an approved Level 6 qualification in the field of education and training, and it creates additional opportunities for further study at Level 7.” (http://www.che.ac.za/media_and_publications/frameworks-criteria/criteria-and-minimum-standards-ace)

or further post-graduate degree. These findings imply that, at the time of the survey, mathematics teachers – who taught mathematics at the time – were fairly well qualified. This finding disputes the assumption that teachers in rural areas tend to be under-qualified. Under, or poorly qualified, teachers are often a contributing factor to poor learner performance. This seems not to be the case in both the Nciba and Mabelemtombi Circuits as the teachers were relatively well qualified. It was pleasing to note that in October 2014 in the Mabelemtombi Circuit, there was one teacher who was teaching mathematics who reported that s/he did not finish matric; but this was no longer the case by October 2015. At the time of writing this report there was, however, one teacher in Nciba and two in Mabelemtombi who only had matric and who were teaching Mathematics. There were a number of radical changes in respect of teachers and their qualifications. It must be remembered that the respondents who participated in October 2015 were not necessarily the same group who responded in 2014. The changes in the number of respondents in Mabelemtombi who reported holding certain qualifications between March 2014 and October 2014 could be attributed to retirement, resignations, rationalisation and/or promotions amongst the mathematics teachers surveyed.

Table 5 Mathematics Teacher Profile by Educational Qualification

		Nciba Schools			Mabelemtombi Schools		
		March 2014	October 2014	October 2015	March 2014	October 2014	October 2015
Academic qualification	Did not finish matric	0	0	0	0	1	0
	Finished Grade 12	0	0	1	2	0	2
	Finished post-matric certificate	1	1	2	0	0	0
	Finished Diploma in Education	10	6	15	11	8	9
	Finished first degree	6	10	13	6	4	9
	Finished honours degree or higher	3	3	3	1	3	4

6.3.2 Years training

Over the three data points, the majority of teachers had three or more years of pre-service training (see Table 6). There was a relatively small number that had less than two years training. It should also be noted with concern that in March 2014 in the Nciba Circuit, there were two Mathematics teachers who had one or less than one year of teacher training. This number did, however, increase significantly to six teachers with none or less than one year of training by October 2015. This situation would definitely need further investigation as it is common knowledge that one of the greatest contributing factors to poor mathematics performance is that teachers lack mathematics content knowledge, and as the data shows, is also due to inexperience within the Nciba Circuit.

Table 6 Years of Pre-service Teacher Training attended by the Mathematics Teachers

Years Training	Nciba Schools			Mabelentombi Schools		
	March 2014	October 2014	October 2015	March 2014	October 2014	October 2015
None or less than one year	2	0	6	2	2	4
1 year	0	3	0	0	2	0
2 years	6	3	2	2	4	2
3 or more years	14	17	26	17	14	20

6.3.3 Teacher professional development

Table 7 reflects the frequency of the various in-service teacher training programmes attended by Mathematics teachers attended over the three data dates. There was a constant increase in the number of mathematics teachers in the Nciba Circuit who attended these developmental programmes between March 2014 and October 2015. This sustained increase in numbers was pleasing, especially in consideration of the attention being given to Mathematics and Mathematics teaching. An area that possibly requires more investigation is into the structure of these training programmes. For instance, if training occurs during school operational times, the problem of a loss of teaching and learning time could be experienced.

Table 7 Mathematics Teachers who Attended Professional Development (In-service)

Teacher professional development programmes	Nciba Schools			Mabelentombi Schools		
	March 2014	October 2014	October 2015	March 2014	October 2014	October 2015
Mathematics content	15	17	25	13	17	21
Mathematics pedagogy/ instruction	13	18	21	9	15	17
Mathematics curriculum	15	20	26	15	18	20
Integrating ICT into Mathematics	12	16	21	5	11	14
Improving learners' critical thinking or problem solving skills	14	16	23	10	17	19
Mathematics assessment	17	19	24	13	17	21
CAPS general training	18	20	27	14	19	19
CAPS training in Mathematics	17	19	27	20	19	20

6.4 Grade 7 and 9 Learners in the Intervention and Comparison Circuits

Questionnaires were administered to learners in Grades 7 and 9 in both the intervention and comparison circuits. Learners in these grades were selected as they were being tested as part of the Learner Performance Study, as mentioned under 3.3.7 in Chapter 3. These learners completed the Background Questionnaire for this survey at the same time as they completed the mathematics test for the Learner Performance Study.

Table 8 reflects the comparison of three key variables related to the profile of learners within the study, namely sex, age and home language. With regards to sex, the sample of the intervention group comprises 53 per cent boys and 47 per cent girls. Similarly, the comparison group comprises 54 per cent boys and 46 per cent girls. In both groups there are a higher percentage of boys than girls with more than 5 per cent difference.

In this analysis, the age of the learners was split by grade so that aspects of age appropriateness and over-age learners for the two grades could be investigated. The age distribution in both the intervention and comparison groups was similar for all age groups. As one would expect, the majority of learners in Grade 7 were between the ages of 13 and 14 years, which is the age appropriate for the grade. It is of concern, however, that about 27 per cent of Grade 7 learners were between the ages of 15 and 16, and 8 per cent were 17 and older, suggesting that they either repeated a grade or dropped in and out of school.

In Grade 9, the age distribution was similar between the intervention and comparison groups, with the majority of learners aged between 15 and 16 years, which is age appropriate for the grade. Almost 40 per cent of the learners in the intervention group and 34 per cent in the comparison group were 17 and older, which is high and indicative of grade repetition.

In both the intervention and comparison groups the vast majority of learners reported isiXhosa as their home language. A total of 98 per cent (n = 745) of the learners in the intervention group and 99 per cent (n = 500) in the comparison group, reported that isiXhosa was their home language.

Table 8 Learner Profile

		Intervention		Comparison	
		N	%	n	%
Sex	Boy	416	53	276	54
	Girl	362	47	234	46
Age of grade 7 learners	<=12	61	15	46	18
	13-14	199	50	131	51
	15-16	107	27	59	23
	17plus	30	8	20	8
Age of grade 9 learners	<=12	3	1	0	0
	13-14	30	8	27	11
	15-16	188	52	128	55
	17plus	143	39	80	34
Home Language	Xhosa	745	98	500	99
	Other	19	2	6	1

Figure 8 illustrates family structure as reported by learners in the intervention and comparison groups. The majority of learners (34%) in the intervention group reported a nuclear family structure. Of the intervention group, 27 per cent reported a single family structure. The third most commonly reported family structure in the intervention

group, at 23 per cent, was the skip-generation structure¹⁹. The pattern reported by the comparison group was similar, with no more than a 3 per cent difference between the three family structures as discussed above. It is noteworthy that, while there is a persistent belief in the existence of high numbers of child-headed households in Cofimvaba, our data indicates that these are either uncommon or under-reported in both groups.

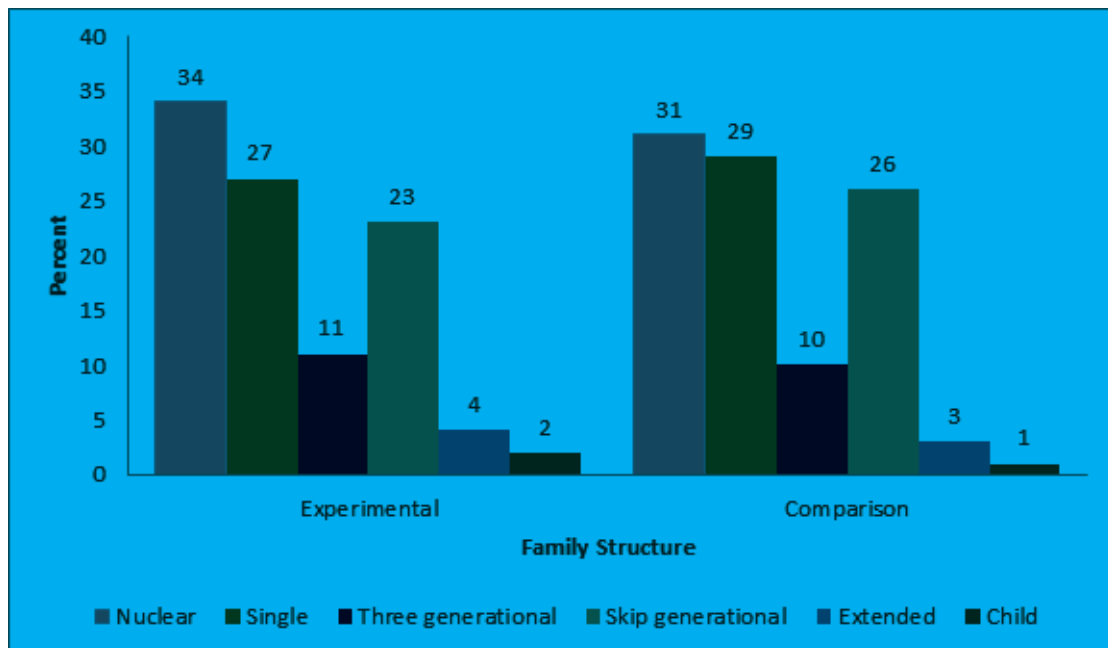


Figure 8 Family Structure of Learners

Table 9 shows that learners in both the intervention and comparison groups had similar access to meals. One would, however, have expected 100 per cent of learners in both groups reporting that they had lunch due to the school feeding scheme, which should be operational under the DBE.

Table 9 Regularity of Meals Provided to the Learner at Home, March 2014

	Intervention	Comparison				
	Breakfast (%)	Lunch (%)	Supper (%)	Breakfast (%)	Lunch (%)	Supper (%)
Every day or almost every day	67	63	75	70	75	70
Once or twice a week	29	31	36	26	21	22
Sometimes	4	6	6	4	4	8
Total	100	100	100	100	100	100

Figure 9 shows that the vast majority of learners in both groups walked to school. Of the learners, 91 per cent of the intervention group and 84 per cent of the comparison group, walked to school.

19 The definitions of these family structures are drawn from the Green Paper on Families (Department of Social Development, 2011):

- Nuclear — two parents and at least one child
- Skip-generation — grandparent with grandchild(ren) but no child(ren) of his/her own also residing in the home
- Single unmarried parent with at least one child
- Single married parent (absent spouse) with at least one child.

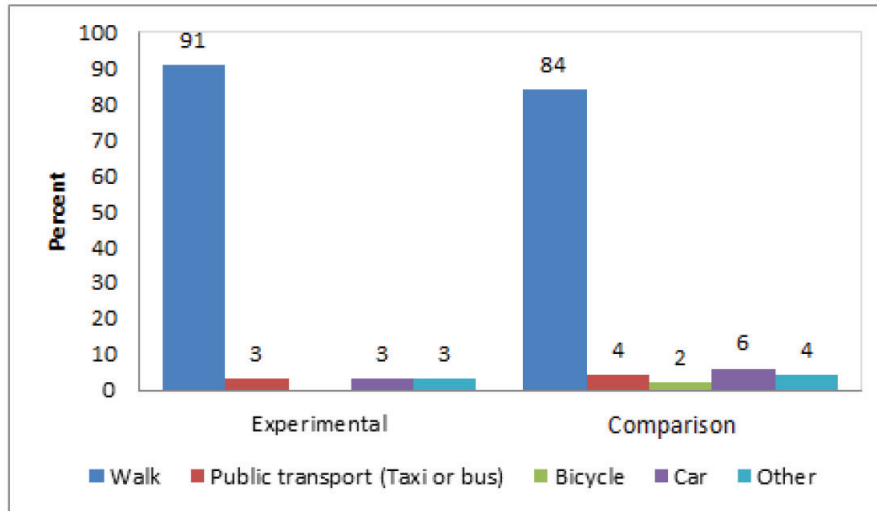


Figure 9 Learner Transport to and from School, March 2014

Figure 10 shows the number of books learners reported having access to at home. In the intervention group, the majority of learners had access to between 1 and 5 books at home, followed by 24 per cent of the learners who said they had no books at home. Combined, this means that more than half (52%) of the learners in the intervention group had, at most, 5 books in their home. The profile is similar, if not slightly worse, for the comparison group where more than 60 per cent of learners reported having, at most, 5 books in their homes. In the intervention group, 16 per cent of the learners said they had more than 20 books in their home, compared to 18 per cent in the comparison group.

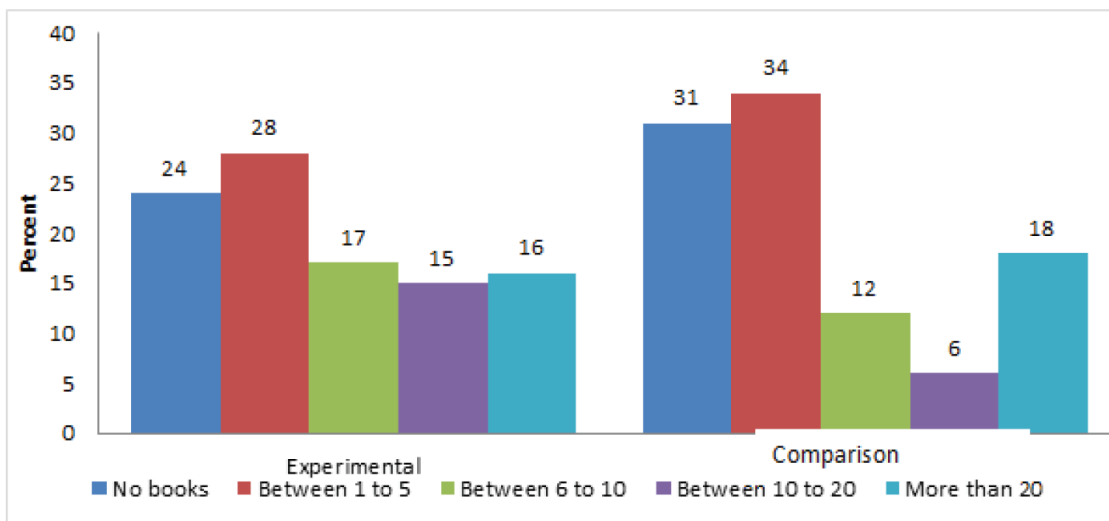


Figure 10 Number of Books at Home, March 2014

Figure 11 illustrates the self-reported frequency of reading among learners in the comparison and intervention groups. It is noteworthy that 50 per cent of learners in the intervention group indicated that they read ‘sometimes’, as compared to 18 per cent of learners from the comparison schools. A comparison of intervention (26%) and comparison (28%) groups shows that a similar percentage of learners read ‘every or almost every day’. Learners who reported ‘never or almost never’ reading is similarly comparable between the two groups, with 12 per cent of the intervention and 10 per cent of the comparison group responding thus.

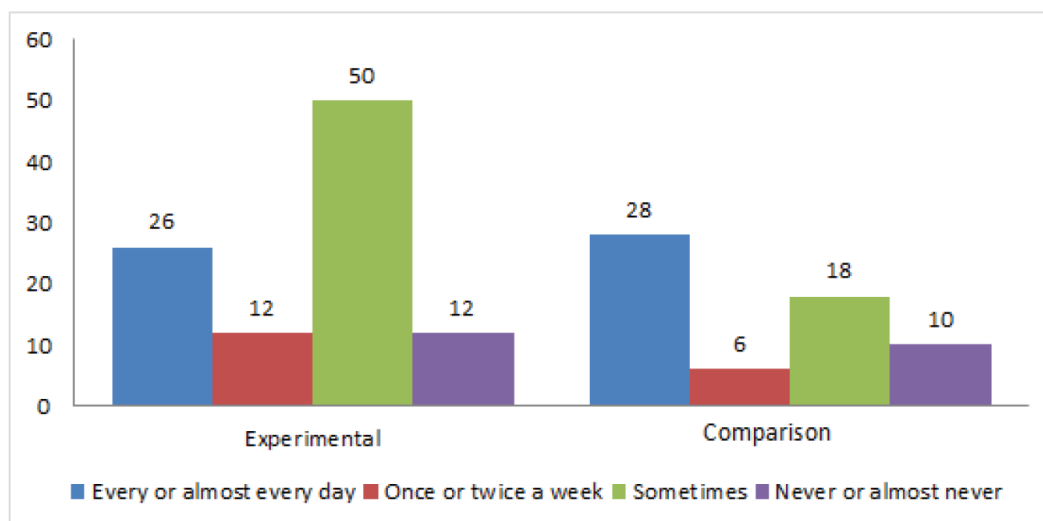


Figure 11 Frequency of Learners Reading at Home, March 2014

Table 10 shows parent/caregiver behaviours, as reported by learners, in terms of their reading habits and enquiries about school work. In the intervention group, 54 per cent of learners reported that their parent(s) or caregiver(s) read sometimes, as compared with 13 per cent who indicated that their parent(s) or caregiver(s) 'never or almost never' read. The comparative figures in the comparison group indicated a similar pattern with 47 per cent of the learners reporting that their parent(s) or caregiver(s) read sometimes, and 17 per cent reporting that their parent(s) or caregiver(s) 'never or almost never' read.

In the intervention group, 62 per cent of learners reported that their parents or caregivers enquired about their school work on a daily basis, as compared to a very low 3 per cent who indicated that their parents or caregivers 'never or almost never' enquired about their school work. The comparative figures in the comparison schools indicated a similar pattern with 73 per cent of the learners reporting that their parents or caregivers enquired on a daily basis, and a mere 1 per cent reporting that their parents did not enquire about their school work.

Table 10 Parental Involvement and Reading Habits, March 2014

	Intervention		Comparison	
	Caregiver who read newspapers, etc.	Caregivers enquire about school work	Caregiver who read newspapers, etc.	Caregivers enquire about school work
Every or almost every day	21	62	25	73
Once or twice a week	12	16	11	12
Sometimes	54	18	47	14
Never or almost never	13	3	17	1
Total	100%	100%	100%	100%

Table 11 reflects learner attitudes towards Mathematics. In the intervention group, overall attitude towards Mathematics appeared to be positive with 80 per cent of learners reporting that they enjoy Mathematics, and only 4 per cent indicating that they do not enjoy it. Similarly, 84 per cent of the learners agreed that Mathematics was useful, compared to 4 per cent who disagreed with this statement. Interestingly, while the majority of learners (56%) agreed with the statement that 'Mathematics is easy', a relatively large percentage (32%) said they neither agreed nor disagreed with this. Only 11 per cent of the learners disagreed with the statements. A similar picture emerged of the comparison group.

Table 11 Learner Attitudes toward Mathematics

	Intervention				Comparison			
	Enjoy Maths	Maths boring	Maths easy	Maths useful	Enjoy Maths	Maths boring	Maths easy	Maths useful
Agree	80	26	56	84	76	32	57	87
Neither/ Nor	16	32	32	12	18	33	34	8
Disagree	4	41	11	4	7	35	9	5
Total	100%	100%	100%	100%	100%	100%	100%	100%

6.5 CONCLUDING REMARKS

This chapter has shown that the profiles of principals, teachers and learners in the intervention and comparison circuits were similar enough to be comparable, so that any measurable differences or impact in the intervention circuit could be attributed to the Tech4RED rather than a significant difference in these profiles. Further, the profiles were important in the analysis of the Tech4RED because of the critical social component to the interventions, technologies and innovations being tested. The interventions fundamentally involve people using innovative technologies. Of particular importance is the impact that various background factors may have had on the outcomes of the Tech4RED and its component interventions.

CHAPTER 7 MATERIAL CONDITIONS IN COFIMVABA SCHOOLS

7.1 Introduction

[S]chools are as much an aspect of rural development as they are a symbol of development. There is a fundamental continuity between the lack of basic services in schools and in the community – water, roads, electricity and sanitation are in poor supply in schools because they are in poor supply in the environment. Lack of basic services in the community affects schooling and impacts on the access to and quality of schooling. Infrastructure in the community and at school is high on the list of priorities... It constitutes a particular social need in communities.” (Emerging Voices Report, HSRC 2005: 77)

This chapter will focus on the infrastructure, services and resources at schools in the Nciba Circuit during the data collection periods of May 2013, March 2014, October 2014 and October 2015; and in the Mabelentombi Circuit during March 2014, October 2014 and October 2015. It will consider any changes to material conditions in schools in the Nciba Circuit over time, and compare changes in the Nciba Circuit and the Mabelentombi Circuit to ascertain any improvements in the material conditions of schools in the Nciba Circuit as a result of the Tech4RED interventions. It should be noted that data is presented in two ways in this section: as percentages or raw scores. All data presented as a percentage will be marked with the percentage symbol (%) or as ‘per cent’.

7.2 Information and Communication Technologies

7.2.1 May 2013

Eight schools reported having access to desktop computers for teaching and learning purposes, while fourteen reported having access to laptops for teaching and learning (Figure 12). Only one school, Arthur Mfebe Senior Secondary School – the site for Phase 1 of the ICT4RED intervention – had access to tablets for teaching and learning. Four schools indicated that mobile phones were used for teaching and learning.

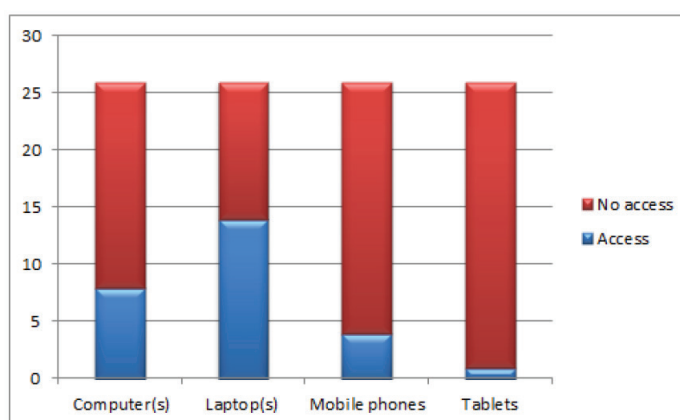


Figure 12 ICT Access at Schools

Participants selected ‘to prepare learners for the future’ (18), and ‘to improve learning’ (17), as the top two reasons why technology was essential to education. Both of these reasons relate to preparing learners to meet the demands of the 21st century.

The top three priorities identified by schools (Figure 8) for the successful integration of technology included:

- All teachers must have training in the use of computers/tablets (14);
- The school must have a suitable room for computers (13); and
- School must have access to electricity and a phone line (11).

Access to computers was a high priority in most schools; however, it was important that schools used the technology appropriately (Figure 13). As the top three reasons for schools to have computers, respondents reported:

- Use of computers in school management and administration (16);

- Use of computers as a teaching and learning tool in all subjects (13); and
- Computer use for the professional development of staff (11).

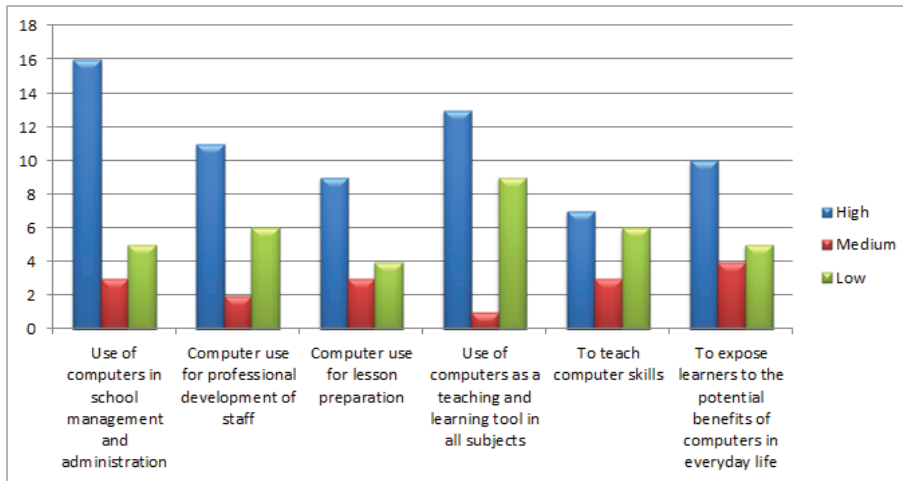


Figure 13 Reasons to Use Computers at a School

As shown in Figure 14, in May 2013, 15 of the 26 schools reported having no access to the internet.

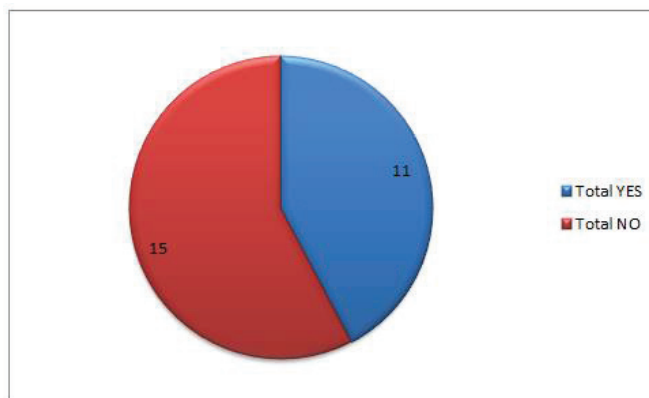


Figure 14 Internet Access at Schools

Of the 11²⁰ schools with access to the internet, the different connection platforms included 3G dongle (8), dial-up modem (3), link via an ISDN (1), and Wi-Fi (1).

With regards to access to email accounts, school management and teachers were most likely to have their own e-mail addresses. Cell phone coverage was reported as good by 69 per cent of respondents.

With regards to maintenance and technical support for ICTs, 58 per cent of the schools indicated that the Provincial Department of Education provided some form of, to 15 per cent of the schools that used commercial providers to provide ICT support.

Figure 15 shows the barriers to the successful integration of computers in schools for teaching and learning:

²⁰ The total is 13 connections, although only 11 schools indicated connections. This is because Arthur Mfebe SS indicated 3 types of connections (Dial up, 3G Dongle & Wireless)

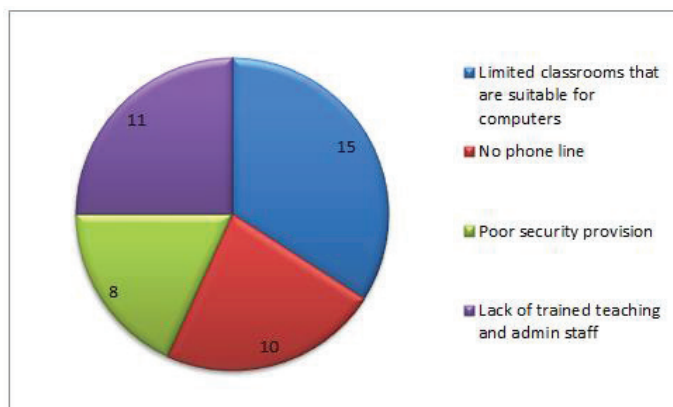


Figure 15 Reasons for Low Computer Use at Schools

Respondents identified six key skills areas vital for teachers in order for the successful integration of ICTs into teaching and learning, as shown in Figure 16.

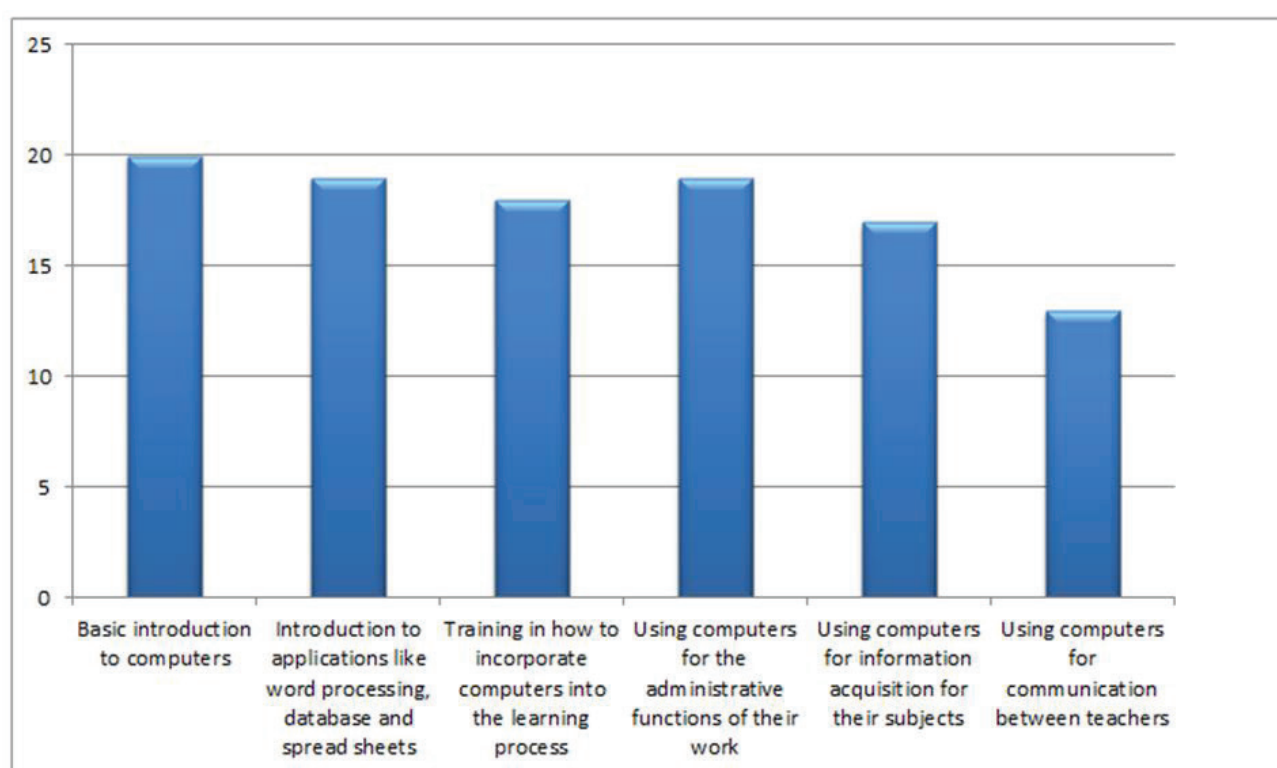


Figure 16 Teacher In-service-Training Required

Among the barriers to the use of ICTs in teaching and learning, as identified by respondents in May 2013, were a lack of computer literacy amongst teachers (15), teachers not having the necessary skills to integrate computers into specific subject teaching (13), and the absence or lack of understanding of the curriculum with regards to computer skills (11).

7.2.2 March 2014 to October 2015

To improve the quality of teaching and learning through the use of technology, the acquisition and effective utilisation of ICTs at school level is critical. Figure 17 reflects the frequency count of the three key ICT factors participants selected – over the three data collection dates – as essential to the integration of ICTs at a school level.

In the Nciba Circuit between March 2014 and October 2014, there was a significant increase in the number of teachers attending ICT training, but a decrease was observed in October 2015. This decrease could be a result of the training rotation schedule of the ICT4RED programme. There was a simultaneous decrease in the number of teachers attending ICT training in Mabelentombi over the three dates.

Between March and October 2014, there was a slight increase in the number of schools in the Nciba Circuit that reporting having a computer laboratory, and this remained constant in October 2015. There was a drop in the number of ICT laboratories at schools in the Mabelentombi Circuit over the three dates.

Within the Mabelentombi Circuit, there was a gradual decline in internet usage between March 2014 and October 2015, but the scenario in the Nciba Circuit was quite different, with similar percentages in March and October 2014. In October 2015, however, a significant increase – from 3 per cent to 12 per cent – in internet access was observed in the Nciba Circuit.

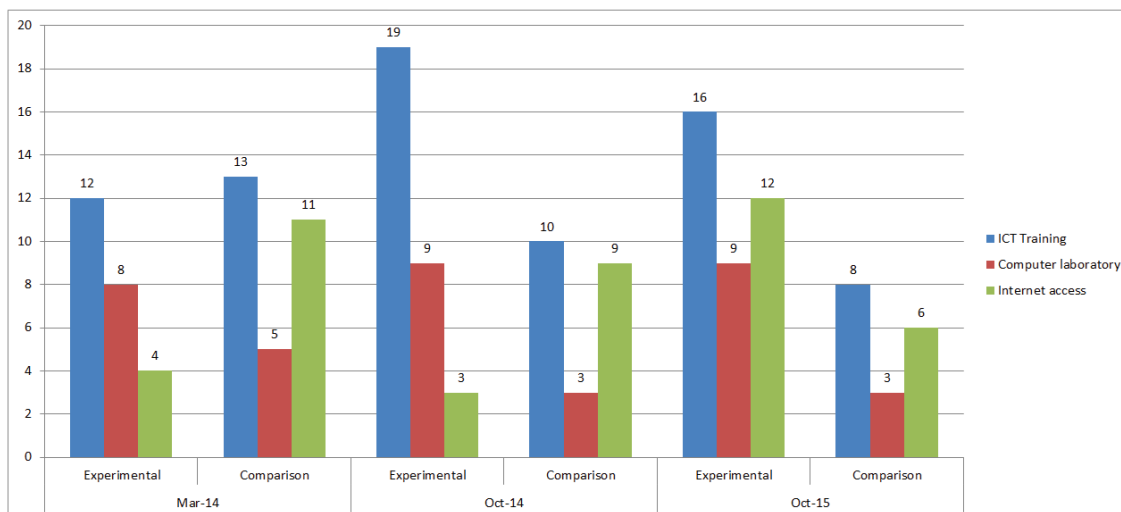


Figure 17 ICT in Schools

7.3 Health

7.3.1 May 2013

Figure 18 shows that 22 of the 26 schools reported a government clinic as the closest medical facility available to the school.

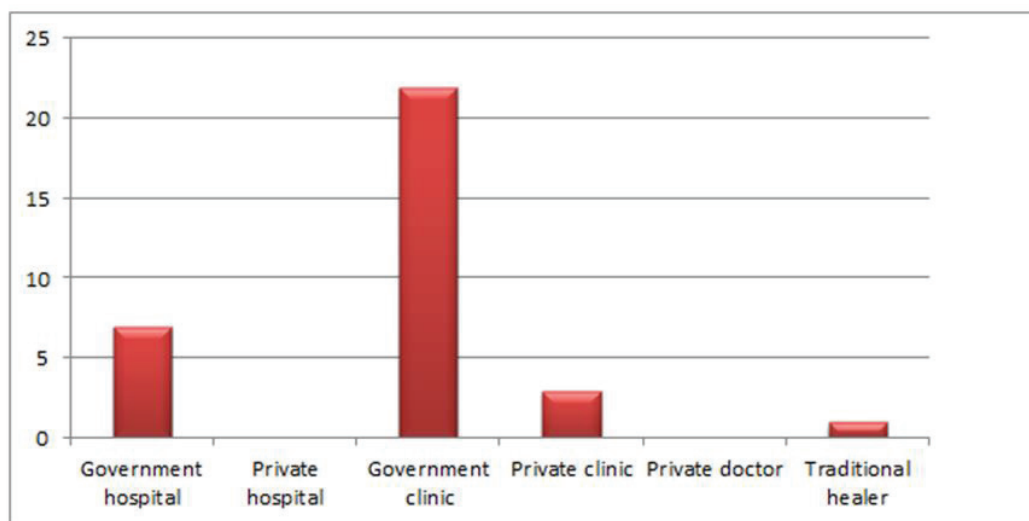


Figure 18 Closest Medical Facilities

Thirteen respondents indicated that the medical facility closest to the school was not more than 5 km away. Twenty respondents reported that there were not enough medical facilities in the area. Elaborating on their responses, participants made the following comments:

- “Some do not have money to go to town and if you call an ambulance you will wait long hours before you get help”;
- “Shortage of medication – sometimes at the government clinic you are told to go and buy medicines from the chemist”;
- “The government clinic is too small for many locations”;
- “Facilities are far from the school and the mobile clinic is not always available (it comes only once a month to some areas)”;
- “There are no ambulances and mobile clinics only visit schools for grade R learners”.

Of the respondents, fifteen were satisfied with the services provided by the medical facilities. Reasons given for satisfaction included:

Yes, the available medical facilities do provide the services needed – we get medicine and help that we need from the clinic, nurses do come and vaccinate learners, tests are done, counselling is done, diagnosis and other related services.

Nine respondents indicated that they were not satisfied with the services. Reasons given for this reported dissatisfaction included:

No, the available medical facilities do not provide the services needed – it functions during the day only, no maternity facilities, no ambulances, no dentists, no doctors, lack of medications, no x-rays – have to go to hospital, lack of funds.

Shortage of medication was identified as the most common healthcare services problem, with nineteen respondents reporting a shortage of supplies at facilities. The opening hours of the medical facilities was also of concern, with sixteen respondents indicating that the facilities were open during times when most people were at work or in school.

According to the majority of the respondents, the physical infrastructure of medical facilities accessed was in good condition. Twenty-three respondents reported that the buildings had been recently renovated.

7.4 Water and Sanitation

7.4.1 May 2013

As illustrated in Figure 17, the source of supply of water to the twenty-six schools varied from school to school. The most common sources were rainwater tanks (15) and municipal supply (14). Other forms of water supply included water tankers (4), boreholes (5), and a well (1).

Twenty-two respondents reported having taps in working order at the time of the survey, but one school had to access a tap outside of the school grounds. The top three uses of water in schools were identified by the respondents as: cooking (26), cleaning of toilets and classrooms (26), and washing of hands (25), drinking (25), and garden/agriculture (15).

Eighteen schools reported a regular water supply and seven reported an irregular supply. In relation to the adequacy of the water supply, eighteen schools indicated that the water supply was adequate and eight schools responded that it was inadequate.

Twenty-one schools reported having pit toilets, three schools reported having no toilets at all, and two schools reported having toilets under construction at the time of the survey. Further, the data showed that of the twen-

ty-one schools with toilet facilities, seventeen reported that the number of toilets were insufficient for the needs of the school. Commenting on the toilet facilities at the school, respondents made the following remarks:

- “The toilets are dirty and old and in poor condition”;
- “Toilets were damaged by extreme weather”;
- “There are too many learners and too few toilets”, “One toilet is not sufficient for the whole school”;
and
- “Grade R learners are not catered for”.

In response to the number of functioning toilets at schools, it was found that a total of sixteen respondents indicated that the toilets were in working order, and nine responded that the toilets were not in working order at the time of survey, or that there were no toilets. With reference to those who indicated that toilets were not in working order, a variety of responses were noted to the question, “How long have the toilets been out of working order?” These responses included: “Since 2006”, “Almost seven years”, “Five years”, “Six years”, and “It is under construction”.

The findings also showed that the condition of the toilet structures was of concern. Sixteen respondents reported that the toilet buildings were not in a good condition. Only seven respondents reported that toilet doors could be locked.

7.4.2 March 2014 to October 2015

Figures 19a and 19b show the percentage change in the different forms of water supply to schools in both Nciba (experimental) and Mabelentombi (comparison) Circuits between March 2014 and October 2015.

The municipal supply of water to schools in the Nciba Circuit showed a significant increase, from 24 per cent to 36 per cent, compared to the drop from 7 per cent to 0 per cent in Mabelentombi schools. In both the Nciba and Mabelentombi Circuits, the data also shows an increase in the supply of water from boreholes and water tankers. In the Mabelentombi Circuit, this reported increase in water supply from boreholes and water tankers could, at least, be a compensation for the drop in municipal supply. The use of wells as a source of water supply to schools dropped from 3 per cent to 0 per cent in both circuits. The use of rain water tanks as a form of water supply remained constant in the Nciba Circuit, but declined slightly in Mabelentombi. This change could be attributed to a number of factors, including a relatively dry year in the area with the result that water tanks failed to fill adequately.

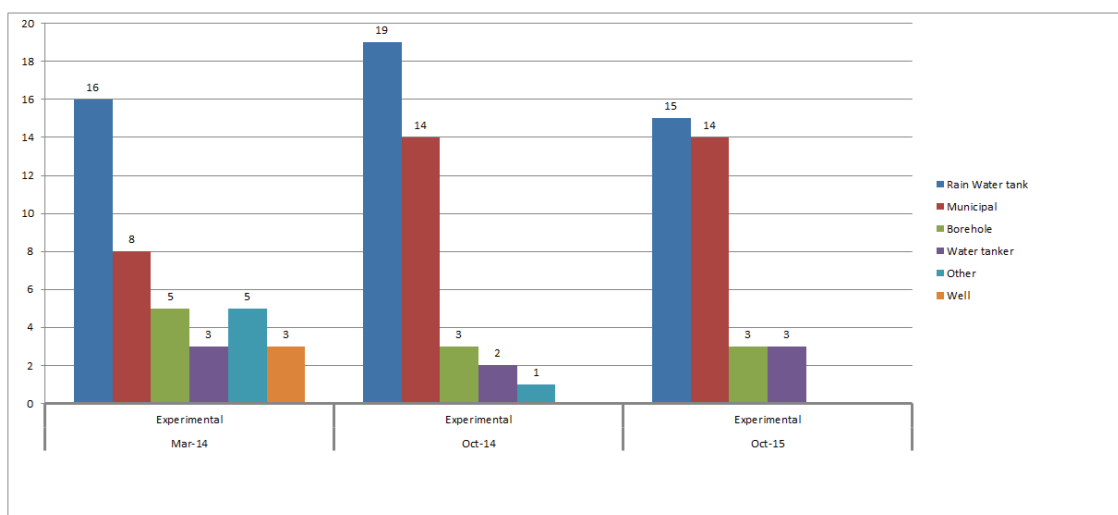


Figure 19a Water Supply at Schools in Nciba Circuit

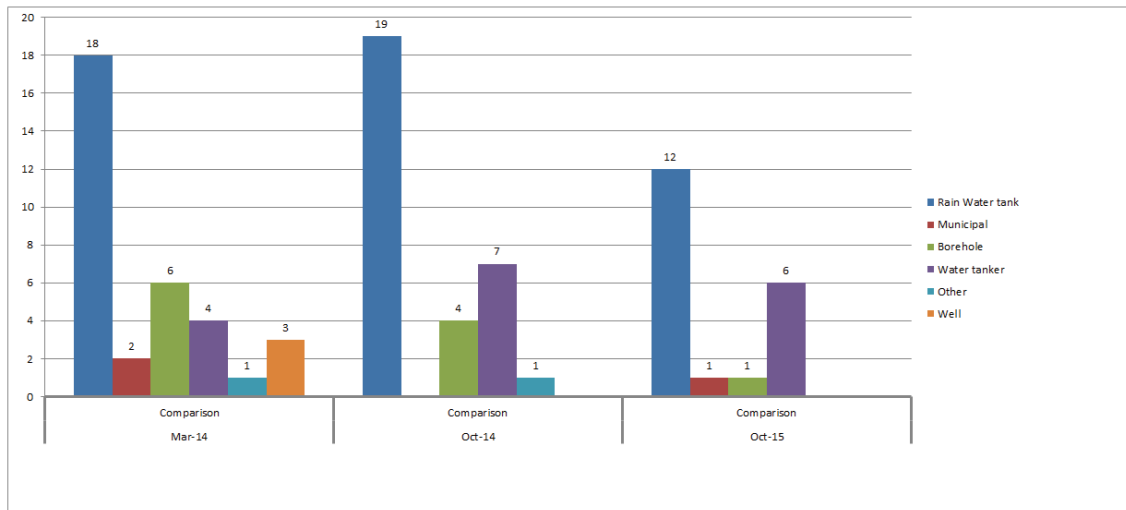


Figure 19b Water Supply at Schools in Mabelentombi Circuit

Figure 20 shows the comparison of the availability of separate toilet facilities for males and females at schools between the March 2014 and October 2014 in the Nciba and Mabelentombi Circuits. In the Nciba Circuit, there was a significant increase in the percentage of schools that reported having separate toilet facilities for males and females from March 2014 to October 2014. In the Mabelentombi Circuit, however, between March and October 2014 there was a 6 per cent drop in schools reporting separate male and female toilets. A possible explanation for this decline was under-reporting by schools in the hope that they might receive assistance, or even an intervention, in this particular area.

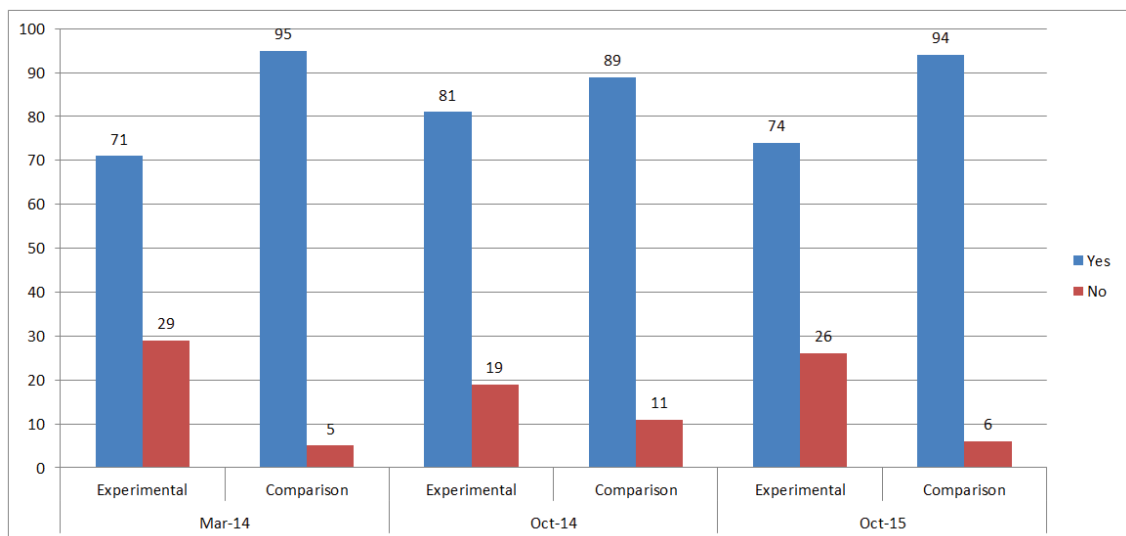


Figure 20 Separate Toilet Facilities for Males and Females at Schools

Figure 21 shows the comparison of the availability of separate toilet facilities for teachers and learners at schools between March 2014 and October 2014, and between the Nciba and Mabelentombi Circuits. A positive picture emerges from this data in that in both Nciba and Mabelentombi there was a significant percentage increase in separate toilet facilities between March and October 2014.

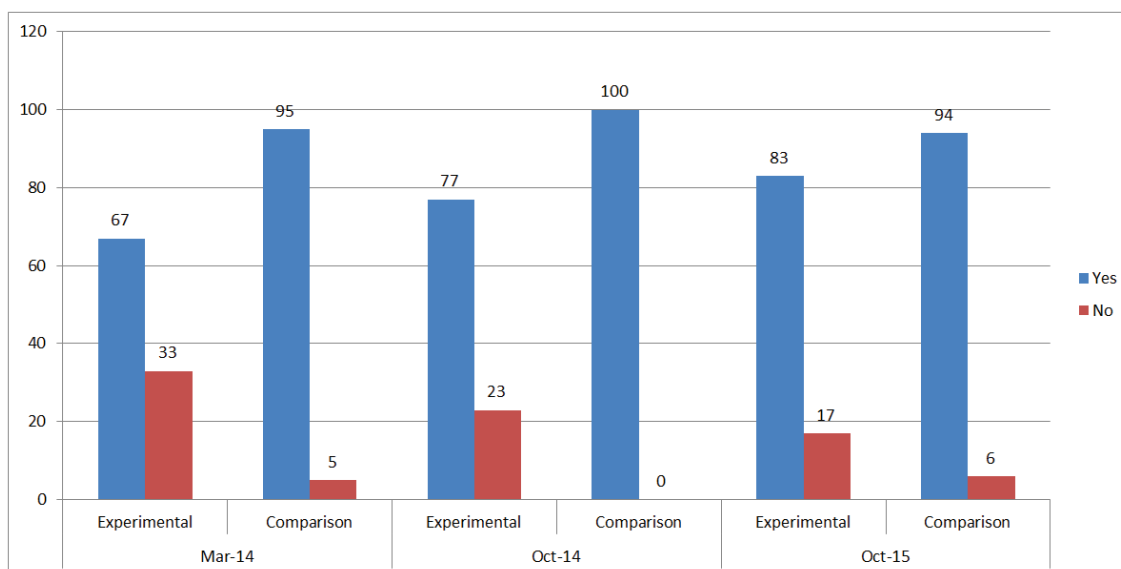


Figure 21 Separate Toilet Facilities for Teachers and Learners at Schools

7.5 Nutrition

7.5.1 May 2013

Eleven of twenty-six respondents reported that learners were poorly nourished, eight reported that learners were well nourished, and six reported that learners are often hungry.²¹

All of the twenty-six schools had a feeding scheme. In May 2013, it was found that thirteen schools found the feeding scheme adequate, but eleven found it to be inadequate. Nineteen schools indicated that the kitchen facilities or the temporary shelter for storage and preparing of food for learners was adequate, but not satisfactory.

7.5.2 March 2014 to October 2015

Figure 22 illustrates the status of learner nourishment as perceived by the school principals in the Nciba and Mabelentombi Circuits in March and October 2014. The frequency counts are fairly consistent in both circuits across time. An interesting pattern emerges from this data in that the frequency count of principals reporting well-nourished learners is higher in Mabelentombi schools than those in Nciba. This pattern could be attributed to the fact that, at the time of the survey, the Nutrition WG's intervention was being piloted in only five schools in the Nciba Circuit, and a disruption in the supply of the nutritional drink during that school year may have resulted in no dramatic change in learner nourishment as reported by school principals.

²¹ We stress that these are the subjective responses of school principals and are not based on the measurement of any biological markers for nutritional status.

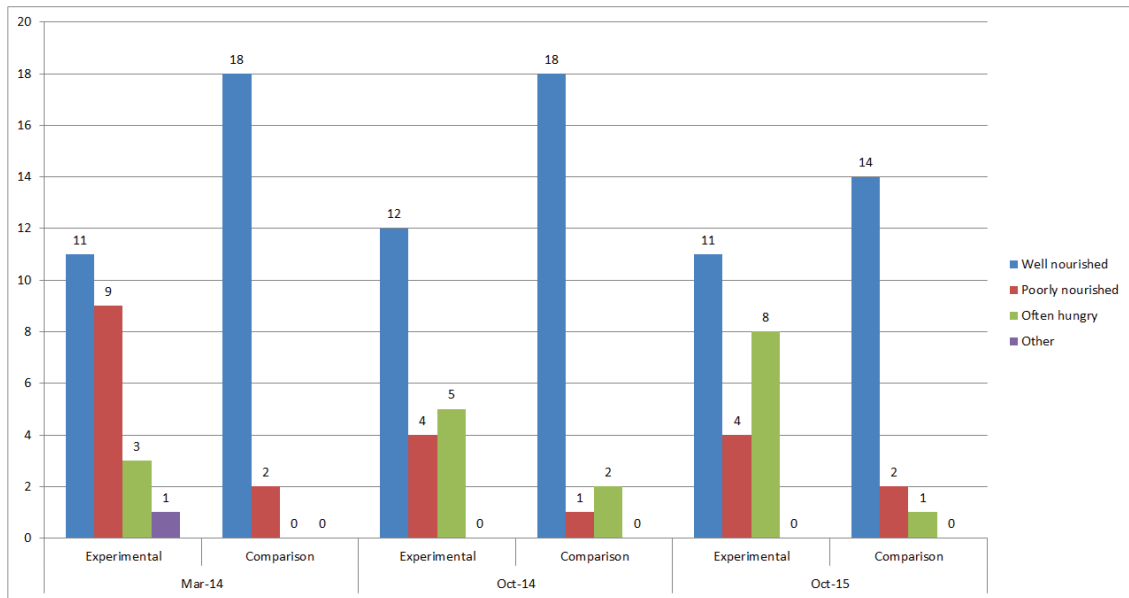


Figure 22 Learner Nourishment by School

Figure 23 draws a comparison in the frequency counts of the response of principals regarding the adequacy of the school feeding scheme between March 2014 and October 2014 in both circuits. A consistent pattern emerged in the data for schools in both the Nciba and Mabelentombi Circuits in terms of the number of principals who reported that the school feeding scheme was adequate.

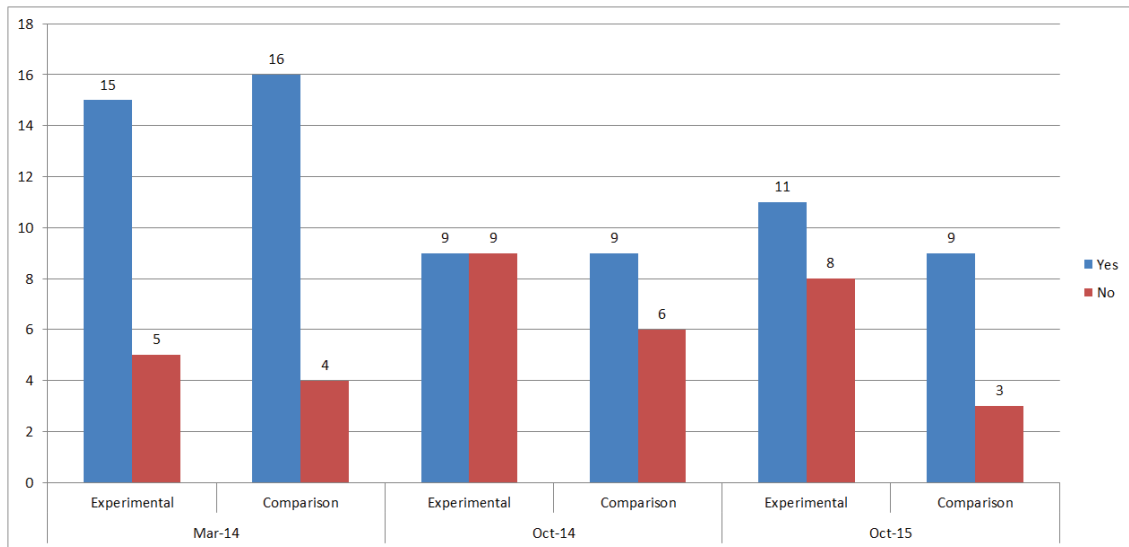


Figure 23 Adequacy of School Feeding Scheme According to School Principals

7.6 Access to and Sources of Electricity

7.6.1 May 2013

In May 2013, concerns regarding the supply of energy (electricity) to intervention schools were moderate. Of the twenty-six sample schools, only two principals reported a complete lack of access to electricity. The findings showed that nineteen schools responded that the electricity supply to the school was adequate for their day-to-day activities and functions, while six indicated that the electricity supply was inadequate.

In terms of the regularity of the electricity supply, nineteen respondents reported that the supply of electricity was constant, while five reported that the supply was not constant. According to our data, seventeen schools were

responsible for funding their own electrical consumption, while twelve schools were funded by the Provincial Department of Education.²² The local municipality was responsible for the funding of one school's electrical consumption.

7.6.2 March 2014 October 2015

Figure 24 shows access to electricity as reported by schools in the Nciba and Mabelentombi Circuits. There was no change in the frequency count reported in relation to access to electricity, from March 2014 to October 2014, in either circuit. There was, however, a small increase from October 2014 to October 2015 in the Nciba Circuit. It is clear from the figure that access to electricity does not seem to be a problem in either of the circuits, with only four schools in the intervention circuit not having access to electricity.

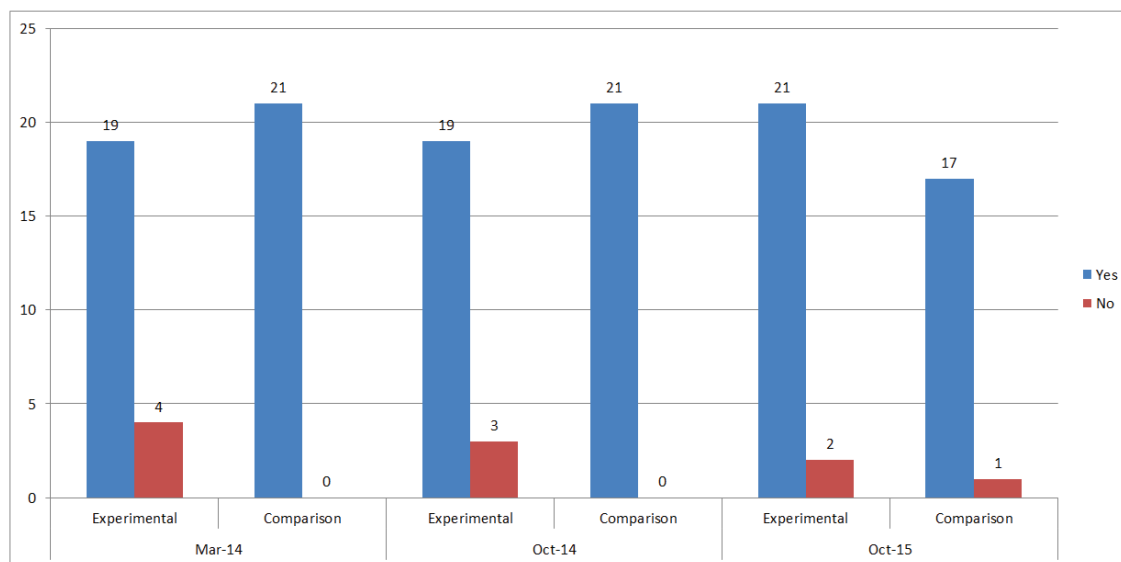


Figure 24 Access to Electricity

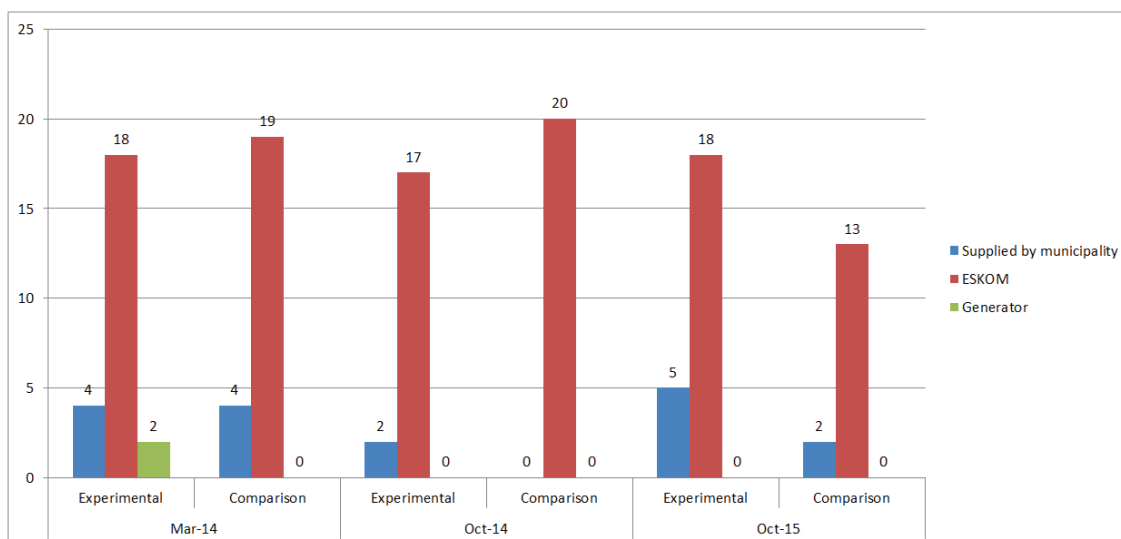


Figure 25 Source of Electricity Supply

Figure 25 shows that South Africa's Electricity Supply Commission (Eskom) was the most frequently reported supplier of electricity to schools in both circuits from March 2014 to October 2015. An interesting and positive finding is that the two schools in the Nciba Circuit that reported using generators in March 2014 had, by October 2014, converted to using either Eskom or the municipality as their main electricity supplier. Electricity usage within both the circuits had remained reasonably consistent from March 2014 to October 2015.

²² This was a multiple response question, so respondents could choose more than one response. The budget allocations for school energy should be interrogated further.

7.7 Summary of material conditions in schools

Table 12 presents a comparative summary of selected variables from the intervention and comparison schools²³ between March 2014 and October 2015. The data in the table is presented as raw figures. In the last column, a negative figure indicates a decrease and a positive figure indicates an increase.

Looking at the intervention schools, it should be noted that a positive pattern emerged in the changes between March 2014 and October 2015 in relation to certain variables. In terms of water supply, it was promising that more schools reported municipal water supply as their main source. The pattern among the comparison schools was less promising. There appeared to be a negative trend in that there was a decline in the number of participants responding that the main source of water supply for the school was from the municipality. It should also be noted that in October 2015, two additional schools in the Mabelentombi Circuit reported receiving water from water tankers.

With regards to toilet facilities, the intervention schools reflected an improvement in respect of separate toilet facilities for male and female learners, and separate toilet facilities for teachers and learners, between the period March 2014 and October 2015. Once again, the comparison schools reflected a decline in conditions related to toilet facilities. Of particular concern is that between March 2014 and October 2015, there was a decline of three schools that reported having separate toilet facilities for male and female learners, as well as for learners and teachers.

In respect of the ICT component, the intervention schools showed an increase in the number of schools that reported teachers attending ICT training as compared to a decline in the comparison groups. The increase noted in the intervention group could be attributed to the ICT4RED intervention. In respect of computer labs and internet access, there was no noticeable difference or change in either group.

In regards to learner nourishment and perceptions around the adequacy of the school feeding scheme, the table reflects a negative response rate from both the intervention and comparison schools. A decline in the number of respondents in the intervention and comparison circuits who responded that the school feeding scheme was adequate, may reflect the inadequacy of the school feeding scheme, increased levels of dissatisfaction with the feeding scheme, or the desire among principals to overstate their lack of resources in an attempt to increase their chances of becoming recipients of the nutrition intervention – which had only reached five schools in the Nciba Circuit.

Considering access to electricity among the intervention schools, it was noted that from March 2014 to October 2015, there was an increase of four schools with access to electricity in the experimental group, as compared to the number of schools in the comparison circuit, where a decrease occurred.

Table 12 Summary of Changes in Material Conditions in Schools

Indicator	March 2014		October 2015		Difference March 2014-October 2015	
	Intervention Schools	Comparison Schools	Intervention Schools	Comparison Schools	Intervention Schools	Comparison Schools
Water supply & sanitation:						
Rain water tank	16	18	15	12	-1	-6
Municipal	8	2	14	1	+6	-1
Water tanker	3	4	3	6	0	+2
Separate toilet facilities (male & female)	16	20	17	17	+1	-3

²³ The March 2014 data collection process received responses from 45 schools, but in October 2014, only 43 schools responded. To ensure a match for match comparison, the two schools that did not respond in the October 2014 school instrument were excluded from the March 2014 comparison.

Separate toilet facilities (teacher & learner)	15	20	19	17	+4	-3
ICT in schools:						
Teachers who attended training	11	13	16	8	+5	-5
Computer labs at schools	7	5	9	3	+2	-2
Internet access	3	11	12	6	+9	-5
Learner nourishment						
Adequacy of school feeding scheme	14	16	11	9	-3	-7
Energy						
Access to electricity	17	21	21	17	+4	-4

7.8 Concluding Remarks

Between March 2014 and October 2015, a number of positive changes occurred in the Nciba Circuit as can be seen from the 'Difference' column in Table 12. Across almost all aspects of material conditions mentioned a positive change was observed, except for learner nutrition where three schools within the Nciba Circuit reported inadequacies.

Attention also needs to be brought to the significant improvement of ICT in schools, especially with Internet usage and training attended by teachers. This was a direct result of the ICT interventions that took place in the experimental group of schools.

Looking at Table 12, a clear difference is observed between the control and experimental groups simply by comparing the positive and negative changes that took place. It is clear from the table that positive changes occurred within the Nciba Circuit as a result of the Tech4Red, and if extended for a longer period more positive changes could be witnessed.

CHAPTER 8 REFLECTIONS OF THE COFIMVABA SCHOOL COMMUNITY ON THE TECH4RED

8.1 Introduction

In this chapter, data generated during interviews and FGDs with members of the Cofimvaba School Community are presented and discussed. The interviews and FGDs explored the community's perceptions of, and attitudes towards, the Tech4RED in general; and in relation to specific interventions in terms of what they knew about the initiative, what changes they had observed, the significance of those changes, challenges encountered, and suggestions for the future. The data offers an opportunity for the voices of the intended beneficiaries of the initiative to be placed foremost, and allows for the development of a nuanced understanding of the Tech4RED in the context in which it was implemented. The data is presented in this chapter in themes, with each discussed in a section of the chapter.

8.2 ICT and Learning and Teaching

The ICT4RED WG was responsible for implementation of the tablets in schools and ensured that teachers were prepared for the use of these gadgets prior to delivery.

8.2.1 Training of teachers in the use of tablets

During the interviews, teachers were asked to reflect on the training they had received on the use of tablets for supporting teaching and learning in the classroom. Unlike the after-school workshops they had previously attended, teachers indicated that their training on how to use the tablets continued for a period of nearly two successive years, and that their trainers visited their schools. Training was also open to all teachers in the schools. One of the interviewed teachers said:

We all went for the training and someone from ICT4RED came to the school and trained all the teachers ... it was all the teachers, they were trained for a year, but I was also trained for a second year because I was trained as a facilitator so I can teach the rest of the teachers that were not part of the training.

What is encouraging about the type of training teachers received, is that selected teachers in schools were trained to support their colleagues. Also, the fact that trainers visited the schools assisted in closing gaps on training teachers received and in its implementation in schools. Teachers reported that they learned to use the following applications (apps) from their training on teaching using the tablets:

- taking photos
- game based learning
- role playing
- King Soft Office
- Google for searching for information.

Although training was provided to teachers prior to the introduction of tablets to schools, teachers in some schools reported seeking further on-site assistance on the use of tablets to enhance classroom teaching and learning.

Also, a gap in teacher training or transfer of information at school level was evidenced when a new mathematics teacher joined one of the schools. This teacher heard about the Tech4RED from his colleague,s but was neither briefed in detail about the initiative, nor was he given the necessary training and information on how to use tablets to enhance classroom instruction. Asked whether he was using the tablets even though he had not received training like other teachers, the teacher responded:

Yes I do use them, but when I use them I don't know if I'm using them the right way... the way that I'm supposed to use them. But there is information that I usually take from them.

Another teacher who was interviewed, mentioned that they were making use of the teaching strategies that they learned during their training. This was a promising finding, speaking to the relevance of the strategies and the quality of the training.

One teacher participant noted that the increase in learner interest had made teaching and learning easier:

You know, in our school teaching and learning is now easier because learners are very, very much interested, especially in using tablets although we have only fifteen tablets ...

8.2.2 Interviews of principals on the use of tablets

When asked to identify the biggest change in the school since the Tech4RED started, one principal noted that, although the training focused only on educators, the tablets also had an effect on the learners:

Attitude [of] both the educators and the learners, though it was only focusing on us as educators when we first started, but I could see that the attitudes ... ha[ve] changed towards the use of these technological devices in the classrooms, and working as a team in order to achieve our goals and to reach our vision through the use of these tablets. When I talk of the attitude, it's how you relate in the classroom. The attitude is pleasing, it feels like you are in a new world, we got new strategies then we are using them. Then the attitude has changed, even the learners can detect that, for instance when you are using one of the strategies let us say game based, the attitude will definitely change because everyone is in the mood of playing while learning.

One of the principals interviewed observed that the tablets had impacted on the confidence of both learners and teachers. He made particular mention of the rural context, arguing that the tablets and access to information that they brought had made teachers and learners feel that they were in a position to compete with learners from urban areas:

... it has given some confidence on the side of learners, in fact on the side of both teachers and learners. Learners now believe that even though they are in a rural area they can access information and things that are in the other parts of the world. They feel now part of the world of South Africa and even when we talk to them we could see that they have confidence. They feel that they can now perform even like learners who are maybe in the townships or in the urban areas now with these gadgets. In terms of confidence and self-belief, yes, they're up there.

Another principal made specific mention of the fact that access to information was difficult, particularly in rural areas.

It gives access to learners to get more information, especially in rural areas, because you know our learners in rural areas, they don't have that much or they aren't familiar with things, but with this Tech4RED it changes their lives to be easier for them ... and to grasp things in an easy way. For example, if we are doing research, in the first place it was not easy for them to go and do this research, but now that they know the internet they know how to do this [and] it's much easier to get more information from this.

8.2.3 Gaining access to the tablets in school

When asked to explain how tablets were used in their schools, teachers reported that they accessed these gadgets following a user time-table they had developed. The time-table ensured that only a limited number of classes could use the tablets during a specified period. This was necessitated by the fact that the number of tablets given to each school did not cover the learner population in that school. One teacher mentioned that learners in their schools use the tablets "... once or twice a week". This is supported by the following statement made by one of the teachers:

They [the tablets] are used for the English subject because the textbooks for English are also loaded there. So if I use them today, the English teacher will also use them the same day, and they [the tablets] also need to be charged. So, it will be impossible to use them every day. Because they have different subjects"

Another teacher had this to say about their school situation:

Yes, each learner gets access to a tablet provided that maybe only two teachers take the tablets, but if – let’s say – three teachers will need a tablet, there are not enough for the classes.

Also, learners only had access to, and were allowed to utilise, the tablets at school during certain periods (lessons). They were not allowed to take the gadgets home with them.

8.2.4 Utilisation of tablets in the classroom

Teachers reportedly used the tablets for instructional purposes in different subjects from grades one to nine, and beyond. From the teacher interviews, the school subjects for which the tablets have been used to support classroom teaching and learning included English, isiXhosa, Mathematics, EMS and Social Science.

One teacher summed this up by reporting that learners used the tablets for developing different language, literacy and mathematical skills or abilities.

They [learners] use them for counting, spelling, spelling game, counting backwards, counting forward, multiplication, addition and division.

On the use of tablets to support teaching and learning, teachers deployed these gadgets to their work at different times. They used them during lesson planning, as evidenced by one teacher who said: “...we use both the tablets and laptops, but we only use laptops to do worksheets, tests, and marking”.

In other instances tablets have been used for lesson planning, lesson delivery and classroom-based assessment. The following are what some teachers said in this regard:

... I would use it [tablet] when I teach a lesson. I would prepare a lesson in a tablet, for instance, I prepared the multiplication lesson on the tablet using the power point presentation, using slides. I firstly introduce multiplications by five, giving them some examples of multiplications in that form. I would then give them an exercise to create their own sums, and they would use tablets for the multiplication games to see how multiplications work [Teacher A].

What they [learners] enjoy the most is reading. They follow the instructions on the tablets, follow the pictures. Some of them are able to translate after listening to the reading. In Maths, they enjoy the calculation [Teacher B].

In those tablets there is a lot, there is a very good scientific calculator for those in the Senior Phase. They also use the internet because we have Wi-Fi. We also have interactive e-books, for instance, if we talk about Pythagoras, the interactive e-books tell us what a Pythagoras is. They know more about things in class, there are also apps that show us how to control the time, for instance, if I instruct them to set the time for five minutes for each exercise. Also, if it’s dark in class, they can see their work using the tablet torch [Teacher C].

Yes, they can also see international trending news and exercises. They can watch and download the exercises and lessons online. Gain more exposure to global lessons on certain topics that they can download, such as Mathematics, Algebra [Teacher D].

One teacher had this to say during the interview:

I normally use them [tablets] more when I teach in the classroom because maybe... let’s say maybe yesterday if I’m going to teach a lesson today, I would take the tablet just in my spare time and check what I can use. Then I would check and see, OK I can use this when I’m going to do a lesson.

This teacher reportedly used the tablet content to plan future lessons. He checked through the gadget’s content for any relevant content that was in line with the lesson he was going to teach the following day.

During FGDs learners commented on their experiences of utilising the tablets in the classroom under the supervision of their teachers. Teachers were the primary link between the learners and the operation of the tablets. In general, teachers were responsible for the following in relation to the tablets in their schools:

- Training the learners on the use and operation of the tablets;
- Supervising learners' utilisation of the tablets during and after lessons;
- Acting as the first point of contact if learners encountered technical and lesson application challenges when using tablets; and
- Storing and recharging of tablets.

Learners in Intermediate Phase (specifically in Grade 5), were asked about their ability to use tablets, when they used their gadgets in school, and the things they did with them. The following are some of the responses they gave during the interviews:

Kwi-tablet siyakwazi ukufunda ngezibalo. Kwi-tablet sifunda ngezibalo ezininzi, i-division, multiplication ne addition. Siyakwazi ukubona izinto ezininzi ngelizwe esihlala kulo.

[English translation: With tablets we are able to learn mathematics. We learn a lot about mathematics, division, multiplication and addition. We are able to learn many things about the world we live in.]

Sikhe sizisebenzise ngoLwesithathu. Ukuba asibhali izinto ezininzi, asibinalo ixesha lokuzifumana. Asizininikwa, zibalapha esikolweni okoko.

[English translation: We use them [tablets] on Wednesdays. If we are not writing many things, we do not get the opportunity to access them [tablets]. We are not given them to take away, they are kept at school.]

Xa ufuna i-information kufuneka uye kwi-internet, uye ku-google ucofe kuye ubhale lento uyifunayo, ufumane i-information. Si-research-e ngobomi bukaThabo Mbeki.

[English translation: When you are searching for information you should visit the internet, go to google, type what you are searching for, get that information. We researched about the life of Thabo Mbeki.]

Siyabhala, sifunda ngezinto ze-English, nee-games. Ukuba asiyazi into, siyijonga kwi-internet xa ungalazi ingama usebenzisa i-tablet kwiklasi yakho.

[English translation: We write, we learn English material and games. If we do not know something, we search for it on the internet; if you do not know the meaning of a word you use the tablet in your class.]

[Xa niyi]Two edesikeni nifumana enye. Kwenye iklasi sikhe sizifumane thina umntu ngamnye, okanye sisebenzise nezo Misi.

[English translation: If you are two at a desk you get one [tablet]. In some classes, each person gets his or her own, alternatively we use the teachers.]

Sizisebenzisela ukudlala i-games, nokubala i-Maths. Siya'googlisha, senze i-puzzle ne-English grammar, nokufota kwento ogqib'oyenza, ne-broadcast ... lanto uMisi xa ethetha arekhode, kengoku asimamelise lento ebeyithetha.

[English translation: We use them to play games, and doing maths. We search on Google, do puzzles and English grammar. We also take pictures of things we have finished making, to broadcast, that is, when the teacher talks and records what she is saying and thereafter lets us listen to what she had been saying.]

Learners in Senior Phase (i.e. Grades 7 to 9) indicated that they used tablets in subjects such as isiXhosa, Social Sciences, English and Mathematics for approximately an hour about three times a week:

In Xhosa, we often write exercises or letters and then save them. In Social Sciences, we do some research. If we have a research on history, we will get access to the internet then search the topic that we've been given to research about.

They make the things that we get taught very easy because we get to see the pictures and stuff... maybe... let's say you are trying to know what a learner looks like. And then on the tablet, you can just type... go to Google and type 'learner' then it will show you the picture of what a learner looks like.

When we are using calculators, it becomes easy. You don't have to use your brains and stuff. You don't have to think a lot and you can just type the question and the answer just shows.

Asked how confident their teachers were in using the tablets, learners reported that their teachers were very confident, and they credited this to the fact that they were trained on how to use the gadgets.

They [teachers] are very confident. Maybe it's the fact that they've been taught how to use these tablets before they took them, the tablets, to use them [to] teach the learners.

According to the learners, teachers used the tablets for assigning research projects to their classes and for research purposes, such as searching for information on Google. The apps that learners used often were Google for conducting information searches, and King Soft. With regard to the latter app, one learner had this to say: "...when we go to King Soft we usually write some new documents then save them".

8.2.5 The language of the apps and other resources on the tablet

The language or languages of the apps could potentially contribute to enabling or constraining teachers' effective use of the tablet in the classroom. According to the South African language-in-education policy of 1998 (DoE, 1997), teaching and learning in the Foundation Phase (i.e. from Grade R to Grade 3) should occur in the home language of the learners. It is only when learners get to Grade 4 that the medium of instruction switches from home language to an additional language, which happens to be English for the majority of the learners in South Africa (DoE, 1997). During interviews, teachers were asked to share their experiences on the following two issues: first, the language of the apps on the tablets; and secondly, the impact the language(s) of the apps had on teaching and learning in the classroom. Predictably, according to teachers, most of the apps on tablets, if not all, were in English. When asked how this situation affected lesson delivery in classes, teachers – of Foundation Phase and the higher teaching grades – viewed this neither as a hindrance, nor a constraint, to effective teaching and learning using the tablets.

These were the views of some of the Foundation Phase teachers:

I can say that the First Additional Language in the foundation phase is more than their mother tongue, I think it's because of this technology because in TV's they know what is going on without being told what is going on... so there is no problem that they are in English.

It does not matter. The learners understand English, in both Maths and English lessons, they understand.

I don't think it matters because they are in the foundation phase, we will use those apps like games. There is no problem with that because they can take the tablet and use it for that.

These were some of the views of teachers in grades higher than Foundation Phase:

No, but I use isiXhosa with them, their home language, so they understand when I teach them in isiXhosa... It's good for them because they think they are playing but they are learning.

Specifically to that question, I do not see any problem with the apps... the language that is being used because the language of communication in South Africa generally is English. You watch the news; it's in English most of the time so I do not see any problem with the language. Because as a teacher, when I'm talking about something that is included in the tablet, I will explain through code-switching... whichever way, but I will explain to the learners what is required of them.

The teacher who explained that he uses code-switching strategy when teaching mathematics further indicated that he does this forty per cent of the time. He reasoned that he uses code-switching as a strategy to assist learners to understand the lesson. According to him, "When you look at the faces of the learners when you are speaking

in English, you just see that from their faces they don't understand", then he would resort to using their mother tongue to help them understand.

Access to Information

Access to information emerged as an important theme in our qualitative data. It was mentioned by learners, teachers, principals, and representatives of the SGB. One learner pointed out that they could "get information easy and fast from the tablets". This access to additional information from the tablets was helpful because they wanted to excel not merely pass. As one participant expressed it: "...when we look for this information [it] is not that we [are] just looking to pass, but we want it ... to have knowledge and to add to our knowledge." A representative from the SGB noted that access to information provided by the tablets benefits both teachers and learners:

So I think these tablets have got almost everything that I think is needed by teachers and learners to make the teaching-learning process easier and faster using various technolog[ies] to get the information, to access the information....

One of the principals who was interviewed made specific mention of the fact that access to information is difficult in rural areas in particular.

It gives access to learners to get more information especially in rural areas, because you know our learners in rural areas, they don't have that much or they aren't much familiar with things, but with this Tech4RED it changes their lives to be more easier for them ... and to grasp things in an easy way, for example, if we are doing research, in the first place it was not easy for them to go and do this research, but now that they know the internet they know how to do this [and] it's much easier and get more information from this.

Significantly, participants felt that the tablets created an environment in which learners and teachers could be equal to urban (and better resourced) schools. One representative of the SGB noted that, "... because we realised that the level of the city is not the same as here in the village, but now we realise that there's not much of a difference".

An important finding in relation to the ICT4RED intervention was that within the community, possession of a tablet seemed to confer some level of respect upon educators. For example, one participant told us that "[e]ven us educators, you know when we get to these meetings and you carrying these gadgets, people respect us".

8.2.6 Attitude and motivation towards ICT usage in classrooms

Improved attitudes towards teaching and learning, and increased levels of motivation among both the teachers and learners, emerged as themes in the qualitative data. In a context in which low levels of teacher and learner motivation can be, to some extent, expected, these reports are encouraging. Learners, teachers, principals and representatives of the SGB observed that the tablets increased the levels of interest and motivation in the teachers and learners. One learner participant told the FGD facilitator that the tablets gave the learners "interest" and "education". A representative from an SGB claimed that the tablets were "motivational" and said of them, "It keeps them [the learners] fascinated." Another representative from the SGB observed that:

[T]here's change that I can see, I mean in being interested with the tablets thing ... all children ... it's like the weekend ... can't wait for Monday and come to school.

It must be noted, however, that these responses may well show the effects of social desirability bias or the Hawthorne effect.

When asked to identify the biggest change in the school since the Tech4RED started, one principal noted that although the teacher profession development (TPD) training offered as part of the ICT4RED intervention focused only on educators, the tablets also had an effect on the learners:

Attitude [of] both the educators and the learners, though it was only focusing on us as educators when we first started, but I could see that the attitudes ... ha[ve] changed towards the use of these technological devices in the classrooms, and working as a team in order to achieve our goals and to reach our vision through the use of these tablets. When I talk of the attitude, it's how you relate in the classroom. The

attitude is pleasing, it feels like you are in a new world, we got new strategies then we are using them. Then the attitude has changed, even the learners can detect that, for instance when you are using one of the strategies let us say game based, the attitude will definitely change because everyone is in the mood of playing while learning.

Importantly, this participant, a teacher, also mentions that they were making use of the teaching strategies that they learned during their TPD training. This was a promising finding, speaking to the relevance of the strategies and the quality of the training.

A teacher participant noted that as a result of the ICT4RED intervention “...teaching and learning is now easier because learners are very, very much interested especially in using tablets ...”.

One of the principals interviewed observed that the tablets had impacted on the confidence of both learners and teachers. He made particular mention of the rural context, arguing that the tablets and access to information that they brought had made teachers and learners feel that they were in a position to compete with learners from urban areas:

...it has given some confidence on the side of learners, in fact on the side of both teachers and learners. Learners now believe that even though they are in a rural area they can access information and things that are in the other parts of the world. They feel now part of the world of South Africa and even when we talk to them we could see that they have confidence. They feel that they can now perform even like learners who are maybe in the townships or in the urban areas now with these gadgets. In terms of confidence and self-belief, yes, they're up there.

This view was echoed by a statement made by the Cofimvaba District Manager during an interview with the MERL research team. Responding to a question on the contribution the TechRED had made in improving the lives of the schooling community in the Nciba Circuit, this official had the following to say:

The tablet on its own can't just make a child want to succeed, but we were impressed that they brought about change in the behaviour of learners and the behaviour of teacher s... Some of these teachers are beginning to use ICTs in their teaching and learning ... the children [learners] ... were able to do some research ... get new information from using ... the tablets. We sent our children from that area, that is Nciba Circuit, to participate in a programme ... they were tracing Christ Hani's steps from the St Marks area, to Boksburg, Ekurhuleni Municipality ... Our children now from that area [Nciba], they were participating in the activities ... some kind of competition, learners from a rural area [Nciba] versus learners from Ekurhuleni municipality. Our children had to do some kind of research ... investigation using their tablets.

What follows is what, according to learners, motivate them to use tablet:

It's easy to use them and they make you want to know more. For example, when you're using a book, you can just say, 'it's boring.' But, when you're using a tablet, you can say, 'What can I do with this?' You have so many ideas in mind and you want to know those ideas and see them. In a book... maybe you're looking for picture of Mandela but you cannot find it. But, when you go to a tablet, you can just see the pictures because Google can give you some pictures to see.

8.2.7 ICT and learner performance

A number of participants made reference to improvements in learner performance as a result of the ICT4RED intervention. For example, one principal attributed an improvement in performance in mathematics to the tablets: “I am sure those tablets that were brought here, which had content on mathematics and science, helped us a lot. In so much that our mathematics that year improved from 54 per cent to 88 per cent.” On the contrary, the some provincial education officials while recognising the significance of grades or test score improvement as a measure or indicator of improved learning and teaching, their sense of the kind of improvement anticipated from the Tech4RED had to do with the interventions improving the schooling lives of the various members of the schooling community. Improvement in learner performance was viewed as something that could be attained in the long run as a by-product of the impact of the various interventions. One education official had this to say:

And you know the people like to ask us nowadays: What is the impact? They think they give you five rand for computers, they want five per cent raise in results, and it is not working like that. If we say ICT is an abler, it is not necessarily going to see a rise in results immediately. It has not happened in Nciba Circuit. Those four high schools' results have not really changed [for the better or significantly]. You are doing an injustice if you only look at impact as far as matric results are concerned. Giving those learners the devices you actually give them skills that help them to compete at the same level with children at urban areas.

8.2.8 Tablet-related challenges encountered by schools

The interviews conducted during the school visits elicited some of the challenges schools faced in their implementation of technology integrated teaching and learning. These challenges varied, to a large extent, from one school to another. Some of these challenges are listed below:

- *Internet connectivity*

Challenges of internet connectivity in certain schools were mentioned by some teachers as an impediment to the possible optimum use of tablets to support teaching and learning.

No, I do not think so. Because, we use it for EMS [a school subject]. Once, we took them to the computer lab, but there was no internet so that they can do research.

- *Teacher workload*

The many responsibilities that teachers have, such as teaching multi-grade classes, may pose a challenge to their ability to deploy tablets for classroom teaching and learning. As one teacher expressed it:

Yes I do, but there is a lot of work to do since I teach both Grade 2's and Grade 3's. One Grade would want to use the tablets while the other Grade is still using them, whereas the lessons are not the same. But there are lessons where we combine both classes.

This reported challenge could, however, have arisen as a result of the teacher's inability to teach multi-grade classes, rather than problem of using the tablets rationally in a multi-grade classroom situation.

- *Technical challenges*

The use of tablets, as experienced by teachers, was not without challenges of a technical nature. Such challenges included the lack of internet connectivity experienced in some schools and malfunctioning gadgets in others (e.g. tablets with frozen screens), as illustrated by the following teacher's comment:

Maths teachers, I don't know with other teachers. But she also says so in the Senior Phase. The tablets don't open for us and the learners to download information. They do not open for Maths, but it's easy for language subjects ..., they [trainers] showed us the apps where we can download the books, but they do not function.

8.3 The Importance of Nutrition for Learning

It emerged from the qualitative data that the nutrition intervention, particularly the nutritional drink, responded to a definite need, gave learners more energy, and helped them to concentrate. One learner said: "When you are at school you have energy and can listen when the teacher is talking." Another noted that some learners arrive at school without having had anything to eat which would mean that they would have to wait until the break to have the meal provided by the school feeding scheme: "...because others come from home without eating anything... This juice gives us energy and makes the body warm". Another learner participant noted that the juice "makes us [learners] healthier than before". In this way, the breakfast drink functions as a valuable supplement to the existing school feeding scheme.

For this member of an SGB, 'the juice', as she calls the breakfast drink, is very important:

... there's a lot of change [at the school since the Tech4RED came] and I want to emphasise the juice ... most children were lazy to come to school ... and they say when they get to school the teachers will complain

'cause others will come and fall asleep ... 'cause they are hungry and there's no food in the stomach so when they get here they first go to the kitchen and get the juice. And the child will now be in the mood to focus on her studies.

The representative of an SGB quoted below, identified a number of the components of the nutrition intervention, including the provision of water:

This Tech4RED has got a lot of interventions in our school; one, we've got an energy drink here on the part of the nutrition programme. Our learners are having, three times a week, different flavours [of] energy drink. This drink has been coming from Pretoria, but now this energy drink is being done by University of Fort Hare. The bakkie from Fort Hare was here yesterday delivering about five drums of energy drinks with different flavours. Also on the part of nutrition Tech4RED has, we are proud of this programme really, we have been short of water here at school but Tech4RED has made a plan for us to have water; we've got a main line here coming from that upper location at Chris Hani's birthplace, but once the water up there has been closed we don't have any water ... but we had engineers from Tech4RED here, than they've done us, you can see we've got reservoirs here, there's big tanks here and as much they took a sample from the school garden, we'll be having now an irrigation scheme here at school ... you see, our learners will be getting fresh veggies from their school garden.

In line with the SGB's views reported above, the district manager explained the value of the nutrition intervention as follows:

There is a nutrition programme which is done by our provincial department, but through Tech4RED there is also ... a nutritional programme in that, there is a nutritional drink that is prepared there early in the morning ... breakfast drink. That breakfast drink is assisting the nutrition programme we have as the department [ECDoE] in that – yah it's good, I have tasted it myself – you go strong for some time, that is going to assist learners. Remember the learners are ... some of them are from poor families, migrant labour[ers], some of them are ... child-headed families ... All these are assisting in their education.

One principal, while stressing the value of the breakfast drink, noted some challenges faced by the school in providing it:

Ja, they [the learners] like the drink but we experience problems with the drink. One of the problems is the electricity, and the equipment, that's the problem that we have with the drink. So, since they do not have the equipment and the Tech4RED doesn't have equipment, it is difficult for the meal servers to prepare the drink because at 10 o'clock they should be serving our nutrition from the Department of Education. So there's that little problem that we are experiencing... Yes, so, although from June until now, they have not been receiving it because University of Fort Hare you see their machine is broken and now they have taken it to Gauteng.

The partnerships between the Nutrition WG, UFH, VUT, and the ARC have been productive and are illustrative of the ways in which science councils, working with universities, can add value to the work of both government and the universities themselves in terms of innovation and implementation. The work of this working group also illustrates the value of public-private partnerships, in this case, with Nestle and the Tiger Brand Foundation.

8.4 Sanitation as a Critical Issue

This intervention was implemented in three of the eleven schools where the South African technology was being tested. Given that the Sanitation WG intervened in only three schools, it is not surprising that our qualitative data showed lower levels of awareness about this working group. Further, due to a number of challenges which included the sourcing of funding, the identification of the most appropriate and acceptable (to the community) technologies to test, and a lack of communication around DBE/ECDoE sanitation plans in the circuit²⁴, this intervention only went into the field during the second half of 2014. It is, therefore, difficult to show the impact of this intervention in the

24 Interview with working group convenor, July 2014.

three schools in which the intervention was implemented. Sanitation is a sensitive and often contentious issue in South Africa, particularly in significantly under-resourced and under-served areas like Cofimvaba. Over the project period, the need for sanitation was raised several times by various stakeholders as a critical issue that needs to be addressed in the area.

There was clearly a need for a sanitation intervention in the circuit. One principal reported that “they [the learners] relieve themselves outside ... there is one down there.” Another school principal mentioned a security risk related to the toilets at the school: “Things like water we need them and toilets for children ... because children ... another year there was someone waiting for them outside. And we didn’t see him here and the teachers didn’t see him and some teacher went to the toilet and there was someone pushing the door”. This issue points to the need to scale up the sanitation intervention to the entire circuit as soon as possible. As a research team, we observed learners at a number of schools using the veld to relieve themselves. We have also documented numerous reports of poor toilet hygiene, including learners failing to wash their hands after going to the toilet or returning from the veld.

The fact that the working group was required to focus entirely on sanitation rather than a shared focus on water and sanitation as originally planned, speaks to the need for the scope of each intervention and the Tech4RED as a whole to be carefully thought out. A separate intervention focusing on water issues may be necessary as the Tech4RED is replicated and/or scaled up.

8.5 eHealth in Education

As can be seen from the description of the intervention above, the eHealth WG attempted to build on existing systems and integrate their work into existing or newly proposed structures. A successful example of this was aligning their intervention with the re-introduction of school nurses in the Eastern Cape. This is, perhaps, an important lesson for other working groups to take into consideration and of which any future initiatives of this nature should be cognisant, i.e. where possible, to integrate or align with existing structures and processes.

It is clear that it was critical to engage with stakeholders and partners as much and as early as possible. The eHealth WG was able to obtain support from the national and provincial Departments of Health which gave them access to the clinics and the school nurses, and generated valuable opportunities for collaboration. Further, commitment from the DBE was a critical element in the successful implementation of the eHealth intervention. The WG’s work operated across the mandate of both departments. Where the implementing partner did not have as solid a relationship with the national and provincial departments of health, it was advisable that the lead agency, in this case the DST as the political champion of the initiative, would ensure that there was commitment and support from all of the departments impacted and involved

The long-term impact of the intervention on the health outcomes of learners in the Nciba Circuit, including access to health care, remained to be seen at the time of this report, and should be measured over a longer period of time.

What can only be considered as preliminary findings at this stage, indicate that the screening apps developed by the eHealth WG, and the training that they provided to school nurses and CHCWs, enabled more patients to be seen per day than was possible using the manual, paper-based system.

The eHealth WG recognised that, as much as possible, the technologies, methods and systems that they were testing in their pilot should build on, enhance and/or improve existing systems. This point of departure seemed promising for a smooth incorporation of innovation into the daily functioning of the clinics and school nurse activities. Further, this approach may have made the intervention more sustainable and easier to scale up in the medium- to long-term. We suggest that this approach be incorporated into any future planning for the Tech4RED, interventions of this nature, and any attempts to adapt the Tech4RED intervention model on a larger scale.

Not only did the eHealth WG intervention develop new technologies and adapt existing technologies in an effort to improve health service delivery in Cofimvaba, by training the school nurses and CHCWs on the use of electronic devices such as tablets and the apps that were developed for their use, there was a skills building component to the intervention.

It is noteworthy that the eHealth WG made every attempt to design an intervention that was responsive to the needs of the community rather than making use of a technology-push approach. Finally, the eHealth WG situated their intervention within the context of the school health policy, and they engaged the necessary political and policy players in dialogue and through demonstration of the apps. In this way, they eHealth WG positioned itself well to inform and influence policy related to the health of learners in a rural context.

For the sake of consistency, and given that the Tech4RED was a school-focused initiative, the cost of this intervention per school has been calculated at approximately R46 153.85. The intervention has, however, the potential to impact on health outcomes at the community level as well.

One of the most promising outcomes of the eHealth WG intervention appears to be the productive relationship developed with the DoH, DSD and DBE. Integrating the work of these three departments through a DST-led intervention has much potential to improve the services offered by these departments for the improved health and well-being of learners in South Africa. This outcome can serve as a demonstration of this kind of relationship and its benefits.

8.6 Energy Support to Schools

Although Eskom, a national energy generating organisation, is making inroads through its massive drive to bring electricity to the rural areas of South African, not all rural schools, including those falling under the Tech4RED, have received full or adequate electrification. It is in this context that the value of the Hydrogen Fuel Cells project distinguished itself as an alternative source of electricity that could make a difference to the schooling lives of the members the Nciba Circuit schooling community. The Minister of Science and Technology launched the Energy WG's Hydrogen Fuel Cells project in Cofimvaba on the 12 June 2015. According to the District Manager, the introduction of alternative technological innovations such as the Hydrogen Fuel Cells project is likely to "influence the policy on infrastructural development".

8.7 Resources for the Teaching and Learning of Science

When asked if there was an intervention that they felt would be beneficial to the Nciba School community, a number of participants expressed enthusiasm for an intervention focused on providing access to a science laboratory, and the opportunity for teachers and learners to engage with science experiments. This teacher was enthusiastic about the potential for the Tech4RED to contribute to science education in the Nciba Circuit:

Interventions things that I think? We do not have the ... science lab ... when I've got to do experiments, the science lab is the one thing that I would like Tech4RED to help me with. And also if Tech4RED can help to, I don't know whether to do some things like excursions to take learners to or to tell me where to take learners to see some science projects ...

This participant's notion of a relevant education is one that teaches about science in a real and meaningful way in order to promote understanding.

Commenting on the proposed erection of a science centre in Cofimvaba by DST, the District Manager saw this as a by-product of the Tech4RED initiative's presence in Nciba Circuit. In his opinion, the positive effect and impact of the Tech4RED would affect not only the Cofimvaba District, but spread across the length and breadth of the entire Eastern Cape Province. This education official had this to say:

They [Tech4RED] brought to us a science centre ... they want to establish a science centre, which we liked. Our teachers, mainly our teachers are going to be trained in the district ... there are facilities which are going to be put up there to assist our teachers ... actually they are trying to promote the maths and science education. That has since influenced the province now [Eastern Cape Province] to also try and make investments in that area

8.8 Concluding Remarks

The themes that emerged from the qualitative data indicate that the Tech4RED interventions were responding to most of the needs of the Cofimvaba Schools Community. Although interventions were rolled out in more or less similar fashion from school to school, different challenges were experienced in each school. This was precipitated by the material conditions prevailing in each school. This was instructive for the future, showing that implementation of interventions should be customised to the prevailing circumstances in each intervention site or school. Also, the issue of sustainability of the various interventions became an urgent matter that needed to be resolved as the whole Tech4RED initiative reached conclusion. This called into question the effectiveness of the process that was put in place to aid monitoring, reflection and learning during the implementation of the Tech4RED.

CHAPTER 9 THE MERL LEARNER PERFORMANCE STUDY

9.1 Introduction

Part of the monitoring and evaluation of the Tech4Red project included assessing learners for their mathematical ability through the administration of Mathematics tests at three dates – in March 2014, October 2014 and October 2015 – to schools in both experimental and comparison circuits.

The aim of this chapter is to report on whether there was a significant change in learner mathematics performance between the two circuits over the time period March 2014 to Oct 2015. The results presented were obtained from carrying out the following data analyses: First, data analysis used graphical representations of the mean mathematics percentage over time for the two circuits; Secondly, we used Repeated-Measures Analysis of Variance (ANOVA) to determine if the average difference in performance was statistically significant.

In addition, the chapter will provide a comparison of the Nciba (intervention group) and Mabelentombi (comparison group) average mathematics performance from March 2014 to October 2015.

9.2 Comparison of Learners' Mathematics Performance by Grade in the Intervention and Comparison Circuits

In March 2014, a total of 776 Grade 4 and 679 Grade 7 learners were tested across the two circuits. Between March 2014 and October 2015 there was a drop in the number of learners who were tested in both circuits. The slight difference in the total from March 2014 to October 2014 can be explained by learner absenteeism on the day of testing, or they may have changed schools and hence the test was not administered to those learners. In October 2015, however, a larger drop in the totals were seen and could be attributed to learners not progressing to the next grade. The analysis that follows was only based on learners who were present at the school at each of the three test dates.

Table 13 Total Number of Learners Tested per Assessment Period per Grade

	March 2014		October 2014		October 2015		Total # Learners included in the current analysis	
	Gr 4	Gr 7	Gr 4	Gr 7	Gr 5	Gr 8	Gr 5	Gr 8
Nciba	485	393	453	362	407	288	383	256
Mabelentombi	291	286	263	250	209	173	193	160
Totals	776	679	716	612	616	461	576	416

9.2.2 Grade 5 Mathematics Performance

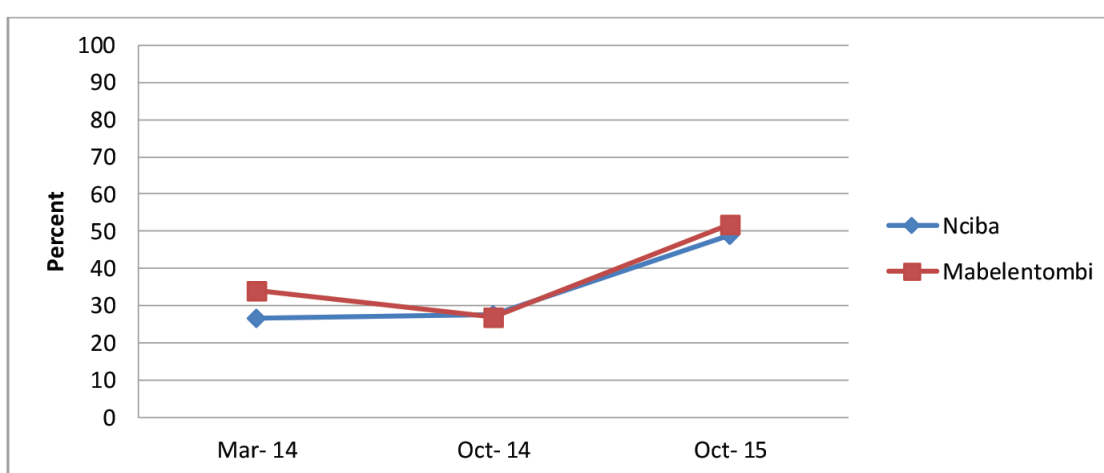
Using t-tests to measure differences between the Nciba and Mabelentombi Circuits at each of the three assessment dates, Table 14 shows significant differences of six percentage points between the two groups in March 2014. In October 2015 the difference, even though significant, dropped to four percentage points. It is clear that the achievement gap between Nciba and Mabelentombi narrowed between March 2014 and October 2015.

Table 14 Group Means and T-test Results for the 3 Testing Periods

Test	Means		Diff between two groups	t Value	Pr > t
	Nciba	Mabelentombi			
Mar-14	28	34	-6	-2.91	0.004
Oct-14	27	26	1	0.79	0.431
Oct-15	49	53	-4	-2.38	0.017

Figure 26 shows that within the Nciba Circuit an improvement of 21 per cent in mathematics performance was observed between March 2014 and October 2015, which is significant at a 95 per cent confidence interval.

A similar pattern was observed within the Mabelentombi Circuit with an improvement slightly lower than the change seen in Nciba. Between March 2014 and October 2015 a statistically significant change of 19 per cent was observed.



	Mar- 14	Oct- 14	Oct- 15	Diff (Mar 14 to Oct 15)
Nciba	28	27	49	21
Mabelentombi	34	26	53	19

Figure 26 Change in Mathematics Performance Between March 2014 and October 2015

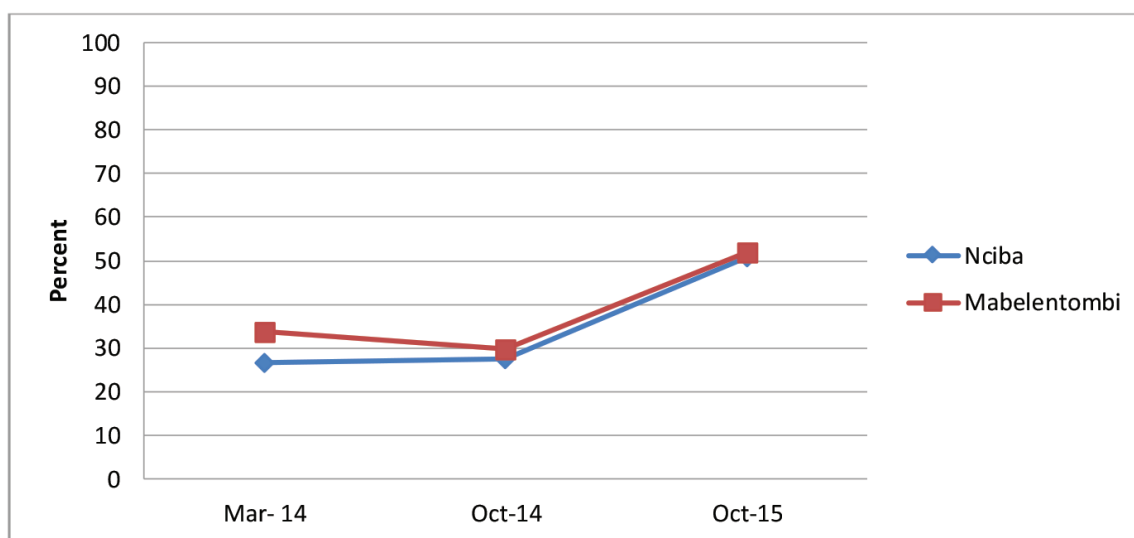
9.2.3 Grade 8 Mathematics Performance

The only significant difference between the Nciba and Mabelentombi Circuits was during March 2014 (Table 15) with learners from the Mabelentombi Circuit performing better than the learners in the Nciba Circuit by a difference of nine percentage points. Learners in the Mabelentombi Circuit performed slightly better than learners in the Nciba Circuit, but important to note is that the achievement gap reduced significantly over time.

Table 15 Group Means and T-test Results for the 3 Testing Periods

Test	Means		Diff between two groups	t Value	Pr > t
	Nciba	Mabelentombi			
Mar-14	27	36	-9	-5.04	0.000
Oct-14	28	29	-1	-0.34	0.738
Oct-15	51	52	-2	-1.06	0.292

In both circuits a significant improvement in mathematics performance was observed from March 2014 to October 2015 (Figure 27). The improvement in the Nciba Circuit (24%) was slightly higher than that of the Mabelentombi circuit (16%), and these differences were statistically significant at a 95 per cent confidence interval.



	Mar- 14	Oct-14	Oct-15	Diff (Mar 14 to Oct 15)
Nciba	27	28	51	24
Mabelentombi	36	29	52	16

Figure 27 Change in Mathematics Performance Between March 2014 and October 2015

9.2.4 Grade 9 Mathematics Performance

The Grade 9 results for the October 2015 assessment cycle will not be discussed in this section due to large amounts of missing data observed during the data management phase of the project. The missing data could be attributed to the following:

- Absenteeism on the day of testing;
- Rationalisation of schools; and
- Large dropout rates after completing compulsory schooling.

This section of the chapter will thus focus on learner performance during the March and October 2014 cycles.

Table 16 shows that there was no significant difference between the two testing periods for either of the circuits.

Table 16 Independent T-Test Comparing Performance in March and October 2014

	T-test statistic	df	P-Value	Average & difference (Comparison – Intervention)
Intervention (March vs Oct 2014)	0.4	648.2	0.662	-1 ↓
Comparison (March vs Oct 2014)	1.2	466.4	0.226	-2 ↓

Grade 9 mathematics performance remained relatively unchanged for both circuits between the March 2014 and October 2014 testing periods.

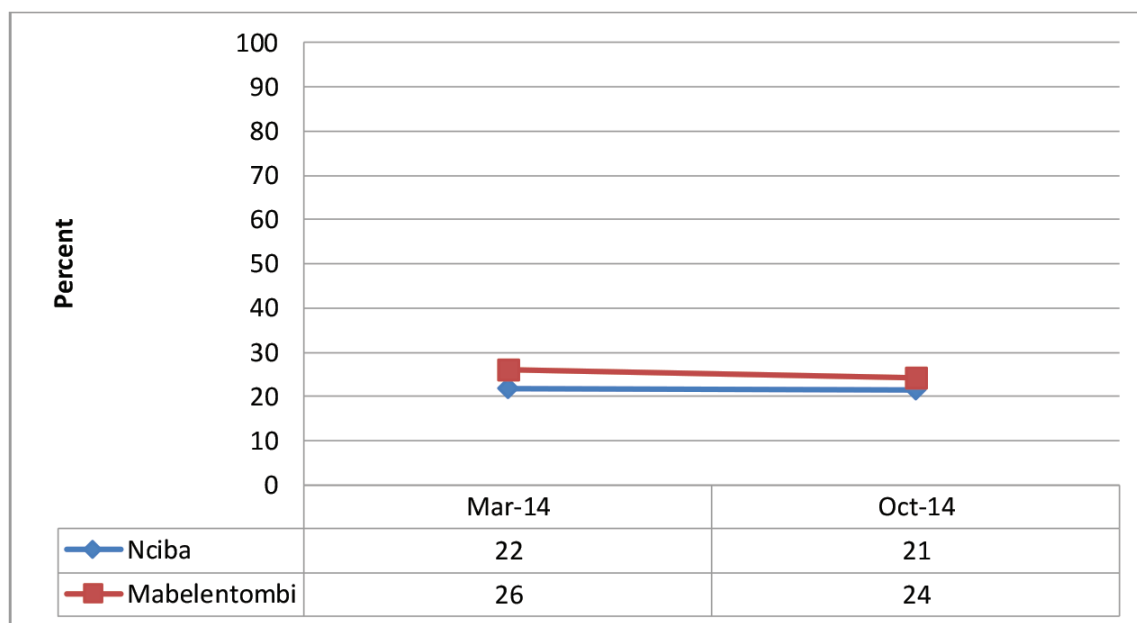


Figure 28 Difference in Grade 9 Mathematics Performance between March 2014 and October 2014 Tests

9.3 Concluding Remarks

The analyses show that in Grades 5 and 8 a positive and significant difference in performance was observed from March 2014 to October 2015. This reflected in both the Nciba and Mabelentombi Circuits. It is clear from the data that learners in Mabelentombi performed slightly better than learners in the Nciba Circuit. What is, however, important to note is that the achievement gap narrows between March 2014 and October 2015. In Grade 5 the difference reduces from six percentage points in March 2014 to two percentage points in October 2015. At the Grade 8 level the difference decreases from nine percentage points in March 2014 to two percentage points in October 2015. The Grade 9 results showed a significant difference in the average performance between the two circuits within each of the two testing cycles. The change in performance from March to October showed, however, that there was no significant difference in the average performance for both of the circuits. The Grade 9 data showed no learning gains but performance remained consistent between the two periods.

In conclusion, it should be noted that changes in performance may not be directly attributed to the effect of any of the TECH4RED interventions administered.

CHAPTER 10 LEARNINGS AND RECOMMENDATIONS

10.1 Introduction

A number of learnings and recommendations emerged from the MERL study. This chapter is divided into three sections: in the first, we give the questions that framed and guided the MERL activities; in the second, we present the learnings and recommendations from the Tech4RED; and in the third, a revised ToC for the Tech4RED is presented based on the reflections and learnings that emerged from the MERL up to the time of writing.

10.2 Research Questions and Findings

The MERL framework and processes were guided by key research questions focusing on the implementation of the Tech4RED. This section gives the four questions that were identified at the beginning of the MERL process and which were given attention throughout the MERL activities, as well as a summary of the findings related to each question.

Question 1:

How was each of the technological innovations chosen, introduced, implemented and embedded in a rural environment?

Following the identification of the need to support education in a rural context, the DST embarked upon the Tech4RED Project in order to intervene in the area of teaching and learning, the material conditions of schools, and human conditions. The six technological innovations were, therefore, selected on the basis of their possibility to contribute to the three identified areas of need. In this respect, the DST identified WGCs who were either based at the DST or at one of the Science Councils, according to their expertise. The majority of WGCs were members of staff working at the DST. In addition, the organisation of each working group was designed to bring together various stakeholders who would contribute to the development and implementation of the technology. The appropriate identification of convenors ensured that the activities of the working groups were in line with the intentions and requirements of the specific technological intervention. It is important to note that in the case of the Science Centres, the DST identified a convenor based at the DST together with a co-convenor from Sasol Nzalo.

Question 2:

How were the multiple interventions chosen, introduced, implemented and embedded in a rural environment?

The different technologies were introduced according to their stage of development and readiness. For instance, ICTs were the first to be introduced in 2012, beginning with Phase 1 in which the technology was introduced as a pilot in one school. Phase 1 was followed by the expansion of the technologies in the second and subsequent phases. In contrast, the low pour-flush technology from the Sanitation WG was first tested in three schools, then introduced fully (after the testing) in five schools in 2014. The Energy WG started with an energy audit of the schools in the Nciba Circuit. This was followed by the introduction of two technologies, the Hydrogen Fuel Cell Technology and Solar Energy. Both technological interventions were launched by the Minister of Science and Technology in June 2015.

In an attempt to embed these technologies in the rural context, the working groups worked in close cooperation with the local community in the Intsika Yethu Local Municipality, especially the communities in the vicinity of the intervention schools, so that these communities would have an understanding of the technology and would also play a role in the future roll out of a specific technology. For instance, the Nutrition WG encouraged the tending of the school gardens by members of the community including, in some cases, the parents of the children where the gardens were introduced. This led to a greater participation and involvement of the parents in the technology implementation.

Question 3:

What has been the impact of the individual and multiple interventions at the level of individuals (teachers & learners), school, and district?

The learners, teachers and principals in the intervention schools generally expressed positive comments about the technologies that were introduced. Some of them went to the extent of saying that the introduction of tablets into

their classrooms had enabled them to reach out and work at a level comparable with learners from urban areas. During data collection periods, learners at schools that had no sanitation facilities (toilets) expressed that they were happy about the introduction of such an intervention. The interventions generated a positive spirit which meant that the learners could focus on their classroom activities rather than worrying about what would happen in time of need.

In terms of performance in mathematics classrooms, the analysis of the results from Grade 4 and Grade 7 showed an improvement following the introduction of the interventions. It is, however, equally important to note that there was a similar improvement in the comparison circuit (Mabelentombi) which did not receive any exposure to the interventions. This leads to the conclusion that the improvement in performance cannot be strictly attributed to the introduction of the multiple interventions. Following the similar improvement in learner performance in the comparison circuit, the conclusion can be reached that there are factors that contribute to improvement in learner performance other than the introduction of technological innovations. The positive role that the interventions played in terms of positive learning experience cannot, however, be ignored.

Question 4:

What were the mechanisms for the lessons from the pilot site to be implemented at a national level (communication and dissemination processes, influencing key actors, financial costing and infrastructure – including human resources)?

Most of the mechanisms and lessons learnt are articulated below. It is important to take note there many lessons were drawn from the Tech4RED project that can be used to inform national interventions in similar rural contexts. Lessons drawn from this project can also be used in other government intervention and implementation projects and processes, such as Operation Phakisa.

10.3 Emerging Learnings and Recommendations

1. In a context of multiple deprivation, the multiple intervention approach taken by the Tech4RED is both unique, and responsive to the multiple and complex challenges faced in the rural education environment in South Africa.

The innovative multiple intervention model demonstrated in the Nciba Circuit by the DST through the Tech4RED resulted in improvements of material and human conditions of the schools in the Nciba Circuit, which directly and indirectly contributes to significant changes in the lives of the school communities. It is recommended that the multiple interventions model should be retained as the Tech4RED is rolled out in the future, not only in the ECDoE, but also in similar rural contexts in other Provinces.

2. Some significant changes have been noted in the material conditions in the Nciba Circuit following the Tech4RED interventions, however, such changes should be considered in the context of multiple deprivation.

The introduction of multiple interventions contributed significantly to the changes in material conditions of the schools (for instance, the number of toilets available for use, and the number of tablets which are accessible in the schools) and their communities. Such changes in material conditions contributed to the positive outlook of learners, teachers, the school and to neighbouring communities. A needs assessment of material conditions of the communities results in the design and introduction of multiple interventions that are relevant and which could make positive contributions to the lives of community members.

3. Learner Performance in Nciba showed improvement between March 2014 and October 2015.

Performance in the Nciba Circuit showed improvement, especially in Grade 4 and Grade 7, between March 2014 and October 2015. Despite these improvements, it is critical to note that changes in learner performance tend to take place over the long term (1.5 years) rather than the medium term (6 months). The recommendation to the ECDoE is that the Tech4RED should continue to be rolled out in the Nciba Circuit (and for all the schools to receive all the interventions) to allow for changes in learner performance to be monitored over a longer period. A similar recommendation would be advanced to the DST where projects like the Tech4RED would be planned for future implementation.

4. One working group was able to reach all 26 schools in the Nciba circuit.

There was a lack of consensus as to whether all interventions targeted all schools – in the education circuit of Nciba – as the smallest organisational unit within the system. It is recommended that consensus be reached about targets and that this be clearly communicated among all stakeholders as early as possible. It is further recommended that in a context of multiple deprivation, and with a view to inclusive education development, all schools in the circuit be targeted by each of the multiple interventions, despite the challenges (for example, availability of funding) that this approach may pose.

5. The national norms and standards governing infrastructure such as toilets within schools do not necessarily speak to the unique and multiple challenges faced by rural school communities in under-resourced areas.

The evidence from the technology-enabled interventions, for example the low pour-flush sanitation technology, should be used to revise the norms and standards documents. The impact of the technology-enabled interventions needs to be investigated further to provide sufficient and appropriate evidence in support of the revision of norms and standards.

It will be necessary for the DBE and provincial departments of education to scrutinise national and provincial regulations and procurement protocols, so that

- a) specific norms and standards are available for schools in a rural context which take into account the unique nature of the rural education environment; and
- b) allowance is made for new technologies (such as the low pour-flush technology being demonstrated by the Sanitation Working Group) to be provided to schools²⁵.

6. There is a need for policy that focuses on rural education due to the unique needs of and challenges faced by the rural education sector.

‘Rurality’ as a concept was embedded in the Tech4RED, which demonstrates that rurality must be considered in policy-making as more than simply a back-drop to project activities.

Many of the challenges that are faced in the rural education districts are unique to a rural education context and, therefore, require specific and directed policy-making and programming. A distinction must be made between the rural and the urban education sector, despite the understandable reluctance to do so. The Tech4RED experience can, and should, be used to raise awareness in different government departments about the emphasis and focus on rural contexts in various policies and interventions. Current efforts in DST to mobilise and work with other governments in these initiatives are encouraged.

7. Communication within the Tech4RED and between the Tech4RED and the community needs to be improved.

A communications strategy is essential for the successful implementation of such a complex project. This need was identified early on by the Tech4RED leadership within the DST, and needs to be revisited.

8. The attitudes of teachers and learners towards teaching and learning and the school environment, and levels of teacher and learner motivation, were not included as initial indicators in the MERL framework. Emerging findings from qualitative data, however, suggest improved levels of motivation and improved attitudes among teachers and learners in Nciba.

The data collected in October 2015 showed that the attitudes of both teachers and learners were impacted favourably and, therefore, contributed to a positive outlook and revived learning environments in the schools. The school communities (of most of the schools) indicated that the technological interventions gave them confidence about the future and that, even though they were located in rural areas, they could compare favourably with their counterparts in urban areas.

25 We would like to acknowledge Martin Mulcahy for this contribution.

9. Very little or limited literature exists on the introduction of multiple interventions in the education arena.

As a demonstration of a new approach to the challenges facing rural education in South Africa, the Tech4RED must be carefully documented and findings disseminated. A collated Tech4RED report on the implementation of multiple interventions is the first step towards adding to the literature.

10. Due to the connectivity offered by the tablets and access to the internet, the ICT4RED intervention is perceived as having reduced the geographical, ideological, emotional, linguistic, and epistemological distance between schools, teachers and learners in rural areas and those in urban areas.

This phenomenon, i.e. the relationship between connectivity and perceptions of distance, needs to be investigated further in rural communities. It is recommended that research on the relationship between connectivity and perceptions of distance be commissioned.

11. Technology for education development goes beyond instructional technologies to include the introduction of technologies outside of the classroom which could contribute to restoring the dignity of individuals, and could affect the quality of teaching and learning.

In addition to classroom performance, the intended outcomes of technology related interventions should be expanded to include the social aspect of technological innovation. In rural contexts, education development should not only focus on instructional technologies, but also on technologies that can contribute to the dignity of individuals, such as sanitation technologies. It is recommended that the unique approach taken by the Tech4RED – incorporating technologies besides instructional technologies – be disseminated in the education development sphere through various means, including policy dialogues, academic papers, and opinion pieces. The discussion in these forums should be informed by the drive to develop ‘joined-up’ state engagement with developmental challenges.²⁶

12. A number of working group interventions have not ‘been on the ground’ long enough to gain traction in the Nciba Schools Community.

In order to accurately capture the contribution made by each of the Tech4RED WG interventions, it is recommended that the Tech4RED multiple interventions continue to be rolled out in the Nciba Circuit and also in the comparison Mabelentombi Circuit, and that research and analysis continues. The implementation of interventions in the Nciba Circuit has raised expectation about their introduction in other circuits in the Cofimvaba District. The ECDoE is encouraged to seriously consider how this initiative can be rolled out to other circuits in the province.

13. A central project co-ordination structure would ensure that the work of the WGs does not take place in isolation, but rather builds on and supports the work of other WGs.

It is recommended that an initiative such as the Tech4RED have a full-time project manager, preferably based in the implementation area. A further recommendation is that a consolidated, initiative-wide project plan and timeline be developed to allow for the co-ordinated, complementary and cohesive design and implementation of WG interventions.

14. Make researchers available in the Nciba Circuit to monitor the MERL activities on a continuous basis.

The MERL research team employed a mixed method approach to data collection. The main data collection strategy that was followed, entailed periodical visits by researchers at designated periods over the year, to engage with targeted members of the school community and district officials on the various aspects of the interventions they were receiving. A glaring omission from this approach was the deployment of a researcher on the ground to continually monitor, observe and document intervention processes by various working groups as and when they unfolded. The presence of such a researcher on intervention sites could have captured data that might have shared light on the following:

- Early engagements between WGs and the schools about the interventions;

²⁶ We would like to acknowledge Martin Mulcahy for this contribution.

- Engagements between stakeholders during the implementation of interventions;
- Engagements regarding the utility of the interventions;
- Unfolding challenges and unintended consequences precipitated by the interventions; and
- How schools and WGs worked together to mitigate the unforeseen challenges and undesirable effects of interventions.

Having a researcher on the ground, working with both implementers and recipients of interventions, could have provided valuable data to assist in the process monitoring of Tech4RED and possibly strengthening the reflections and learnings dimension of MERL. The monitoring, evaluation, reflection and learning processes should consider the availability of researchers at the research site to monitor the implementation of the interventions on a regular and continuous basis.

15. A functional MERL Buddy System would have provided appropriate support to the WGs and a useful process in the implementation of Tech4RED interventions

The MERL Working Groups Forum (WGF) was intended to serve as a forum for formal feedback and communication between the MERL team and the WGs – a space for participation, reflection and learning. Given low levels of response to and participation in WGF, a MERL Buddy System (MBS) was proposed and adopted in its place. The buddies, who were MERL team members, were assigned to various WGs for the purpose of facilitating the intervention reflection and learning processes. The implementation of the MBS was not universal across the WGs owing to organisational and leadership issues of intervention agencies. In order to ensure that this critical component of monitoring and feedback functions properly, it is suggested that an accountability mechanism be created to ensure the consistency of supportive activities for aiding reflections and learning processes of the Tech4RED.

10.4 Revised ToC for the Tech4RED

In this last part of the report, we present a revised ToC (Figure 29) which can be used as a starting point for further discussions a ToC for future Tech4RED projects.

The ToC, as represented in Figure 29, illustrates how the Tech4RED, through each WG intervention, uses multiple interventions in the classroom, school and community environments to improve the quality of teaching and learning in a rural context. The Tech4RED interventions focus on improvements in the rural education context at three levels:

- teaching and learning conditions,
- material conditions, and
- human conditions.

The objectives of the initiative have been refined, but still form the basis for each of the WGs, which have articulated their own goals as outputs of the Tech4RED itself. Figure 29 illustrates the pathways of change that make up the ToC that are being suggested for the Tech4RED. By completing all of the action steps, each WG would achieve its goal, which would contribute to achieving the objectives of the Tech4RED as a whole. As each Tech4RED objective is achieved, so it contributes to achieving the goal of the Tech4RED. The Tech4RED and each of the WG interventions were implemented within a policy context and which they sought to inform and influence, to enhance policy-making around rural education and development. The ToC diagram shows how multiple interventions, and a multi-sectoral approach to addressing the challenges of a context of multiple deprivation, can be harnessed to achieve change in rural education and development.

10.5 Concluding Remarks

The Tech4RED project has clearly shown that the introduction of various interventions contributes significantly to the change in material conditions of the schools that participated in the Nciba. Even though the interventions were limited according to the needs of the schools, it has showed promise of what could be achieved in the future with interventions like the Tech4RED. The future projects such as the Tech4RED Project and other projects – in the Cofimvaba Education District and other Education Districts – depends on the commitment and sustenance of

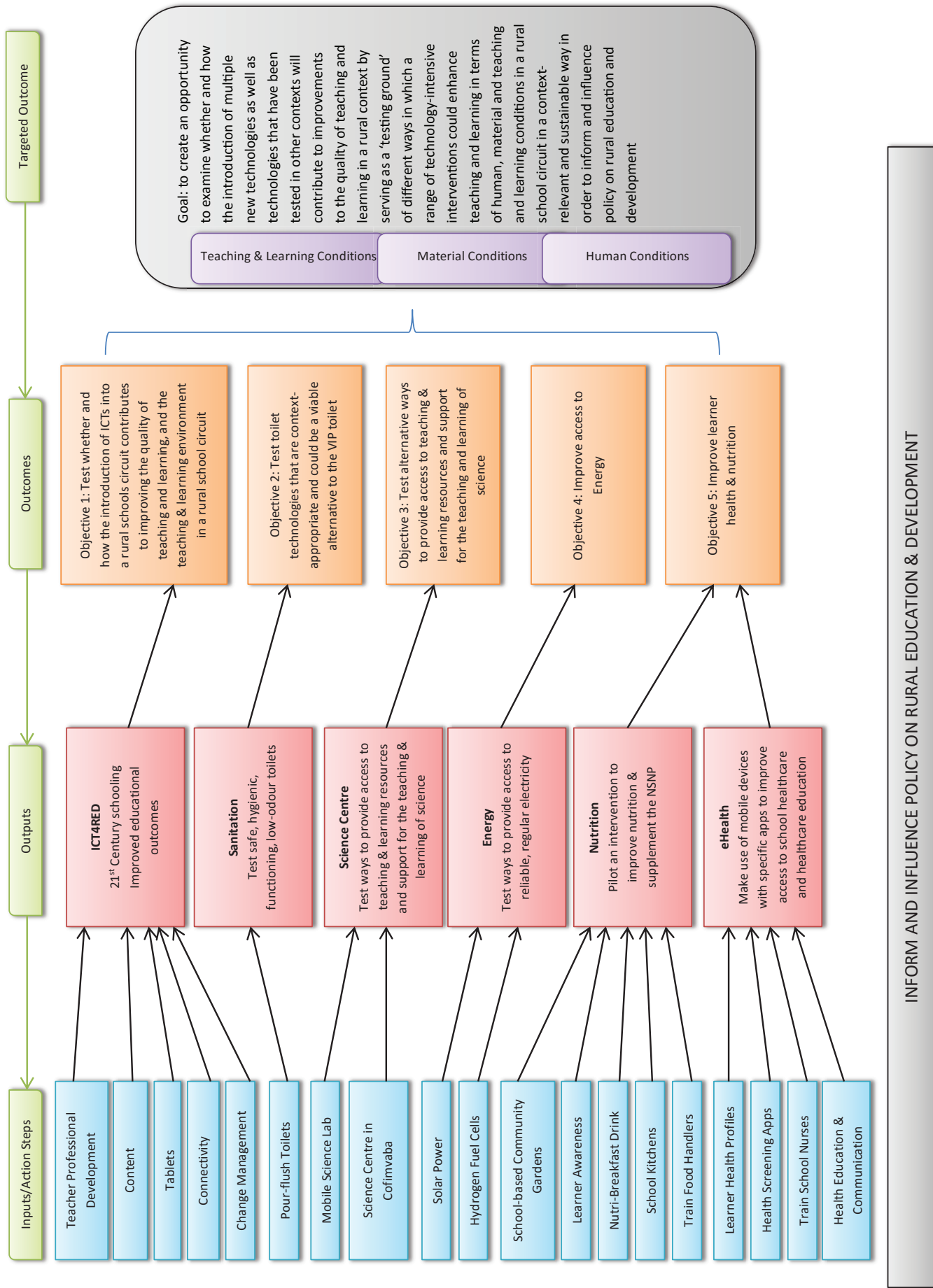


Figure 29 Theory of Change for the Tech4RED

these projects through involvement of relevant stakeholders, especially at the provincial level. Emerging findings related to improved attitudes and levels of motivation among teachers and learners in the Nciba Circuit are positive outcomes of some of the Tech4RED interventions. The important contribution that the Tech4RED initiative can make in informing and influencing policy, particularly the need for specific policy-making in relation to rural education, should not be underestimated.

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APPENDIX A OUTPUTS

1. A report titled *MERL for the Tech4RED - Report on Contextual Baseline Data Collection – Nciba Circuit*, was written by the MERL Team and submitted to the DST in September 2013. Further, observations from field notes as well as informal interviews with school principals or their representatives were presented as preliminary feedback at the 03 June 2013 task team meeting, shortly after the MERL team’s return from the field.
2. A report on the historical documenting of the Tech4RED project was written and submitted to the DST in September 2014.
3. The data generated in these interviews has informed the writing of this report.
4. The data generated in these interviews has informed the writing of this report.
5. An analysis of the data collected during March 2014 formed part of a report called *The MERL Project Learner Performance Baseline Study* submitted to the DST in September 2014. The data collected during October 2014 is reported on and compared to the March 2014 data in this report.
6. The data collected on the material conditions of schools in the Nciba Circuit in May 2013 were presented in the *Contextual Baseline Report* which was submitted to the DST in October 2013. An analysis of the data collected in March 2014 formed part of a report called *The MERL Project Learner Performance Baseline Study* submitted to the DST in September 2014. The data collected during October 2014 is reported on and compared to the March 2014 and May 2013 data in this report.
7. The data collected during March 2014 was reported on in a report called *The MERL Project Learner Performance Baseline Study* submitted to the DST in September 2014. The data collected during October 2014 is reported on and compared to the March 2014 data in this report.

APPENDIX B SCHEDULE OF INTERVENTIONS BY SCHOOL

School Name	ICT4RED	Nutrition	Sanitation	eHealth	Energy	Science Centre
Arthur Mfebe Senior Secondary School	X	X	X		X	
Bangilizwe Junior Secondary School	X	X				
Cube Senior Primary School	X					
Gando Junior Secondary School	X	X				
Gqoboza Junior Secondary School	X					
Gudwana Junior Secondary School	X					
Itlangano Senior Primary School	X					
Khwaza Senior Secondary School	X					
Mbudlu Junior Secondary School	X					
Mgcawezulu Primary Junior Secondary School	X					
Mpomvane Senior Primary School	X					
Mtimbini Senior Primary School	X				X	
Mvuzo Junior Secondary School	X				X	
Ntshingeni Junior Secondary School	X					
Sentile Junior Secondary School	X					
S'dubipoort Junior Secondary School	X					
Siyabalala Senior Secondary School	X	X				
St Marks Junior Secondary School	X	X	X		X	
Thembisile Martin Hani Junior Secondary School	X					
Zamuxolo Junior Secondary School	X		X			
Zanendyebo Senior Primary School	X					
Zenzile Junior Secondary School	X				X	
Zigudu Combined School	X					
Zwelibangile Junior Secondary School	X					