

**Designing and implementing an
Information Communication Technology for
Rural Education Development (ICT4RED) initiative
in a resource constrained environment:
Cofimvaba school district, Eastern Cape,
South Africa**



ICT4RED



TECH4RED
ENHANCING EDUCATION

Marlien Herselman and Adele Botha
2014



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First published in December 2014

First Print December 2014

Design done by: Go Fish Designs



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Herselman, M. and Botha, A. (2014). *Designing and implementing an Information Communication Technology for Rural Education Development (ICT4RED) initiative in a resource constrained environment: Cofimvaba school district, Eastern Cape Province, South Africa*, 1 ed. 2014, CSIR Meraka: Pretoria, South Africa.

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ISBN: 978-0-7988-5618-8 (hbk) | ISBN: 978-0-7988-5619-5 (ebk)

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Designing and implementing an Information Communication Technology for Rural Education Development (ICT4RED) initiative in a resource constrained environment: Cofimvaba school district, Eastern Cape, South Africa

This book is a representation of the activities, which were recognised as essential components to consider, when implementing a certain ICT4D initiative in a resource constraint area in the poorest province of South Africa which is faced with significant educational challenges. This initiative was coined the ICT4RED initiative and was a research, development, innovation and implementation project that changed the way in which teachers teach with technology in their specific context over a period of 3 years (2012-2015).

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Herselman, M. & Botha, A. (2014). *Designing and implementing an Information Communication Technology for Rural Education Development (ICT4RED) initiative in a resource constrained environment: Cofimvaba school district, Eastern Cape, South Africa*. Pretoria, South Africa: CSIR Meraka.

ISBN: 978-0-7988-5618-8 (hbk)

ISBN: 978-0-7988-5619-5 (ebk)

We would like to thank Estee Wiese (estee.wiese@gmail.com) for her editorial support during preparation of this book.

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Acronyms

CAPS	Curriculum Assessment Policy Statements
DBE	South African Department of Basic Education
DRDLR	South African Department of Rural Development and Land Reform
DSR	Design Science Research
DST	South African Department of Science and Technology
EAYL	Earn as You Learn
ECDoE	Eastern Cape Department of Education
ICT4D	Information and Communication Technology for Development
ICT4RED	Information and Communication Technology for Rural Education Development
ICTE	Information and Communication Technology in Education
IS	Information Systems
IT	Information Technology
LTSM	Learner Teacher Support Material
M&E	Monitoring and Evaluation
MoA	Memorandum of Agreement
MoU	Memorandum of Understanding
NDP	National Development Plan
NEIMS	National Education Infrastructure Management System
NGO	Non-Governmental Organisation
SGB	School Governing Body
SMT	School Management Team
Tech4RED	Technology for Rural Education Development
TPACK	Technological Pedagogical Content Knowledge
TPD	Teacher Professional Development

Executive summary

This book is a representation of the activities, which were recognised as essential components to be considered, when implementing a certain ICT4D initiative in a resource constrained area in the poorest province of South Africa which is faced with significant educational challenges. This intervention was coined the ICT4RED initiative and was a research, development and implementation project that changed the way in which teachers teach with technology in their specific context over a period of 3 years (2012-2015).

The book aims to provide an overview of the design and implementation of an *Information and Communication Technology for rural education development initiative* in a resource constrained environment.

Various frameworks, models, guidelines and tools were developed by adopting Design Science Research as the chosen methodology. Certain specific case study phases were applied within the Design Science Research process and lessons were learnt in each phase which was documented as the initiative moved from one phase to the other. Certain steps were followed during each phase. The book provides an overview of how each of the components, within the ICT4RED Implementation Framework (Section 2), were managed and how they were operationalised to provide specific deliverables or to reach certain aims.

The core team (one representative from each component) met once a week to track and trace progress and deliverables. What emanated from this ICT4RED initiative was far more than just frameworks, models, processes or tools, to be tested and refined, it was a *change* in the way 350 teachers (in 26 schools) applied technology and teaching strategies to support their teaching and learning and to improve their 21st century teaching skills. This initiative can be viewed as a successful intervention within a specific period of time involving specific people in a specific context where technology was deployed to support education.

What became evident from this initiative was that it was NOT about the technology, but about the PEOPLE who are empowered to use the technology in order to improve their lives and that of their learners!

New technology is common, new thinking is rare.

- Sir Peter Blake-

This book will guide readers through the journey of this initiative and it is hoped that it will inspire all new prospective students, teachers and academia to realise that the value of using technology does not lie in that it can ever replace the teacher, but that it can *enhance* teaching and learning and *transform* traditional teaching methods in a classroom. This transformation can only be successfully done where technology is earned and not just given away or provided free of charge.

The book is divided into Sections (1-9). **Section 1** provides the Introduction and Background to the ICT4RED initiative and describes how the ICT4RED Framework evolved and how it was adapted after every phase. The methodology, which underpinned the development of the framework, is also dealt with.

Section 2 delivers an overview of the ICT4RED implementation framework, as one of the key artefacts to describing the ICT4RED initiative.

Section 3 summarises how Teacher Professional Development (TPD) was developed and deployed.

Section 4 covers the importance of the Monitoring and Evaluation framework and how it was applied in the ICT4RED initiative, over a period of 3 years. It is not the intention to focus on results but to share *how* the M&E framework was used to obtain results and effect impacts.

Section 5 provides details regarding Initiative Management, Operations Management and School ICT. The focus is on *how* the ICT4RED initiative applied different processes, used certain tools and actioned suppliers to equip schools and teachers in the Cofimvaba school district.

Section 6 addresses the ways in which Change Management and Stakeholder Management contributed to the integration of technology in a resource constraint community in a specific context.

Section 7 focusses on Sustainability and how value is derived through improved decision-making. The issue of sustainability, and how it plays an important role in the ICT4RED initiative, is discussed. Total Cost of Ownership-, Cost utility- and Tablet selection-models, which were developed to address sustainability, are also discussed.

Section 8 deals with the use of social media in the management of the ICT4RED initiative. The Twitter and WhatsApp feeds (over a period of time)

were analysed and provided some interesting results.

Section 9 provides a synthesis in which the objectives and aims, and how these were achieved, are addressed. This last section also looks at changes, which were eminent in the context of the initiative, and ends with some recommendations for similar future endeavours.



Photo 1-1: TPD Phase 2

Acknowledgement

This work acknowledges the TECH4RED Initiative, and more specifically the ICT4RED component, which is supported by the Department of Science and Technology, the Department of Rural Development and Land Reform, the Department of Basic Education and the CSIR for allowing us to collect data from the participants in the Nciba district of Cofimvaba in the Eastern Cape Province of South Africa to inform this work. We also acknowledge the support provided by the Eastern Cape Provincial Department of Education, the ICT4RED core team, other outsourced companies and universities. Special recognition has to be given to the district officials, circuit manager, local suppliers, teachers, learners, parents and community of the Nciba circuit in the Cofimvaba School District who have enthusiastically embraced this initiative and have become co-creators of their own destiny and innovation.

It is not about the technology; it is about sharing knowledge and information, communicating efficiently, building learning communities and creating a culture of professionalism in schools. These are the key responsibilities of all educational leaders.

- Marion Ginapolis-

Initiative Participants

The following participants are recognized:

- CSIR Meraka Institute (Initiative Management and component championing)
- Department of Science and Technology (DST) and Department of Rural Development and Land Reform (DRDLR) (Initiative Sponsors)
- DST, DRDLR, Department of Basic Education (DBE) and Eastern Cape Education Department of Education (Initiative Stakeholders)
- Human Science Research Council (HSRC) (Monitoring and Evaluation of TECH4RED)
- Benita Williams Consultants (Monitoring and Evaluation)
- Impact Advantage (Modelling)
- CoZaCares Foundation (Content)
- Maskew Miller Longman (Content)
- Pearson (Content)
- SchoolNET SA (Teacher Professional Development)
- AfroFusion (Communication)
- Hive Holdings (Technology infrastructure design, Operations Management)
- Tipp Focus (Change Management)
- Nelson Mandela Metropolitan University Govan Mbeki Mathematics Development Unit (Content)
- Fort Hare, Rhodes, Nelson Mandela Metropolitan University, University of Pretoria, University of Johannesburg, University of the Free State, University of South Africa, University of Manchester, Monash University (Postgraduate students and Research)
- Faranani (Professional Services)
- University of Pretoria (Ethnography and Content)
- Lymmyl Technologies (ICT Infrastructure Implementation and Support)
- Liquid Telecom (Satellite Connectivity)
- Maggie Verster (Teacher Professional Development)
- Sandy Malapile (Stakeholder Management)
- Uys du Buisson (Operations Management)
- Redline (Wireless Mesh Networks and Wi-Fi Implementation)
- Google South Africa (Technology infrastructure)

Section 9. Synthesis of the ICT4RED initiative

M Herselman

9.1 Introduction

This section will provide a synthesis of the ICT4RED initiative and will highlight certain important elements of success. It will re-address the aims and objectives which were provided in Section 1 and also address some significant changes which became evident while and after the implementation occurred.

The Sections above provided evidence of how the ICT4RED initiative was managed and developed over a period of three years through the application of Design Science Research in three different iterations (one school, then 11 schools and finally 14 schools) in four phases (cf Table 1-3 in Section 1). After every phase the feedback from all the stakeholders, teachers, district officials and community were noted and these were used to improve the components for the next phase. The phases also assisted in refining the various artefacts in all the 12 components.

9.2 Addressing the aim and objectives

In Section 1 it was explained that this initiative had clear aims and objectives with frameworks, models, guidelines and tools (as artefacts), which had to be tested through research and implementation in order to develop a final ICT4RED framework which could inform policy changes and to make recommendations for future implementations of a similar nature.

The main aim of the ICT4RED initiative was to investigate the application and deployment of tablets, supported by other technologies (which include school infrastructure, network connectivity, e-textbooks and other electronic resources) to the identified 26 schools in the Cofimvaba school district in the Eastern Cape of South Africa, in order to improve rural education via technology-led innovation in a specific school district in one province of South Africa.

The result was that this aim was reached. Through the investigation more than 6500 learners, 350 teachers and 16 district officials were affected in the Cofimvaba school district over a period of three years. The whole

community was involved and this also had an effect on their own lives. The improvement of rural education is not just evident from the infrastructure that was provided (Wi-Fi, Satellite dishes, content server, charging stations, security cages, etc), but also from how the schools were changed. The tablets allowed for better planning, the establishment of an ICT committee for each school to make decisions on the use of the tablets to support teaching and learning and allowed for teachers to be exposed to new ways of teaching with technology. Each school has an ICT champion to support them in the use of the technologies. Teachers became co-creators of new content and classroom settings changed from sitting in rows to working in groups and finding new ways to make teaching fun and exciting for learners. Teachers for the first time in that area felt empowered with new knowledge to use technology with confidence. Some teachers have excelled more than others have, but all of the teachers earned their technology with evidence of successful applications of teaching strategies. It is not often that you get a 100% pass rate for earning technology through the badge system.

The following **objectives** were envisaged:

- Explore and design systemic and sustainable approaches to providing access to digital content at resource constrained rural schools in South Africa. This incorporated an investigation into new and evolving educational technologies, devices, platforms and processes that support the access to digital content for rural school environments.
- Explore and design approaches for Teacher Professional Development (TPD), towards the evolution of a more emerging teaching and learning engagement for the information age. This extends to the development of 21st Century teaching practices of teachers and 21st Century skills of learners, and
- Use the evidence from the research within this context to inform policy in an integrated and coherent manner.

These objectives had to test the following models:

- Infrastructure and Connectivity
- Integration into the school
- Operations, Logistics, Support and Maintenance
- Costs (Total Cost of Ownership) and Sustainability

- Content selection and organising content on servers
- Tablets (selection and upgrades)
- Change Management
- Teacher professional development
- Other training needs

The table below indicate how each objective was addressed and what the results was to support each:

Table 9-1: Addressing the objectives with evidence of how

Objective	Evidence of achievement	Section where it was discussed in this book
<p>Explore and design systemic and sustainable approaches to providing access to digital content at resource constrained rural schools in South Africa. This incorporated an investigation into new and evolving educational technologies, devices, platforms and processes that support the access to digital content for rural school environments.</p>	<p>Developed monitored the 12 essential components which resulted in the ICT4RED Implementation Framework as well as other frameworks (M&E), models, guidelines and tools. Arranged access to digital content on the content servers at each school which teachers and learners can download via Wi-Fi to their tablets. Access to McMillan and Pearson e-books. Developed processes for procurement of infrastructure equipment, tablet loading, support and maintenance. Developed Decision-support tools (cost utility model, Total cost of ownership model, Tablet selection model)</p>	<p>Section 1 Section 5 (School ICT) and Section 6 (sustainability and tools)</p>
<p>Measure the effect of this initiative on the 21st century skills of learners</p>		
<p>Use the evidence from the research within this context to inform policy in an integrated and coherent manner</p>	<p>Developed guidelines, models and frameworks, standards, recommendations, policy briefs to national and provincial governments. Developed practitioner outputs (planning and implementation guidelines, tools, templates, checklists) to various practitioners (schools, NGOs,</p>	<p>Section 1 and 2 (Evolution of Evidence-based ICT4RED implementation framework) Section 5 (Initiative Management)</p>

Objective	Evidence of achievement	Section where it was discussed in this book
	provincial implementing agencies, etc.)	

All the objectives were addressed and various outputs (artefacts) were indicated above. The learning from this initiative was designed to feed into the system in a multi-dimensional way, to a variety of stakeholders in the rural educational eco-system.

9.3 What were the biggest success factors?

What made the ICT4RED initiative a success was that it was an implementation initiative with a sound research basis and the monitoring and evaluation component provided lessons learnt which could be applied to improve the implementation of each phase.

The Design Science Research methodology proved to be the best suited for this type of initiative as can be seen in Section 1. The phased approach with applicability of the lessons learnt after each phase allowed for improvement and more successful outputs. If the whole initiative was implemented at all 26 schools at the same time, I think, we might have had less success. The fact that the initiative was well researched and planned in the beginning and was organised around essential components with champions allocated to each component who were all experts in their own domains is one of the most important success factors.

The Department of Education (2014) indicated that South Africa has 12.3-million learners, some 386 600 teachers and 26 292 schools, including 1 098 registered independent or private schools. Of all schools, roughly 6 000 are high schools (Grade 7 to Grade 12) and the rest primary (Grade 0 to Grade 6). In the Eastern Cape Province the Department of Education (2014) indicated there are 7407 schools. This initiative only target 26 schools in a very remote and resource-constrained environment. Although this is a small number compared to the total number of schools in the province, it still made an impact in the lives of the teachers, learners, district and community. Teachers who did not necessarily know who was teaching the same subject in the same area as them got to know each other and started sharing ideas and lessons with the intent to support learners to become more skilled in 21st century skills. We target an 80%

pass rate for teachers who will eventually earn their tablets in the training and in the end we had a 100% pass rate, which is a huge achievement. Teachers are more motivated and keen to learn more and have already requested additional training on specific topics which were not covered in the TPD training modules (like Internet use).

Spence and Smith (2010) define five main stories in their review of the literature of ICT, development and poverty reduction, namely: universal access, economic and social services, openness, human development, and innovation. These five can all be found in the ICT4RED initiative as openness and transparency were some of the values that were communicated from the start. Economic and social services were not measured, however it was observed that on a social level the initiative did provide support and on an economic level the district and principals were trained in the Change leadership courses to develop a vision and planning their budgets. Human development of all involved are evident in all the sections above and innovation were seen as playing an important role in that the teachers became co-creators of new knowledge and created new innovative lessons based on the training and application of the training in their own classrooms.

Heeks and Molla (2009) and Heeks and Molla (2010, p. 635) indicate that good practice of ICT4D project managers are measured around three issues:

- Design: ensuring that designs are sufficiently aligned to local realities.
- Governance: drawing on the strengths of multiple actors.
- Sustainability: ensuring this from an economic and socio-political perspective.

The ICT4RED initiative complied with all three issues above as it was well designed and used its phases and a sound research methodology to track changes and progress. Governance was well managed and multiple actors or component champions provided progress on the developments in their components over a period of three years. Sustainability was addressed although one can never claim that economic sustainability can be guaranteed. There are just too many factors that can influence this (Provincial commitment to maintain and deploy tablets, cutting budgets and expenditure on upgrading technology, the context of poverty where

parents do not always have the means to buy new tablets for their children, etc.). The ICT4RED initiative has supported sustainability from a socio-political perspective as all political leaders in the community (chiefs, tribal leaders etc.) were involved in community engagement meetings and workshops from the beginning until the end. They felt that they were part of the initiative and their roles in the community were valued. Sustainability of ICT4D interventions has shifted the focus away from the technology aspects to the human aspects. The role of technology has become clearer as being “only a magnifier of human intent and capacity” (Toyama, 2010).

As Marais, Steyn and Villeneuve profoundly indicates (2011) the role of technology is limited in sustainable ICT4D interventions, the human dimension is paramount. In each of these overviews of sustainability issues, the focus is wider than the individual project and includes the greater context within which the project is conceptualised and executed, and within which it ultimately has to become sustainable.

Having a sustainability plan, as a district, does not guarantee sustainability. The same can be said about having a Mobikit with 15 loaded and ready to use tablets at each school. If it is not executed and used, it cannot work and if it is not supported by national and provincial government departments, it will also not suffice. These are the contentious issues that can play a role in the future of this initiative.

You cannot teach a man anything, you can only help him find it in himself. Galileo Galilei

Issues relating to sustainability for each of the 12 crucial components in the ICT4RED implementation framework will be discussed in Section 9.7.

9.4 Other significant results

The following are some other important results from the ICT4RED initiative:

- A greater variety of Learning and Teaching Support Material (LTSM) is available to more learners and teachers.
- 21st century skills of teachers and learners have been influenced.
- Innovative and practical focussed Teacher Professional Development training modules were developed, which can be

adapted and used by anyone and is available online under a Creative Commons Attribution-Non-commercial-Share Alike 3.0 licence. This allowed for teachers who were empowered with knowledge on how to use technology in their classrooms and to apply new teaching strategies;

- The principals can now communicate via e-mail and not just over the phone or in meetings and have received Change leadership training.
- The province and the Nciba circuit manager have developed a sustainability plan to support teachers and learners after the initiative.
- Schools are better equipped with electricity, security, storage and charging of mobile devices and with satellites and Wi-Fi for Internet access and for downloading content from servers.
- Schools all have an ICT committee which takes decisions about the use of the technology in their school.
- All schools have an ICT support person to assist with bookings and maintenance and support of the technology at their schools.
- Other provinces are duplicating the TPD training material for their teachers.
- Universities are developing the training material to offer short courses to industry and other academia.
- Overseas universities are translating the training content into Arabic to use in Morocco.
- Advice is provided to other schools and lessons are shared at conferences, workshops and at forums.
- The overall changes are mostly positive and initiative is well received both nationally and internationally.
- The uptake and use of the technology have affected every person who was part of the initiative. There is ownership and use which can affect impact.
- New decision-support tools were developed (Total Cost of ownership model, Cost utility model, Tablet selection model, Application evaluation tools to ensure the apps support CAPS)
- A sustainability model was developed for this type of initiative in this type of environment
- Guidelines were developed to deploy tablets in resource-constrained schools.

- The schools seemed to have support from parents, but safety and security issues will always remain a concern.
- Teachers are also using the tablets for administrative purposes which was not covered in any of the TPD training modules
- Schools also report a change in way the district interacts with them after the project started in their school. Especially the officials involved in e-learning and institutional development are visiting schools more frequently and assisting with tasks such as co-ordination of training, assisting in incorporating tablets into teaching, providing moral support and boosting teachers' confidence, suggesting strategies on how to keep tablets safe.
- The ICT4RED initiative is contributing towards the Department of Science and Technology's Human Capital Development goals: The ICT4RED initiative is actively supporting 6 Master's degree students and 3 PhD students with funding for their studies, and a further 3 Honour's Students, 2 Post-Doctoral students and a team from SAP research are also using the ICT4RED initiative in their research.
- The ICT4RED initiative is contributing to the body of knowledge in fields such as ICT for Education, Rural Development and Evaluation. By 2015, the ICT4RED initiative had delivered 10 published papers in local and international conference proceedings, with other research outputs in process. This number is expected to rise even further.
- The initiative did not focus on improving results of learners if this was the case the whole scope and objectives would have been different. There are too many variables that can play a role in saying that this initiative has had a positive influence on results of learners.

These are the most important results.

9.5 Challenges

- State of buildings, which has to be attended to safely secure the tablets.
- Rationalisation/Reallocation - Grade 8, 9 classes from Junior Secondary schools that are close to Senior Secondary schools have been merged into new 'Secondary Schools' in 2014. This has

caused severe disruptions in schools.

- Financial sustainability – ECDoE have requested ICT4RED to help with their budget so that the operational costs can be integrated into the departmental budget. This is a major step forward in terms of long-term financial sustainability of the initiative.
- Crime is always an issue to contest with in this type of implementation initiatives, especially in rural areas.
- Electricity is a real challenge, both in terms of quality of electricity, cost of electricity as some schools use prepaid and budget R100 a month. This issue is critical as the equipment is dependent on electricity. The aim should be to use renewable energy as a possibility.

9.6 Recommendations for further implementations

Integrating technology is a facilitated process and as such meaningful integration needs to be planned and facilitated. This is not a process that happens overnight and can be experienced as disruptive and stressful to the school system as well as the individual teachers. As such change management forms an important mitigating activity.

Teachers need to be met where they are and their current competencies and skills matched to expectations and activities. As this is often not possible when doing TPD with a number larger number of teachers, it is advisable to aim at the lowest common denominator and to scaffold from there.

If you cannot model it don't do it. Actions speak louder than words and there is very little that can replace the actual experience of a strategy. It is often easier to lecture but as teachers often teach like they are taught it is imperative that strategies and skills be modelled.

The **teacher professional development interaction** is costly and needs to be seen as an investment in more than just mastering a technology for the sake of it. Careful consideration needs to be given to content, strategy as well as technology use.

The interaction design of a TPD learning intervention must be a positive learning experience for the teacher to translate into a willingness to experiment in their own classroom. In conclusion simplicity and repetition

is essential for success.

The **badging system has to become a digital badging system**. The linkage of badges as a measurement of achievement was very successful. It also had the added benefit of ensuring very close monitoring of the teachers and enabled the team to intervene very quickly when problems occurred. Digital badges are evolving into a key credentialing and assessment tool for the 21st century and are particularly effective in promoting lifelong learning and can accredit accomplishments or skills attained outside formal learning environments.

The developing of **an intelligent, distributed, cloud-on-demand rural content service** that takes the concept of a content repository to a new level. The proposed Content Server will act as a localised content repository that will intelligently harvest, download, tag and present relevant content from either a cloud repository or the web via Wi-Fi, Bluetooth or tethered download. It will implement collaborative filtering techniques to anticipate download requests from schools that are similar in nature. The content server will facilitate the packaging of learning activities and the creation, sequencing and pacing of learning pathways to facilitate the completion of complex tasks as a series of smaller tasks or activities

There is a need to continue **work with the district and province in terms of integrating tablets** into all the processes at both levels. This is part of the research that needs to be done in order to identify what needs to be done to embed technologies sustainably into the system. This includes a lot of work at a national level, in terms of using the research evidence from the initiative to support policy and implementation.

A particular need would be to **continue monitoring and evaluation activities over the next 2 years**, in order to measure the true impact of the initiative, once the larger ICT4RED initiative team has withdrawn. Because of the 'Earn as you Learn' and phased implementation approaches, rollouts of the various technologies have only occurred once schools have demonstrated they are ready.

Other important considerations are to consider the load on each school pertaining to **Wi-Fi downloads for each classroom**. This can inform broadband policies especially if content will be hosted in the cloud.

Further research on **specific content and Application uses** are recommended in order to develop a **South African Educational Application store** in the future. This provides opportunities for local content creators and entrepreneurs in terms of e-textbooks, videos, applications.

The concept of a **‘Digital Library’** for rural communities consists of a central library management server and distributed ‘digital libraries’ hosted at any facility which has access to the Internet and which provides Wi-Fi hotspot access to communities.

Based on the above recommendations it is also important to identify the sustainability issues that are related to each of the crucial 12 components in the implementation framework.

9.7 Recommendations relating to sustainability and policy

It has been mentioned earlier in this section that having plans and technology does not guarantee future use, uptake, ownership and thus sustainability. The chapter on sustainability also provided some excellent insights on possible cost models to assist in supporting decision makers in arriving at financially sustainable implementations in different contexts. Based on all the evidence and results in the ICT4RED initiative, it was decided to provide some considerations (guidelines) pertaining to sustainability for each of the 12 components in the implementation framework. The following issues were identified:

Table 9-2: Table of Components with Sustainability guidelines

Component	Sustainability guidelines
Project management	<p>Project selection</p> <p>Develop a strategy for pro-active management of donor-funded projects within the operations of the Department of Education (including project screening, project scope definition, project contribution to operational costs).</p> <p>Joint project vision</p> <p>Develop a joint vision of impact (for adoption by the system)</p> <p>Within the project implementation team</p> <p>Jointly between implementation team and education system</p>

Component	Sustainability guidelines
	<p>owners Jointly between implementation team and beneficiaries</p> <p>Sustainable financing</p> <p>Plan a <i>modular</i> implementation to fit the budget of the province. Develop a cost model (TCO model) and associated scenarios within the design phase of the project in conjunction with the Department of Education. The TCO model should consider implementation of the project by either a project team or by the Department, and should include, for example, replacement costs of devices. The model should be validated and scenarios should be updated on an annual basis.</p> <p>Project execution and handover</p> <p>Define a temporary implementation structure that gradually learns about the operational requirements of the implementation over the duration of the project. This process results in the following actions:</p> <p>Facilitation of the development of the structures and processes that are required to maintain the implementation at handover. These could include:</p> <ul style="list-style-type: none"> Capacity building at district level Motivation for new resource requirements at school or district level, with updated budget requirements Assignment of a Project Manager (PM) liaison person at District and Province level, who can participate in planning and PM aspects and be involved in handover on completion of the project. The assignment is to be done by the Department of Education, at both District and Province level. Initiation of a process of gradual handover of selected PM and project admin functions, from the onset of the project. Joint development of recommendations pertaining to handover by the implementation agency and the Department on a yearly basis.
Stakeholder management	<p>Define the specific stakeholders that are vital to the realisation of different dimensions of sustainability.</p> <p>Develop joint understanding of key sustainability factors from top-down and bottom-up perspectives.</p> <p>Develop a high-level sustainability plan with the stakeholders.</p>

Component	Sustainability guidelines
	Define appropriate and realistic governance structures to link funders and system owners.
Communication	<p>Design project communication mechanisms to solicit quick feedback from the beneficiaries as well as the project implementation team (e.g. through use of social media).</p> <p>Provide regular (monthly) status updates to the community, SGBs, and all levels of Department of Education via various channels (fax, email, paper) .</p> <p>Drive communication on the ground by feedback from the schools.</p>
Change leadership and management	<p>Define a change management strategy upfront, through close liaison between the project management, operations management and stakeholder management functions. The strategy should quick reaction when important change management issues arise.</p> <p>Facilitate leadership of the change management process by the Province, District, and Principals.</p> <p>Conduct change readiness assessments, from organisational, personnel capacity and personal motivation perspectives.</p> <p>In practice, foster change agents at every level as they emerge and legitimate their role within formal structures.</p>
Community engagement	<p>Include methodologies that enable development of community ownership (i.e. school and district level) of the initiative.</p> <p>Engage each school as a partner at the start, and facilitate handover of the community engagement role to them as soon as possible.</p>
Teacher professional development	<p>Design this function to be complementary to the existing provincial Teacher Development Strategy, since the focus is on teacher pedagogical practice and not on content (CAPS). Discuss the joint strategy with the Province. Provide credit to teachers (SACE accreditation) for completion of the training. Facilitate capacity building and accreditation of the training entity (e.g. SchoolNet).</p> <p>Adopt the TPD approach that is advocated (pedagogical approach not just CAPS alignment) by the provincial department in the long term, for training at school level as well as at circuit and district levels.</p> <p>Develop Communities of Practice at Circuit level with teachers,</p>

Component	Sustainability guidelines
	<p>which include Circuit participation. The latter could be led by a member of the Circuit (principals or district person) or by an emergent champion.</p> <p>Provide change leadership training and TPD training to District officials and Principals. It is advisable to provide tablets, and it would be ideal to have District officials participating as trainers.</p> <p>Define performance parameters that are related to this initiative that are incorporated into performance measures for district and teachers.</p>
Content and curriculum	<p>Develop relationships with major content providers to get regular content updates at a good price. Use Open Education Resources that are mapped to the curriculum. Stimulate the generation of local content, curate the content and use it in a wider context, with suitable recognition of authorship.</p> <p>Engage with the Department of Education to develop a strategy for incorporation of local content into the curriculum</p>
School ICT infrastructure	<p>Assess the readiness of the school infrastructure for the incorporation of ICT infrastructure.</p> <p>Facilitate a change in the policy of the schools as asset owners in order to ensure that long term maintenance and replacement costs are covered by the Province.</p> <p>Facilitate School and district-level learning in terms of asset management.</p>
Operations Management	<p>Assess the readiness of the school to manage ICT operations. Pilot formal operations management from the start, employing both bottom-up and top-down models of operations management. Train staff or community members at the school level for low cost local support, and develop a top-down professional support network that has a footprint per circuit.</p> <p>Develop a cost-effective and affordable operations management model, cognisant of local conditions and resources.</p> <p>Institute a trickle-down model so that replaced teachers tablets are used as stock for learner tablets.</p> <p>Policy issues: Make provision for upgrades and replacement of devices at a policy level.</p>
Network	Use of national broadband initiatives.

Component	Sustainability guidelines
	<p>Collaboration with existing connectivity initiatives in the province via the creation and support of an ICT steering committee.</p>
<p>Monitoring and evaluation</p>	<p>The M&E strategy should include a focus on people aspects as well as on the system within which the intervention is delivered: The introduction of ICT in schools places an extra burden on the school management system, and monitoring should notice this early in order to allow project to adapt. The personal focus should include skills development and the usage of skills in classroom.</p> <p>Start monitoring as early as possible and identify key factors relevant to sustainability.</p> <p>Ensure that M&E informs project design decisions on an ongoing basis during project execution, as well as inform the project design framework.</p>
<p>Evidence-based policy</p>	<p>Collect evidence about critical success factors from various perspectives: System in context, sustainability, and systemic relationships are crucial to success of future implementations. Required policy changes include: Adoption of the predominantly pedagogical focus of the TPD approach by provincial education departments. Provision for upgrades and replacement of devices.</p>

This table is intended as a guideline for implementers in the Education system to use when engaging in providing tablets to schools, especially in the context of resource constrained schools. If sustainability is considered from the beginning of a project, it will ensure better planning and hand-over. These sustainability guidelines are unique in the fact that they, together with the ICT4RED implementation framework, can act as guidelines or support mechanisms to apply when embarking on future projects with a similar nature and in a similar context.

Based on the most significant results (Section 9.4) and challenges (Section 9.5) in the ICT4RED initiative, the following most significant policy recommendations emanated from the implementation of the ICT4RED initiative:

- Integrating mobile technology into a resource-constrained environment to support teaching and learning has to be done by

focusing on empowering teachers through professional development training courses before deploying technology. The earn-as-you-learn reward-based badge system proved to be very successful in this context.

- Provision needs to be made for new responsibilities for district officials and principals (along the whole command chain), so that they can actively support tablet implementations as part of their daily tasks.
- Support by the Department of Basic Education, together with the local provincial department, and budget for mobile tablet upgrades, teacher professional development training courses extra staff, and maintenance of infrastructure will contribute towards sustained change in rural education.

Successful integration of technology into schools has the potential to transform schools and the education system as a whole. Change will be sustained if the capacity of the environment to adopt change is understood and planned for, and if the intervention is absorbed into the bigger educational system.

In practice, facilitating a sustainable intervention requires a holistic focus on understanding the ability of the environment to adopt the intervention, the creation of a temporary structure that implements the intervention in interaction with the system owners, followed by the negotiation of the absorption of the project in the bigger educational systems.

These considerations are crucial for future sustainability of this initiative. It is hoped that these recommendations will be applied by government departments in their quest to address educational and technological challenges in all schools in South Africa.

9.8 Evaluation

This book aimed to balance the narrative of a methodologically grounded Design Science Research Process (Figure 9-1 below) with the practical application of designing and implementing an ICT4RED initiative in a resource constrained environment. It documents the design and development of the various artefacts culminating in frameworks, guidelines, models and tools as evident in the 12 crucial components. This book is validated through expert peer review and this completed the how

the evaluation part (second last part of DSR process) was effected.

The expert reviewers (5 have PhDs) have the following background and expertise:

Table 9-3 Expert reviewers and their expertise

Expert and field of expertise	Experience
Two from Education	One has been an established researcher in the field of Education for 17 years and has worked with many NGOs and industry partners to deploy technology in resource constrained environments. The other one has 12 years lecturing experience at an established South African university and has been working with teachers on a daily basis.
One from Informatics	This person has 8 years' experience in developing models and frameworks for business analysis field and works at an established South African university as a Research Professor.
Two (one national and one international) from ICT4D implementation in rural areas	One person is from a well-known UK university who has written numerous publications on ICT4D implementations and the impact of technologies in rural communities. The other expert is from a research council (with a PhD) who has been deploying and testing technology products in rural communities for over 10 years.



Photo 9-1: Teacher Professional Development session

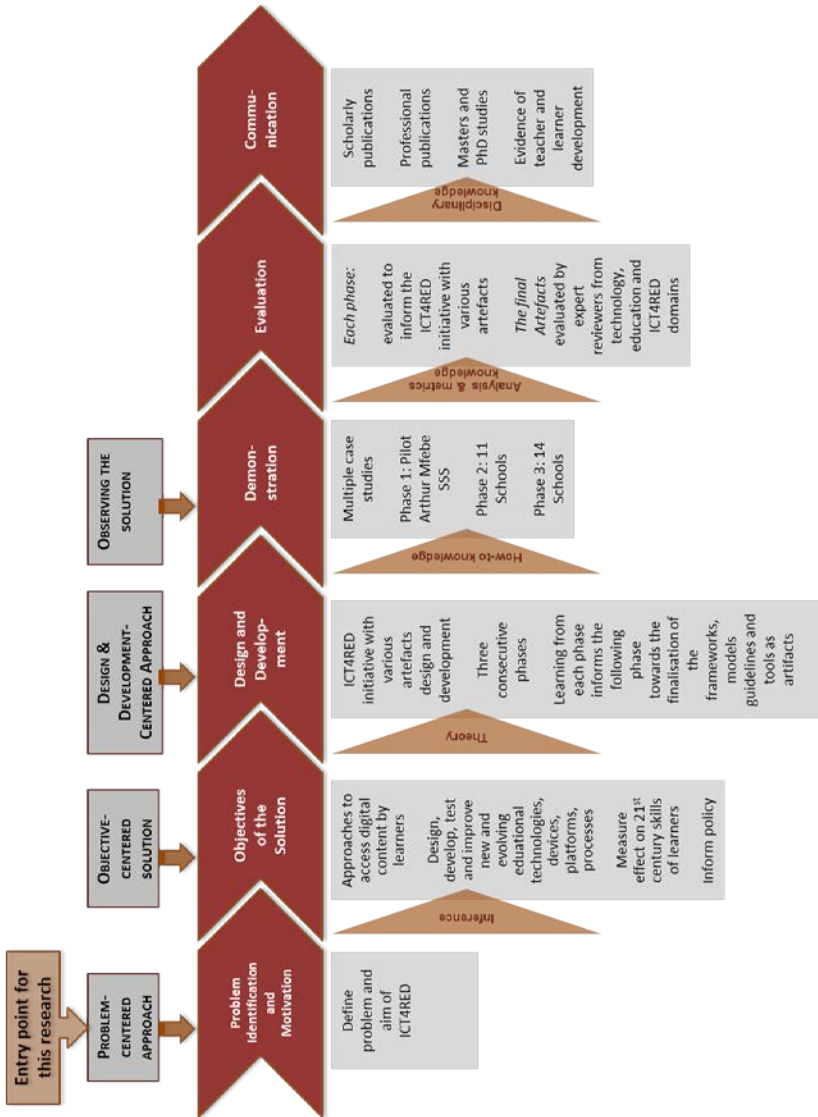


Figure 9-1: Design science process applicable to ICT4RED

The diversity of experts is important as it provided credibility to the final frameworks, models, guidelines and tools. Experts provide a higher level of feedback which validates an idea as their inputs are regarded as

trustworthy and valuable.

From the feedback the following was indicated:

- The resulting artefacts can inform similar initiatives in the specific resource constrained environment if replicated.
- This is valuable to any ICT4D initiative, which wants to start with deployment of technology to support teacher development through ICT.
- The artefacts should be shared to a wider audience and tested in other environments as well.
- The artefacts provide insight into the importance of empowering people first before providing technology.
- Monitoring and evaluation of the process should not be underestimated or neglected.
- For sustainability it is important to have operations management, School ICT and initiative management separately as they operate on different levels to support the TPD.
- The value of the processes and artefacts developed through the multi-disciplinary DSR process provide sufficient evidence of how these were improved through different phases.
- The narrative of ICT4RED is a valuable resource to anyone, from Education to ICT4D practitioners and industry wishing to duplicate aspects of the initiative.
- The book as a descriptive narrative provides a high level interpretation of the most important aspects to consider in the deployment of technology in schools in this context.

The feedback from the experts supports the layout and focus of all components in the initiative.

The NDP vision 2030 (2011) emphasizes that South Africa needs knowledge that equips people for a society in constant social change. It believes that quality education encourages technology shifts and innovation that are necessary to solve present-day challenges. The NDP argues that education, training and innovation are not a solution to all problems, but society's ability to solve problems, develop competitively, eliminate poverty and reduce inequality is severely hampered without them. If schools are the building blocks for learning and socialization then the quality of the schooling system impacts significantly on further education and society's

ability to innovate. However, UNESCO Bangkok asserts that in order to make successful use of ICT in enhancing the reach and quality of teaching and learning, policy makers need to be aware of how ICT can be leveraged in their country's education system, and need to develop a supportive policy environment to accommodate this.

9.9 Summary

The impact of the ICT4RED initiative will only be seen years after this publication as many postgraduate students are still in progress to complete their studies. The uptake and use of the technology is now evident, but the real impact of that on the development of the 21st century skills of both the teachers and learners will only be realised in future. However, it is certain that if the teachers stay as dedicated and motivated as they are now to apply the technology in their classroom, it can only have positive results for the future of this school district.

9.10 References:

- Department of Basic Education. 2014. Province of the Eastern Cape. Online. Available at: <http://www.ecdoe.gov.za/ecdoe/schools>. Assessed: 01/12/2014.
- Heeks, R. (2010) Do Information and Communication Technologies (ICTs) contribute to development? .*Journal of International Development*, 22, 625–640.
- Heeks, R. & Molla, A. 2009. Impact assessment of ICT-for-development projects: A compendium of approaches. *Development informatics: Working paper 36*. http://www.sed.manchester.ac.uk/idpm/research/publications/wp/di/documents/di_wp36.pdf [19 November 2014].
- M A Marais, in J Steyn and E M Villeneuve (eds). 2011. An analysis of the factors affecting the sustainability of ICT4D initiatives. *Proceedings of the 5th International Development Informatics Conference (IDIA2011): ICT for development: people, policy and practice*, 26-28 October 2011, UCT, Lima, Peru. Conference CD. Published by the School of Information Technology, Monash South Africa. November 2011. ISBN 978-0-620-51717. (pp. 100-120) Available at <http://hdl.handle.net/10204/5374>
- Toyama, K. (2010). Can Technology End Poverty? *Boston Review*, Nov/Dec 2010. Retrieved from <http://www.bostonreview.net/BR35.6/toyama.php>
- Unwin, T. (ed.) (2009). *ICT4D, Information and Communication Technology for Development*. Cambridge, UK: Cambridge University Press.

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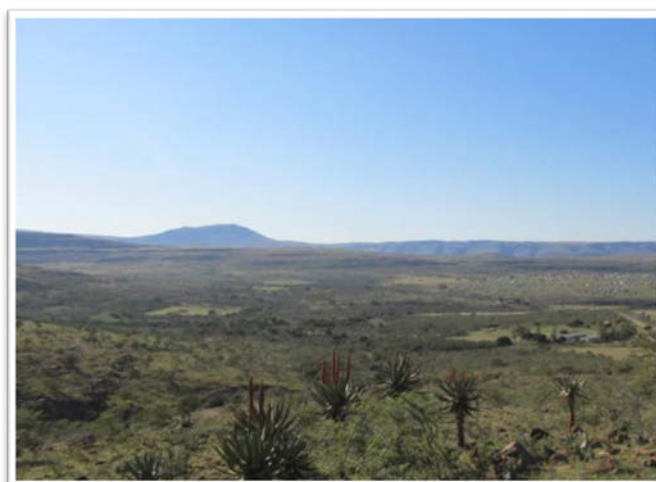


Photo 9-2: Bangilizwe Junior Secondary School

This book was
PEER
reviewed
by experts
in the field of
ICT4D,
Mobile
learning
a n d
ICT
in Education



ICT4RED

Herselman, M. and Botha, A. (2014). *Designing and implementing an Information Communication Technology for Rural Education Development (ICT4RED) initiative in a resource constrained environment: Cofimvaba school district, Eastern Cape Province, South Africa*, 1 ed. 2014, CSIR Meraka: Pretoria, South Africa.

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ISBN: 978-0-7988-5619-5 (ebk)



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