

# Barriers in Rural Technology Integration: A Case Study from the Trenches

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**Abstract:** Teachers recognize the importance of integrating technology into their classroom practice and the endeavour has attracted much attention. Teacher Professional Development (TPD) initiatives have focused on enabling and supporting teachers. Rural teachers are acknowledged as having specialized needs and limitations that are seldom addressed through general TPD efforts. The ICT for Rural Education (ICT4RED) initiative has, adapted and improved a TPD course that was specifically developed to address the challenge of rural teacher's use of ICT in classroom practice. This paper's focus is on the fourth iteration of the ICT4RED TPD Curriculum deployed in a vastly different setting than in which it was designed and developed. The extent to which external (first order) and internal (second order) barriers were mitigated by the intervention was recorded and is presented towards further scaling within the same context.

**Keywords:** Technology, Teacher Professional Development, Rural

## 1. Introduction

The *Information Communication and Technology for Rural Education Development* (ICT4RED) initiative was a large-scale longitudinal pilot (over 3 years) that explored the use of tablets in 26 deep rural schools in the Nciba district of Cofimvaba in the Eastern Cape Province of South Africa. The ICT4RED initiative extended to include 3 senior secondary schools (Grades 10 to 12) and 23 junior and primary secondary schools (Grades R to 9) [1]. The Teacher Professional Development (TPD) challenge was to introduce tablets in ways that would enhance the rural teaching and learning classroom practice. The ICT4RED TPD can be described as a supported process to guide the development of relevant teacher knowledge and proficiency (pragmatic pedagogical and technology knowledge and skills) through relevant practice based experience and the attainment of related technology hardware, to enable classroom practice to portray a 21<sup>st</sup> century technology enhanced teaching and learning engagement [2]. To operationalize this scaffolding, gamification was used as a design strategy and incorporated elements such as simulation, fun, interim goals, rewards and a clear learning path was instituted [3].

Building on the gains from the ICT4RED initiative, the Department of Science and Technology requested the ICT4RED TPD course to be adapted and implemented in the Square Kilometre Array (SKA) e-Schools as part of the Human Capital Development mandate to stimulate a sustainable pipeline for local rural youth employment and community upliftment [4].

Despite the various technology endowments to the SKA eSchools, the envisaged uptake and use of technology within the schools classes has not been realised. Results from the implementation in Cofimvaba suggested that the ICT4RED TPD could assist in changing classroom practice and thus maximize the technology infrastructure investment at the SKA e-Schools. The following section briefly overviews the ICT4RED TPD course and its implementation at one of the SKA eSchools.

## 2. ICT4RED TPD Course outline

A single high school, where a significant investment in infrastructure had been made, was identified as an initial site for a case study. All of the academic teaching staff, including the principal were invited to participate and voluntary enrolled. As the language of instruction at the school, as in most of the schools in the Northern Cape, is Afrikaans, the courseware was translated from English into Afrikaans. In addition, it was initially thought that the teachers would have access to the internet. A section was added to accommodate the anticipated additional resource. The ICT4RED TPD course took about 9 months to complete as each of the modules were separated by approximately 3 weeks teaching time to allow teachers to implement the module strategy and collect the relevant evidence in their own classes to obtain a badges as the outcome of interim goals See Figure 1).

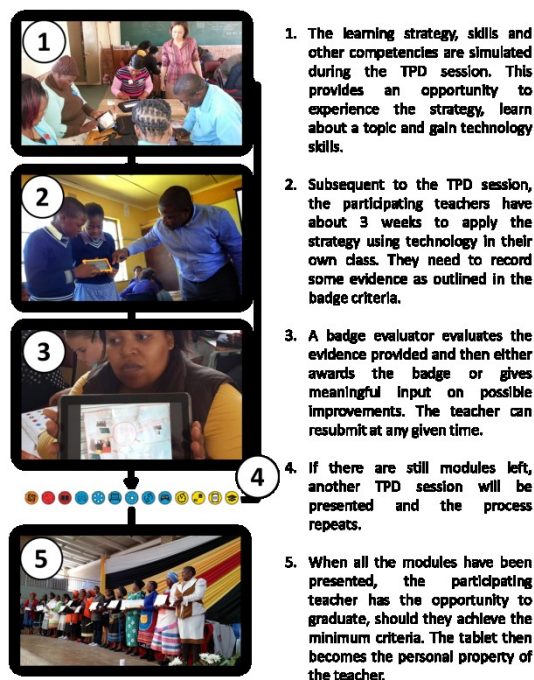


Figure 1: ICT4RED TPD course methodology

Figure 1 illustrates the course implementation methodology and Figure 2, the badges that represented the interim goals associated with each module. Teaching staff stayed after school on a Friday and attended a Saturday session the following day, each day covering a module. The 10 modules, their teaching strategy and content focus are presented in Table 1.

Table 1: Outline of Badges in the 10 Modules

| Module   | Compulsory Badges   |
|----------|---|
|          | ICT4RED badge. Committing yourself  |
| Module 1 | Jigsaw strategy and getting to know your tablet.  |
| Module 2 | Storytelling as a strategy and my technology journey  |
| Module 3 | Roleplay as a teaching strategy and navigating issues that arise when implementing ICT in my school.    |
| Module 4 | Learning stations as a teaching strategy and creating digital content. What types of content are there? |
| Module 5 | Mind mapping strategy and implementing an acceptable  |

| Module    | Compulsory Badges  |
|-----------|--|
|           | user's policy in your class.   |
| Module 6  | Flipped classroom as a teaching strategy creating lesson plans for ICT integration.  |
| Module 7  | Game-Based Learning strategies and creating educational video's . Copyright, plagiarism, Creative Commons.   |
| Module 8  | Field trips as a teaching strategy.<br>Gallery walk as a teaching strategy. Taking my classroom into the world through a scavenger hunt.                           |
| Module 9  | Gallery Walks as a teaching strategy.<br>Digital Identities, Phishing, Online safety, Cyberbullying, Personal Learning networks, Professional Learning communities |
| Module 10 | Reflecting on the journey. How to present  |



Figure 2: Badges that a teacher can obtain. Compulsory: Orange, Red, Blue and Yellow. Optional challenge badges: Green.

The Narrative of the course illustrated as a learning path in Figure 3 progressed from *My use of the technology* (Red badges), then, *Teaching with the technology* (Blue badges), to *Communicating with others through the technology* (Yellow badges).

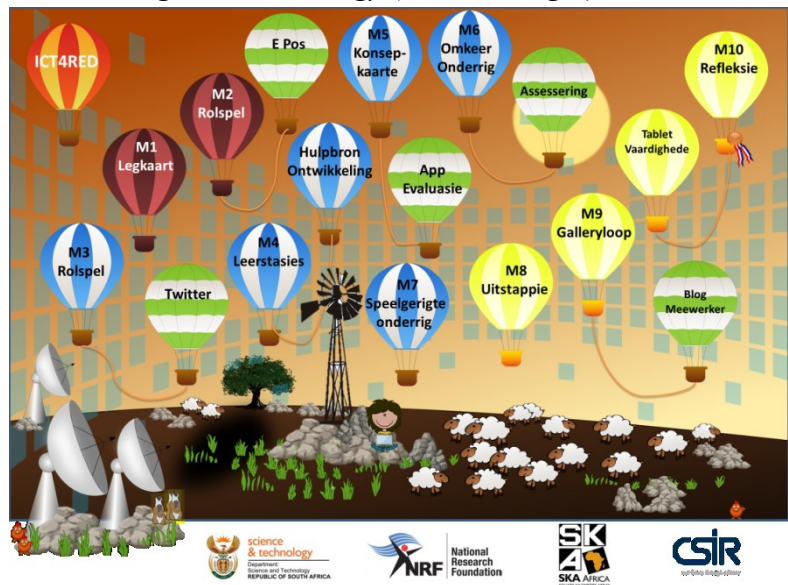


Figure 3 : Course narrative illustrated as a learning path.

The rest of this paper will address the methodology followed, the theoretical framework used and the results obtained towards suggestions for similar contextual interventions.

### 3. Methodology

The objective of the implementation in the SKA eSchools was to stimulate the uptake and use of technology within the SKA e-school's academic classes. The progress and specific challenges are described using Ertmer's [5-8] first and second order barriers, as a theoretical framework. The purpose of this study was to describe to what extent the ICT4RED TPD implementation addressed first and second order barriers towards stimulating the uptake and use of technology within SKA eSchool's academic classes? The implementation assumes the ICT4RED TPD course, methodology and associated technology endowments.

The research, grounded in a phenomenological research philosophy, applied an inductive reasoning approach and was operationalized through a single case study methodology [9].

A qualitative research strategy was deemed appropriate as the attitudes and pedagogical beliefs of teachers were considered.

Yin [10] argues that the “reliance on theoretical concepts to guide the design and data collection when using a case study, remains one of the most important strategies for completing case studies”. As such, the literature study presented in section 4 provided the necessary insights towards developing a conceptual understanding operationalized as a theoretical framework (Figure 4).

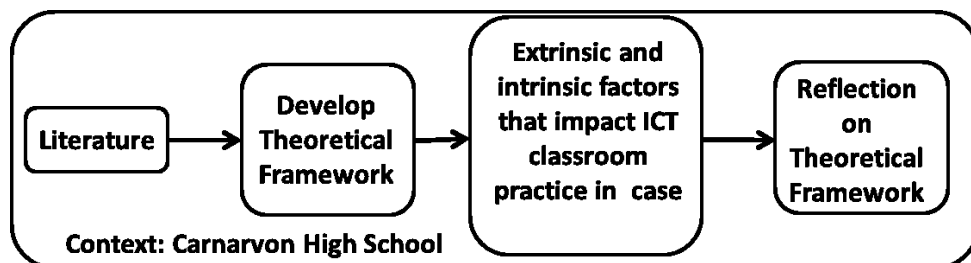


Figure 4: Research flow: Single Case study with embedded units of analysis.

For the purpose of this study, the quantitative/qualitative methodological distinction is not to be interpreted as a positivist/interpretivist epistemological distinction and refer merely to data collection methods [11]. Qualitative data collection aimed to relate the relationship between aspects of the phenomenon under investigation to enable the researcher to interpret and assign meaning. The quantitative data collection make an effort to gauge the association between different aspects of the phenomenon by presenting it in a numerical manner.

Data was collected through questionnaires, digital artefacts collected from the teachers as evidence of their attainment of the interim goals, and the researcher’s research journal. Data triangulation was supported through the use of different data collection methods to explore the same unit of analysis.

A *baseline questionnaire* was administered to participating teachers to determine what technology they were currently using in class and what their expectations were (Section 5.1). In addition a *reflection questionnaire* was completed by all the present teachers after attending each module session. The purpose of the reflection questionnaire was to gauge the relevance and experiences of the teachers regarding the TPD course and course material (Section 5.2). A *final questionnaire* was administered after the intervention to measure teachers’ self-reported perceptions of their competency gains. These self-reported competency gains were triangulated with the digital evidence collected after each module. (Section 5.3).

Having outlined the research methodology the following section outlines relevant literature towards presenting a theoretical framework.

#### 4. Integrating Technology into Teaching and Learning

The history of the debate concerning teachers’ role in integrating technology into the classroom has been documented since the early 1980’s. Heinich [12, 13], for example, disparages the informal approach to integrating technology and advocates a more technological approach. He suggests that educational technology has less to do with *teaching* and *substantially* and more to do with *technology*. In effect, he advocates distancing the point of integration from the planning of the integration. This view is eloquently contested by the likes of Kerr [14] who, while acknowledging the need for a diverse skillset, argues for teachers to “...use technology to define and strengthen teachers’ roles, to empower them in their institutional context and to allow them to find and amplify their collective voice” [14]. McDonald [15], in describing this *voice*, refers to enhancing

teacher professionalism, altering the student role and also suggests new ways in which to address teacher preparation and/ or teacher professional development.

Thirty something years later, technology has progressed tremendously and teachers are now presented with an abundance of devices, services and software. The research focus of technology enhanced learning has undoubtable matured and progressed with teachers firmly established as the *implementers* of technology in classroom practice. There is, however, a disquieting echo as Teacher Professional Development is, on occasion, either seen as *inadequate* to facilitate the integration of technology into teaching practice [16-18], or *unnecessary* [19, 20]. This is often exasperated in rural contexts [17].

Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur and Sendurur [8] suggests that teachers struggle to transcend practical and philosophical barriers that they consider significant in any endeavour to integrated technology into their own classroom practice. They identify two types of barriers as *first-order barriers* and *second order barriers*. First order barriers refer to extrinsic barriers. These are typically resources that teachers have no access to or that is lacking in their context. Some examples are electricity, internet, devices and time. Second order barriers are described as barriers that “interfere or impede fundamental change” and are “typically rooted in teachers’ underlying beliefs about teaching and learning” [5]. This understanding as developed and described by Ertmer et al.[8] was aligned to two comprehensive studies to identify barriers to technology integration in teaching and learning by Hew and Brush [21] and Botha and Herselman [3]. These two studies were chosen as most of the relevant literature was covered by either or both of the studies. Additional studies that were found did not add any new relevant barriers, as such it was assumed that data saturations was reached. [22]. Relevant barriers were taken as barriers that would impact of formal class practice in secondary education with a significant focus on rural education. These studies and resulting theoretical framework is very briefly outlined below.

Hew and Brush [21] in their wide-ranging review of past empirical studies identified 123 barriers that they classified into six main categories. These are resources, knowledge and skills, institution, attitudes and beliefs, assessment, and subject culture. Recourses were mostly identified as the lack of access or availability of technology hardware, time or technical support. Knowledge and skills was associated with specific technological pedagogical skills and related classroom management skills. In addition the lack of technological proficiency contributes to this facet. Institutional barriers are identified as school leadership, timetabling and school planning. The attitudes and beliefs of teachers are described in terms of underlying beliefs about teaching and learning and the role of technology in the classroom. [21, 23].

Botha and Herselman [3] surveying the eLearning landscape focussing on the “use and integration of ICT into the teaching and learning engagement and the TPD activities that support this” [3]. Their review identifies classroom practice, teacher attitude, teacher experience, teacher support, technology access and hardware and the TPD process as barriers that can impede the integration of technology into classroom practice. They further argue that *classroom practice* is a critical factor to integration and positively influenced by relevant TPD. Teacher attitude and experience both affect the willingness of teachers to integrate ICT into classroom practice and needs to be facilitated, formed or changed to enable technology integration into classroom practice. Additionally, Teacher support and access to technology hardware are acknowledged as critical. The TPD process is cited as needing to cultivate “positive attitudes towards technology integration” [3].

From the overview above the first and second order barriers [5-8] were identified and aligned [3, 21] to present the theoretical framework in Table 2. These first and second order barriers are considered as the units of analysis for this case study.

Table 2: Theoretical Framework

| First and second order barriers. Adapted from Etmer <i>et al.</i> [5-8] | Barriers adapted from Hew and Brush [21].                                    | Barriers adapted from Botha and Herselman [3]                  |
|---|--|--|
|   |  | TPD Process  |
| First order barriers (Extrinsic)  | Lack of resources<br>Insitutional challenges<br>Subject culture<br>Assesment | Technology access and hardware<br>Teacher support              |
| Second order barriers (Intrinsic)                                       | Attitudes and beliefs<br>Knowledge and skills                                | Teacher attitudes<br>Classroom practice<br>Teacher experiences |

The units of analysis for this case study is:

- *First order barriers (Extrinsic barriers)*: Easy access to technology resources; Institutional challenges; Support and Assessment strategies
- *Second order barriers (Intrinsic barriers)*: Attitudes and beliefs of teachers; Knowledge and skills and Teacher experience.

The following sections document the findings of each.

## 5. Results and discussion

### 5.1 At the outset

In the baseline questionnaire, teachers indicated that their classroom technology use was rather sporadic. The most used technology was the data projector and the computer to project Power Points in the Maths and Science classes. The use of Power Point instead of chalk is fundamentally still a teacher centric endeavour and does not really relate to a change in classroom practice. Prior to the ICT4RED TPD course implementation, teachers reported to using Cell phones for mainly personal use and, in one class, for classwork.

#### 5.1.1 Regarding First Order Barriers

The teachers cited the availability of technology as a challenge. They described access to technology they could use in the classroom as a major challenge. All requests to use shared technology hardware and technology spaces had to be submitted either to the headmaster or the CAT (Computer assisted Typing) teacher. The teachers reported that this restricted access resulted in a lack of time and freedom to experiment with the technology and stressed that they were unable to set up the equipment in a way that they wanted. There was no structures support for teachers and the brunt of the help fell to the CAT teacher that, in addition to his teaching load, was expected to assist. He in turn became frustrated with the situation and teachers were more reluctant to ask for help. Despite having internet access in the computer lab, the general lack of available access prevented teachers from tasking learners to access and searching for information online.

#### 5.1.2 Regarding Second Order Barriers

Teachers expressed some fears and expectations when introduced to the initiative. They reported that the way the school was currently functioning they were unable to become comfortable with using the available technology. The safety of the devices was also mentioned as a concern as teachers were hesitant to accept responsibility for the devices not under their control. Teachers reported that they were unsure of how they would manage the learners in a technology enhanced learning environment as experience had shown them that learners tend to get *side-tracked* when using devices and were accessing social media and games.

To summarize, teachers found the available technology difficult to access and tedious to use. They indicated that they found the devices and internet access difficult to navigate and unreliable. They felt that they always had to have a plan B in store and that the technology enhanced lessons did not link directly to the curriculum and was a luxury. Learners were

distracted and *teachers* found classroom management difficult. Their expectations centered on a reduced workload, possibly less work and improved teaching and learning engagement. They expressed an expectation of improved learner engagement in the learning process.

### 5.2 The ICT4RED TPD Process

After each session a *reflection questionnaire* was distributed that evaluated the participant feedback to the specific sessions' content, relevance and usefulness. The summary of the feedback gathered over the 10 sessions for each module are presented and discussed in this section. The participants indicated that they found the TDP session well organized, facilitated and that the training material met their expectations. They indicated that the technology hardware, teaching strategies, mobile applications used and other supporting content around assessing outcomes were relevant to their classroom practice. The participants indicated that they were confident in their gained skills and competencies to apply the technology hardware, teaching strategy, mobile applications and other content regarding the 21<sup>st</sup> century teaching strategies into their own teaching practice (Figure 5).

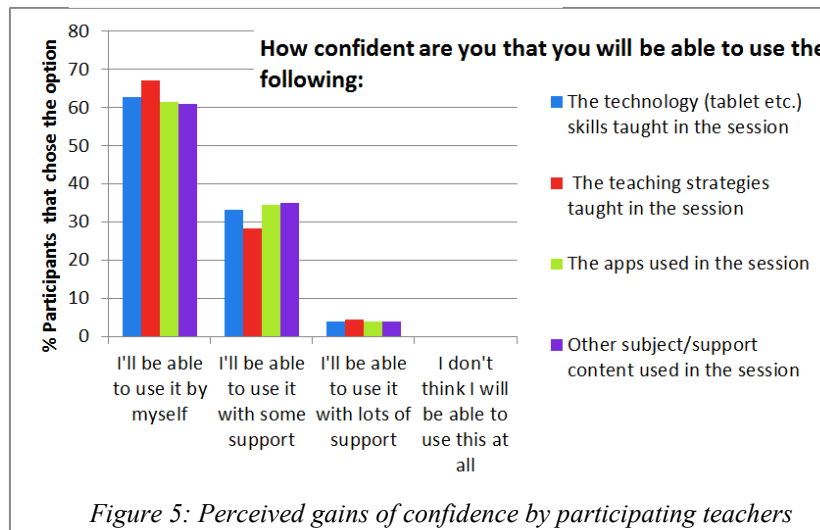


Figure 5: Perceived gains of confidence by participating teachers

In addition, they stated that the ICT4RED TPD instruction methodology gave them an opportunity to not only experience the teaching strategy and technology use, but they were able to become familiar with it and gain confidence.

### 5.3 Self-Reported Progress

The following section outlines the self-reported progress of the participating teacher as well as an outline as to how the ICT4RED TPD course mitigated the factor.

#### 5.3.1 Regarding First Order Barriers

*Easy access to technology resources:* The teachers were given a tablet to use while they were busy with the course. Each teacher received their own tablet and on completion of the minimum compulsory badges would own the tablet. The course material was structured so that there were examples of integrating the technology into the classroom using a single device, five devices and each learner having their own device.

The teachers indicated that the dedicated access to technology and guided integration was very valuable in gaining confidence and being in control in their own classes. They liked the idea that they could control the whole teaching and learning intervention and that they were not reliant on other people to get access to the devices. Some of the teachers borrowed each other's tablets to have access to more devices in their classes. Teachers did

express frustration at having only one Mobikit available for the school and would have liked dedicated class devices.

*Institutional challenges:* Teachers cited end of year pressures as a challenge to complete the modules. The exams and amount of administrative work that was required of them left little time to contemplate integration and even less time to experiment.

*Support:* Most of the teachers felt that they did not get enough classroom support from the project team in the initial stages of the intervention. They also expressed a frustration at the institutional support citing that the processes to gain access to additional devices were not clear and that the committee that was put in place was not supportive enough.

*Assessment strategies:* The teachers indicated that the assessment strategies that they had been exposed to during the training was adequate and appropriate for assessing work done using the tables in their classroom practice. They indicated that they were able to assess and assign value to the work that was delivered by the students.

### 5.3.2 Regarding Second Order Barriers

*Attitudes and beliefs of teachers:* Teachers felt that they were familiar with the tablet and was confident that they could use it productively for preparing and presenting lessons. They indicated that they felt that they knew how to teach with the tablet. They stated that they were willing to experiment with the tablet as teaching aid and felt it enhanced their classroom practice. They indicated that they had previously had misgivings about the technology and its ability to support their classroom practice but had, through experience, come to change their mind.

They felt that learners were much more active and attentive in class and that they had fewer discipline problems. These were in direct contrast to their earlier misgivings and support their expectations.

*Knowledge and skills:* Teachers indicated that they had gained sufficient technology skills; knowledge and pedagogical proficiency to use the tablet for teaching and learning in their classrooms. They were able to produce sufficient evidence for each of the modules to meet the criteria for being awarded a badge.

*Teacher experience:* The teachers gained guided experience and were found to be combining teaching strategies and technologies to facilitate their classroom practice.

In completing the 13 compulsory badges it could be deduced that teachers had experience in applying the 10 teaching strategies and had displayed classroom competence. Most of the teachers found the course beneficial and were satisfied with their progress, stating they felt they had gained new relevant practice based skills and competencies. Some teachers had, however, indicated that, although they could, *they did not want to change* the way they teach.

The pupils loved working with the tablets and were observed to be much more engaged and was described as actively learning. The teachers indicated that they felt confident enough that they could support the learners with technology queries. They indicated that they were experienced less disciplinary problems in the classroom when integrating the technology through the appropriate learner centered teaching strategy.

## 6. Conclusion

This paper aimed to describe to what extent the ICT4RED TPD implementation addressed first and second order barriers towards stimulating the uptake and use of technology within one SKA eSchool's academic classes? The course ran over 9 months and introduced teaching strategies, technology and pedagogical competencies and skills through 10 modules. The main objective of changing classroom practice was operationalised through the attainment of interim goals articulated as badges in a learning path. The badge goal,



achievement, assessment and the conferring of the badges served a number of functions [24]:

- It outlined clear transparent expectation;
- It provides an opportunity for the teacher to demonstrate individual proficiency;
- It acknowledges achieved competence;
- It allows teachers to individualize and appropriate learning into practice;
- It acts as a scaffolding environment for achieving the teacher development goal;
- It allows the initiative initiators to acknowledge individual growth;
- It acts as an early warning signal of teachers falling behind;
- It allows for timeous investment in further technology needs; and
- It allows for champions to surface and to be acknowledged.

The structured and systematic methodology that was implemented helped to overcome some of the first and second order barriers. It is clear that the complete eradication of all barriers will not ever fully be reached as teachers experience new barriers on a higher level when initial barriers are removed. As such the process of TPD and technology endowment should remain a continuous process and not seen as a goal in itself.

The findings of this study represent a single perspective on the implementation of the ICT4RED TPD course on the classroom practice of teachers within one of the SKA eSchools. It is envisaged that by extrapolating the findings of this study to the classroom practice of a typical SKA eSchools's teacher, practitioners will be able to anticipate initial barriers to integrating technology into classroom practice. Further abstraction of these findings could, under specific conditions, facilitate TPD as a supported process to guide the development of relevant teacher knowledge and proficiency to enable classroom practice to portray a 21<sup>st</sup> century technology enhanced teaching and learning engagement.

The *ICT4RED Teacher Professional Development Course* was licensed under the Creative Commons Attribution-Non-commercial-Share Alike 3.0.; it can be downloaded, changed and implemented free of licensing charges from <http://www.ict4red.blogspot.com/p/about.html>. The study acknowledges the teachers of the SKA eSchool, the SKA eSchool management for their enthusiastic support and the DST (specifically to Mr J.Neethling for his support) for the funding and support.

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