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Schools

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FACTORS AFFECTING ICT POLICY IMPLEMENTATION IN RURAL NAMIBIAN SCHOOLS.

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Abstract

ICT provision is often limited in scope to allow optimal usage of education systems. A study to investigate factors that affect ICT Policy implementation in Namibia was conducted in 2010. In order to describe the rural area situation with regard to ICT implementation in the education sector, a quantitative approach was used to collect data from a sample 137 science teachers and 107 principals out of the 163 participating secondary schools in three rural regions. In this research school level data were used to identify the factors that affect ICT implementation in rural area science classrooms in Namibia. The results show that the implementation is enormously affected by leadership of the principals, lack of expertise as well as general use of ICT by the science teachers. The results might influence policies on ICT use and how ICT is to be used in the future at classroom level.

Key words: ICT Policy, rural schools, pedagogy, professional development, attitude, ICT infrastructure

Introduction

The Namibian National ICT Policy for Education was first introduced in 1999. A review of this policy took place in 2005 resulting in a new National ICT Policy for Education (Ministry of Education, 2005) and the National ICT Policy Implementation Plan (Ministry of Education, 2006). The new policy stipulates that pre-service and in-service teacher education institutions would be priority areas for ICT deployment, followed by schools with secondary grades (Ministry of Education, 2005). The Namibian Ministry of Education reserved in the National Budget from 2006/2007 onwards funds for ICT in education for deployment, training, monitoring and evaluation of the implementation of the programme. In addition, stakeholders such as the Global e-School Initiative (GeSCI), SchoolNet Namibia, Namibia Education Training Academy (NETA) and Computer Education Community Service (CECS) have been supporting ICT development by donating ICT resources to schools mostly located in the rural areas. These non-governmental organisations (NGOs) also provide teacher training to rural schools.

A number of countries have developed their national ICT policies for education that encompass global and cross-national policies, national policies and school-level policies. It has been noted over time that having national policies that did not have implementation plans in place did not guarantee feedback to decision-makers. The policies need to state a developmental strategy that articulates a vision on how this goal is to be achieved (Kozma, 2008; Law, 2009). This would require introducing school-level policy to engage the school leadership more in the implementation process.

Ainley, Enger, Searle (2008) have noted that there is currently little understanding of the way in which ICT is used in schools and classrooms around the world due to a number of factors. Statistics that were collected for the SITES 2006 regarding the use of ICT in education internationally have confirmed that this trend is increasing but for the majority of teachers it is still a tool used only in the margins of the educational process (Plomp, Pelgrum & Law, 2008). In the same light, Anderson and Plomp (2009) have noted that making decisions about whether and how to integrate ICT into teaching and learning is sometimes complex, technically demanding, and the effects thereof are not always known due to lack of research on which to base the decision. A study that identifies factors that affect ICT Policy implementation in rural areas where the teaching is often of poor quality and poorly supported in terms of attracting high quality teachers, infrastructure and teaching resources would be important (World Bank, 2000). The study reported here posed the question: *What factors affect ICT Policy implementation in rural Namibian schools?*

This study aimed at increasing our understanding of the use (or lack of use) of ICT in rural classrooms. It is generally expected that the pedagogical practices used by the teachers are an important means of improving ICT policy implementation, and, if necessary, changing teachers' curriculum goals and practices. The paper presents the literature review, followed by the conceptual framework, research methodology, and results of the study. Further the results are discussed before the conclusion. Finally, the implications of the outcomes of this study are summarised.

Literature review

The literature review focuses on factors affecting ICT implementation at school level, with a focus on rural areas, in terms of infrastructural development at national level, professional development, vision,

leadership, support, digital learning materials, ICT infrastructure at school level, expertise, and pedagogical use of ICT. This is followed by the conceptual framework.

Infrastructural development

ICT infrastructure is limited and not provided to all educational institutions with the depth needed to allow optimal usage of education systems (Cossa & Cronje, 2004). In particular, rural areas are more affected by the lack of electricity and there are cases of low density of Internet connectivity which pose many challenges to rural areas (Howie, 2010). Other challenges include the cost of ICT provision, which can be high in comparison to the costs of other equipment. In under-resourced schools, the cost can even be higher due to the need for installation of electricity and landline connectivity. Provision of infrastructure competes with the provision of other basic needs, such as textbooks, furniture, teacher training, and nutritional supplements (Cawthera, 2002). Chile deployed ten computers to every school, which is less than the number received by rural schools in Namibia, but the quality of support in Chile contributed to the effective use of computers (Hinojosa, Hepp & Cox, 2009). Balanskat, Blamire and Kefala (2006) argue that schools with good ICT resources achieve better results than those that are poorly equipped. However, a host of other factors may also contribute towards ICT implementation in schools. The next section examines the influence of ten such factors or components.

Components of ICT policy implementation

Professional development of science teachers

It is argued that professional development is necessary for ICT integration in schools. Both teachers and the school management need to be trained in skills that will enable them to effectively perform their duties in the advancement of teaching and learning. Teachers must understand the place of ICT in schools and its educational role. However, a number of researchers (Howie, 2010; Kozma, 2008; Matengu, 2006) have argued that policies are well articulated but often teachers are not aware of the specifics of these policies or their goals. ICT policy implementation is best assured when teachers' professional development includes specific skills and tasks that include ICT in their everyday classroom practices and explicitly connects these practices to ICT and broader education policies (Kozma, 2008).

Comprehensive plans for professional development should include

wider opportunities for teachers to learn through a number of platforms. More importantly, the learning goals should be linked to the school goals and policies both at national and school level. However, Ward (2003) warns that time for teachers to learn how to use computers is limited, but for the sake of continuity of learning up-to-date skills that will enable the teachers to keep up with the technological and pedagogical demand, it becomes necessary that the teachers create time for professional development activities.

A study recently conducted in Namibia found some inefficiency in the professional development of science teachers (Ngololo, Howie & Plomp, *in press*). In addition, Iiping (2010) found that lecturers at the Teacher Training Colleges have not been trained themselves in ICT and therefore do not have the necessary expertise and skills to train the teacher trainees. It is necessary that the view of science teachers on professional development with regard to ICT professional development be sought, especially in the rural areas.

Vision of principals

A clear vision statement for ICT in education is a critical component of the policy (Law, 2009). The World Bank (2000) reports that ICT should aim at delivering resources to the poor, taking markets within reach of rural communities, improving government services and transferring knowledge needed to meet the challenges of the Millennium Development Goals (MDGs). In this light, ICT can increase access to education through distance learning, enable a knowledge network for teachers, develop teacher training, and broaden opportunities for accessing quality educational materials.

Implementing ICT is the responsibility of the school principals. The principals need to ensure that ICT implementation is reflected in the vision of the schools. The principals' knowledge of ICT is essential so that their guidance on ICT implementation is more efficient and practical, especially in promoting pedagogical use of ICT.

Leadership of principals

Kozma, (2008) raised concerns about strategic policies to provide specific goals on how technology can advance economic, social, and educational development. It is argued that operational policies should describe how leadership will impact the education system with measurable outcomes. In Namibia, Katulo (2009) found that principals were usually the initiators of the acquisition process of computers. Also,

principals that demonstrated the qualities of transformational leadership promoted computer usage on different platforms and they also participated in teachers training workshops for knowledge acquisition. These principals continuously encouraged the teachers to use computers. The leadership approaches are useful to determine the kinds of ICT leadership styles that are present in Namibian rural schools and how it can be improved.

Support by principals

ICT support is essential for the sustainability of ICT projects, many of which in African countries were discontinued because neither the government nor the schools made plans to sustain them (Cossa & Cronje, 2004). Support in the model adopted from the Kennisnet (2009) is divided into two: pedagogical support; and technical support.

Technical support refers to support towards basic trouble shooting in and out of the classroom. McGhee and Kozma (2000) offer a benchmark for infrastructure in the World Evaluation Conceptual Model (p.6), particularly, the technical support requirements, namely hardware installation; software provision; network installed; and technical assistance available. This information is useful to determine the availability of technical support.

Pedagogical support refers to support related to teaching and learning of science. In order to develop capabilities of teachers, principals should foster intellectual stimulation amongst them, provide well-designed professional development, and facilitate focused activities such as integrating ICT to meet the learning needs of a learner (Dexter, 2008b). Thus, support needs to come from the principals, Heads of Departments and the experienced teachers.

Sutherland and Sutch (2009) offer a model demonstrating how pedagogical support can be offered to novice or less experienced teachers. Within the InterActive project, Sutherland and Sutch (2009:30) developed a way of working that enabled teachers to work together with teacher educators and researchers in order to start the process of using ICT in the classroom. Although this model is used by teacher educators and researchers, it may still be useful in providing guidance towards increased use of ICT through the pedagogical support model.

Teachers' collaboration

The Delphi project (2004) offers an insight on the indicators for uses of ICT in learning. Amongst the identified indicators is teachers'

knowledge of the ICT in order to choose the appropriate tool for the intended purpose.

Science teachers' expertise

Anderson (2008) offers a taxonomy of knowledge related skills and knowledge-related task processes with or without ICT. These knowledge-based skills are implicit in the level of teacher technology competency (Baylor & Ritchie, 2002), which is in line with the development of the knowledge society and guides the design of the curriculum, learning and assessment activities more in cases where learners can access ICT. Ngololo (2011) found that teachers, particularly, science teachers, lack expertise in ICT. Similarly, Matengu (2006) found that there was no school capacity to deal with ICT integration. The required teacher expertise for the knowledge-based society is summarised by Anderson (2008: 12). The information is useful in detecting the skills that Namibian science teachers possess against what they need to have if they are to integrate ICT effectively.

Pedagogical use of ICT

Mioduser, Nachmias, Tubin and Forkosh-Baruch (2003) developed an analysis schema for the systematic study of transformational processes in schools using ICT. From their schema, the levels of pedagogical use of ICT in rural schools are taken. They distinguished a progressive continuum of three levels of innovation: assimilation, transition, and transformational. Studies conducted in Namibia revealed that there is low use of ICT in general (Matengu, 2006) and in rural schools, in particular (Ngololo, 2011). This schema is useful in determining the level of pedagogical use of ICT in the rural schools. This information is added to the conceptual framework to describe the pedagogical use of ICT as an outcome of the ICT implementation process.

Science teachers' attitudes

Cavas, Cavas, Karaoglan and Kisla (2009) claim that as in many developing countries, ICT tools are provided to teachers without considering their attitudes towards ICT. Cavas et.al. (2009) conducted a study in Turkish primary schools to test the science teachers' attitudes towards ICT in education and then explored the relationship between teachers' attitudes and factors which are related to teachers' personal characteristics. The Turkish teachers indicated attended in-service training related to ICT use in classroom. The findings of the Turkish study revealed that the science teachers, irrespective of their gender had a positive about ICT use in education. Another study conducted in Syria,

exploring attitudes of English as Foreign Language high school teachers revealed the same findings that teachers had the positive attitude towards ICT in education (Alibrini, 2006). The attitudes were explored through a number of independent variables such as computer attributes, cultural perceptions, and computer competence.

The discussion above provides information on variables that need to be considered in a description of how ICT can be implemented in a rural context. In addition, the information on the efforts spent on infrastructural development for rural areas is vital as this study is focusing on the rural setting. The same discussion lays a basis for formulating a conceptual framework of the study.

Conceptual framework

The conceptual framework draws from the Four-in-Balance-Model (2009) that was developed to structure key factors that influence ICT use at school level. The Four-in-Balance-Model, a research based approach used to introduce ICT in education (Kennisset, 2009) was first presented in 2001 by the ICT at School Foundation and updated in 2004 as Four-in-Balance Plus (ICT op School, 2004). From this point on, the model has been referred to as Four-in-Balance, and suggests successful implementation of ICT at school. Teacher/classroom level requires a balanced approach towards deploying the four basic elements: vision, expertise, digital learning materials and ICT infrastructure (Kennisset, 2009). This model has been chosen to structure the presentation of the findings from the literature:

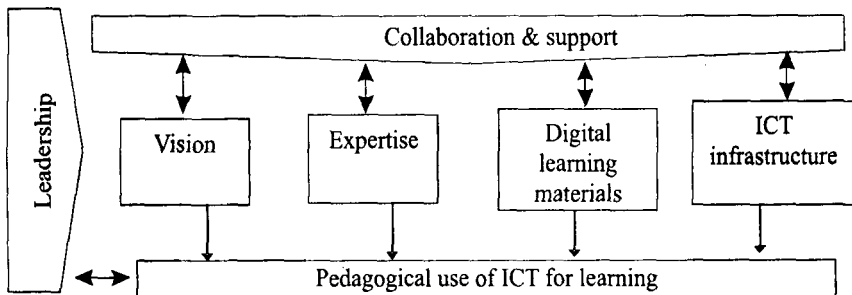


Figure 1: Basic elements of the Four-in-Balance model adopted from Kennisset (2009)

The model illustrates that the successful introduction of pedagogical use of ICT is more than just the acquisition of hardware and educational software (Plomp, 2006). Deliverance of effective pedagogical use of ICT

is influenced by the resources and efforts put in the vision statement, expertise, digital learning materials and ICT infrastructure at each school. The research question for this study is operationalised by surveying a number of statements per construct to affect the implementation of the Namibian ICT Policy by the science teachers in rural science classrooms.

Vision refers to the schools' view of what constitutes a good teaching approach and how the school aims to achieve its objectives, considering the role of the teachers and learners, the teaching, and the materials being used to teach. The vision of the principals and teachers determine the policy of the school and the design and organisation of its teaching.

Expertise implies that teachers and learners need to have sufficient knowledge and skills in order to utilise ICT to achieve educational objectives. This requires skills beyond basic ICT skills to operate a computer. Pedagogical ICT skills are also necessary to help structure and organise learning processes. This means that the principal and his staff should be well informed and have the capacity to deal with ICT at the school level and thus to support those teachers that are still learning to use this new technology. Digital learning materials refer to all digital learning educational content whether formal or informal. This includes educational computer programmes.

ICT infrastructure refers to the availability and quality of computers, networks, and Internet connections. ICT constitutes infrastructure facilities. In addition, electronic learning environments and the management and maintenance of the school's ICT facilities are also considered as ICT infrastructure. Collaboration and support refers to collaboration between teachers in the same school sharing knowledge in a team and the ability to consult teachers from other schools. Support refers to supporting teachers with the use of ICT, i.e, pedagogical support and/or technical support.

The concepts in the model have been found suitable to serve as a guide for generating items of variables to be considered in the generation of instruments for data collection for this study. In addition, this model summarised the factors that affect ICT implementation in line with the research question of the study. Based on these reasons, the Four-in-Balance Model (2009) was adopted for use in this study.

Methodology

To address the research question, descriptive information is needed for all the concepts of the conceptual framework. The survey method has been used to obtain descriptive information of how science teachers and principals implement ICT at junior secondary schools in rural Namibia. A pilot study was conducted to assure validity of the instruments and the reliability coefficients of the indicators were calculated (see Ngololo et. al., *in press*).

Data gathering

Population and sample

The population consisted of 163 secondary schools in three rural regions with electricity and functioning ICT as identified from the EMIS database (MoE, 2010). The questionnaire was sent to a total of 163 schools of which 137 science teachers and 97 principals responded. The author obtained information from one science teacher per school from 91 schools and at most two science teachers per school from the remaining 23 schools. Some schools were larger than others and had two science teachers answering the questionnaire. An average of the two science teachers was calculated to upgrade the data at school level. The response rate achieved was 69.94%. The population and sample size are presented in Table 1 below:

Table 1: Population and samples of schools per educational region

Region	Population (No. of schools)	Sample (No. of schools)	Sample (No. of science teachers)	Sample (No. of single science teachers)	Sample (No. of double science teachers)	Achieved sample (%)
Ohangwena	63	33	43	23	20	52.38
Oshana	62	53	62	44	18	85.48
Oshikoto	38	28	32	24	8	73.68
Total	163	114	137	91	46	69.94

Table 1 shows an indication that fewer principals and science teachers in the Oshikoto region responded than in the other two regions.

The instruments

To address the research question, information was needed from each

school in the sample on the constructs of the conceptual framework. As all relevant concepts and issues presented in Figure 1 (next to other variables) were addressed in the Second International Technology in Education Study (SITES) 2006 study, a survey of pedagogical use of ICT in schools conducted under auspices of the International Association for the Evaluation of Educational Achievement (IEA) (Law, Pelgrum & Plomp, 2008) - use could be made of the instruments of the SITES 2006 study with approval of the IEA. The SITES questionnaires were adapted to the Namibian situation (see Ngololo, 2011).

The questionnaire asked for information about science education, leadership and policy matters in the school related to pedagogical practices and ICT. Items on the 'Impact of ICT Use' have been deleted from the original questionnaire of the science teachers as ICT was recently introduced to schools in Namibia and so would not yet warrant an impact study. The questionnaires were piloted to 20 schools within the reach of the researcher. A total of 18 principals and 18 science teachers responded without suggesting major changes to the questionnaires. All the principals and science teachers who responded were included in the main data collection.

Data collection

Data collection occurred during the first term of the 2010 school year (January to March). The self-administered questionnaire was posted to schools through the Ministry of Education Internal Mail Services. The questionnaires were collected through the School Inspectors Offices in the respective regions.

Data Processing

Data was entered in version 18 of Statistical Package for Social Sciences (SPSS). Data cleaning and validation was done using SPSS. Variables in the database were defined using data set codes.

Data analysis

In order to analyse survey data, the relational analysis and the regression analyses were applied to determine the factors that affect ICT policy implementation in rural areas. The responses from the principals and the science teachers were combined to form one data set, representing the school level. The responses from the principals were matched to those of the science teachers and a reduction in data was noted. Data from principals and science teachers was considered sufficient to represent

their respective schools. Responses from schools that had two science teachers were averaged to indicate a response at school level. A Pearson's correlation was run for factors with values above ± 0.30 as moderate fit for explanation (Cohen, Manion & Morrison, 2007) to determine the strength of the relationship between the respective construct. In addition, linear regression analyses were also run to strengthen and direct relationships between variables and to be able to assess the "statistical significance" of the estimated relationships, namely, the degree of confidence that the true relationship was close to the estimated relationship (Zikmund & Babin, 2007).

Results

Correlation analysis

A Pearson's correlation was run to determine the strength of the relationship between the respective construct (Cohen, Manion & Morrison, 2007).

The relational results are presented in Table 2 below:

Variables	Pearson's correlation	Variables	Variables	Variables	
Pedagogical use of ICT	Science teachers' attitude	Expertise of science teachers	ICT infrastructure	Professional development	
	Correlation	0.307	0.387	0.421	0.339
	Significance level	0.003	0.000	0.000	0.001
	N	91	91	91	91
Leadership of principals	Vision of Principals	-	-	-	
	Correlation	0.469	-	-	
	Significance level	0.000	-	-	
	N	91	-	-	
Vision of principals	Collaboration	-	-	-	
	Correlation	0.317	-	-	
	Significance level	0.002	-	-	
	N	91	-	-	
Variables	Pearson's correlation	Variables			
Technical support for science teachers	ICT infrastructure		-	-	
	Correlation	0.368	-	-	
	Significance level	0.000	-	-	
	N	91	-	-	
Pedagogical support	Vision of principal		Leadership of principals		
	Correlation	0.446	0.434	-	
	Significance level	0.000	0.000	-	
	N	91	91	-	

Table 2: Correlations of constructs between the principals and the science teachers

Table 2 suggests that pedagogical use of ICT has relationships with a considerable number of constructs, such as attitudes, expertise, ICT infrastructure and professional development of the science teachers. The correlations show that there is a significant relationship at $p < 0.01$ between the factor pedagogical use of ICT with attitude ($p=0.307$), expertise ($p=0.387$), ICT infrastructure ($p=0.421$), and professional development ($p=0.339$) of the science teachers. This means that principals and the science teachers are likely to agree on matters regarding science teachers' attitude, expertise and professional development. They are also likely to agree on statements about ICT infrastructure as perceived by the science teachers. The leadership of the principals has a strong positive relationship ($p=0.469$). This correlation suggests that both the principal and the science teachers are likely to agree on statements that reflect the vision of the principals in relation to the leadership style.

The vision of the principals has a strong relationship with the science teachers' views on collaboration ($p=0.317$). This correlation suggests that both the principals and the science teachers are likely to agree on issues of collaboration as perceived by the science teachers in relation to the vision of the principals. There is a strong relationship between the technical support offered to science teachers and ICT infrastructure ($p=0.368$). This correlation suggests that both the principals and the science teachers are likely to agree on issues of ICT infrastructure and technical support being offered at their respective schools.

There is a strong relationship between pedagogical support and the vision of the principals ($p=0.446$). This correlation suggests that the principals and the science teachers are likely to agree on matters related to the vision of the principal in relation to pedagogical support towards the science teachers.

Regression analysis

A regression analysis with data from the principals and science teachers was performed in order to assess the magnitude of the contribution of various constructs to the pedagogical use of ICT by science teachers. The scores from the responses in all the questionnaires were converted into indices to allow for regression analyses. Variable selection or regressions procedure considered all possible subsets of the pool of potential independent variables (factors). The dependent variable of interest is pedagogical use of ICT by the science teachers. The independent

constructs of interest in the model include: professional development, general ICT use, vision, digital learning materials, support, collaboration, expertise, leadership, infrastructure, and attitude of the science teachers, while the principals mentioned the support, expertise, vision, leadership, collaboration, infrastructure, and pedagogical support. The proportionate reduction in the variability of the pedagogical use of ICT when all the above constructs were included in the regression model is about 85.2%, while the outcome of the analysis of variance (ANOVA) for the fitted model presented in Table 3 shows that at 5% level there is a significant difference in the contribution of the constructs toward pedagogical use of ICT by science teachers.

Table 3: ANOVA

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	73416.349	22	3337.107	17.493	.000a
	Residual	12781.748	67	190.772		
	Total	86198.097	89			

The individual coefficient of the model parameters indicates that the only constructs that were found to be significant in the model at the 5% level of significance were leadership by principals (0.022), expertise (0.041) and general use by science teachers (0.000). As a result, for every activity added to leadership, the pedagogical use of ICT increases on average by 0.022. An increase in expertise, that is, adding knowledge and skills-related activities, pedagogical use of ICT increases on average by 0.267. Similarly, for every activity added to the general use of ICT, the pedagogical use of ICT increases on average by 0.877. This result suggests that the model can be applied to rural schools in the same situation.

Discussion and conclusion

Results from Pearson's correlation analysis suggest that there was a strong relationship between support and collaboration by the principals and digital learning materials. There is a strong relationship between leadership and the vision of the principals as well as curriculum goals as perceived by the science teachers. In addition, there is also a strong relationship between the vision of the principal and collaboration and curriculum goals as perceived by the science teachers. These results lead

to a main conclusion that both the principals and the science teachers are likely to agree on the statements made about those constructs. Matengu (2006) found that there was no school capacity to deal with ICT integration. Baylor & Ritchie, (2002) argue that the knowledge-based skills are important for the development of the knowledge society, guidance in the design of the curriculum, learning and assessment activities. But the development of the material to be used in the delivery of the curriculum needs to be of the desired quality (Cawthera, 2002).

The regression analysis suggests that constructs that were found to be significant in the model were leadership of the principals, expertise as well as general use of ICT by the science teachers. This suggests that a second major finding of the study is that for every increase in the significant construct, the pedagogical use of ICT also increases. This finding is consistent with SITES M1 that there is lack of computer literacy amongst teachers and lack of training on the computer integration into different learning areas, an observation that was also made by Ngololo et al. (2011) that in Namibia, the use of ICT in rural schools is generally low. Matengu (2006) also observed that there is a need for both technical staff and pedagogical support with increased training and personalized access to enhance ICT use in teaching.

Recommendations

1. Principals need to be trained in basic computing courses, content development and pedagogical use of ICT in order for them to provide the necessary support. Training should be provided by certified trainers who should be available on a constant basis to provide in-service support at the regional and where feasible school level. The courses should be appropriate and should meet the needs of the individual schools as schools are at different levels in their expertise and knowledge to use ICTs in education.
2. A strategy should be put in place that will coordinate pedagogical and technical support initiatives for rural schools.
3. Science teachers should establish a collaboration forum where they can share resources and experiences.
4. The Ministry of Education should investigate the types of leadership styles that exist within the different school leadership and try to identify the most appropriate for enhancing ICT-related activities in the rural schools.
5. There is a need to further investigate the following:
 - a. optimal scenarios for pedagogical and technical support for rural-based science teachers;
 - b. the quality of the e-content made available and its relevance to rural Namibia schools; and
 - c. the motivating factors that enable continuous use of ICT for pedagogical purposes despite the difficult rural environment the science teachers are working under.

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