Digital content and sustained use in integrating tablet technology into teaching in resource constrained environments in South Africa: *Educators' views*

Jabulisiwe Mabila[1], Marlien Herselman[1,2], Judy van Biljon[1]

[1]University of South Africa, [2] Council for Scientific and Industrial Research, South Africa

Abstract: Government initiatives have been undertaken to provide ICT infrastructure including digital content to public schools in South Africa, however the educators' views on the sustainability of integrating tablet technology into teaching in resource constrained environments have not been adequately advanced. Cost, sustainability and efficient use of ICTs are critical elements which will define ICT's future as an effective tool for social and economic development. The purpose of this paper is to investigate educators' perspectives on digital content and sustained use in integrating tablet technology into teaching in resource constrained environments in South Africa. Participants in the study included educators from eight public schools at one of the school districts in the Eastern Cape Province of South Africa. A case study approach using open-ended questions was used to gather information on educators' perspectives on content related factors that affect their ability to use tablets for teaching and the steps that can be taken to address their concerns. The findings provided evidence that while educators' use of the tablets is affected by the availability and accessibility of digital content and e-resources for different subjects, communication and knowledge gaps also affect digital content use by educators. The findings validate the elements in existing frameworks and model of sustainability for mobile learning in schools. However, identified differences in the context and environment necessitate some adaptation of the exiting frameworks and the person-centred sustainable model and that was presented as an adapted framework for sustainable mobile learning in resource constrained environments.

Keywords: Tablets, digital content, sustainability, resource constrained environment

Introduction

In order to understand how to sustain ICT education programs, it is necessary to understand what influences teachers to use technology to support teaching (Chiu &Churchill, 2015). There is no consolidated view of how to sustain the practices and learning with mobile devices because of the diverse contexts, devices and theoretical frameworks for mobile learning (Ng, 2013). Teachers' willingness and preparedness to adopt mobile learning are critical to successful implementation of ICT programs (Ismail, Azizan & Azman, 2013). Hardware and software resources, training and support, institutional culture (first order barriers), and educators' beliefs, confidence and their perceived value of technology to the teaching and learning process (second order barriers), have an influence on educators' use of ICTs (Ertmer & Ottenbreit-Leftwich, 2010). Educators may be concerned that the level of support provided to them may be insufficient and inconsistent, and that new technologies will increase their workload or responsibilities (Chiu & Churchill, 2015). Access to effective, engaging and sustained digital learning resources to support the curriculum has been identified as a critical prerequisite (DoE White paper, 2004).

Digital content is essential to e-Education as it can be easily accessed from many locations, and can be easily adapted and manipulated. Development and deployment of innovative and sustainable e-Learning resources is critical, and educators, content developers and administrators should effectively contribute to development of these resources (DoE White paper, 2004). The government, private sector, and non-governmental organisations are involved in developing and providing electronic content resources (Thutong, 2016; Mindset Learn, 2015; Vodacom Digital Classroom, 2016). In South Africa examples include educational portals initiated by the Department of Basic Education (DBE) to provide digital content resources, and content resources developed by other organisations which are available via satellite television, Internet, multimedia and supplemented by printed material (Mindset Learn, 2015). The strategic, pedagogical, and developmental framework on e-education

implementation in South Africa is outlined in the "White paper on e-Education" published by the South African Department of Education as early as 2004.

The White paper on e-Education advocates for a blended approach in the use of learning and teaching support material (LTSM), stating that digital resources in e-schools should be complimented by conventional print media and radio broadcasts (DoE White paper, 2004). There is a move to digital online teaching, and knowledge and information sharing via the Internet, and educators need to be equipped with the necessary ICT skills to utilize online e-education platforms (DTPS, 2014). Educators can also enhance their personal development by engaging in online programs to enhance their ICT skills and content knowledge (More, 2015). The objective of the White paper on e-Education is "Transforming learning and teaching through information and communication technologies", (DBE, 2004). This is in line with other national policies such as the National Development Plan (NDP).

South Africa's National Development Plan (NDP) asserts that greater use of technology, backed by high-speed broadband, could open new opportunities for teachers and learners to match the needs of the changing world (National Planning Commission, 2012). The DBE, through Operation Phakisa ICT in Education, seeks to deploy ICT programs that will develop and modernize the skills of teachers and learners. Establishing an e-literate society by 2030 is one of South Africa's National Development Plan (NDP) objectives. The Eastern Cape Department of Education (ECDoE)'s key priority of accelerating the deployment of ICT by providing infrastructure, financial, and human resources to schools (ECDoE, 2016), is aligned to this objective.

The challenge of sustaining ICT projects in resource constrained environments has been discussed in various studies (Pade-Khene, Mallinson, & Sewry, 2011; Mamba & Isabirye, 2014). Trucano (2010) stated that many educational initiatives for adoption of ICTs at schools in developing countries fail. Failure mode or decay often occurs when the project leadership transitions from the project managers to the institution's middle managers who are supposed to continue with the project (Parsons & Cornett, 2011). This study seeks to answer the research question: What are educators' perspectives on digital content and sustained use in integrating tablet technology into teaching in resource constrained environments in South Africa. Participants in the study included educators from eight public schools at one of the school districts in the Eastern Cape Province of South Africa who participated in a South African government ICT implementation initiative which involved the deployment of tablets to the schools.

The rest of the paper is organized as follows: Section 2 outlines the background to the study, defines digital content, explains the concept of sustainability, and the context of the study. Section 3 presents a framework for the sustainability of mobile learning in schools. The research methodology is described in section 4, and the results are presented and discussed in section 5. This is followed by the conclusion in section 6.

Background

Educators require the knowledge, skills, values and attitudes, as well as the necessary support, to integrate ICT into teaching and learning (DoE, 2007). Educators are required to teach learners to be competent with ICT, and help students become collaborative, problem solvers, and creative learners through using ICT so they will be effective global citizens (Unesco, 2016). As mobile technologies emerge, educators have to keep up with the changes, and take advantage of the power of technology to design and deliver learning and teaching support material which promote students' understanding of concepts, and equip their students with relevant skills. In South Africa, the DBE has developed plans and strategies in line with the countries' 2030 Vision which states that "By 2030, South Africans should have access to education and training of the highest quality, leading to significantly

improved learning outcomes" (National Planning Commission, 2012). Despite the programs that have been undertaken to address this, some challenges in the education system still prevail.

Some of the challenges in the basic education system include the large numbers of learners. South Africa spends about 5% of its Gross Domestic Product (GDP) on basic education (DBE Strategy, 2016). The number of public schools in South Africa in 2014 was 24060, and there were12 117 015 learners served by 390608 educators (DBE Strategy, 2016). The high costs associated with purchasing large numbers of textbooks and transportation of these from publishers to warehouses and eventually to schools, some of which are remote, can result in delays in the delivery and availability of textbooks (DBE, 2014; DBE Metcalfe Report, 2012). The use of electronic content such as e-books, accessed through tablets, can potentially alleviate some of the content and curriculum related challenges experienced in the education system. Tablet devices provide a powerful multimedia interface for accessing digital content such as e-books, and enable Web access.

Sustainable provision of digital content

Digital Content

"Digital content" can be defined as data produced and supplied in digital form (Wesssing, 2015). It is information available for download or distribution on electronic media (Mullan, 2011). This includes computer programs, applications, games, music, videos or texts, ebooks, irrespective of whether they are accessed through downloading or streaming, from a tangible medium or through any other means (UCITA, 2000). A distinction can be made between digital content itself and the method by which it is supplied. Digital content itself cannot be regarded as a "tangible item", and it is often copyright protected. Digital content can however be "sold" because it can be supplied on a physical medium, the "tangible item". Where digital content is not supplied on any tangible medium, it is 'accessed' or provided as a service and is not 'sold' (Hervé Jacquemin, 2010), hence the need to consider digital management rights (DRM).

Digital content is often covered by intellectual property rights, and right-holders protect and enforce their rights through technological measures, or DRM. DRM enable copyright holders to set rules of access and use of digital content and enforce these rules (Benčová, 2015). The purchase of digital content is universally governed by an "end user license agreement" (EULA) which requires that an account be created with the content provider.

These are some of the digital content related facts which teachers need to be aware of when they get a tablet to use to support teaching and learning in their classrooms as they can affect access to digital content, and the sustained use of e-resources.

The sustainability concept

Sustainability necessitates that any use of resources should take account of the stock of resources and the impacts of its utilization on the social, economic and political context of people today and in the future (Unesco, 2010). It has financial, technological, social, institutional, and environmental dimensions (Best & Kumar, 2008). Sustainability is inextricably linked to basic questions of equity, fairness, social justice and greater access to a better quality of life (UNDP, 2011). The provision of equitable and quality primary and secondary education, leading to relevant and effective learning outcomes is critical, as stated in the Sustainable Development Goal 4 (SDG4) on education (United Nations, 2016). Technology literacy enables learners to use ICT in order to learn more efficiently, acquire in-depth knowledge of their school subjects, and apply it to complex, real-world problems (Unesco, 2016). At the innovation level of the Teacher professional framework, educators should be able to use ICT to develop critical thinking, informed decision-making, collaborative and experiential learning, and to use ICT to develop higher levels of cognitive processing (DoE, 2007).

Initiatives have been undertaken to provide ICT infrastructure and e-resources to public schools. However, educators' views on the sustainability of integrating tablets into teaching in resource

constrained environments have not been adequately advanced. Educators who participated in this research are from schools that participated in the ICT for rural education and development (ICT4RED) initiative.

Research context - ICT for rural education and development (ICT4RED)

ICT4RED is a large-scale pilot South African government research, development and implementation initiative, which was carried out to improve the quality of teaching and learning in a school district in the Eastern Cape province of South Africa. The initiative was carried out over three years between 2012 and 2015. Educators were trained through the Professional Teacher Development program (TPD) on how to teach with technology and integrate mobile tablets in their classrooms. The TPD used the "earn as you learn" model which enabled educators to "earn" 10 inch Android tablets which became their personal property through a formalized (digital) badges system when they completed specific modules and provided evidence of how they applied their training in their classrooms (Botha & Verster, 2013). Additional incentives such as projectors, screens and "mobikits" consisting of a set of 15 to 20 tablets were awarded to schools based on the specific badge level that was achieved by educators from the school. Each school established their own ICT Committee and selected one of the educators as an ICT Champion. Support of the programme at the schools also included provision of infrastructure.

In the ICT4RED programme the deployment of tablets was supported by provision of technology hardware and software for the school infrastructure and network connectivity, including WiFi equipment, safe-keeping and charging facilities as well as e-books, content server and related electronic resources (ICT4RED, 2015). Digital content which was made available on the content servers for teachers and learners to download via the WiFi at schools include digital forms of existing paper-based South African Learning and Teaching Support Material (LTSM), such as workbooks, e-books, lesson plans. There were also Curriculum Assessment Policy Statements (CAPS) documents focusing on numeracy, literacy, mathematics, science and English as a first additional language. CAPS, for each approved school subject is a single, comprehensive, and concise policy document which provides details on what teachers need to teach and assess on a grade-by-grade and subject-by-subject basis (DBE CAPS, 2016; Variend, 2013). In addition to these, new digital or multimedia content, consisting of educational apps, quizzes, tests, games, audio books, video material, interactive workbooks, interactive stories, music, animations, that are appropriate for the South African curriculum, and Open Educational Resources (OERs) were provided (Herselman & Botha, 2014).

Despite the provision of these resources, effective integration of ICTs into teaching remains a challenge. Like in many other educational ICT4D projects, sustainability was identified as a major risk for the ICT4RED initiative (Ford & Botha, 2013). There is a framework that has been developed for sustainable mobile learning at schools (Ng & Nicholas, 2013). The diversity in contexts in which mobile learning occurs however, makes it difficult to establish a consolidated view of how to sustain the practices and learning with mobile devices (Ng, 2013).

A framework for sustainable mobile learning in schools

In 2013, Ng and Nicholas stated that at the time there was no model of sustainability for mobile learning in schools in the literature (Ng, 2013). They have since developed a "Framework for sustainable mobile learning in schools" and a "Person-centred sustainable model for mobile learning" (Ng & Nicholas, 2013). They utilize a more general framework, known as the "Framework for sustainability of information and communication technology (ICT) in education" (Cister, 2011). This framework comprises of economic, political, social, and technological sustainability. Ng & Nicholas (2013) propose a "Framework for sustainable mobile learning in schools". Despite the differences between the concept, *ICT usage in educaton* and the concept of *mobile learning* the same dimensions are relevant to sustainability. Therefore a fifth element, pedagogical sustainability can be added to the four elements in Cister's framework, as shown in Table 1. This Framework forms the basis for the "Person-centred sustainable model for mobile learning" (Ng & Nicholas, 2013) shown in Figure 2.

Table 1: Framework for sustainable mobile learning in schools
Framework for sustainability of ICT usage in education (Cister, 2011)
1. *Economic sustainability:* Financial capability of educational institution over a "long" period
2. *Political sustainability:* Role of leadership and institutional policies required to adopt and maintain mobile learning programmes. Leaders (Principals, heads of schools/faculties, coordinators of programmes need to identify *"the requirements"* Manage the change process such as ensuring teacher readiness
3. *Social sustainability:* Community involvement (parents, political leaders, business partners such a computer companies)
4. *Technological sustainability*: Decision making on type of technology based on institutional need and goals for "extended periods of time". Considerations of costs of technology and innovation such as uptake of IPads and Tablets   Technical support; Access to infrastructure; Technical assistance
Framework for sustainable mobile learning in schools (Ng & Nicholas, 2013)
Includes the four elements from Cister (2011) - Economic, Political, Social and Technological sustainability PLUS:
5. *Pedagogical sustainability:* Teaching and learning practices to support *"long-term"* goals of the mobile learning programmes. Roles of teachers (and learners) in facilitating learning with mobile devices; Preparation and practices to facilitate learning with mobile devices; Peer collegiality required to ensure best pedagogical practices; Informal learning facilitated by mobile learning

The "Person-centred sustainable model for mobile learning" (Ng & Nicholas, 2013), recognizes the complex relationships between the technical aspects and people-related factors. People related factors are the interpersonal relationships between leadership and management (principal and programme coordinator), teachers, students, technicians and the wider community (parents, suppliers, policy makers, software developers and researchers).
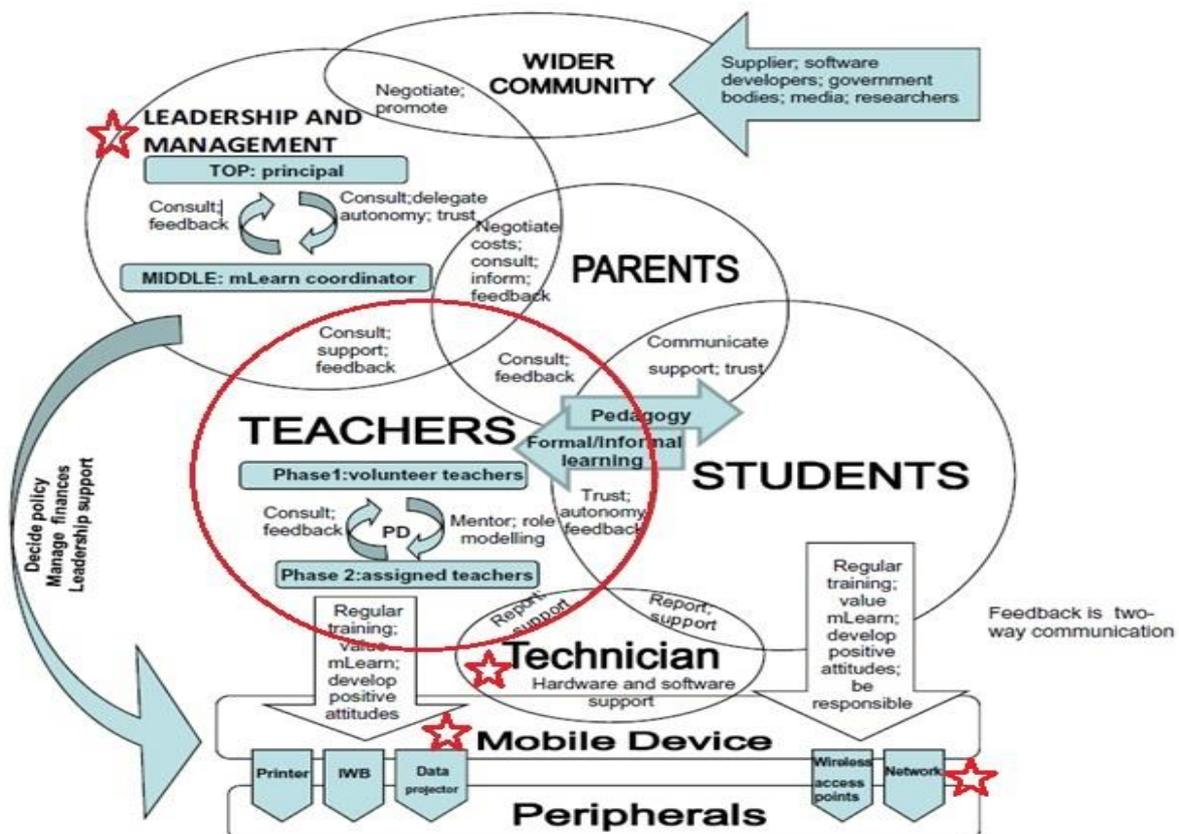
Figure 2: Person-centred sustainable model for mobile learning in schools (Ng & Nicholas, 2013) (*Highlights added for emphasis)

The context of Ng and Nicholas (2013)'s framework and the "Person-centred sustainable model for mobile learning" is secondary education in Australia, and is based on data collected at an Australian school. The Australian school was selected because of the enthusiasm and active involvement of the technologically 'savvy' principal who actively participated in the "mLearn programme". Funding for the programme was internal, provided within the school. This differs from the context of this study. Funding for the ICT4RED initiative was external, provided from outside of the schools, provided by government departments. In addition, the environment of the schools is considered to be resource constrained. However, the framework provides a useful tool for discussing educators' views on sustained use of digital content and tablet technology use in resource constrained environments.

Research Methodology

The underpinning philosophy of this paper is interpretivism as the educator's views will be interpreted by applying the hermenuetics. According to Odman (2003) and Gummesson (2003) hermenuetics is concerned with the interpretation of non-lingual expressions of human life where tacit knowledge is transformed into words. The position adopted in interpretive research is that our knowledge of reality is a social construct by human actors (Walsham, 1995). Educators' views on the role of digital content in the sustained use of tablets were obtained from 58 educators from 8 schools using a questionnaire. The questionnaire was administered through personal interviews with the educators at the schools ? Open-ended questions were used to ascertain what was going well, what should be done to make things better, and the concerns that educators had. Ethical approval for the research was obtained from the educational institution which supported the study and the research adhered to the research guidelines required by the Department of Basic Education in South Africa. Qualitative analysis of participants' responses to the open-ended questions involved the use of ATLAS.ti, a computer-based qualitative data analysis (CAQDAS) tool. ATLAS.ti entails developing codes and using quotations in primary documents to enhance analysis of data (Woolf, 2014).

Sample

A case study was used in this research. The case study method requires that the case should be defined (Creswell, 2014; Yin, 2013), in an endeavour to understand complex social phenomena (Yin, 2013). Research conclusions are made based on data collected from the unit of analysis. The sampling applied was purposive in order to represent schools from the three different phases of the ICT4RED project. The ICT4RED project involved 1 school in phase one, 11 additional schools in phase two, and 14 more schools in the third phase. The total number of educators was 350 (Herselman & Botha, 2014).

In this study questionnaires were distributed to 100 educators from ten schools. There were 58 responses received from 8 schools. A profile of the participants shows that a large proportion (81%) of participants were aged above 40 years, and were mostly female (62%). There was also a large composition (50%) of respondents who were aged between 41 and 50 years of age.

Findings and Discussion

Educators' perspectives were abstracted from the data in response to the research question namely, *What are educators' perspectives on the sustained use of digital content in tablet technology use to support teaching in resource constrained environments in South Africa?,* The perspectives were categorized according to the advantages, benefits, as well as the challenges and requirements from the educators' perspective

Main themes emerging from analyzed data

Educators noted that the use of tablets offered advantages by improving information storage, access to the Internet, and the potential for creating digital content and communicating online. The five main

themes that emerged when the data collected was analyzed were: "Digital content is available, but should be more comprehensive, and must ensure that it is CAPS aligned"; "It is easier to store digital information"; "Internet access is important"; "Educators and learners can create digital content and communicate it online"; and "Monitoring and evaluation is necessary". The findings are presented and discussed according to these themes in the following sections.

Digital content is available, but should be more comprehensive, and must ensure that it is CAPS aligned

Educators acknowledged the digital content loaded in the tablets and the school servers such as e-books, and commended its usefulness, stating that:

> "Even if there is a shortage of textbooks at school, we can find the textbooks".

However, some educators felt that the content focused on some learning areas, maintaining that:

> "Teachers are using tablets. Tablets should be loaded with different content not science subjects only";

> "As a language teacher what I have observed is that our tablets are not fully loaded with our content as well as e-books", "Upload a lot of content for different subjects", and "Ensure that content covers all grades".

The analysis uncovered the perception g that some of the digital content was not CAPS alignment. These educators stated:

> "Ensure that content is CAPS aligned"; "Content material is not enough to capacitate educators and learners", and "The problem is that tablets are not installed with the content".

This perception conflicts with the fact that all the tablets were loaded with content, the content provided was CAPS aligned (and covered all the learning grades (Herselman & Botha, 2014). There may have been gaps in communication or knowledge gaps, regarding the digital content accessible or how the educators could access it from the content server, and whether it is CAPS aligned or not.

Information storage support

The tablets and servers provide an effective storage facility in which information can be easily stored and retrieved at any time, including educators' lesson plans, teaching materials such as videos, and information on learners and learners' assignments. Statements made by educators regarding information storage include:

> "Information storage is easier", "It is easy for the teachers to keep the information in the tablets and also learners' work", and that "It is easy for the teachers to keep the information in the tablets such as lesson plans, videos for learners when doing their activities".

The easier, anytime access of data using tablets is reflected by one of the educators who stated that:

> "We are introduced to ICT, so we can store and retrieve information anytime"

While educators acknowledged the the usefulness of tablets and the server for information storage less was said regarding the school "network" or the use of an "intranet". The essence of a network is the ability to share things, and this could be a tool for improving communication within the school. A network also facilitates tracking and monitoring of pupils' web and chatroom activities, plus software usage.

The element "Technicians" shown in Figure 2 in the "Framework for sustainable mobile learning in schools" (Ng & Nicholas, 2013) indicates that system users, educators and learners, require technical support to identify and solve hardware and software faults. There seem to be a need to define the feedback mechanisms and processes regarding how to address infrastructure and technical problems such as network problems, Internet access problem, tablets that need to be fixed, with broken screens, ports, and freezing screens. Appropriate measures should be taken to ensure economic sustainability,

which is the "financial capability of educational institution over a long period" as depicted in the "Framework for sustainability of ICT education" (Cister, 2011) in Table 1. Planning should involve long-term consideration taking issues like copyright into account. The availability of financial resources also influence provision of technicians to support educators.

Some educators' were unable to access the digital content on the servers even though this was loaded on the content servers. The provision and access to digital content cannot be viewed in isolation. There is a need for continuous monitoring and evaluation in order to identify challenges and provide support. Formal platforms and processes for information gathering within schools, and interaction between schools and district officials pertaining to how ICTs are used, and challenges faced should be defined and communicated.

Access to the Internet

It was evident that educators considered access to the Internet as an important aspect in the use of the tablets. Educators indicated that they are able to find information from specific Web sites. They remarked that:

> "Educators can get the lesson plans through 'Thutong' and 'Quick Mathematics".

"Thutong" and Quick Mathematics" are some of the websites developed and supported by the government, private sector, and non-governmental organizations. These websites provide electronic content resources at no charge.

This provides evidence that these websites are accessible to educators, but the degree to which educators use these resources need to be established in order to determine the support that educators require in order to sufficiently exploit the resources. The use of learning analytics has the potential to transform the education system and can serve as a foundation for systemic changes that can be made to maximize support provided to educators. This is because online learning, digital records, and mobile devices used can provide a digital footprint, and rich data that can provide valuable insight into the learning process. The use of learning analytics can improve teaching, learning, decision making, and organizational efficiency. This would however require careful consideration of what data needs to be gathered, and why it is required.

Some educators indicated they had difficulty accessing the Internet, and stated that Internet access is "required" as it enables easy access to information. This was an unexpected finding because all the schools were provided with the necessary infrastructure to ensure Internet access. Further investigation is required to ascertain what access-related issues could account for the educators' inability to utilise the Internet. For example,communication deficiencies, knowledge gaps or technical support. . Some educators may not fully understand the process that needs to be followed to ensure continued access to the Internet that was provided through the ICT4RED program.

Can create digital content and communicate it online

According to the educators, the tablets offer educators and learners the opportunity to create and communicate digital content using email and applications such as Facebook, WeChat, and Youtube with the tablet devices. Educators' proclamations regarding this include:

> "Making lesson plan of the lesson you are going to teach, and assessments",

> "Using of apps like email, Facebook, WeChat, and Youtube, is exciting e.g photo taking and video clips, watch and listen to it", and

> "Social network such as Whatsapp and Facebook. Making videos and taking photos of learners during teaching and learning".

However, concerns were raised regarding responsible use of the Internet, which indicates the need to ensure the appropriate use of social networks, and the Internet. As indicated by one of the educators:

"Social networks are good to know but use in a proper way/manner".

Monitoring and evaluation needed

Educators expressed the need for increased interaction with DBE officials, who should monitor and evaluate the use of the tablets and provide support. Educators stated the need for:

"Regular monitoring by the district education officials to monitor the usage and the condition of the tablets", "Check-ups, assessment and intervention by the department of education both at National and Provincial (level)", and "Visits from ICT4RED to check the situation would help".

Educators also stated that monitoring is necessary because:

"Educators can concentrate on apps that are not mostly relevant to their subject."

The need for increased monitoring by district officials of how tablets are used also relates to the need for support.

The findings in view of the sustainability model for mobile learning in schools

The findings highlight both the advantages experienced and the critical requirements for sustained mobile technology usage. The perceived advantages include the improved ease of information storage and the opportunity afforded to create and communicate digital content. The requirements include the scope (cover all grades) and applicability (CAPS curriculum) of the digital content made available. It is important to note that the issue was a communication problem rather than a content provision problem. The need for internet access emerged, this was assumed as a prerequisite for the implementation and it was not clear whther the problem was with the imlementaiton or with the communication. Finally there was a request for monitoring and evaluation that boilded down to a request for management to stay involved in ensuring technical and other support. This relates to the need for "consulting, feedback, and support" as indicated in the "Person-centred sustainable model for mobile learning in schools" outlined in section 3, between educators and, Leadership and management (Principal and ICT Champion). In addition to this, in the context of resource constrained schools in this study, it is imperative that "consulting, feedback and support" between the schools and the District should be maintained. In the context of South African public schools, Districts are tasked with "facilitating ICT connectivity in all institutions within their district" (DBE, 2013 - Roles & Responsibilities), and to provide support to and collaborate with principals and educators to improve the quality of teaching through school visits, classroom observation, and cluster meetings so the issue seems to be one of communication and accountability
As stated in the DoE White paper, "Any solution that South Africa adopts has to be cost-effective to meet the developmental demands of reaching the most remote areas. It is no use having state-of-the-art technology unless it can be sustained. Deployment of ICTs does not guarantee their efficient utilization and therefore capacity building and effective support mechanisms must accompany deployment" (DoE White paper, 2004: 6). This means that economic, political and social sustainability are essential elements of any sustainability framework. The educators perceptions analysed lie more on the level of technological and pedagogical sustainability.
The findings validate the elements in existing frameworks and models of sustainability for mobile learning in schools such as Ng & Nicholas' model however differences in context necessitate some adaptation, an indication that effective integration of ICT into teaching is complex. Ng & Nicholas' "Person-centred sustainable model for mobile learning in schools" seems to represent a different reality than occurs in resource constrained schools in South Africa, mainly because the funding in the school used in Ng's case was internal to the school. The Principal in Ng's case is also described as an "enthusiastic, tech-savvy" individual. This is not always the case for the schools in this research. In addition, the Principal already had resources allocated to the program and for employing a technician. The model is also non-hierarchical (Ng & Nicholas, 2013). These conditions and institutional environment differ in resource constrained environments where schools (micro level) are largely

dependent on external funding and acquisition of technicians, which is influenced by processes, leadership support and policy implementation at district (meso level), provincial and national levels (macro level). A sustainable model for mobile learning in resource constrained schools would need to take these factors into account. It is thus proposed that the "Framework for sustainable mobile learning in schools", should add the element, "institutional sustainability" as depicted in Table 2..

Table 2: Revised framework for guiding sustainable management of mobile ICT technology in resource constrained schools based on **(Cister, 2011) and** Ng & Nicholas'(2013).
1. Economic sustainability: The financial capability of the educational institution to support the ICT technology over an extended period.
2. Political sustainability: The role of leadership and institutional policies required to adopt and maintain and monitor the success of mobile learning programmes. Consulting and feedback between the different levels of the institution.
3. Social sustainability: Community involvement which includes parents, political leaders and business partners such a computer companies.
4. Technological sustainability: Informed technology selection based on institutional needs and mid-to longer term strategic goal. Mindful considerations of technology, access and maintenance costs, access to infrastructure and technical support. Consulting and feedback between the service providers in terms of content, technical support and the users (teachers).
5. Pedagogical sustainability: Teaching and learning practices to support the goals of the mobile learning programmes. The roles of teachers (and learners) in facilitating learning with mobile devices; Preparation and practices to facilitate learning with mobile devices; Peer collegiality required to ensure best pedagogical practices; Informal learning facilitated by mobile learning
6. Institutional sustainability: Alignment between processes, leadership support and policy implementation at district (meso level), provincial and national levels (macro level).

Thus the "Person-centered sustainable model for mobile learning" would need to incorporate institutional structures, which in this research refers to the Department of Basic education's District, and their interaction with the school. This is necessary because in this context the District's interaction with the school affects the deployment of resources, finances, technicians, and the District is also expected to provide leadership and management, and to monitor and support schools.

Conclusion

The study highlighted the considerations when developing and deploying digital content to public schools in resource constrained environments. Effective support mechanisms must accompany deployment of ICTs. Provision of digital content is closely related to other factors such as technical support, monitoring, and economic sustainability. Financial resources are required to ensure that technical support is afforded to educators. The nature of digital content, or data produced and supplied in digital form and distributed on electronic media, requires that infrastructure be provided, supported and maintained. Institutional structures which are tasked with monitoring and support functions should be strengthened, and provided with resources so that they can perform their monitoring and support responsibilities effectively. Based on educators' views, the "Framework for sustainable mobile learning in schools", some consideration needs to be made for an additional element, "institutional sustainability" to be added for a framework that can apply to resource constrained environments. The "Person-centred sustainable model for mobile learning" (Ng & Nicholas, 2013) would also need to be adapted to depict institutional structures and processes and their interaction with the school as they affect the deployment of resources, finances, technicians, and affect monitoring and support in this environment. Advancing educators' views can help to identify the benefits experienced and the challenges that need to be addressed for sustainable deployment of digital content to support teaching.

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