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Electronic Pedagogies and Educators' Digital Technology Literacy for the TV White Space Pilot Project In Mankweng Circuit, South Africa
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ABSTRACT The inevitability of electronic education for "effective teaching and learning" in South Africa underestimates the complexities of establishing pedagogic abilities, skills and confidence in the application of attendant digital technology informatics among educators. Broadly denoted E-learning, the use of digital technologies in teaching and learning is ubiquitous; and, educators are challenged to blend technological informatics with traditional didactics. In South Africa, universities' infrastructure is used for implementation of educational technologies for schools; and, TV White Space Pilot Project in Mankweng Circuit, hosted by the University of Limpopo, is one such initiative. Literature suggests that successful implementation of electronic and information communication technology-based teaching and learning is, beyond infrastructure resourcing, dependent upon "computer and information literacy" among both students and educators. Additionally, incorporation of electronic learning places a demand on both students and educators to invest time and energy to acquire relevant educational methodologies, strategies and skills. This article examines

survey results of 24 educators from three high schools involved in the TV White Space Pilot Project for confidence in computer and information pedagogic literacy. It infers that implementation of the TV White Space Model has not revolutionized the use of digital technologies informatics or e-pedagogies in the three high schools. The article recommends that an educational campaign should be mounted in order to promote digital participation of educators in the online learning environment, with attendant official acknowledgement and provision of resident technical support at schools.

INTRODUCTION

The search for techniques to enforce effective teaching and learning has in many ways been underlined by the strife for active, rather than passive, learning (Subramanian, Timberlake, Mittakanti, Lara and Brandt 2012; Little wood, Shilling, Stem land, Wright and Kirk 2013; Wolff, Wagner, Poznanski, Schiller and Santen 2014; Webster and Son 2015). Concurrently, global knowledge economy as well as the advancements in information communication technology (ICT) bore crucial implications for teaching and learning informatics (Garrison and Vaughan 2008; Youtie and Shapira 2008; Deltsidou, Voltyraki, Mastrogiannis and Noula 2010; Marginson 2010; Ecampus 2011; Garrison 2011; Button, Harrington and Belan 2014; Gu, Shao, Guo, and Lim 2015; Valtonen, Kukkonen, Kontkanen, Sormunen, Dillon and Sointu 2015). For all intents and purposes, ICT epitomizes globalization and educational innovation (Peeraer and Van Petegem 2014). Educational ICT includes the so-called mobile learning (m-learning) wherein enhancement of pedagogy unfolds through “handled devices” like smart phones, tablets and game concoles (Pegrum, Oakley and Faulkner 2013; Kearney, Burden and Rai 2015). The irony of the global advancements, “inevitability” and “ubiquity” of ICT is that its pedagogic applications in education for teaching and learning have not been unproblematic, especially given the rigidities of adherence to the traditional face-to-face didactics (Peeraer and Van Petegem 2014; Valtonen et al. 2015; Webster and Son 2015). Indeed, technology does not “automatically bring about particular learning outcomes” because “there is nothing inherent in technology that automatically guarantees learning” (Peeraer and Van Petegem 2014: n.p.).

Valtonen et al. (2015) observed that ICT is a broad concept and that it includes applications such as laptop computers, smart phones, social media, emails and internet online environment. Governments across the world, in both developing and developed countries,

have made significant resources and effort investments in education technology (Teo 2011; Al-Mansour and Al-Shorman 2012; Ertmer, Ottenbreit-Leftwich, Sadik, Senddurur, and Sendurur 2012; Kirkwood and Price 2013; Peeraer and Van Petegem 2014; Webster and Son 2015). South Korea, for example, invested billions of US$ between 1978 and 2001 in ICT in order to "modernize and globalize the education system", also changing the name of the Ministry of Education and Human Resources Development to the Ministry of Education, Science and Technology (Webster and Son 2015: 84). Increasingly, the requirement to incorporate digital technology in teaching and learning has become ubiquitous with attendant race to install advanced computer and information communication technology infrastructure (Garrison 2011; Button et al. 2014; Wolff et al. 2014; Gu et al. 2015; Oyedemi 2015; Webster and Son 2015). The fashionable use of digital technology to facilitate teaching and learning is commonly denoted E-learning (Ecampus 2011; Garrison 2011; Button et al. 2014), which entails several preconditions (Valtonen et al. 2015; Webster and Son 2015), some of which consist of necessary requirements whilst other are sufficient conditions. Without installing the necessary infrastructure, the use of E-learning would be improbable or unsuccessful if there are no computers, unreliable computer systems and applications, freezing computer screens, frequently dropping online connections and long download time spans (Button et al. 2014). But, as South Korean experience demonstrates, years of investment in technological infrastructure in education ended-up with trained educators, seldom using ICT during face-to-face contact sessions due to the dearth of classroom implementation support and lack of time (Webster and Son 2015). Additionally, Valtonen et al. (2015) report that in Finland where ICT resourcing in education is good, application is "very low" because most educators have low self-believe in their abilities and skills to use the technology in teaching and learning.

Developed countries with the state-of-the-art ICT infrastructure have continued to struggle to integrate E-learning in education, notwithstanding the positive benefits associated with digital technology. To this extent, infrastructure is not a sufficient condition to precipitate successful implementation of E-learning; instead, technology informatics is critical. That is, levels of computer and information communication technology literacy, which are not an osmotic process, among students and educators define the primary determinants for successful implementation of E-learning. However, E-learning is time intensive and blending it with the traditional face-to-face interactions entails significant investment of time and resourcing for the students and teachers. Acquisition of skills for developing the online courses, facilitating

learning and interacting with students requires training, financial and technical support for educators too (Garrison and Vaughan 2008; Deltsidou et al. 2010; Marginson 2010; Ecampus 2011; Garrison 2011; Button et al. 2014; Peerear & Van Petegem 2014; Valtonen et al. 2015; Webster and Son 2015). To this extent, implementation of digital and information communication technologies for teaching and learning begs questions of the levels of computer and information literacy as well as technology informatics among students and educators, beyond mere delivery of infrastructure and access. These competences are denoted elsewhere in this article as “capacity” and “self-efficacy” (Webster and Son 2015).

The move towards incorporation of E-learning in South Africa, a developing country, is so ubiquitous that it may seem to be unproblematic. This article examines the levels of computer and information communication technology literacy among educators at three high schools in Mankweng Circuit where the TV White Space Pilot Project is implemented. The project involves a partnership of the University of Limpopo, Microsoft South Africa, Centre for Scientific and Industrial Research (CSIR) and Multisource. Additionally, there are institutional collaborators that are involved in the project; and, they are Independent Communications Authority of South Africa (ICASA), South African Broadcasting Corporation (SABC), Department of Basic Education and Department of Science and Technology. This high profile partnership and collaboration highlight the significance of digital technology to efforts towards revolutionizing South African education. The increased demand to provide for digital participation, especially in the education system, motivated for the exploration of geo-location databases through the so-called TV White Spaces (Carlson, Ntlatlapa, King, Mgwili-Sibanda, Hart and Geerdts 2013; Lysko, Masonta, and Mfupe 2013). This digital model exploits vacant channels in the television spectrum to provide wireless internet connection (Carlson et al. 2013; Lysko et al. 2013). Broadly, TV white spaces are the allocated spectrum in the TV and radio bands either unassigned or assigned to licensee but are completely or partially unused across all geographic locations therefore being available for alternative wireless communication services (Carlson et al. 2013: 8; Lysko et al. 2013: 6). This model is invaluable for developing countries such as South Africa in narrowing digital inequalities by providing opportunities for wireless internet connections for formerly disadvantaged education systems through spectrum sensing of available channels in the geo-locational databases (Carlson et al. 2013; Lysko et al. 2013). Whereas the TV White Space Model provides low costs wireless internet connections without interfering with the existing spectrum band usage, its installation involves costly infrastructure resourcing and operations.

This article examines computer and information literacy among TV White Space Pilot Project users, specifically educators, at three high schools in Mankweng Circuit, South Africa.

PURSUIT OF EFFECTIVE TEACHING AND LEARNING: FACE-TO-FACE INTERACTIONS, E-LEARNING AND BLENDED PEDAGOGIES

In recent years, the pursuit of effective teaching and learning has been largely captivated by the didactics of passive versus active learning (Subramanian et al. 2012; Little wood et al. 2013; Wolff et al. 2014; Gu et al. 2015). The traditional educators' delivery of information to students was criticized for reinforcing passive learning and suboptimal knowledge acquisition (Subramanian et al. 2012; Little wood et al. 2013; Wolff et al. 2014; Gu et al. 2015). Research has conclusively demonstrated that students "do not retain a significant portion of what is taught during lectures" from traditional didactic-ridden sessions of passive learning (Wolff et al. 2014: 1). Conversely, active learning shifts attention to the students' learning, away from the educators' didactic delivery, in order to solicit their active participation in the process of achieving improved retention and deeper understanding of content (Subramanian et al. 2012; Littlewood et al. 2013; Wolff et al. 2014; Gu et al. 2015). Hence, a variety of teaching techniques have been recommended, guided by the aspiration for fostering increased student engagement and inculcation of "self-directed learning" through effective delivery of core knowledge, contextualization and simplification of difficult concepts (Wolff et al. 2014: 1). According to Noh, Mustafa and Ahmad (2014: 145), "Although teachers may believe that computers can lead to improved teaching and learning, they may choose not to use this technology if they have low confidence in their abilities to use computers". Besides, evidence suggests that the ICT revolution has not been realized in terms of the enhancement of pedagogy (Pegrum et al. 2013; Kearney et al. 2015). Indeed, the new techniques are not supposed to supersede and replace traditional didactic sessions; instead, they are recommended for supplementation that advances the learning goal of analysing and applying, beyond mere remembrance and comprehension (Subramanian et al. 2012; Littlewood et al. 2013; Wolff et al. 2014; Gu et al. 2015; Webster and Son 2015). According to Suh (2004: 1040 cited in Webster & Son, 2015: 85), the question of how to integrate computer technology in teaching and learning is one of the "major challenges facing educational policy in the information age". However, as Valtonen et al. (2015: 49) put it, the value of ICT for teaching and learning "is widely recognised". E-learning is indeed associated with the "so

called twenty-first century skills" at a global scale (Ahonen and Kinnunen 2014; Valtonen et al. 2015).

Given the strife for transformational pedagogy from passive to active learning, ICT has become "inevitable" and "ubiquitous" across the world that there have been insinuations that the online environment provides for "deeper learning" than the traditional face-to-face classroom contact model (Pegrum et al. 2013; Button et al. 2014; Peeraer and Van Petegem, 2014; Gu et al. 2015; Kearney et al. 2015; Valtonen et al. 2015). But the impacts of ICT on knowledge acquisition continue to be contested, notwithstanding shared acknowledgement of attendant advantages of student learning flexibility and self-pacing. In some cases, it has been argued that students who use E-learning have been likely to achieve higher grades than those who relied solely on the face-to-face classroom model alone (Button et al. 2014; Gu et al. 2015; Hanus and Fox, 2015). Citing Collins and Halverson (2009), Peeraer and Van Petegem (2014: n.p.) show that whereas technology transformed society, its impacts on education has remained uncertain as most studies could not establish a positive correlation with students' achievements. In practice, the uptake of ICT in education has in general been mixed with the result that educational revolution did not take place in teaching and learning (Peeraer and Van Petegem 2014). There are those voices that questioned heavy reliance on digital technology for gamification of learning on the grounds that there is a probability that it could lead to demotivation and poor performance among students, if not properly applied (Wolff et al. 2014; Hanus and Fox 2015). Cognitive formulations involve extremes that computers are essentially incompatible with teaching, on the one end, whilst at the other end some studies affirm that ICT improves pedagogy (Schmidt et al. 2014: 286 cited in Webster and Son 2015: 85).

However, there is cognitive convergence on the idea that E-learning does not necessarily replace the traditional face-to-face classroom interactions (Button et al. 2014; Wolff et al. 2014), even among those digital technology fanatics. As a result, there has been a shift towards blended learning, which integrates traditional classroom interaction strategies with the online teaching and E-learning model (Garrison and Vaughan 2008; Button et al. 2014; Wolff et al. 2014) and/or a variety of other nuance techniques and approaches (Subramanian et al., 2012; Littlewood et al. 2013; Hanus and Fox 2015). An exclusively online learning environment is possible, but there are serious limitations that arise due to the nature of knowledge. Whereas it could be easy to transfer codified knowledge, the tacit version would

be lost in the process because it is vested with the educator and it therefore requires face-to-face contact to be experienced by the receiver (Storper and Venables 2004; Smedlund 2006; Bramwell and Wolfe, 2008; Hong 2008; Rosenthal and Strange 2008; Youtie and Shapira, 2008; Marginson 2010). For this reason, it is always important to adopt blended learning to incorporate various techniques and approaches, rather than exclusive reliance on one or the other model (Subramanian et al. 2012; Littlewood et al. 2013; Wolff et al. 2014; Hanus and Fox 2015). However, incorporating techniques such as "gamification", "pause procedures", "team-based" activities, "case-based scenarios", "role-play and commitment-generating exercises" (Subramanian et al. 2012; Littlewood et al. 2013; Wolff et al. 2014; Hanus and Fox 2015) into traditional designed-didactic sessions may entail additional time, energy and resources, which the institutions and educators may not be willing to invest (Button et al. 2014; Gu et al. 2015). Equally, blending E-learning environment with the traditional face-to-face classroom interactions is not unproblematic because it requires among other things computer and information literacy relating to internet skills and their use to retrieve information, which are largely conditional upon acquisition of costly personal computers and training (Elder and Koehn 2009; Bond 2010; Deltsidou et al. 2010; Button et al. 2014; Gu et al. 2015). Additionally, information literacy relating to the skills of managing large volumes of data when conducting internet database searches are as important as those for basic use of computer for information retrieval from the internet (Elder and Koehn 2009; Bond 2010; Deltsidou et al. 2010; Button et al. 2014; Gu et al. 2015). Computer and information technology competences among students and educators are critical to the successful blending of E-learning in teaching and learning (Button et al. 2014; Noh et al. 2014; Peeraer & Van Petegem 2014; Gu et al. 2015; Valtonen et al. 2015). Hence, computer and information technology literacy are often stipulated as the preconditions for the implementation of online learning environment and for lifelong learning (Button et al. 2014; Gu et al. 2015).

E-LEARNING INFRASTRUCTURE VERSUS INFORMATICS LITERACY FOR DEVELOPING COUNTRIES

Developed countries such as Australia, Canada, United Kingdom and the United States of America have incorporated E-learning in education relating to various curricula; however, complexities relating to computer and information literacy among both students and educators have hindered the advancement of the envisaged effectiveness of teaching and learning through digital technology (Button et al. 2014; Wolff et al. 2014; Valtonen et al.

2015). Notwithstanding Noh et al.'s (2014) believe that ICT makes for good teaching and learning, these challenges for the developed countries, where infrastructure is not problematic, educators' capacity to use "pedagogically sound delivery models" and students' skills in digital technologies have become critical to the successful implementation of E-learning (Teo 2011; Al-Mansour and Al-Shorman 2012; Ertmer et al. 2012; Kirkwood & Price 2013; Button et al. 2014; Valtonene et al. 2015; Webster and Son 2015). The latter complexity is more than trivial for developing countries where infrastructure may not be adequate, therefore demanding excessive time and energy for both students and educators. Besides, Webster and Son (2015) show that ICT resourcing does not necessarily yield positive implementation in classrooms. Indeed, "the presence of institutional enablers is essential" to the successful incorporation of E-learning in the teaching and learning methodologies (Button et al. 2014: 1312). However, institutions have prioritized adequate access to digital technologies and resourcing ahead of the training requirements for students and educators regarding integration of E-learning informatics in the teaching and learning activities (Deltsidou et al. 2010; Gu et al. 2015; Oyedemi 2015; Valtonen et al. 2015). However, provision of adequate digital technologies and computer resourcing is only a necessary condition to ensure successful implementation of E-learning. As Webster and Son (2015: 84) observed, educators in South Korea have not employed educational technology "regularly and consistently" in their teaching, notwithstanding "considerable effort and expenditure" by government and universities to promote its use.

First, though, it is important to allude to the various positive effects in teaching and learning associated with the implementation of ICT. It is assumed that the adoption of mobile ICT and the online learning environment, especially that relating to emails and digital discussion fora, allow students to "access their educators rapidly", to receive timely responses and to be flexible as well as being self-paced in studying (Kelly, Lyng, McGrath and Cannon 2009; Button et al. 2014; Gu et al. 2015). The m-learning is, in particular, highly regarded for providing a flexible and self-paced learning in a digital environment described by Mifsud (2014) as "anywhere, anytime", "on the move" and "multiple contexts". Whereas the online learning environment encourages students and educators, as it were, to engage in collaborative learning, to motivate each other and "to know each other outside of the classroom" (Button et al. 2014: 1313), there are pitfalls as some uses involve excessive social discussions, undue gamification and less of academic activities. That is, ICT applications in teaching and learning are not unproblematic (Valtonen, Dillon, Hacklin and Väisänen 2010;

Valtonen, Pöntinen, Kukkonen, Dillon, Väisänen and Hacklin 2011; Valtonen, Hacklin, Kontkanen, Hartikainen-Ahia, Kärkkäinen and Kukkonen, 2013; Noh et al. 2014; Valtonen et al. 2015). A variety of factors affect, negatively and/or positively, the use of E-learning among students and educators. This article seeks to move beyond the challenges related to computer infrastructure and access to it, such as reliability of the computer system, working computer applications, non-freezing computer screens, reliable online connections and reduced download time, to examine educators' levels of competence in digital technology informatics. More importantly, it has been demonstrated that when challenged to use ICT, both students and educators experience increased levels of anxiety precipitated by the lack of relevant skills (Elder and Koehn 2009; Bond 2010; Deltsidou et al. 2010; Button et al. 2014; Noh et al. 2014). Such anxiety with the use of ICT creates negative impact on teaching and learning activities, unambiguously demonstrating the significance of self-confidence and self-believe associated with the competence in technology informatics. To a large extent, this negative impact entails a significant level of technical support (Elder and Koehn, 2009; Bond 2010; Deltsidou et al. 2010; Button et al. 2014), which is not always possible. Besides, the justification for the incorporation of E-learning is to create flexibility in the teaching and learning activities. To ensure effectiveness in teaching and learning, technology informatics should be tacitly held by the E-learning users themselves.

E-learning requires, at the minimum, specific levels of computer and information literacy as well as pedagogic technological informatics. Computer literacy refers to "an understanding of the concepts, terminology and operations that relate to general computer use" (Computer Literacy USA 2012 cited in Button et al. 2014: 1311). According to Bundy (2005 cited in Button et al. 2014: 1311), information literacy means the ability to recognize the need for information, to determine the extent of the need, to access it efficiently, to critically evaluate it and its sources, and to collect or generate, classify, store, manipulate, redraft and incorporate it into existing knowledge systems or base. Pedagogic technological informatics involve the skills necessary for educators to integrate teaching, computer and information sciences in their management and communication of data, information and knowledge in facilitation of learning (authors' own formulation drawn from Button et al. 2014). Successful implementation of E-learning is, therefore, dependent upon the levels of computer and information literacy among students and educators (Button et al. 2014; Noh et al. 2014; Webster and Son 2015). To be equipped with lifelong learning skills, students and educators need to be supported with ongoing education and informatics as current education

methodologies and teaching strategies increasingly incorporate E-learning (Button et al. 2014; Gu et al. 2015).

For these reasons, E-learning entails costly interventions relating to financial, training and technical support for both students and educators (Moule, Ward and Lockyer 2010; Nguyen, Zierler and Nguyen 2011; Gu et al. 2015). Both computer and information literacy, which cannot be acquired by osmosis, are fundamental to technology informatics in teaching and learning (Bond 2010; Button et al. 2014; Noh et al. 2014; Webster and Son 2015). That is, students and educators alike require financial, technical and training support in order to acquire and improve their technology informatics, necessary for successful implementation of E-learning. Students and educators should be able to manage digital technology and information as well as being provided with the "opportunities for progressive development of ICT competence" (Button et al. 2014: 1320). Additionally, there is time cost, because blending means that whilst traditional face-to-face interaction model is maintained, educators should find time to "develop E-learning resources" rendering the online learning environment time intensive (Button et al., 2014: 1320). Crews, Miller and Brown (2009), Chapman (2010), Moule et al. (2010), Nguyen et al. (2011) and Webster and Son (2015) demonstrated that the amount of time involved in developing and facilitating E-learning is multifaceted because educators are, beyond interacting with the students on the online learning environment, required to learn the new technologies and to prepare new lectures that incorporate ICT. It is estimated that one hour of preparation of online content requires almost 80 hours of production, whereas developing one hour of online educator-led teaching requires over 40 production hours (Chapman 2010). Beyond being time intensive, E-learning entails high financial costs too (Crews et al. 2009; Chapman 2010; Moule et al. 2010; Nguyen et al. 2011). Also, it was estimated that educators' interactions with students on the online learning environment could take twice as much as the face-to-face facilitation, thereby enforcing low levels of motivation for adoption (Crews et al. 2009; Chapman 2010, Moule et al. 2010; Nguyen et al. 2011). Given that educators too are captivated by the logic of the "goodness" of E-learning to effective teaching and learning, adoption of educational technologies is often accompanied by the lack of requisite skills and, therefore, attendant poor quality of online courses, occasioned by the lack of consideration and incentivization of the time intensive course development as overtime (Crews et al. 2009; Chapman 2010, Moule et al. 2010; Nguyen et al. 2011; Noh et al. 2014). For the latter reason, developing and facilitating online learning is construed by most educators as additional unpaid work as it does not supersede

the face-to-face interactions model. Most educators tend to be less keen to invest the amount of time, cost and energy into developing online courses; and, relevant institutions that provide the digital technology infrastructure are not blameless in this regard as they do not seem to acknowledge that E-learning is time intensive (Webster and Son 2015). More often than not, institutions prioritize acquisition and installation of computer hardware and software above students' and educators' technological training and incorporation in teaching and learning (Valtonen et al. 2010; Valtonen et al. 2011; Valtonen et al. 2013; Oyedemi 2015; Valtonen et al. 2015; Webster and Son 2015). Besides, E-learning informatics are in a continuous state of flux, implying that educators and students are challenged to keep up with the developments.

Collectively, computer and information literacy for the application of E-learning involves issues of the user's "capacity" or "self-efficacy" rather than mere access for both the students and educators. Whereas Noh et al. (2014: 144) argued that "Computers and computing technology are … indicative of good teaching and student learning", digital technology has revolutionized social networking but the same has not been true with the onset of educational ICT (Peeraer and Van Petegem 2014). Perhaps, the low levels of applications of ICT in education, amidst excessive technological resourcing, is a function of the negligible "capacity" and "self-efficacy" among educators. Drawing from Bandura's (1977) and Ford's (1992) conceptions of "self-efficacy" as "a person's ability to be successful in organizing and executing actions towards a specific goal" and "capacity" as beliefs about personal empowerment, respectively (both cited in Webster and Son 2015: 85), computer and information literacy should involve the educator's and student's ability to successfully use the E-learning environment for knowledge acquisition through analysis, application and evaluation. For this article, the survey data collected in the TV White Space Pilot Project was scanned to identify information about educators' self-assessment of and confidence in their abilities and skills relating to computer and information literacy. The next section describes in brief the research design adopted for the survey conducted in the TV White Space Pilot Project.

RESEARCH DESIGN

Survey material used in this article is part of a broader TV White Space Pilot Project implemented in July 2013, hosted by the University of Limpopo in Mankweng Circuit, South Africa. The primary goal of this project is to promote application of digital technology in teaching and learning among high school students and educators. The pilot project covers five

high schools, which are: Mamabudusha, Doasho, Ngwanalaka, MountainView and Mphetsebe. Students and educators at these schools constituted the target population for the TV White Space Pilot Project questionnaire survey. The plan is that the initiative would be extended to other high schools in Mankweng Circuit if this pilot enhances the effectiveness of teaching and learning. For this reason, one of the first requirements was to establish the baseline data relating to infrastructure as well as the levels of computer and information literacy among the students and educators. For the pilot baseline data, the questionnaire survey was conducted among students and teachers at only three conveniently sampled schools (MountainView, Mamabudusha and Doasho) during mid-2014 (table 1).

	Students			**Educators**		
	Sampling Frame Total	Sample	%	Sampling Frame Total	Sample	%
MountainView	1 542	311	20.2	61	7	11.5
Mamabudusha	710	142	20.0	30	9	30.0
Doasho	727	147	20.2	33	8	24.2
Total	**2 979**	**600**	**20.1**	**124**	**24**	**19.4**

Table 1: School Distribution of Sampled Population

Source: Compiled by Authors from the TV White Space Project Survey Results

The three schools represented both the rural and township contexts: whereas Mountain View is a township school, Mamabudusha and Doasho are rural. Among the student population, Grade 8 to 11 were selected using simple random sampling techniques. As the survey was designed to provide baseline data for the longitudinal study to be continued in 2015 and beyond, Grade 12 students were excluded because they were expected to exit the school education system at the end of 2014. The student sampling frame of 2 979 was compiled from lists provided by these schools, out of which a decision was made to take a 20% sample, representing 600 elements, for questionnaire survey. Similarly, a sampling frame of 124 educators was compiled from lists provided by the three schools; and, a total of 24 educators were selected through simple random sampling techniques for survey (table 1). Separate questionnaires were used for students and educators. As already indicated, this article is focused on survey results relating to ICT competence among educators alone. The questionnaires covered a wide range of issues inclusive of the users' confidence in their

technological abilities and skills, which is the focus of this article, to use TV White Space for learning and teaching. The questionnaires were loaded into android phones using the online data collection application, Open Data Kit (ODK). University of Limpopo Computer Science final year students were employed to administer the ODK-based questionnaires. This article draws data from the frequency tables generated from the TV White Space Project survey through Microsoft Excel; and, it examines results of only two sets of questions on the educators' levels of computer and information literacy, necessary for TV White Space informatics usage.

TV WHITE SPACE MODEL AND EDUCATORS' ICT LITERACY IN MANKWENG CIRCUIT HIGH SCHOOLS: MOUNTAINVIEW, MAMABUDUSHA AND DOASHO

The survey results show that 67% of the sampled educators were trained on the use of ICT for teaching and learning. Whereas the significance of the 33% of educators who did not receive ICT training cannot be underestimated, it is reasonable to examine the use or lack thereof in teaching and learning. Reliance on printed official curriculum resources has continued to be dominant because its frequency of use is daily and weekly compared to that for internet which is dominated by weekly and never (fig. 1). It is interesting to note that most educators used internet resources weekly for both official curriculum and other general purposes; and, the same holds true for those who never used internet resources. Indeed, a significant proportion of educators use internet resources monthly. Apparently, most educators are not using internet as frequently, implying that the implementation of the TV White Space Model did not revolutionize digital teaching and learning. That is, its uptake appears to be minimal amidst training of 67% of educators who could have been expected to promote the use of ICT on a frequent basis. This observation is however consistent with the trends in developed countries where the uptake of digital technology in pedagogy has remained low or even negligible as educators have continued to rely on face-to-face didactics interactions. Expectations of establishing active learning among students through the flexibility and collaborative opportunities provided by digital technologies have not drawn interest among the educators who have access to the TV White Space, almost 18 months after implementation. The first set of columns (fig. 1) suggests that teaching and learning has in the three high schools remained business as usual because the traditional didactics of the face-to-face teaching have continued to be predominant. The implication is that the implementation of the TV White Space Pilot Project has not agitated for the incorporation of digital technologies in teaching and learning among the 67% of the trained educators. If

blending had happed to any significant degree, the daily reliance on printed curriculum resources would have moderated downwards as a reflection of the incorporation of digital technologies.

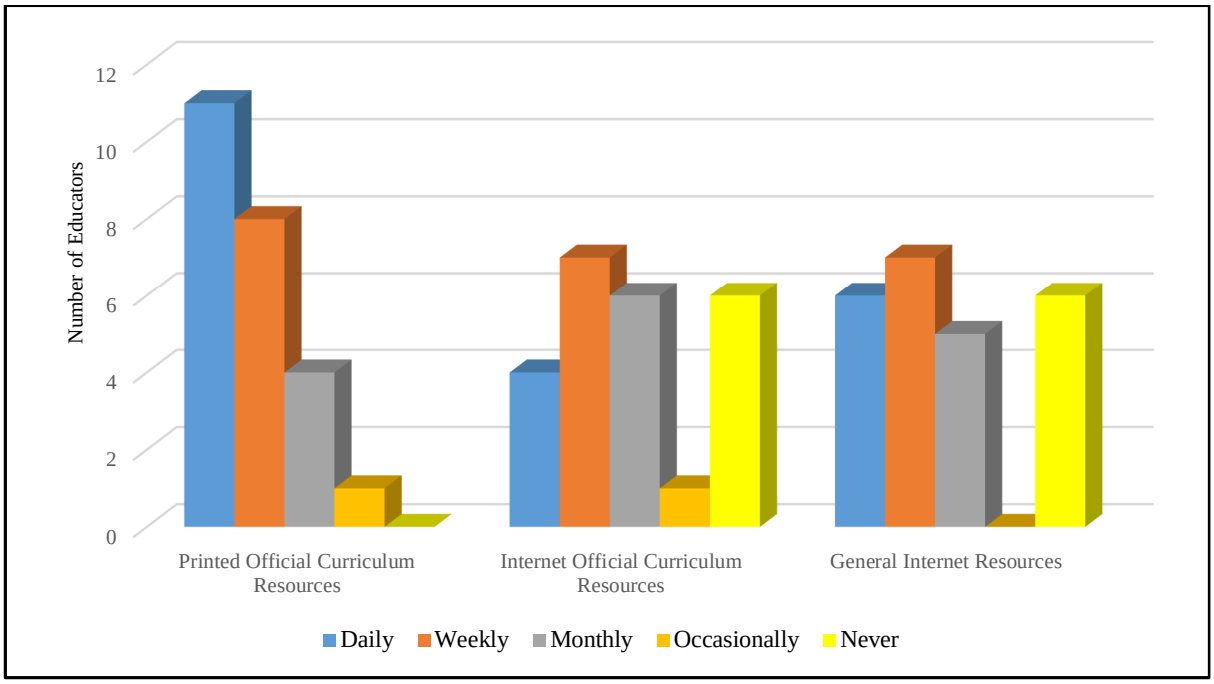

Fig. 1: Frequency of Usage of Printed versus Internet Curriculum Resources among Educators

Source: TV White Space Project Survey

Importantly, the survey results seem to suggest that, notwithstanding 67% educational ICT trained educators, the low usage frequency could be a function of the limited literacy in computer and information management. A significant majority of educators are evidently capable of basic operations of computer technology and they are highly confident about it (fig. 2). But the proportion of educators who are confident of their abilities and skills to use computers drops significantly when it comes to applications relating to the management of information.

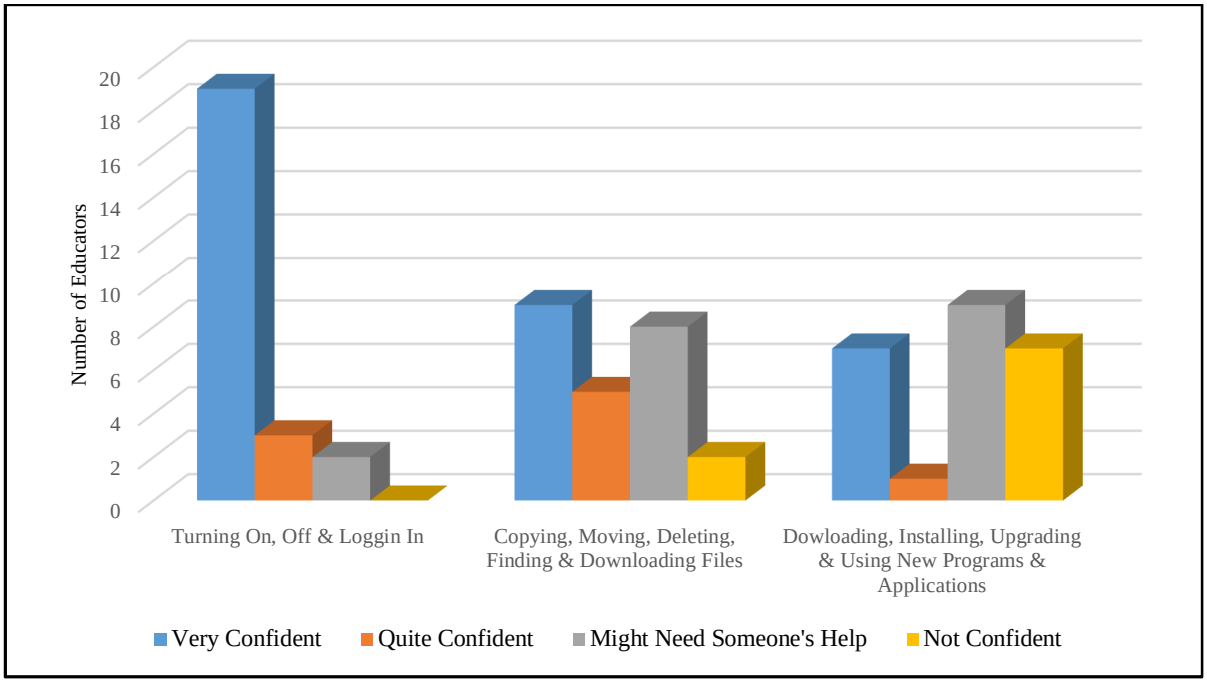

Fig. 2: Levels of Confidence about Computer and Information Literacy among Educators
Source: TV White Space Project Survey

The fact that an increased majority of educators might need technical support to perform information management using internet may be the reason that discourages most respondents from making frequent usage of ICT because high schools do not employ technicians. With this observation, it is important to note that incorporation of the digital technology in this case could entail added time and energy, which is not necessarily acknowledged as overtime. The discrepancy of confidence about basic operations of the computer and its use to manage volumes of information appears to be a function of the specific use that is prominent among the respondents. As it would be expected, most educators use computers for typing and e-mails (fig 3). Indeed, the majority of educators are confident about their abilities and skills to search the internet and less so about downloading files and creating online accounts. The observation made above implies that the educators are scarcely, if at all, involved in the E-learning environment. This point is affirmed by the low frequency of educators' use of the internet for official curriculum resourcing, especially given that the proportion of educators who never used digital technologies in this way is significant and only surpassed by that for weekly frequency (see fig 1). Reading the statistics on the use of internet for e-mails and general purposes, rather than official curriculum, should suggest that educators find the digital spaces to be a resource for social networking than for educational revolution.

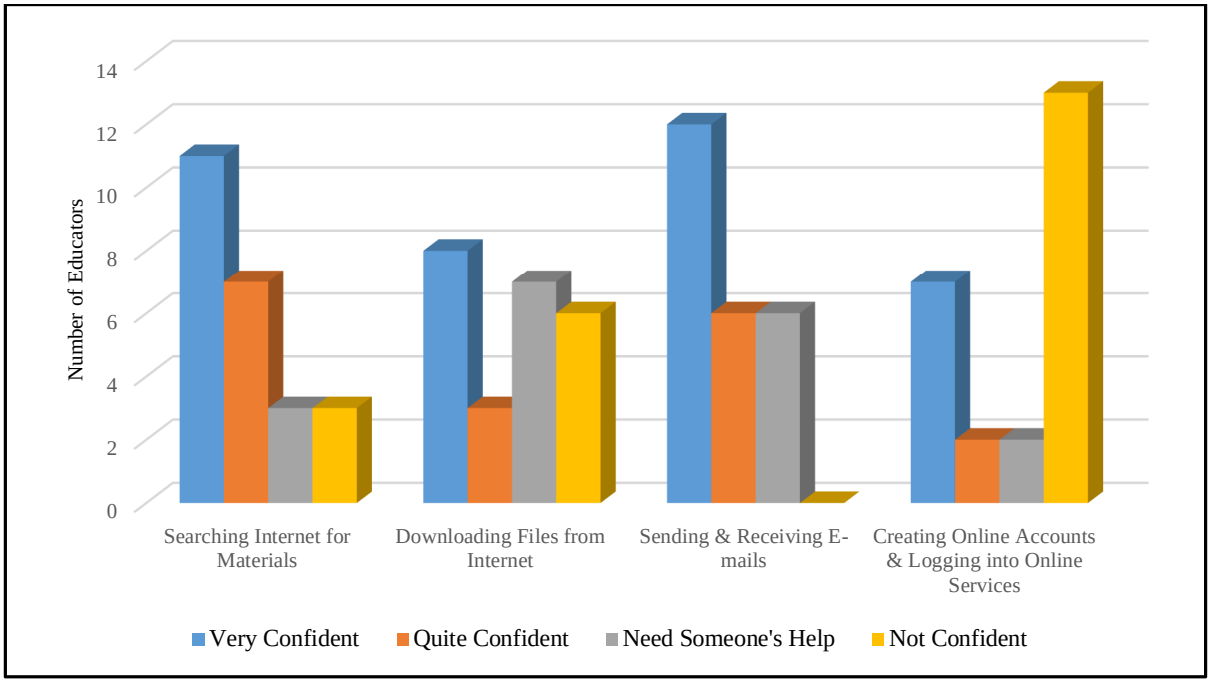

Fig. 3: Educators' Confidence in Abilities and Skills to Use the Internet

Source: TV White Space Project Survey

Evidently, the majority of educators are confident about their abilities and skills in using MS Word and, to a limited extent, MS Excel, and even worse so, for MS Powerpoint (fig 4). These results should be read in the context that Powerpoint is one of the most basic expectations of the didactics applications of computer technologies to enhance the effectiveness of teaching and learning. That is, educators have continued to rely on the traditional didactics rather than incorporate computer technologies. The confidence in the use of MS Excel above Powerpoint too is understandable because educators would have found it efficient to administer students' marks using computer technologies rather than hardcopy material. However, the educators' low confidence in their abilities and skills to use Powerpoint, which has a direct bearing on the effectiveness of teaching and learning, should be a serious matter of concern about the uptake of ICT in the education system. It could implying that the provision of digital technologies in the TV White Space Model may have been scarcely understood by educators as a means of revolutionizing teaching. This observation is affirmed by the high confidence levels that educators have in their use of computer technologies in MS Word and e-mails than in managing information (see figs 2, 3 & 4).

These results provide important leads in respect of the educators' computer and information literacy. Overall, it can be inferred that educators lack confidence in their abilities and skills in using computer and information technologies for teaching and learning purposes, especially because 67% of them were trained in ICT usage. Notwithstanding the latter, it can be argued that educators' ICT literacy is low and that their understanding of digital technologies as teaching and learning tool is severely limited. Whereas most of them are able to operate computers at the basic minimum of typing and emails, they lack competence in relation to management of large volumes of information. Despite the awareness about the TV White Space resourcing, those educators who use it have found in it a digital tool for social networking rather than for teaching and learning.

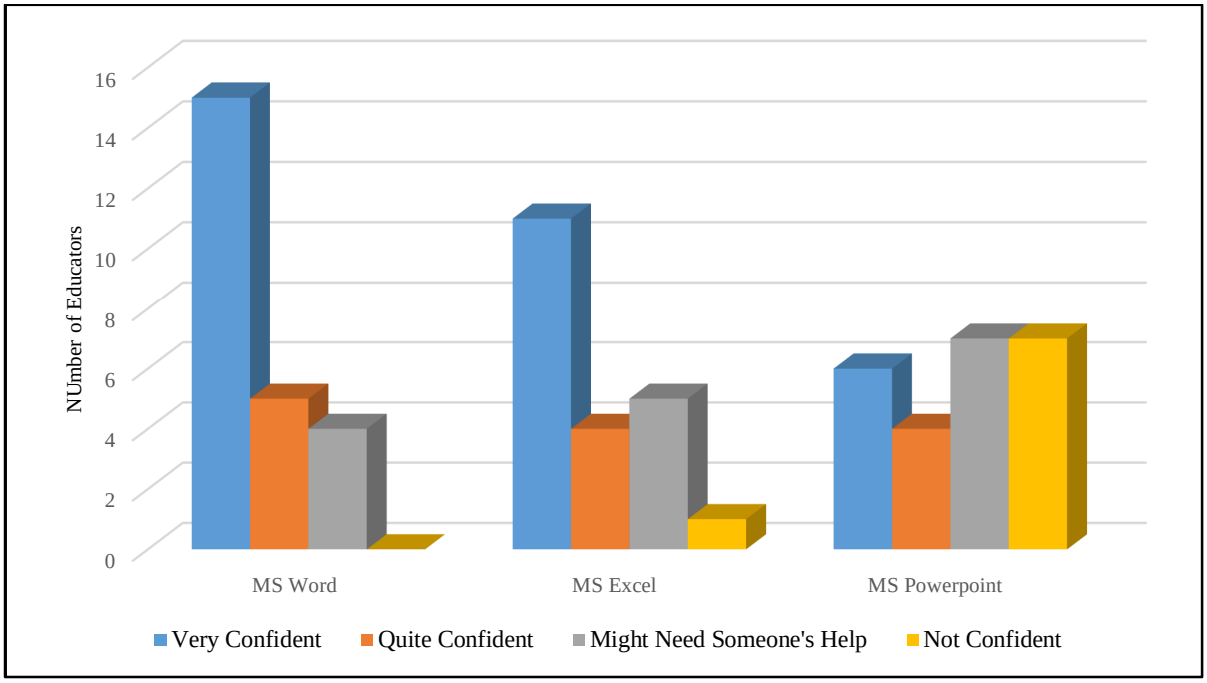

Fig. 4: Educators' Confidence in Abilities and Skills to Use Microsoft Office Applications
Source: TV White Space Project Survey

It can be inferred that the implementation of the TV White Space Model has not necessarily revolutionized the use of digital technologies for teaching and learning. For this reason, this article recommends that an educational campaign is mounted among the five high schools in order to unambiguously promote digital participation of educators in the online learning environment. This campaign would entail deeper involvement of all partners and collaborators, especially the Department of Basic Education, in order that digital participation

is acknowledged as part of the education system and educators are provided with resident technical support at schools.

CONCLUSION

This article has examined the theoretical justification for the incorporation of digital technologies in the enhancement of effectiveness of teaching and learning, affirming therefore the significance of training and promotion of the uptake among educators. Further, it drew and analyzed data from the three Mankweng Circuit high school participants in the TV White Space Pilot Project survey, which consisted of 600 students and 124 educators. Being focused only on educators' confidence in their abilities and skills to use digital technologies in teaching and learning, the article examined survey results among a sample of 24 educators, which were selected through probability sampling. The article observed that the implementation of the TV White Space Model has not revolutionized digital technologies applications in teaching and learning at the three high schools. It therefore recommends an educational campaign that promotes digital participation of educators in the online learning environment as well as increased involvement of all partners and collaborators in order that digital participation is acknowledged as part of the education system and that educators are provided with resident technical support at schools. Importantly, this article proposes that the implementation of educational digital technologies needs to be thoroughly discussed and explained to educators so that undue anxieties may be avoided.

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