Barriers to the Implementation of Electronic Textbooks in Rural and Township Schools in South Africa

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Abstract

The use of information and communications technology (ICT) is gradually increasing in South African schools. In the Gauteng province, the Department of Education has prioritised the provisioning of electronic textbooks (ebooks) to public schools since 2014. However, to this day, there seem to be multiple barriers that hamper the adoption and use of digital technologies, and specifically ebooks. This study was premised on the technology acceptance model, and a mixed-method approach was used with an online questionnaire and a semi-structured interview protocol as the data collection instruments. For the qualitative data, thematic analysis was used to identify themes and patterns. For the quantitative data, descriptive statistics, such as frequencies and percentages, and inferential statistics, such as the two-proportions z-test and the chi-square test of independence, were utilised. Results indicated that although portable electronic devices that facilitate the reading of ebooks are readily available at public schools in Gauteng, the availability and use of ebooks are still very limited. The results also show that the participants found digital resources easy to use and easy to navigate and indicated that teachers would like to have more training to fully develop the necessary skills required to implement the ebooks effectively. Teachers do not seem to have adequate time to prepare teaching materials and learning activities using these ebooks. In this article, the barriers to the successful implementation of ebooks are explored, and the article culminates in putting forward some guidelines to create an enabling environment to support the successful adoption of ebooks in schools.

Keywords: barriers; technology acceptance; electronic textbooks; ebooks; ICT implementation; technology acceptance model; public schools

Introduction

The introduction of information and communications technology (ICT) has revolutionised teaching and learning over the past number of years, and this has changed the way educators communicate and transmit information (Popovic 2015). In 2014 the Gauteng Department of Education (GDE) embarked on a drive to provide ICT resources to teachers and learners in Gauteng (GDE 2014). One of the aims was to eliminate the use of printed resources and introduce electronic textbooks[1] into classrooms according to certain projected timelines. However, the drive was marred with challenges, which has resulted in a situation where very few schools have actively introduced ebooks to their classrooms, even years after the project was originally implemented. Even though existing literature is clear about the benefits and advantages associated with the use of ebooks, it is evident that there are obstacles that hamper the adoption and use of them in schools (Vorotnykova 2019), such as the availability of IT infrastructure at schools, which includes hardware (computers, tablets, ebooks), a local network/access to the internet, licenced software (ebooks), access to digital libraries/cloud services, support services (system administers, IT technicians), and even medical barriers such as the effect of ebooks on users' eyesight. These barriers, whether perceived or real, are therefore the focus of this article. This study aims to add to the corpus of knowledge on ICT in education by establishing whether schools, in mainly rural and township areas in Gauteng, are ready to adopt and implement ebooks in their classroom, focusing on the barriers to the implementation of ebooks in public classrooms. The GDE and other departments of education nationally can use the findings of this study to address some of the barriers that hinder the use of ebooks, to plan for more advocacy campaigns, to assist with the training initiatives regarding the use of ebooks, and to provide more support for the adoption and use thereof.

Context

Historically, South Africa appears to have been unable to introduce ICT and subsequently ebooks successfully in the classroom, and, therefore, the Department of Education (DoE) decided to take the lead in implementing the prescripts of the e-Education White Paper of 2004 (DoE 2004). The GDE, through its Paperless Classroom programme, prioritised certain schools that were then provided with ICTs (GDE 2014). The Paperless Classroom programme was an initiative that focused on the integration of ICT in the classroom, and it was envisaged that traditional classrooms with multiple printed resources would be converted into paperless smart classrooms where digital texts are used (GDE 2014). The programme was implemented in phases, with a certain number of schools prioritised each year. A roll-out in 2017 had targeted 356 schools in mainly rural and township areas across all the education districts in Gauteng. These

1 Electronic textbooks are also known by many other terminologies such as "e-textbooks," "e-texts," "digital textbooks" or "ebooks"; for conciseness, the latter is used in this research.

schools face different challenges to other schools (e.g. city schools), as it has been well documented that South African rural schools lack basic infrastructure (e.g. electricity, running water, toilets, books and teaching material, to name but a few) (Du Plessis and Mestry 2019; Mojapelo 2018; Thaba-Nkadimene 2020). In fact, the GDE stated that there were delays with the implementation of the Paperless Classroom project as about 30% of the targeted 375 schools had to undergo major infrastructural refurbishments (GDE 2015a).

The Paperless Classroom project included, among others, the conversion of conventional classrooms into paperless ones by installing smartboards and by providing much-needed electricity and connectivity. The project also included the provisioning of tablets to learners and laptops to teachers and training for teachers. Although the Gauteng Member of the Executive Council (MEC) of Education, Panyaza Lesufi, envisioned that all Gauteng classrooms would be paperless by 2018, this has not been achieved and, according to many researchers, the Paperless Classroom project (which is not no longer ongoing) has failed (Minty and Mull 2020; Msiza, Malatji, and Mphahlele 2020). There are many reasons for this, including the theft of devices, non-academic material being accessed by learners, and poor internet connectivity (Msiza, Malatji, and Mphahlele 2020). Poor planning by the GDE resulted in barriers that hampered the implementation of ebooks. The GDE should have placed greater emphasis on encouraging community members and parents to protect school property. Furthermore, greater investments in infrastructure to protect the resources should have been made. Msiza, Malatji, and Mphahlele's (2020) study concluded that the department failed to have control over learners' devices because there were no firewalls to restrict learners from retrieving irrelevant material. Teachers were unable to control this situation as there were no measures in place to enforce strict and correct usage of the devices. The irrelevant material downloaded by learners contributed to the disappearance of ebooks and slow internet connectivity (Msiza, Malatji and Mphahlele, 2020).

This research contributes to the body of knowledge of mobile learning. Mobile learning is an emerging and rapidly expanding field of educational research and practices in schools (Fojtik 2015). Mobile devices, such as smartphones, are most commonly used for communication and reading ebooks (Fojtik 2015). Degenhard (2021) reports that, in the year 2021, 37.41 million South Africans (approximately 63.1%) were smartphone users and estimates that this number will increase to 41.89 million in the year 2025. With the number of smartphone users growing exponentially in South Africa, it is worth investigating the integration of ebooks in schools in countries such as South Africa, which does not have a high-income economy, as it comes with the possibilities opened up by being able to study anywhere, at any time, using a portable, lightweight device that fits in one's pocket.

This research fills a gap in the literature as many studies focus on the introduction of ebooks into schools; however, these schools typically, at the very least, have the basics

such as electricity, running water, toilets, books and teaching material (see, for example, Li 2021; Warning, Griffiths-Zee, Poon, Wong, Wu, and Sinclair 2021). In our study, a new dimension is brought to the fore of the problem of ebook integration that other studies, conducted at schools that have the basics such as electricity, running water, toilets, books and teaching material, do not have to consider. In addition, the majority of studies on the integration of ebooks are either quantitative (Al-Moniem 2019; Mboya 2019; Santoso, Siswandari, and Sawiji 2018), qualitative (Matthee, Hattingh, and Weilbach 2017; Mello and Matthee 2019; Ndwiki and Thinguri 2017) or small-scale mixed-method (Warning et al. 2021); however, this study used a large-scale mixed-methods approach (356 questionnaires and 19 interviews) that combines the advantages of quantitative and qualitative approaches and creates a more comprehensive and complete understanding of ebook integration (Cohen, Manion, and Morrison 2018). In our study, we investigate the outcomes of the Paperless Classroom project (specifically ebook implementation) by combining quantitative and qualitative approaches. In addition, in our qualitative phase, we used not only interviews but also open-ended questionnaire items. We believe that by using a mixed-methods approach, through data triangulation, a more comprehensive understanding of barriers to implementing ebooks is attained. It should further be noted that South Africa has been severely limited by operational, strategic and pedagogic challenges (Padayachee 2017). In part, addressing the strategic and operational challenges involves understanding the current landscape of ebook integration in South African schools.

This study aims to address the following issues and gaps: (i) mobile learning is rapidly expanding as more people have access to mobile devices, and investigating the optimal use of these devices for teaching and learning in relation to ebooks in countries that are not high-income countries is of great importance; (ii) the focus of most studies is in schools that do have access to the basics, whereas the majority of schools in the current study were rural and township; (iii) the majority of studies on this topic are either quantitative or qualitative, whereas the current study holds the advantages of both approaches, as it is mixed-methods, and (iv) the majority of mixed-method studies that are available in the literature are small scale, whereas the current study is large-scale mixed-method.

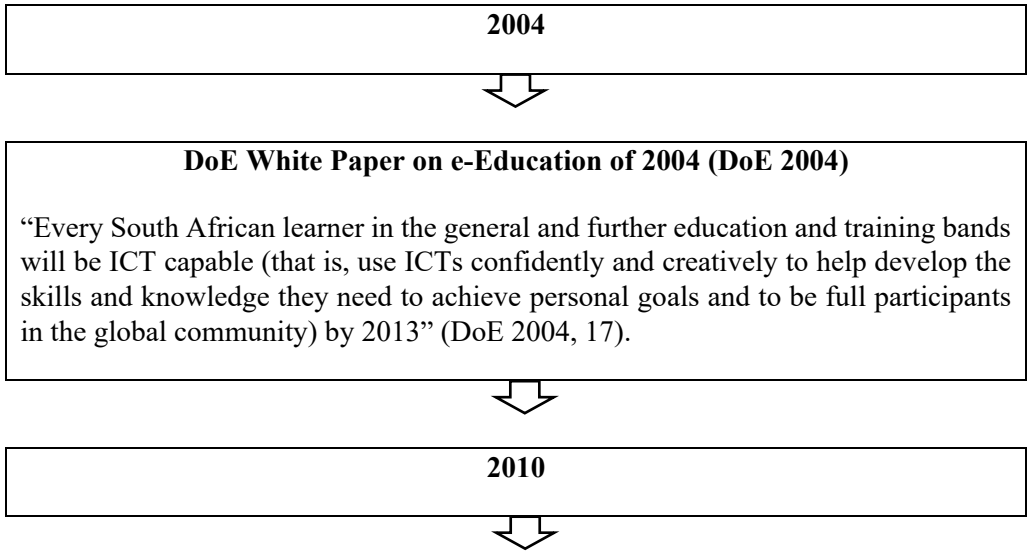
Literature Review

A broad understanding of the current state of ICT integration and the existing barriers of the ICT in education project in general in South Africa is required to comprehend this study's context fully.

ICT Integration in South African Schools

In South Africa, the White Paper on e-Education of 2004 acknowledged the magnitude of providing ICT, together with the necessary infrastructure required, to all schools in the country (DoE 2004). This dilemma is argued extensively in the existing literature,

highlighting that considerable investment is required to implement the ICT in Education project (DoE 2004). It is a worthwhile endeavour; nonetheless, South Africa, like other developing countries, can benefit immensely from using ICT and, consequently, digital content in the classroom (Lee, Messom, and Yan 2013). However, in many South African schools, the current number of computers provided do not yet match the number of learners, and where other ICT devices are provided, only certain grades or levels are prioritised (Hart and Laher 2015). Furthermore, the successful integration of technology in the classroom depends on the technical support given to educators in schools (Chikasa, Ntuli, and Sundarjee 2014). Over the years, there have been many ICT-related initiatives in South Africa, such as well-known ones like the Khanya project in Western Cape and the Gauteng Online Project in Gauteng, which were both provincial ICT in schools implementation projects that started in 2001 (Isaacs 2007). Ideally, we would like to discuss all ICT policies implemented and initiatives taken in South Africa, from government policy to hardware to teacher training. However, since there have been hundreds[2] of ICT initiatives in South Africa over the last few years, we only focus on the initiatives and publications of note since the ground-breaking DoE White Paper on e-Education (2004) to date in Figure 1.



2 As part of its monitoring and support to provinces, the DBE receives quarterly reports on ICT implementation in provinces. In the 2013/14 financial year, the DBE conducted an internal audit of ICT initiatives in all provinces and it was found that there were 162 ICT initiatives implemented across all provinces over the last decade (ending in the 2013/14 financial year) (Mnisi 2015).

National e-Skills Plan of Action (NeSPA) (Department of Communications [DoC] 2010)

NeSPA was designed to enhance e-skills in South Africa. The definition of e-skills proposed in the South African context is: "the ability to use and develop ICTs within the context of an emerging South African Information Society and global Knowledge Economy, and associated competencies that enable individuals to actively participate in a world in which ICT is a requirement for advancement in government, business, education and society in general" (DoC 2010, 2). The DoC (2010, 2) document goes on to state that, "it is important to view this e-skills concept within a broad context that encompasses the ability of people to use and create all forms of ICT to improve life opportunities in their: Personal and educational spaces; Work environments; Community interactions, and Participation in and contribution to governance processes."

2014

GDE Paperless Classroom programme

(GDE 2014)

In 2014 the GDE embarked on a drive to provide ICT resources to both teachers and learners in Gauteng (GDE 2014). One of the aims was to eliminate the use of printed resources and to introduce ebooks into classrooms.

e-Learning Solution (South African Government 2013)

The Gauteng Provincial Government launched the e-Learning Solution aimed at allowing learners to access ebooks and grade-specific curriculum content using devices (2,200 public schools were provided with 88,000 tablets with a 24-month uncapped network connectivity lease, starting January 2014, at a fraction of current operating lease premiums).

2015

Action Plan to 2019: Towards the Realisation of Schooling 2030 (Department of Basic Education [DBE] 2015, 3)

Goal 16: "Improve the professionalism, teaching skills, subject knowledge and computer literacy of teachers throughout their entire careers."

Goal 20: "Increase access amongst learners to a wide range of media, including computers, which enrich their education."

Schools of the Future (GDE 2015b)

For some schools in Gauteng, the GDE created structural transformations in the classrooms by "removing the use of the chalkboard and duster" (GDE 2015b, 99) and completely overhauled the classrooms to create a paperless classroom and support tech-based teaching, including installation of smart boards in every classroom, delivery of tablets to every secondary school learner, teacher training and other enablers required to deliver on tech-based learning (e.g. security, network connectivity).

2016

National Education Collaboration Trust (NECT): The status of ICT in education in South Africa and the way forward (Meyer and Gent 2016)

The NECT, in collaboration with the ICT4RED team at the Council for Scientific and Industrial Research (CSIR)'s Meraka Institute, summarised the status of ICT in education in South Africa and the policy environment in the form of policy documents; they also listed concerns (Meyer and Gent 2016, 12, Table 4).

2019

Department of Science and Technology White Paper on Science, Technology and Innovation (Department of Science and Technology 2019, 49–50)	Big Books DBE (2019a)	Digital Content to promote e-learning DBE (2019b)
"Structured mechanisms will be created by government to strengthen the links between researchers and scientists, on the one hand, and school teachers on the other, to encourage the introduction of scientific concepts from primary and pre-primary level (in particular in ICT-related skills training linked to the 4IR), as well as to enhance the development of appropriate educational technologies."	The DBE has made available "Big Books" as learning and teaching support materials (LTSM) for grades 1–3.	The DBE has made available digital content to promote e-learning in the form of grade 4–6 natural sciences and technology textbooks, Grade 10 technical mathematics and technical science learners' books and teachers' guides and some thunderbolt kids extras which include, for example, posters of energy and change.

Figure 1: Initiatives and publications of note regarding ICT integration in South Africa since the ground-breaking DoE White Paper on e-Education of 2004 (DoE 2004) to date.

Although not on government level, it is worth noting that other South African institutions have played their part in the adoption of ebooks and ICT integration, for example, the South African Broadcasting Corporation (SABC) Education and the Institute for Technology Strategy and Innovation (ITSI) launched an online library with more than 350,000 books which have 45,000 free ebooks which include academic books

as used in the CAPS[3] curriculum and other supporting material (MyPR 2019). Pick n Pay School Club is a project that has been operating for 16 years and is one of the most influential and dynamic public-private educational initiatives in South Africa; they reach 3,025 schools and provide educational resources to them through private sector funding (Pick n Pay School Club n.d.). In 2020, Snapplify announced their initiative to help learners during the COVID-19 shutdown by providing short-term access to digital ebooks and other resources to learners at no cost (Snapplify 2020); the selection of material covers educational resources for the CAPS curriculum. There are many more initiatives like this that were introduced due to COVID-19, too many to name. Ebooks specifically are discussed next, followed by the typical barriers to ICT integration.

Electronic Textbooks (ebooks)

There are mainly two types of ebooks: basic and enhanced ebooks (Engbrecht 2018). The former are digitised versions of paper-based textbooks that may or may not[4] have interactive functions and tools (Choppin, Carson, Borys, Cerosaletti, and Gillis 2014), whereas the latter create a more interactive experience for the reader, which include, amongst others, customisation tools, hyperlinks and links to videos and podcasts (Dobler 2015). Some enhanced ebooks also have animations, music, sound effects, audio narration, dictionary functions (Rockinson-Szapkiw, Courduff, Carter, and Bennett 2013), note-sharing capabilities, "discussion boards" where learners can have discussions on the content of the ebook, and formative assessment capabilities upon where learners receive immediate feedback on activities completed (Choppin et al. 2014). Under the category of enhanced ebooks, there are now adaptive ebooks that detect reading difficulty and simplify the text for learners struggling with the readability or understanding of the text (Dingli and Cachia 2014). Also, under the category of enhanced ebooks, there are "gamebooks" that use gamification (the integration of the mechanics of gaming in non-game activities) in the educational field to get learners more involved in the activity of learning through exercises, edu-games, trophies, badges and leader boards (Bidarra, Figueiredo, and Natálio 2015; Li and Chu 2021). Although making use of all these new advances might sound attractive, literature has shown that teachers are unwilling to make use of it due to simply not wanting to change traditional teaching methods (Bidarra, Figueiredo, and Natálio 2015), believing the effects are short term and not sustainable (Li and Chu 2021) and that learners waste precious classroom time by playing games or visiting social media sites during their lessons (Msiza, Malatji and Mphahlele 2020).

Traditionally, prescribed paper-based textbooks were specifically designed and approved for use in schools as stipulated in curriculum policies (Al-Mashaqbeth and Al Shurman 2015). Ebooks are similarly evaluated and approved before being used in

3 CAPS refers to the National Curriculum and Assessment Policy Statement.

4 These types of basic ebooks are created when publishers simply take existing paper-based titles and convert them into PDF format without adding any videos, simulations, interactive quizzes, etc.

schools (Amornkitpinyo and Piriyasurawong 2015). The procurement procedures for the printed books and ebooks are typically the same. One advantage of ebooks is the fact that the delivery period is very short, as materials can be installed or downloaded remotely. Fojtik (2015, 744) summarised the advantages as "Easier distribution and purchase; Simple backup and storage; The ability to adjust font size; Add text to multimedia; Read on different devices; The ability to have a large number of devices in electronic books."

Barriers to Electronic Textbook (ebook) Usage

There are many barriers to ebook adoption; for example, not all the titles on the printed textbook catalogues are yet available in an electronic format (Al-Suqri 2014; GDE 2014). In addition, many ebooks have licences that must be bought and renewed annually before they can be accessed (Birdsong, Chen, Tseng, and Victorino 2015). Pierard, Svihla, Clement, and Fazio (2019) conducted a study in the United States of America with master's level instructional design students and identified 11 barriers to the adoption of ebooks, the main barriers being that they are difficult to navigate, difficult to print or download, and the interface being challenging. Other barriers were tiring (e.g. causes eyestrain), access difficulty (e.g. login, checking ebooks in and out is cumbersome), not being convenient, error messages being encountered, session timeout, syncing across devices not supported, e-reading being uncomfortable, and offline reading not being supported. Marques de Oliveira (2012) also found eyestrain to be a barrier to ebook adoption. Wang and Bai (2016) found a lack of awareness about ebooks and uncertainty in using ebooks for research as a barrier. Al-Suqri (2014), who applied the technology acceptance model (TAM) to acceptance of ebooks by faculty at a non-Western university, found that language is a barrier as most ebooks are in English (for many of these staff members, Arabic is their first language). Other barriers mentioned by Al-Suqri (2014) include technical issues, internet disruptions, the inconvenience of carrying a device, poor computer skills, and training needed in using ebook platforms. When it comes to presenting ebooks in library catalogues, there are some unique barriers such as "availability of record metadata, lack of standardisation, difficulties managing the addition and removal of titles, and the generally low quality of vendor-supplied records" (Zhang and Niu 2016, 212). The disappearance of ebooks that a library decides not to purchase after a set amount of time is another barrier (Thomas and Chilton 2016, 259) as this discourages purchasing the ebooks in the first place. Interlibrary loan of ebooks is also experiencing barriers that include "license agreement restrictions, different purchasing models, unstandardized platforms, and technological barriers" (Zhu 2018, 343).

Theoretical Framework

The theoretical framework used in the study was the TAM (Davis 1989) and is intended to determine the user's attitude or readiness to accept new technology (Davis, Bagozzi, and Warshaw 1989). The model claims that if the user finds technology useful and easy

to use, then a positive attitude towards that technology develops leading to a positive behavioural intent and ultimately into actual use. The model has variables that can be categorised as both exogenous and endogenous (Gyamfi 2016). The exogenous variables are the external variables that are not influenced by other variables, while the endogenous variables are internal and have effects between themselves (Gyamfi 2016). The external factors, therefore, have a great influence on the internal factors. The endogenous variables are the perceived usefulness (PU); perceived ease of use (PEoU); attitude towards use (AU), and behavioural intention (BI).

PU is the "prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context" (Davis, Bagozzi, and Warshaw 1989, 985). It was posited that a person's tendency to use, or not to use technology, is influenced by their belief in the extent to which using technology would enhance job performance (Davis, Bagozzi, and Warshaw 1989). PEoU refers to "the degree to which the prospective user expects the target system to be free of effort" (Davis, Bagozzi, and Warshaw 1989, 985). Attitude guides behaviour and refers to how an individual responds to and is disposed towards an object (Ajzen and Fishbein 2005). This response or disposition may be negative or positive. In the educational milieu, the successful integration of technologies into educational programmes relies much on teachers' attitudes (Kisanga 2016; Teo, Ursavaş, and Bahçekapili 2012). BI is a measure of a person's strength of intention to perform a certain behaviour or adopt a system (Bundot, Yunos, and Mohammed 2017). The TAM implies that two behavioural beliefs, PU and PEoU, influence the BI.

The variables on PU and the PEoU are regarded as the most important because they raise the level of the users' expectations and increase satisfaction (Al-Azawel and Lundqvist 2016; Al-Suqri 2014; Lawrence and Tar 2018); they are explained here in terms of ICT integration. PU is the extent to which a person trusts that the use of ICTs (in this case, ebooks) will yield the best results (Gyamfi 2016). In a classroom environment, PU relates to both teachers and learners who should believe that the use of ebooks would provide a better experience and will result in better performance. The variable on PEoU relates to the belief by the user that the use of the ebooks provided will be easy and thus motivate them to use them daily (Gyamfi 2016). The TAM has been applied to ebooks in other literature; for example, Al-Suqri (2014) applied the TAM to acceptance of ebooks by faculty and Smith, Rodriguez, Miller, and Xu (2019) applied the TAM to students' ebooks preferences.

Method

The research methods used are discussed below in terms of the research philosophy, research design, data collection instruments, and the population and sample size of the study.

Research Philosophy

A research philosophy as a worldview is necessary to guide the research study. A researcher should take a stance concerning a particular worldview or philosophical assumption to use certain research methods to answer the research questions. A pragmatic worldview is adopted to guide this research study. De Vos, Strydom, Fouché, and Delport (2014, 438) define pragmatism as a paradigm that focuses on the practical aspects or "what works" as the truth. Morgan (2014) reckons that the mixed-method approach is linked to pragmatism. Pragmatism can be used across all methods in social research, either qualitative, quantitative or mixed-method (Morgan 2014).

Research Design

This study employed a concurrent mixed-method research design since both qualitative and quantitative research methods were used in the study simultaneously (Hadi, Alldred, Closs, and Briggs 2013). Within this mixed-method study, the researcher integrated and analysed the data both qualitatively (through a semi-structured interview instrument and an online questionnaire [the open-ended questions only]) and quantitatively (through an online questionnaire [the closed-ended questions only]).

Semi-structured Interview

The semi-structured interview protocol, consisting of 15 open-ended questions, had two sections, one dealing with the perceived barriers to the adoption of ICT and ebooks in the classroom, and another on possible solutions to eliminate these barriers. For the qualitative data, trustworthiness was ensured by sending the transcriptions of the interviews to the participants for member-checking.

Online Questionnaire

A self-constructed questionnaire based on the aim of the study and the components of the TAM was used in this study. To ensure content validity and face validity (Heale and Twycross 2015), the questionnaire was piloted with five district officials, and these responses were analysed to confirm whether the sampled schools would be able to respond to all the questions (i.e. the check the appropriateness of the questions to the target population). Questions that were unclear to the district officials (which were minor problems) were revised. To determine whether the questionnaire was reliable, Cronbach's alpha measure of internal consistency was calculated. A Cronbach's alpha value of 0.60 or greater is generally accepted by researchers in the social sciences (Ghazali 2008). The overall Cronbach's alpha value was above 0.6, showing that the questionnaire was reliable. The questionnaire had both closed-ended and open-ended questions. For conciseness, the entire questionnaire is not provided here; however, the items, in relation to the variables of the TAM model, are depicted in Table 1. In terms of scoring, the closed-ended items consisted of items with binary (Yes–No) responses, for example, "Does your school use ebooks?". Other items were Likert-type questions where respondents had to agree on a scale of 1 to 5 with statements, where 1 = "totally

disagree," 2 = "disagree," 3 = "neutral," 4 = "agree," 5 = "totally agree" (see Table 4 for examples of such Likert-type statements). Other questions were asked to indicate the level of difficulty with responses ranging from "very difficult" to "very easy" (see Table 5 for an example).

Table 1: Online questionnaire items

TAM variables	**Items related to**
External factors	Availability of technical support
	Availability of resource materials
	Availability of electronic textbooks per subject per grade
	Availability and location of school internet connectivity
	Sufficient number of electronic textbooks
	Sufficient bandwidth and signal strength to access electronic textbooks and other online resources
	Time for teachers to integrate electronic textbooks
Perceived usefulness	Use of ICT and electronic textbooks
	Awareness on the advantages of electronic textbooks such as portability, searchability and the ease with which information can be updated
	Delivery costs when procuring electronic textbooks
	Relatively affordability and environmentally friendliness
	Mobility
	Interactive nature and ease of retrieval processes
Perceived ease of use	The format of electronic textbooks is easy to use
	Ease of navigating electronic textbooks
	Teachers' willingness to prepare lessons using ICT
	Teachers' necessary skills and ability to integrate electronic textbooks

Population and Sampling

The GDE Paperless Classroom project was originally intended for all 2,080 public schools in the province (GDE 2017). However, the current study only focused on the 356 schools that participated in the Paperless Classroom project in 2017. These schools were selected based on their socio-economic status and were mostly in the rural and township areas. The schools were purposively selected as they previously had no access to ICTs; the selection was done by the main researcher (first author) of this research study. The implementation of ebooks is even harder for these schools than schools that start off with the basics. The 356 purposively sampled schools were targeted for the distribution of the online questionnaire; while a further 20 schools were sampled purposively and conveniently to be interviewed. The targeted participants, for both the quantitative and qualitative phases, were the principals, the deputy principals and the ICT co-ordinators of these 356 schools.

Sample Size: Qualitative Data

Twenty schools in the Tshwane West education district were selected for the semi-structured interviews. The schools were purposively selected as they previously had no access to ICTs and were part of the Paperless Classroom project. They were conveniently selected as they were in close proximity to the main researcher (first author) of this research study who made the selection. The protocol targeted only the principal or deputy principal and the school's ICT co-ordinator. One interview was declared invalid because the interviewee was neither a principal/deputy principal nor a school ICT co-ordinator at the school, giving a total of 19 interviews. The recorded interviews were transcribed, and the interviewees were given code names, P1–P6 for the principals/deputy principals and C1–C13 for the school ICT co-ordinators. The online questionnaire was sent to the 356 schools. Some schools did not receive the online questionnaire for various reasons, such as incorrect email addresses and some unread emails. A total of 51 questionnaires were completed, and the data from the open-ended questions were analysed using thematic analysis with pseudonyms being O1–O51.

Sample Size: Quantitative Data

Of the total of 51 questionnaires that were completed, data from the closed-ended questions were analysed using Statistical Package for the Social Sciences (SPSS) version 25.

Data Analysis

Data Analysis: Qualitative Data

The interview recordings were transcribed verbatim with no identifying information of the participants. The responses to the open-ended questions of the questionnaires were captured by Qualtrics and exported to Microsoft Excel. For both the transcribed

interview recordings and the responses to the open-ended questions of the questionnaire, thematic analysis was used to identify themes and patterns. The process of conducting thematic analysis required us to notice and look for common concepts, patterns of meaning, and re-reading by interpreting the codes in the text of which it is collected, whether homogenous or contrasting (Terry, Hayfield, Clark, and Braun 2017). We familiarised ourselves with the qualitative data, we generated initial codes and generated three themes, and we reviewed the themes and named them.

Data Analysis: Quantitative Data

For the closed-ended questions of the questionnaire, descriptive statistics, such as frequencies and percentages, and inferential statistics, such as the two-proportions z-test and the chi-square test of independence, were calculated using SPSS. The z-test comparing two proportions is equivalent to the chi-square test of independence; thus, to compute the power of the statistical analysis, the software program G*Power was used for the chi-square test of independence with the level of significance being equal to 0.05, sample size = 51 and df[5] = 4, giving an achieved power of 0.829, which is above the recommended power of 0.8 (Cohen 1988). All assumptions of the chi-square test (McHugh 2013) were met, i.e. the data in the cells are frequencies, the categories are mutually exclusive, the groups being compared are independent (e.g. male and female). Note that one of the assumptions of the chi-square test states that the expected frequencies in each cell should be at least 5; however, where this was not met, the Fisher's Exact test was interpreted as opposed to the chi-square test.

Findings and Results

Findings: Qualitative Data

The thematic analysis revealed three themes. Theme 1 is *facilitating factors influencing ebook implementation*. This theme links to the external variables part of the TAM. Theme 2 is *perceptions about usefulness* that links to the PU part of the TAM. The last theme, theme 3, is *degree of ease associated with use* that links to the PEoU part of the TAM. The results are discussed per theme.

For Theme 1, *facilitating factors influencing ebook implementation*, Sub-theme 1.1 is *availability of support*. Most of the participants confirmed that there was adequate support in the implementation of ebooks:

5 df = degrees of freedom = (# rows – 1)(# columns – 1). As an example, for a Likert-scale question with 5 rows (totally disagree, disagree, neutral, agree, totally agree) cross-tabulated with gender (male, female); df = (5 – 1)(2 – 1) – (4)(1) = 4. Thus, df = 4 was inserted into to software program G*Power.

> "Yeah, our teachers are assisted in terms of using them, in our school, and there is also a technician." [P2]

> "[T]he teachers are helped by the ICT technician, the one hired by the GDE, and he is helping teachers with the day to day barriers that might occur." [P3]

> "[T]here is an intern who is helping." [C5]

> "We are covered in terms of technical support." [O13]

> "ICT interns solve problems." [O27]

However, not having adequate support surfaced as a barrier:

> "[B]ut we always log a call and then they take, they don't even answer the call." [C12]

> "The school contact to the district is still to send the technician." [O24]

It is important to note that the GDE did not appoint technical staff in all the schools that participated in the Paperless Classroom project. The participants reported that they could log a call for assistance but often had to wait for numerous days before someone came to their school to assist. Overall, Sub-theme 1.1 has mixed results, as some participants indicated adequate support and others indicated that there was not. It would be worthwhile for the GDE to identify and reach out to the schools that felt that there was a lack of support to identify specific problem areas and develop solutions to these problems.

For Sub-theme 1.2, *availability of resource materials*, it was found that the participants were still relying on printed textbooks and workbooks, either because a suitable ebook was not available for their subject [C6] and/or grade [C11] that they teach or the fact that the printed books that they were already using are not available as an ebook [C4, C11 and O46] causing problems:

> "[M]y book is not part of, not available [in the ebook catalogue]; Engineering Graphics and Design." [C6]

> "[T]hey received tablets with their names, but the software, the ebooks inside their tablets is not for the relevant grade" [C11]

> "The other thing is the ebook on the tablet is different from the book we use in our school. When we attended some meetings, they said they have not yet received approval from the publishers." [C11]

> "The challenge was that the textbook that is on the board [smartboard] is not exactly the same as the one that is printed. So, you cannot give learners homework based on a

> textbook which they not have. I can't give them work on the book they do not have with them." [C4]
>
> "Some textbooks with history sources are not included in ebooks." [O46]

Overall, for Sub-theme 1.2, the participants felt that there was a lack of resources as not all printed books are available as ebooks.

For Sub-theme 1.3, *availability of internet connectivity and sufficient bandwidth*, it was found as a barrier as the participants explained:

> "[W]e are using it but not as effective as if it's supposed to be; the reason been it's because of lack of internet." [C7]
>
> "We do, but we have a challenge in terms of internet connection; yeah, those devices are being looking for the Wi-Fi connection; they don't connect through Wi-Fi. Yeah, actually it wants the fixed line or a modem per se, but it cannot access, it doesn't have the Wi-Fi drivers, to deal with it." [C13]
>
> "Data is required to download if not delivered by CD or USB." [O9]

Overall, for Sub-theme 1.3, a lack of availability of internet connectivity and sufficient bandwidth was identified as a barrier.

Teachers also need time to integrate ebooks into their teaching practices. For Sub-theme 1.4, *adequate time for implementation*, the fact that ebooks jam or freeze, wasting time in class because teachers have to re-boot the device or find another way to teach that day, as a barrier:

> "[A]nother barrier is that some, at some point, the software jams, yes, when you try to own the ebook it does not open." [C9]
>
> "[T]hey freeze most of the time." [C4]
>
> "They didn't even install anti-viruses." [C2]

Concerning the last remark by C2, C9 also indicated viruses as a problem and explained that viruses takes time away from teaching as the electronic device, which has the ebook on it, keeps loading. Although the use of ebooks can be time-consuming when they jam or freeze and have to be restarted, some participants mentioned that the implementation of ebooks into the classroom saves time:

> "It's not time-consuming like some of the ordinary textbooks where you have to flip page by page trying to find a particular concept, but you can simply search for the concept, and it will take you directly." [C6]

"I can quickly jump to different parts of the ebook" [O15]

For Sub-theme 1.4, there were contradictory remarks where some participants felt that the implementation of ebooks wasted time, whereas others felt that they saved them time.

For Theme 2, *perceptions about usefulness*, Sub-theme 2.1 is *belief of a better teaching and learning experience*. Although there are barriers to the implementation of ebooks, it appears that the majority of participants believed that ebooks would ultimately lead to a better teaching and learning experience:

"I'm very excited with this initiative of the Department of Education because I think it's going to learners benefit them a lot because learners are no longer a reading generation, they just want to see things, playing with things and do things their own way, so the initiative is to make them become very creative." [P2]

"I have been looking forward for ICTs to be implemented ever since I started teaching in this school since 2007 and I always wished that things like computers could be used to develop our learner education system and also that because ICTs like computers and stuff is something that children like the most, so if you can use something that they like the better, they learn better from what they know into what they don't know." [C4]

For Sub-theme 2.2, *awareness of advantages of ebooks*, it appeared that the participants believed that there are many advantages of ebooks over printed books:

"My subject needs me to draw, which is Biology, so I don't have to draw on the chalkboard; I simply have to connect on the smartboard." [P4]

"You don't have to wait for physical books to be delivered. As soon as you order and pay for it, you have access to it" [P2]

"Teachers, yeah, they will, in fact, they do use ebooks more than printed because they don't want may hate to carry textbook around." [C2]

"Learners do not need to carry heavy texts books around all day." [O3]

Having said this, they are also aware of the disadvantages such as battery life, costs, eyestrain:

"If teachers or learners forget to charge their devices, they can't use it." [C1]

"The cost to update the textbooks, yeah, it's costly, yes, you need a license." [C12]

"It seems like ebooks had to be purchased by the school. So, our school, I wonder if they can have enough finance to purchase all the ebooks that are needed by the whole school." [C4]

> "Electronic devices have the problem of affecting people's eyes." [P2]
>
> "Learners because of the reflection of light they may acquire eye ill health, they may be affected the learner's health, yeah, health-wise." [P6]
>
> "Ebooks damage the eyes." [O49]

For Sub-theme 2.2, it is clear that participants are aware of the advantages of the implementation of ebooks; however, they are equally aware of the disadvantages.

For Theme 3, *degree of ease associated with use*, Sub-theme 3.1 is *teachers' willingness to implement ebooks*. The willingness of teachers to move away from printed books to ebooks appears to be a barrier:

> "[S]ome teachers, they feel as if they are competent in using them, but they still don't want to use them." [P1]
>
> "[S]till relying on [printed] textbooks; teachers' method of teaching is still conservative. We still prefer textbooks." [P2]
>
> "[B]ecause some of the educators are not yet confident in the usage of this devices, if truth be told, they are not confident. They still rely on these, usage of hard copy, the hard copies. Yes, but I think with time, they would then have to, you know, adjust. But it's not something that is going to happen overnight. It's going to take some time, because no matter how many [training] courses you may take them, whenever they come here, they then go back to traditional method of using the hard copy textbook." [C10]

For the open-ended questionnaire items, one participant mentioned being willing to implement ebooks, if they receive training on how to implement it by someone who has mastered this skill:

> "Workshops should be presented by educators who happen to master the use of ebooks." [O9].

Overall, for Sub-theme 3.1, some teachers were unwilling to use ebooks due to various different reasons but mentioned that they would be willing should they receive sufficient training.

Sub-theme 3.2, *teachers' necessary skills to implement ebooks*, showed that although they were sent for training, they feel that the training was inadequate, leaving them with inadequate skills to integrate ebooks into their classrooms, except for C10 and O12, who stated that "I for one, am confident" [C10] and "We have development plan in place which is used to assist teachers who have problems" [O12]. Some extracts from the other participants:

> "Yes, training was done, and then they sent people to keep on improving the little that was done in training, but the problem was one, we were trained in the afternoons whereas we were tired coming from classes, yes exhausted and then little, we cannot say we are well equipped." [C7]

> "Yes, we received training, although it was not enough." [C3]

> "[B]ut truth be told, I wouldn't consider that as a training, the training was one-dimensional." [C6]

> "The School ICT Coordinators must be fully trained by competent people either from the Education Department of from external support so that they can pass informative and hands-on approach to their fellow teachers." [O13]

Overall, from Sub-theme 3.2, it is evident that the participants desired more training for themselves and even training for their peers.

Results: Quantitative Data

The responses relating to whether there is a qualified person available to address technical problems are presented in Table 2. For login problems, lack of connectivity and backup problems, most respondents confirmed that the DoE had provided technical support.

Table 2: Support from a technical person at a school

Kind of support	**No**		**Yes**	
	Frequency	**Per cent**	**Frequency**	**Per cent**
For login problems	10	19.6	41	80.4
For lack of connectivity	17	33.3	34	66.7
For backup problems	16	31.4	35	68.6

In Table 3, the respondents had to mention whether the available resources materials were printed workbooks or electronic workbooks, and it was found that most schools are still relying on printed textbooks and workbooks. Since all the p-values in Table 3 are less than 0.05, there is a significant difference between the availability and use of printed textbooks and workbooks and their electronic counterparts.

Table 3: Availability of resource material

				Two-proportions z-test	
Type of resource	**Yes (frequency)**	**Type of resource**	**Yes (frequency)**	**z-value**	**p-value**
Printed textbooks	49	Electronic textbooks	38	3.23	0.001***
Printed workbooks	46	Electronic workbooks	6	12.77	0.000***

***Statistically significant different at a 5% level of significance

The respondents were asked to indicate the location of internet connectivity at their schools. Although many of the respondents indicated no internet connectivity at their school (29.4%), for those with internet connectivity, it was mostly available in the principal's office and the staff room (18%). Despite the absence of internet connectivity in some schools, access to ebooks was not disturbed, as the titles did not require connectivity.

Respondents were asked to indicate their level of agreement regarding the sufficiency of ebooks at their schools (see Table 4). It was found that 66.7% of respondents were in agreement that the number of ebooks in the schools is not sufficient. Schools require internet connectivity and bandwidth to access digital resources. The respondents were asked to indicate whether or not there was sufficient bandwidth to access ebooks and other resources. Fifty-seven per cent of respondents indicated that they did not have sufficient bandwidth to access ebooks and online resources. This is regarded as problematic, as some ebooks require a user to be online when they access multimedia such as videos and animations. If large groups of learners need to access the internet at the same time, sufficient bandwidth is of the utmost importance. Also, if ebooks with high levels of interactivity are to be encouraged, sufficient bandwidth capacity is required.

Teachers also need time to integrate ebooks into their teaching practices. The respondents were asked to indicate their level of agreement on whether there was time for teachers to integrate ebooks (see Table 4). It was found that less than half of the respondents (41.2%) were in agreement that teachers had enough time to integrate ebooks in the classroom. However, it is surprising that 29.4% of respondents were neutral on the question on time. Also, in Table 4, the respondents were to mention their level of agreement on whether the formats of ebooks were easy to use. More than 50% of respondents agreed that the format of ebooks was easy to use and manipulate. To integrate ebooks successfully in class, teachers should prepare their lessons using the available ICT. Whether teachers are willing to prepare their teaching content using ICT

or not are summarised in Table 4, and it was found that more than half of the respondents (54.9%) were in agreement that teachers already prepare their lessons using the available ICT.

In another question, respondents were asked to indicate whether teachers have the skills they need to integrate ebooks successfully (see Table 4), and it is evident that a high percentage (47.1%) of the respondents were in agreement that teachers had the necessary skills to integrate ebooks in the classrooms. However, since a large percentage was neutral (35.3%), it creates doubts about teachers' ability to integrate ebooks.

Table 4: Level of agreement to statements regarding barriers to the implementation of ebooks

	Sufficient number of ebooks	**Time for teachers to integrate ebooks**	**Formats of ebooks are easy to use**	**Teachers' willingness to prepare lessons using ebooks**	**Teachers have the necessary skills to integrate ebooks**
Level of agreement	**n (%)**				
Totally disagree	13 (25.5%)	2 (3.9%)	5 (9.8%)	1 (2.0%)	0 (0%)
Disagree	21 (41.2%)	13 (25.5%)	1 (2.0%)	8 (15.7%)	9 (17.6%)
Neutral	6 (11.8%)	15 (29.5%)	16 (31.4%)	14 (27.5%)	18 (35.3%)
Agree	2 (3.9%)	19 (37.3%)	5 (9.8%)	23 (45.1%)	23 (45.1%)
Totally agree	9 (17.6%)	2 (3.9%)	24 (47.1%)	5 (9.8%)	1 (2.0%)

Respondents were also asked to indicate the level of difficulty in navigating ebooks (see Table 5). The majority (68.7%) of the respondents stated that they regarded ebooks as easy, or very easy, to navigate.

Table 5: Navigation of ebooks at the school

Ease of navigation	**n (%)**
Very difficult	1 (2.0%)
Difficult	4 (7.8%)
Easy	24 (47.1%)
Very easy	11 (21.6%)
Not applicable	11 (21.6%)

For the responses in Table 4 and Table 5, although not the focus of the study, since literature has shown that older teachers are less likely to implement ebook use (Al-Suqri 2014; Rowlands, Nicholas, Jamali, and Huntington 2007) and that females are less likely to implement ebook use (Al-Suqri 2014; Maduku 2015), this comparison was

made using a chi-square test of independence. Although not all detail is shown here for conciseness, for the statements in Table 4 and Table 5, all the p-values were greater than 0.05 for all cross-tabulations (each statement vs age [younger group vs older group; the median age was used to create the two groups] and each statement vs gender), and the null hypothesis of independence was not rejected and the results are independent of age and gender. This could be attributed to the fact that, in South Africa, teachers are either "forced," or not "forced" in using ebooks, regardless of your age or gender.

Discussion

The findings and results mentioned above show that several barriers hamper the successful implementation of ebooks in mainly rural and township Gauteng schools. In terms of teachers' perceptions about the usefulness of ebooks, it became clear in the study on the advantages and disadvantages of ebooks that they are valuable for use in teaching and learning (see Masango, Van Ryneveld, and Graham 2019).

Relating to TAM's construct of external factors, this study identified several barriers that hinder the actual use of ebooks in the classroom. One study confirmed that the availability of ebooks and the ICT devices, internet connectivity and access to the online resources required by the use of ebooks influence the use of ebooks (Ngampornchai and Adams 2016). Our findings also show that a lack of stable internet connectivity and sufficient bandwidth in classrooms (qualitative [Sub-theme 1.3]) were still hampering any real attempt at introducing interactivity for online resources. The external factors, as depicted in the adapted TAM framework, have a direct influence on the use and adoption of technologies. Both the qualitative (Sub-theme 1.1) and quantitative (Table 2) data showed that there was adequate support from a technical person at school, with some responses (in the minority) indicating the support was lacking by mentioning problems such as logging a call at the GDE but not getting a response. Both the qualitative (Sub-theme 1.2) and quantitative data (Table 3 and Table 4) further showed that teachers are still relying on printed textbooks and workbooks, either because there are only a limited number of titles available in electronic format for their subject and/or grade that they teach or the fact that the printed books that they were already using are not available as an ebook. This limitation meant that ebooks could not be used in all the grades in all the subjects.

Another problem was that some publishers have not yet made specific titles available, as there were also instances where existing ebook titles were incorrectly indicated in the database of approved titles, leading to teachers not being able to order their preferred titles. In addition, some textbook titles were not available for schools to order. Other subject areas already had electronic titles available, but teachers did not yet have access to them because the GDE prioritised grades 11 and 12 only for the Paperless Classroom project. Both the qualitative and quantitative data revealed that time is a problem, for example, the devices freezing and teachers having to restart the device in class. The quantitative data showed that participants felt that navigation was easy, but having said

this, it is important to note that not all the available textbooks had full interactivity and navigation. Ebooks should allow for ease of navigation to access various embedded multimedia. As a result, such materials are not user-friendly because they do not interact with the users and are not easy to navigate when searching for information.

Licencing issues were raised in the qualitative data; this issue became a barrier for teachers and learners because they could not access ebooks on their devices. In the cases where ebooks were loaded onto the hardware, schools experienced problems of licences when they had to be renewed or where ebooks had to be upgraded to new editions. An ebook with an expired licence cannot be accessed by teachers and learners. It then becomes a disadvantage using licenced ebooks because, if not renewed, they cannot be accessed for use in teaching and learning. Both the qualitative (Sub-theme 2.1) and quantitative (Table 4) data revealed that although teachers may not be willing to integrate or be confident in integrating ebooks, support through adequate training should be provided to improve teachers' ability and skills to integrate ebooks. However, ease of navigation of ebooks appeared to be easy and eased used use of ebooks (Table 5).

The absence of the enabling conditions for the use and implementation of ebooks requires both external and internal interventions to provide possible solutions to integrating technologies in the classroom. We suggest the following strategies and actions required to enhance the external factors:

- Greater emphasis should be placed on sharing the vision and technology integration plan among schools and all the stakeholders in education so that there is similar understanding regarding the integration of ICT in the classroom. This is in line with the recommendations of Khan, Hasan, and Clement (2012) and Nsolly and Charlotte (2016), who advocated for larger-scale awareness of the advantages that ICT integration holds in teaching and learning to capture stakeholders' interest.

- The department should place greater emphasis on sourcing quality, low-cost equipment that is also low on maintenance costs. This is in line with the recommendations of Nsolly and Charlotte (2016), who suggest low-cost but high-quality equipment be purchased in their study on ICT integration in schools in Cameroon.

- Schools should be provided with a constant supply of electricity and alternative power supplies in case of a power outage.

- There should be regular professional development and training of teachers until they have confidence in adopting and using ICT in the classrooms, which is in line with the recommendations by Khan, Hasan, and Clement (2012) and Nsolly and Charlotte (2016). Training can be provided by the Education District officials or an ICT service provider.

These findings are valuable as there are aspects considered that are not adequately represented in other works on this topic. Figure 2 is presented in a top-down approach, where one first needs the government to create and support policies and plans of technology integration. Second, basics such as electricity and sufficient bandwidth are necessary. Third, one needs the hardware itself to download the ebooks. Fourth, quality ebooks must be available. Fifth, training and support to everyone involved are needed, and last, logistics (e.g. convenience and speed of ordering ebooks) play a role.

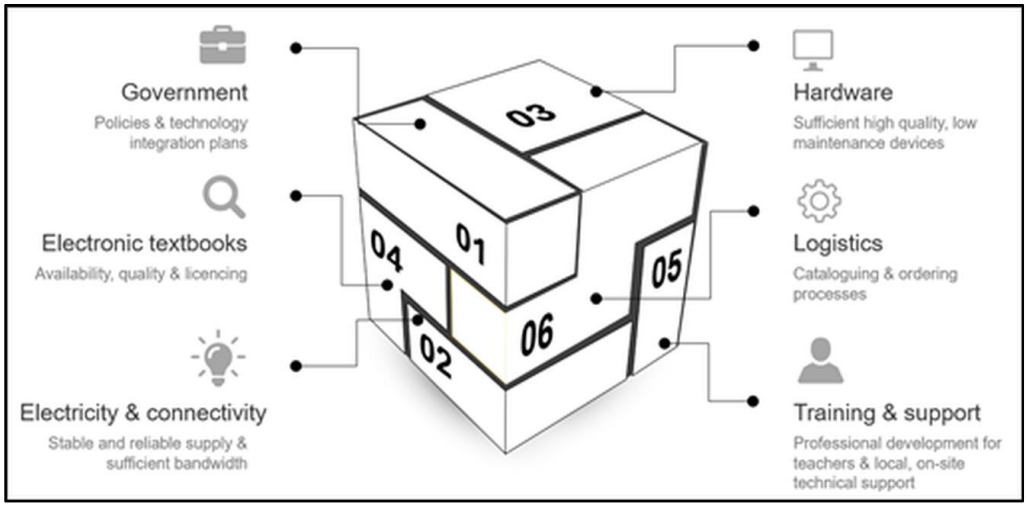


Figure 2: Barriers and interventions required

Conclusion

The study confirms there are still multiple barriers to the successful integration of ebooks in mainly rural and township Gauteng schools, despite the valiant efforts of the GDE to provide schools with ICT, internet connectivity, training and support. The availability of all the titles on the approved textbooks catalogue in the electronic format will encourage the adoption and use of ebooks. The smartboards should have more than one title from the approved textbooks catalogue so that teachers and learners have a choice between ebooks. Internet connection at schools may also encourage the use of digital texts because, for resources with embedded multimedia, access to the animations, audio and video clips becomes easy.

In the short term, parallel provisioning of both printed and electronic resources may be ideal so that in case there are technical problems, a shortage of devices and software, and failure to access electronic content, the printed resources can serve as an alternative. However, the parallel provision may not be an alternative if the department can ensure that the barriers mentioned for the implementation of ebooks are addressed. The parallel

use of printed books and ebooks will make teachers and learners rely more on the printed textbooks, which will greatly impede progress on the implementation and use of ebooks.

The DoE should consider developing their own resources (Open Educational Resources – OERs) so that schools can access them freely without experiencing hindrances such as licencing and compatibility. This recommendation is based on the fact that some participants highlighted the cost of licences for ebooks. The department will solely own the OERs, making them always available and accessible for use in teaching and learning. These freely accessible ebooks can be accessed from the department's content platform or be downloaded directly to the available devices used by teachers and learners.

The ebooks should be correctly titled so that when schools procure them, they can select the correct ebook titles. Incorrectly titled textbooks mislead schools about their content, and such cannot be procured and used for teaching and learning. The department should develop and make available to schools a complete catalogue of ebooks so as to guide schools on which textbooks are available and may be suitable for use in the classroom.

A constant supply of electricity to schools may enhance the use of ICT devices and the use of ebooks and other online resources. Externally, access to electronic resources, including textbooks from the devices, depends mostly on the availability of electricity. The safety of the devices used by learners is of utmost importance. The DoE should provide safety measures for ICT devices. The GDE and administrators in other provinces need to pay more attention to the issues identified in this article before spending more funds on rolling out hardware.

There are huge potential benefits of using ebooks that schools can achieve when the barriers mentioned are addressed. There is a dramatic change towards using ICTs. In line with the Fourth Industrial Revolution (4IR), a conducive environment should be created at schools so that the use of ebooks can be implemented. Such an environment can be created by the DoE for the teachers and learners to adopt ebooks for teaching and learning. More training and support on the use of ICT generally and the ebooks specifically is required so that teachers can be better skilled and equipped to use ICTs in the classroom. There is also technical support and regular maintenance of the devices required to ensure regular use of ICT in the classroom by the schools.

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